The Dusty and Molecular Universe
A prelude to HERSCHEL and ALMA

27 - 29 October 2004, Paris

Programme and Abstract book

Contents

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DUSTY04: Scientific Program

Wednesday 27 October 2004

Plenary Session 1. General Overviews

09:00-09:40	G. Pilbratt	Herschel mission and observing opportunities
09:40-09:50	T. de Graauw	HIFI
09:50-10:00	A. Poglitsch	PACS
10:00-10:10	M. Griffin	SPIRE
		
10:40-10:50	P. van den Bout	ALMA: Genesis of the project from the scientific visions of the European, North American, and Japanese communities
10:50-11:10	C. Debreuck	Scientific requirements of ALMA, and its capabilities for key-projects: Extragalactic
11:10-11:30	J. Richer	Scientific requirements of ALMA, and its capabilities for key-projects: Galactic
11:30-11:50	T. Soifer	Spitzer Space Observatory: achievements so far Extragalactic
11:50-12:10	N. Evans	Spitzer Space Observatory: achievements so far Galactic
12:10-12:30	T. Nakagawa	ASTRO-F: status of the project

LUNCH

Plenary Session 2. Potential Herschel/ALMA impact

14:00-14:30	A. Franceschini	Herschel and Cosmology
14:30-15:00	S. Chapman	ALMA and Cosmology
15:00-15:30	P. Barthel	Herschel and Galaxies/AGN
15:30-16:00	C. Carilli	ALMA and Galaxies/AGN
		
16:30-17:00	M. Walmsley	Herschel and ISM/star-formation
17:00-17:30	S. Guilloteau	ALMA and ISM/star-formation
17:30-18:00	T. Encrenaz	Herschel/ALMA and planetary science
18:00-18:30	B. Guiderdoni	Herschel and Planck synergy

Thursday 28 October 2004

Parallel Session 1. (ROOM 1- morning) ISM and Global Star Formation

Talks of 15+5min

09:00 - 09:20	A. Bolatto	The CARMA array
09:20 - 09:40	E. Erickson	The SOFIA Program

Interstellar medium, gas and dust

09:40 - 10:00	E. Falgarone	The various phases of the ISM
10:00 - 10:20	F. Boulanger	The dust cycle through the ISM phases
10:20 - 10:40	Y. Fukui	Molecular Clouds and Star Formation

11:10 - 11:30	A. Fuente	Chemical study of the envelopes of intermediate-mass YSOs
11:30 - 11:50	W. van Breugel	Star formation in high pressure environments: laboratory experiments of ISM dust analogs

Global Star Formation

11:50 - 12:10	C. Wilson	Nearby galaxies on GMC scale
12:10 - 12:30	F. Walter	Star formation triggered by interactions

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Parallel Session 2. (ROOM 1- afternoon) Galaxies and Cosmology

Talks of 15+5min

Deep fields, Clusters

14:00 - 14:20	G. Lagache	Deep far-IR surveys, and source counts
14:20 - 14:40	E. Daddi	Clustering and dusty high-z galaxies
14:40 - 15:00	M. Franx	Deep surveys and galaxy evolution
15:00 - 15:20	E. Schinnerer	The COSMOS 2-Degree Survey from the Radio Perspective
15:20 - 15:40	R. Ivison	Spitzer observations of SCUBA and MAMBO galaxies: weeding out AGN in starbursting proto-ellipticals

15:40 - 16:00	A. Koekemoer	EXO's: A Population of Dusty, High-Redshift AGN

High-z galaxies

16:30 - 16:50	I. Smail	Submillimeter galaxies
16:50 - 17:10	P. Cox	Molecules and dust at high z
17:10 - 17:30	S. Malhotra	Starburst galaxies at any redshift
17:30 - 17:50	G. Helou	The Puzzle of Cold Galaxies at High Redshift
17:50 - 18:10	V. Charmandaris	Probing the energy source of ULIRGs using the Infrared Spectrograph of Spitzer

Thursday 28 October 2004

Parallel Session 3. (ROOM 2- morning) Planetary Systems

09:00 - 09:15	J. Crovisier	Comets and asteroids with Herschel
09:15 - 09:30	N. Biver	Comets with ALMA
09:30 - 09:45	L. Jorda	TNO, cometary nuclei and asteroids with ALMA
09:45 - 10:00	B. Butler	Telluric planets with ALMA
10:00 - 10:15	J.-F. Lestrade	Dusty Debris Discs at Submillimeter Wavelengths
10:15 - 10:30	A. Moro-Martin	Signatures of planets in debris disks

11:00 - 11:20	R. Moreno	Planetary atmospheres with ALMA
11:20 - 11:40	P. Hartogh	Planets with Herschel
11:40 - 11:55	S. Wolf	ALMA: Searching for Giant Planets in Circumstellar Disks
11:55 - 12:15	A. Dutrey	Observations of proto-planetary disks with ALMA
12:15 - 12:35	C. Dominik	Prospects for proto-planetary disks with Herschel

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Parallel Session 4. (ROOM 2- afternoon) Local Star Formation and ISM

Talks of 15+5min

Star forming regions

14:00 - 14:20	P. Andre	Early phases of star formation
14:20 - 14:40	E. Bergin	Chemistry of pre-stellar cores
14:40 - 15:00	T. Henning	Circumstellar disks
15:00 - 15:20	E. van Dishoeck	Chemistry in the embedded phases
15:20 - 15:40	H. Smith	Spitzer-IRAC Observations of Star Forming Regions and their YSOs
15:40 - 16:00	V. Minier	High-mass star formation in the Southern Hemisphere Sky

Molecular Species, and chemistry

16:30 - 16:50	J. Cernicharo	Far-infrared and millimeter spectral surveys
16:50 - 17:10	E. Herbst	Gas and dust astrochemistry
17:10 - 17:30	K. Menten	Molecules in high-mass star-forming regions
17:30 - 17:50	J. Le Bourlot	Line emission in shocks and PDR
17:50 - 18:10	A. Hjalmarson	Molecular Line Searches from the Odin Satellite
18:10 - 18:30	J. Goicoechea	Diagnostics in the Far-IR: from OH to carbon chains

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Friday 29 October 2004

Parallel Session 5. (ROOM 1- morning) Galaxies and Cosmology

Talks of 15+5min

History of star formation

09:20 - 09:40	O. Le Fèvre	Optical Surveys and Star Formation

09:40 - 10:00	D. Sanders	Starbursts and ULIRGs
10:00 - 10:20	J. Afonso	The population of faint radio sources in the GOODS-South field

Physics of normal galaxies, AGN-hosts

10:50 - 11:10	A. Baker	Molecules and dust in Galaxy Nuclei
11:10 - 11:30	S. Garcia-Burillo	Dynamics and Star formation
11:30 - 11:50	T. Wiklind	Elliptical and early-types
11:50 - 12:10	D. Burgarella	GALEX Spectroscopy + Spitzer/SWIRE of (U)LIRGS: bridging UV and IR
12:10 - 12:30	M. Rubio	Molecular Gas and Dust in the Magellanic Clouds

Parallel Session 6. (ROOM 2- morning) Stars and Dust production

Talks of 15+5min

09:00 - 09:20	T. Lebertre	AGB mass-loss and recycling
09:20 - 09:40	H. Olofsson	Molecular abundances in circumstellar envelopes
09:40 - 10:00	T. Millar	Chemistry of proto-planetary nebulae
10:00 - 10:20	F. Schuller	Exploring the star formation in the Galactic Center: from ISO to ALMA

10:50 - 11:10	A. Jones	Grain formation and survival
11:10 - 11:30	A. Tielens	Dust and ices infrared spectroscopy
11:30 - 11:50	B. Draine	Infrared emission and models of interstellar dust
11:50 - 12:10	F. Kerschbaum	Solid State features in the Herschel-PACS-Range
12:10 - 12:30	P. Morris	Production of Dust and Molecular Gas in Nebulae of the Most Evolved, Massive Stars

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Plenary Session 3. (ROOM 1- afternoon) Synthesis and Strategy

14:00 - 16:00 Plenary discussion

Summaries from parallel sessions (by four moderators)
Herschel PI's describing KP ideas/plans in their instrument teams

Moderators C. Carilli, S. Guilloteau, M. Harwit,

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Session Galaxies

Molecules and Dust in Galaxy Nuclei
Andrew J. Baker
(University of Maryland)
With the current generation of millimeter interferometers, sensitivity considerations typically limit high-resolution mapping of other galaxies to transitions of the dominant CO molecule. With the advent of ALMA, high-resolution observations of less abundant molecular species, tracing a wider range of physical conditions, should become nearly as routine. I will discuss some of these probes and what they may be able to tell us about the properties of dust and molecular gas in galactic nuclei.

HERSCHEL and Galaxies/AGN
P. Barthel (Kapteyn Institute Groningen)
(Kapteyn Institute Groningen)
Herschel will represent a breakthrough in the study of nearby gas-rich and gas-poor galaxies, as it will for the first time permit imaging photometric and spectroscopic observations of their ISM in the FIR-submm wavelength range. The unprecedented sensitivity and angular resolution of Herschel will furthermore yield a breakthrough in our understanding of distant galaxies and AGN, as their gas and dust - both the ISM and the AGN-related - will for the first time come within reach. Herschel will undoubtedly yield major discoveries concerning the cosmologically evolving gas and dust properties in galaxies, back to very early epochs.

ALMA : galaxies and AGN
C. Carilli
(NRAO)

ALMA and Cosmology
Scott Chapman
(caltech)

Gas and dust in high redshift quasars
Pierre Cox, Alexandre Beelen, Frank Bertoldi, Chris Carilli, Alain Omont, and Fabian Walter
(Institut d'Astrophysique Spatiale)
The recent progress made in the study of the dust and gas content of high redshift quasars will be reviewed. We will present the results of surveys of the dust emission of high-z optically luminous, radio-quiet quasars at millimeter and submillimeter wavelengths. More than 200 sources have been observed with a detection rate of about 30 percent. We will present the first evidence for a relation between the optical and far-infrared luminosities, linking the growth of the central massive black hole and the activity of the starburst. The current status for the search of lines of CO and other species (CI and HCN) in high-z sources will be summarized and discussed in the light of the starburst properties of these sources. The future of this field will be briefly presented, in particular the progress expected from Herschel, the e-VLA and from ALMA.

Clustering and dusty high-z galaxies
E. Daddi (ESO, Garching)
(European Southern Observatory)
We have calibrated a new photometric technique based on B-, z-, and K-band imaging that allows to identify high-redshift star-forming galaxies ($1.4<2.5$) regardless of their dust reddening content. We suggested that star-forming galaxies at $z \sim 2$ that are bright in the K-band are good candidates for the progenitors of local massive early type galaxies. Measuring their clustering is a crucial step to elucidate the evolutionary relation to local galaxy populations. I will report on measurements of clustering of K selected galaxies at high redshifts from a number of ongoing surveys and discuss the possible role of dusty star-forming galaxies to $z \sim 3$ for galaxy evolution.

Scientific requirements of ALMA, and its capabilities for key-projects : Extragalactic
Carlos De Breuck, Tom Wilson
(ESO)
The Atacama Large Millimetre Array (ALMA) will initially observe in 4 frequency bands between 84 and 720 GHz with spatial resolutions down to 10 mas and velocity resolutions as fine as 0.05 km/s. After a brief overview of these technical capabilities, I shall illustrate the scientific potential of ALMA for extragalactic studies with examples ranging from distant submm galaxies to the Large Magellanic Clouds.

Herschel and Cosmology
A. Franceschini et al.
(Padova University)

Deep surveys and galaxy evolution
Marijn Franx
(Leiden University)

Star Formation and Dynamics
Santiago GARCIA-BURILLO
(Observatorio Astronomico Nacional-OAN)
The study of the distribution and kinematics of molecular gas allows us to have an insight into the dynamical mechanisms that regulate star formation in galaxy disks. In this talk we will review the latest results issued from the mapping of CO lines in galaxies by present mm-interferometers with a special emphasis on galactic nuclei. The current understanding of how to set off activity and how this is connected to the starburst phenomenon in galactic nuclei are discussed. The physical and chemical status of molecular gas in starbursts and AGNs clearly depart from that of quiescent star forming disks. The use of specific tracers adapted to probe the onset of large-scale shocks, photon dominated chemistry and X-ray processing in the molecular gas reservoir of galaxies helps to study the feedback of the starburst phenomenon on molecular gas. ALMA will provide a unprecedented view of the dynamics of molecular gas in galaxies by expanding the number of objects studied at high spatial resolution using CO lines. ALMA, together with HERSCHEL, will also push the study of extragalactic chemistry of molecular gas beyond the limits imposed by the small sample of a handful of galaxies that have been thus far studied through multi-lines /multi-species observations .

LIRGs and ULIRGs in Models of Hierarchical Galaxy Formation
B. Guiderdoni and the GalICS collaboration
(IAP, CNRS)
Luminous and ultra-luminous IR galaxies are considered to be the signposts of interaction and merging during the process of hierarchical galaxy formation. I will review the state-of-the art implementation of such an idea into current models, with a focus on the semi-analytic post-processing of large numerical simulations. It turns out that the current models do not reproduce the submm data, and that this result seems to be very robust. I will explore various solutions to this problem.

Deep far-IR surveys, and source counts
G. Lagache
(IAS)
To understand the sources contributing to the Cosmic Infrared Background and to interpret the deep source counts from mid-infrared to the millimeter, we have developed a phenomenological model that constrains the IR luminosity function evolution with redshift, and fits all the existing source counts, the available redshift distributions, the CIB intensity, and, for the first time, the CIB fluctuation observations. In particular, the agreement between the model and the recently observed SPITZER counts at 24, 70 and 160 microns is excellent. I will first briefly present the model and its cosmological implications. In particular, I will show that the very close agreement between the model and number counts at 15 and 24 microns strikingly implies that : (1) the PAHs (Policyclic Aromatic Hydrocarbons) features remain prominent in the redshift band 0.5 to 2.5 and (2) the IR energy output has to be dominated by $3\ 10^{11}$ to $3\ 10^{12}$ solar luminosity galaxies from redshift 0.5 to 2.5. The model is intended as a convenient tool to plan further observations.This will be illustrated through predictions for Herschel and ALMA observations.

Optical Surveys and Star Formation
Le Fevre, Tresse, Vettolani, and the VIMOS-VLT Deep Survey Team
(Laboratoire d'Astrophysique de Marseille)

Starbursts at any redshift
S. Malhotra
(Space Telescope Science Institute)
The history of unobscured star formation from z=6 to the present day is now well documented by rest frame optical and UV studies of star forming galaxies. However, our understanding of the interstellar medium where this star-formation takes place is quite limited at moderate and high redshifts. I will review (A) what we know about star-forming galaxies based on optical/UV light from redshifts up to seven, and (B) what we know about ISM conditions at z=0 from ISO observations of a variety of star-forming galaxies.
I will then combine these observations to predict what the Herschel Space Observatory and ALMA will tell us about the ISM at high redshifts. Our ISO data show that the [CII] and [OI] cooling lines are underluminous relative to continuum emission in the brightest infrared galaxies. Nonetheless, we predict that HSO can detect these lines in about 100 detect normal galaxies per square degree at z 1. This will provide a powerful new probe to understand the physics of star formation at the epoch when most of the stars in the universe were born.

Starbursts and ULIRGs
D. B. Sanders
(University of Hawaii, Institute for Astronomy)
Our view of galaxy evolution has been dramatically enhanced by new deep field surveys at far-infrared (90,170um with ISO/ISOPHOT) and submillimeter (850um with JCMT/SCUBA) wavelengths. Current evidence suggests that the luminosity density in the far-IR/submm exceeds that in the UV by factors of 3-10 at redshifts $z > 1$, implying that as much as 80-90% of the "activity" in galaxies at z = 1-4 is hidden by dust. I will review the current evidence which suggests that the SCUBA sources are plausibly the high-z (1-4) counterparts of more local ($z < 1.5$) luminous infrared galaxies that have been identified in IRAS and ISOPHOT deep field surveys, the majority of which appear to be major mergers of gas-rich disks accompanied by dust-enshrouded nuclear starbursts and powerful AGN. The SCUBA sources plausibly represent a primary epoch in the formation of spheroids and massive black holes. This major event in galaxy evolution, which is largely missed by current deep UV/optical survey, will be a major science driver for
Herschel and ALMA.

Submillimeter galaxies
Ian Smail, Scott Chapman, Andrew Blain & Rob Ivison
(Institute for Computational Cosmology, University of Durham)
I will discuss observational results on obscured activity at high-z based coming from ground-based submm surveys.

Star Formation triggered by interactions
F. Walter
(NRAO)

Early Type Galaxies : Observations of the cold ISM component

T. Wiklind
(ESA Space Telescope Division/STScI)

A surprisingly large fraction of all early-type galaxies contain a cold and dense interstellar medium. This is manifest through observations of atomic hydrogen, molecular hydrogen (viewed through carbon monoxide) and continuum emission from dust grains. The origin of the cold ISM in these galaxies is believed to be external, although the cumulative mass loss from evolved stars could be a source for the gas and dust. The presence of the cold ISM will ultimately lead to the formation of stellar disks in these galaxies, comprising up to 5-10% of the total stellar mass. The ISM can also be fuel for a central AGN. The mere presence of a dissipative gas component in early-type galaxies provide us with a diagnostic of the gravitational potential and a probe of the dynamics of the system in question. This is particularely important for elliptical galaxies where the dynamics is difficult to assess using stellar spectra. Both Herschel and ALMA are prime instruments for studying the cold ISM in early-type galaxies. They will allow detailed data on the distribution and kinematics to be obtained and will probe the possible existence of a very cold dust component in these systems. A summary of the questions addressable through Herschel and ALMA will be discussed.

The population of faint radio sources in the GOODS-South field

J. Afonso, A. Koekemoer, B. Mobasher
(Lisbon Astronomical Observatory)

Insensitive to dust obscuration, radio wavelengths are ideal to select star-forming galaxies free of dust induced biases. Using the superb optical and X-ray data available in the GOODS-South field, the diversity of sub-mJy and microJansky radio sources is analysed. The relation of star-formation to the HST ACS morphology in star-forming galaxies is investigated, and the nature of the optically/X-ray unidentified microJansky radio sources debated.

The CARMA Array

Bolatto, A. D.
(U. C. Berkeley)

OVRO, BIMA and the SZA are in the process of relocating and merging to create the Combined Array for Research in Millimeter Astronomy (CARMA) in Cedar Flat, a new site in the Inyo National Forest in southern California. I will present some of the recent extragalactic science done with the parent arrays, in particular surveys of nearby GMCs done with BIMA where we look at the cloud properties as a function of environment and at the relationship between CO and star formation. Finally, I will discuss how the new capabilities of CARMA will advance this and other research.

GALEX Spectroscopy + Spitzer/SWIRE of (U)LIRGS : bridging UV and IR

Denis Burgarella et al.
(Observatoire Astronomique Marseille Provence - LAM)

Some fields were observed by GALEX in its spectroscopic mode in UV and by Spitzer/SWIRE in IR. We will report on these observations and present the first UV spectroscopic observations of IR-bright galaxies. More specifically, we will the UV attenuation curve(s) of galaxies and compare them to parametric models of attenuation. Several dust attenuation tracers and their respective quality to estimate the Star Formation History of galaxies are analysed.

Probing the energy source of Ultraluminous Infrared Galaxies using the Infrared Spectrograph of Spitzer

V. Charmandaris, L. Armus, H.W.W. Spoon, J.R. Houck, B.T. Soifer, S.J.U. Higdon, T. Herter, J. Marshal
(Cornell University)

Ultraluminous Infrared Galaxies (ULIRGs) have power outputs rivaling quasars, yet they emit nearly all of their energy in the mid- and far-infrared. While rare in the local Universe, ULIRGs may play a dominant role in producing the far-infrared background as well as the star formation energy density at high redshifts. One of the outstanding issues in understanding the physical properties of ULIRGs is whether the presence of a supermassive black hole in their nuclei is responsible for a substantial fraction of the radiation reprocessed in the infrared. As a part of the IRS GTO program, we are taking advantage of the unprecedented sensitivity of the Infrared Spectrograph on Spitzer to conduct a large systematic spectroscopic survey over the 5-35 micron range of 110 ULIRGs with redshifts of $0.02 < z < 0.9$. Our goal is to provide the definite answer to the origin of their dominant energy source. We apply a diagnostic method which enables us to identify the presence of an active galactic nucleus in the mid-infrared using high ionization lines as well as global properties of the slope of the continuum and broad emission features. We have calibrated our method using a sample of well studied nearby starburst and Seyfert galaxies and we have applied it to 50 ULIRGs we have observed so far. The preliminary results of this study will be presented and their implications to the nature of high-z ultraluminous systems will be discussed.

The Puzzle of Cold Galaxies at High Redshift

G. Helou, et al.
(Caltech/IPAC)

Galaxies which are luminous (L 10^{12} L(sun) or more) but cold in the far-infrared (fnu(60um)/fnu(100um) 0.4 or less) can be found in the local universe, and are also luminous in Aromatic Feature mid-IR emission.
Similar objects have been reported at redshifts up to z 1 in follow-ups of ISO far-infrared surveys (e.g. Chapman et al 2002).
Submm surveys naturally favor colder sources, but Blain et al (2004) find a broader distribution in "dust temperature" for submm galaxies at $0.5<3.5$ than for any other population of galaxies. The most puzzling however is the subset of galaxies exhibiting cold dust and high opacity (high IR/visible light ratio), supported by direct and indirect evidence. This talk will review the evidence for such cold luminous galaxies, present new evidence from Spitzer, and propose some solutions to the puzzle.

Spitzer observations of SCUBA and MAMBO galaxies : weeding out active nuclei in starbursting proto-ellipticals

Rob Ivison
(ATC, Royal Observatory Edinburgh)

Owing to the coarse resolution of submm/mm instrumentation, submm galaxies have traditionally been difficult to identify. We compare deep multi-wavelength catalogs to show that the degree of overlap at 24, 850 and 1200um is large, particularly when the submm galaxies have 1.4-GHz counterparts. We show that sensitive 24-um observations are a useful route to identify counterparts to high-redshift far-IR-bright galaxies, complementing what is possible via radio imaging. Even at the relatively poor resolution of Spitzer, the mid-IR morphologies of submm galaxies are indicative of mergers. Accretion onto an obscured central engine is betrayed by the shape of the mid-IR continuum emission for several sources. This confirms Spitzer's potential to weed out active galaxies, and we develop a powerful color-color diagnostic for this purpose. However, the majority of submm galaxies have rest-frame 0.2-300um SEDs commensurate with Arp220-like starbursts.

EXO's : A Population of Dusty, High-Redshift AGN

Anton M. Koekemoer
(Space Telescope Science Institute)

A significant population of obscured black holes at high redshift has recently been revealed by Spitzer detections of Extreme X-ray / Optical sources ("EXO"s). These AGN are detected in deep Chandra and XMM surveys but are completely undetected in deep optical imaging, and are thus at the extreme end of the Fx/Fopt plane with values about 100 times above typical AGN. Their Spitzer detections indicate high reddening of their hosts due to substantial amounts of dust that obscure the AGN as well as most of the stellar population, suggesting intense on-going starformation that may also be linked to increased accretion onto the central black hole. These objects therefore provide a unique opportunity to probe the relationship between galaxy evolution and black hole growth in the early universe.

A resolved ISOPHOT-GALEX study of the reprocessing of ultraviolet light by dust in M 101.
Cristina C. Popescu, Richard J. Tuffs
(Max Planck Institut fuer Kernphysik, Astrophysics Department)
Here we compare 60, 100 and 170 micron maps of M 101 made using the ISOPHOT instrument on board ISO with UV maps of this galaxy obtained with GALEX in its near-UV and far-UV bands. The main result of this study is the discovery of a tight dependence of the FIR/UV ratio on radius, with values monotonically decreasing from 4 in the nuclear region to nearly zero towards the edge of the optical disk. A trend was also found for the FIR/UV ratio to take on higher values in the regions of diffuse interarm emission than in the spiral-arm regions, at a given radius. This investigation is indicative of what will be achievable using Herschel for galaxies out to around 35 Mpc.

Molecular Gas and Dust in the Magellanic Clouds
Rubio, M. Boulanger, F. Bot, C., Contursi, A., Rantakyro, F.
(Departamento Astronomia)
In low metallicity environments, due to the reduced shielding, CO emission is expected to trace the densest parts of molecular clouds but not their diffuse envelopes which makes most of the mass in Galactic GMC's. Sub-mm/mm observations of dust emission from low metallicity galaxies show a large excess of cold dust emission above whatwas expected from the extrapolation of the far-IR dust emission. The cold dust emission could be pointing at the existence of a large amount of so-far hidden interstellar matter.We have obtained deep SIMBA observations towards individual star forming regions and molecular clouds in the LMC and SMC. These observations show in some cases, the existence of cold dust emission as indicated by 1.2mm emission excess, while in other cases, the 1.2mm emission is mainly due to thermal free-free. A comparison of the 1.2mm emission spatial distribution of cold dust with that of known ISM components traced by CO, H I gas emission and far-IR dust emission can allow to obtain clues on the nature of the cold dust. For an SMC cold molecular cloud we suggest that the virial mass derived from CO emission gives only a lower limit to the gas mass of the cloud. An important question is raised from this study. Do CO observations grossly underestimate the amount of dense self-gravitating clouds where stars can form ?

The COSMOS 2-Degree Survey from the Radio Perspective
Eva Schinnerer
(MPIA)
The COSMOS HST treasury project is a pan-chromatic imaging and spectroscopic survey of a 2 square-degree field designed to probe galaxy and SMBH (super-massive black hole) evolution as a function of cosmic environment. It is the largest contiguous field ever mapped by HST. Numerous state-of-the-art imaging campaigns at all wavelengths (X-ray to cm) are underway for the COSMOS HST field. I will briefly describe the COSMOS project and will summarize the first results of our 1.4 GHz Very Large Array (VLA) pilot project of this field. I will also discuss our ongoing 250 hour observing campaign at the VLA to obtain deep, high-resolution imaging of the entire COSMOS field. The aim of this large VLA project is to study dust-obscured star formation and evolution of AGNs as a function of redshift and environment.

Poster contributions

The mid-IR properties of young radio AGN

P. Alexander, B. Nikolic, D.A. Green, K. Inskip, D. Ford
(University of Cambridge)

GHz Peak Spectrum (GPS) and Compact Steep Spectrum (CSS) are thought to represent the earliest phases of the development of radio loud AGN. Using radio observations alone the time since the onset of jet activity can be estimated reasonably accurately and is typically of order a few thousand years. These systems therefore provide a unique laboratory in which to study the relationship between nuclear activity and any associated star formation. Using multi-frequency radio data obtained with the GMRT, VLA and RT, we have defined a sample of young radio AGN in the Spitzer FLF which are associated with mid-IR sources. The broad-band Spitzer colours of these systems are modelled to constrain the evolution of AGN and dust relative to the onset of radio-loud phase of the AGN.

The Relationship Between Molecular Gas and Star Formation in Large and Small Galaxies

Bolatto, A. D., Leroy, A., Simon, J. D., & Blitz, L.
(U. C. Berkeley)

We explore the relationship between molecular gas and star formation as a function of galaxy size using a new large survey of CO in dwarf galaxies in combination with literature data. Within the sample of dwarfs we find that CO is strongly correlated with galaxy luminosity in the optical, NIR, FIR, and radio, and also with B-K color and morphology : these correlations appear to stem from an underlying CO to stellar mass relationship. We also find that these galaxies do follow the same RC-to-CO star formation law irrespective of size, with a similar scatter for dwarf galaxies and large spirals, suggesting that the underlying SFR-to-H2 relationship is unaffected by galaxy size or metallicity.

Sub/mm observations of optically selected high-z galaxies lensed by clusters

Boone, F., Combes, F.
(Astronomisches Institut Ruhr Universitaet)

A report is given on MAMBO observations of high redshift galaxies gravitationally lensed by clusters. The sources taken from the literature were selected morphologically as giant arcs or by drop out techniques near the caustics. Contraints on the dust content of these optically selected galaxies are derived. The interest of this kind of observations as a complement to other samples (e.g. SMG, LBG, quasars) is shown and the prospects in the context of APEX and ALMA are presented.

Discovery of hyperluminous infrared galaxies with Spitzer and SHARC-II

C. Borys, C. Bian, A.W. Blain, A. Dey, C.D. Dowell, D.T. Frayer, E. Le Floc'h, B. Jannuzi, B.T. Soifer
(Caltech)

We have used Spitzer MIPS observations taken in the Bootes field to preselect high redshift luminous starforming galaxies. Subsequent ground-based sub-millimeter imaging with SHARC-II at the CSO has discovered a particularly exotic object : An extremely bright infrared galaxy with an apparent luminosity in excess of $10^{13.5}$ solar luminosities. It has a spectral energy distribution (SED) almost identical in shape to Arp220, but is 100 times more luminous and lies at z 1.5. To discuss this object in detail, we present followup observations obtained from ground based radio and optical telescopes. Finally, we show how silimar systems can be selected using a silicon absorption feature in the Far-Infrared SED.

BLISS and SPICA : Revealing the History of Energy Production in Dusty Galaxies with Far-IR Spectrosocpy at the Background Limit.
C.M. Bradford, J. Bock, M. Harwit, G. Helou, T. Matsumoto, T. Nakagawa, E. Young, the BLISS team
(JPL)
Half the energy produced since the Big Bang emerges in the far-infrared, the result of dust in luminous galaxies around the historical peak in energy production, redshifts of 1-5. Measuring the redshifts, masses, and conditions in these dusty galaxies is critical for a complete history of star formation, metal and dust production, and galaxy evolution. While tens of thousands of these galaxies are being and will be discovered in the continuum, far-IR spectroscopic follow-up will be difficult for galaxies beyond z 1 with existing platforms. The combination of a cold telescope and a sensitive direct-detection spectrometer offers factors of 100-10,000 sensitivity gain for moderate resolution spectroscopy, allowing line diagnostics of dusty galaxies throughout the era of galaxy evolution. We are studying ways to construct such an instrument (BLISS) for the Japanese SPICA mission as one of NASA's Origins Probe concepts. We outline the astrophysical experiments enabled by BLISS-SPICA, the complementarity with ALMA, our instrument concepts and the key technologies which will enable the experiment.

The Radio - FarInfrared Correlation in the ELAIS field S1
P. Ciliegi, C. Gruppioni
(INAF - Bologna Astronomical Observatory)

Proposition of a normal galaxy survey with ALMA
Combes F.
(Observatoire de Paris, LERMA)
I will present the motivations to carry on with ALMA a mapping survey of normal galaxies in the CO lines, (and a restricted survey in isotopes and high-density tracers) which could be called ALMA-SONG. The motivations include – the goal of resolving individual molecular clouds, and through the virial relation, investigate the CO/H2 conversion ratio, – to tackle with high resolution, the star formation rate and efficiency in various environments, and – investigate the various dynamical features (waves, resonances) that drive evolution in galaxies.

A Search for CO in the Elliptical Component of a Sample of E+S Pairs
Harriet Cullen, Paul Alexander
(University of Cambridge)
We present CO(J=1-0)and CO(J=2-1) observations of eight elliptical galaxies, forming part of a sample of interacting galaxies each consisting of one late and one early-type system. All the elliptical galaxies observed are undetected in CO to low levels, allowing use to place tight constraints on their molecular gas content. The implications for possible gas transfer from the late to early-type galaxy during the interaction are discussed.

The faint counterparts of MAMBO 1.2mm sources near the NTT Deep Field
Helmut Dannerbauer, M.D.Lehnert, D. Lutz, L. Tacconi, F. Bertoldi, C. Carilli, R. Genzel, and K.M. Menten
(MPIA)
Using the Max-Planck-Millimeter-Bolometer (MAMBO) array at the IRAM 30 m telescope, we surveyed the region surrounding the NTT Deep Field. The aim is the detection of a significant number of the brightest (sub)mm background sources at 1.2 mm. Due to the large angular size of the IRAM 30 m millimeter telescope beam, a proper identification of the mm sources based only on bolometric data is impossible. The key element for the follow-up of these dusty, high-redshift sources is therefore mm and cm interferometry, which can provide resolution of better than 1 arcsec. We have obtained accurate positions from VLA 1.4 GHz interferometry, and in a few cases IRAM PdBI interferometry, and have also made deep BVRIzJK imaging at ESO. We present results of this multi-wavelength identification program. Further, we compare our findings with results from 850 micron surveys of similar depths and discuss the basic properties of the near-infrared/(sub)millimeter/radio spectral energy distributions of our galaxies and of interferometrically identified submm sources from the literature.

The dust and gas content of dwarf HII galaxies

Joanna N. Fabbri, M. J. Barlow, X.-W. Liu, W. K. Gear
(University College London)

We have investigated the dust and gas content of a sample of nearby dwarf HII galaxies having a range of metallicities, since the evolution of the dust to gas ratio as a function metallicity is still poorly understood for HII galaxies and for young high-redshift galaxies. Our investigation of the dust component of these galaxies has used SCUBA 850-micron continuum data together with IRAS data and ISO FIR photometry and spectrophotometry, where available, to produce best-fit SEDs, from which dust temperatures, emissivity indices and total dust masses were estimated for each galaxy. Published HI 21-cm data have been used to estimate atomic hydrogen masses for the sample, while Halpha and radio free-free fluxes were used to derive ionized gas masses. To estimate masses for the molecular component, we have obtained new CO 2-1 and 3-2 JCMT observations for a number of the galaxies, while [CI] 609um observations have been approved. We will present our results to date on the relative masses of the various gas components and of dust in these galaxies.

Chemical study of the giant PDR in the nucleus of M82

A. Fuente, S. Garcia-Burillo, M. Gerin, R. Rizzo, D. Teyssier, A. Usero
(Observatorio Astronónico Nacional)

M82 is one of the nearest and brightest starburst galaxies (D=3.3 Mpc). Its nuclear starburst has been extensively studied in all spectral regions and is considered as a prototypical object. Recent observations reveal that the nuclear starburst is formed by small (1 pc) moderate dense (10^3 - 10^4 cm^{-3})
and hot (50 - 100 K) clouds immersed in a strong UV field. The intense UV field is expected to dominate the chemistry of these low extinction clouds.
Now, we present a chemical study of the the nucleus of M82. We have mapped the Galaxy disk in the radicals CN,HCN, C2H andc-C3H2, and the reactive ion HOC+ using the IRAM 30m telescope. All these species are well-known tracers of PDR chemistry. We have detected the small hydrocarbons C2H and c-C3H2 with an abundance similar to that found in dark clouds in spite of the strong UV interstellar field in this galaxy. Moreover, we have detected the HOC+ 1-0 line with an intensity similar to that of the H13CO+ 1-0 line. This implies that the HCO+/HOC+ ratio $<$ 100 in the nucleus of M82 and unambiguosly shows that the PDR chemistry is propagating outwards over the disk of this galaxy.

Predictions for Cosmological Infrared Surveys with Herschel and ALMA from a Mid-Infrared phenomenological evolution model

C. Gruppioni, F. Pozzi and C. Lari
(INAF - Osservatorio Astronomico di Bologna)

We make predictions for the cosmological surveys to be conducted by the future Herschel mission operating in the far-infrared. The far-infrared bands match the peak of the CIRB, the brightest background of astrophysical origin. Therefore, surveys in these bands will provide essential information on the evolutionary properties of Luminous and Ultra-Luminous Infrared Galaxies (LIGs and ULIGs), starburst and normal galaxies. Our predictions are based on a new phenomenological model obtained from the 15 micron luminosity function of galaxies and AGN, fitting all the ISOCAM observables (source counts and redshift distributions) and also the recently published Spitzer source counts in the 24 micron band. We discuss the confusion noise due to extragalactic sources, depending strongly on the shape of the source counts and on the telescope parameters. We derive the fraction of the CIRB expected to be resolved by Herschel in the different wavebands and we discuss extragalactic surveys that could be carried on by Herschel for different scientific puropouses (i.e. ultra-deep, deep and shallow).

History of starbursts in quasars

Martin Haas
(Astronomisches Institut Universitaet Bochum)

Detailed Infrared SEDs of 64 Palomar-Green quasars drawn from the ISO data archive show a diversity of shapes, consistent with the physical evolution of the dust distribution and the heating sources, namely AGN and starbursts. Regarding cosmic evolution, our hyperluminous quasars in the "local" universe at z=1 do not show the hyperluminous starburst activity inferred for z=4 quasars detected in several (sub)-millimetre surveys. This talk addresses central open questions for the quasar research with Herschel/ALMA.

The Antennae - a ULIRG in the making

Martin Haas (AIRUB Bochum), Ulrich Klaas (MPIA Heidelberg)
(Astronomisches Institut Universitaet Bochum)

SCUBA and ISOPHOT maps of the Antennae Galaxy resolve the nuclei of NGC 4038/39 and two prominent regions in the overlap area of the galaxy disks. Beside the warm dust heated by active starbursts they possess simultaneously dense concentrations of cold dust which are presumably still in a pre-starburst phase and will increase the luminosity once star formation has been ignited.

Attenuation law in disk galaxies by the mega-grain approximation

Akio K. INOUE
(Laboratoire d'Astrophysique de Marseille)

The attenuation law is different from the extinction law obtained for the Galaxy and Magellanic Clouds ; the attenuation law includes the effects of scattering and the configuration of dust and stars. It can be called as the effective extinction law. I investigated the attenuation law through the clumpy interstellar medium (ISM) in disk galaxies by using the mega-grain approximation, which is an approximation to treat dusty clumps as very large particles (i.e. mega-grains). I solved the radiative transfer equation in a 1-D plane-parallel geometry with multiple anisotropic scatterings, and then, obtained attenuation laws through the clumpy ISM. Further, I also introduced a physical model of the clumpy ISM as an extention of the multi-phase ISM model. In this framework, the attenuation law is determined by three physical quantities : the mean ISM gas density, the mean ISM pressure, and the dust-to-gas ratio. I found that the attenuation law in normal spiral galaxies is much steeper than that in starburst galaxies observed by Calzetti and co-workers.

Dense Gas in Galaxy Centers

F.P. Israel
(Sterrewacht Leiden)

A systematic survey of about 30 galaxy centers in various transitions of 12CO and 13CO shows that late type galaxies contain very massive and compact circumnuclear molecular clouds at relatively high kinetic temperatures. The warm or even hot mass fraction, typically half or more, is too large to be explained by PDR zones powered by circumnuclear starbursts. We discuss alternative energy input mechanisms.

Vertical Distribution in a Galactic Disk Constrained by a Molecular Cloud Complex

Chanda J. Jog, and Chaitra A. Narayan
(Indian Institute of Science, Bangalore, India)

We investigate the dynamical effects of a molecular cloud complex with a mass of 10^7 solar masses and a size of a few 100 pc on the vertical distribution of stars and HI gas in a galactic disk. Such massive complexes have now been observed in many spiral galaxies, including the Galaxy. The extended mass distribution in a complex, with the average mass density six times larger than the Oort limit, is shown to dominate the local gravitational field. This results in a reduction of the vertical scaleheights of stars and HI to 1/3 of their initial values. Surprisingly, the complex influences the disk distribution over a large radial distance of about 500 pc from its centre. The net result of many such complexes in a disk is that : first, the galactic disk potential is highly non-uniform on scales of the intercomplex separation of about 1 kpc ; and second, the scaleheights of stars and HI show local corrugations.

The Double Emission Line Feature of H_2 and HD From Primordial Molecular Cloud Cores
Hideyuki Kamaya and Joseph Silk
(Kyoto University)
We study the prospects for observing H2 and HD emission during the assembly of primordial molecular cloud cores. The primordial molecular cloud cores, which resemble those at the present epoch, can emerge around 1 +z 20 according to recent numerical simulations. A core typically contracts to form the first generation of stars and the contracting core emits H2 and HD line radiation. These lines show a double-peak feature. The higher peak is the H2 line of the J= 2-0 (v= 0) rotational transition, and the lower peak is the HD line of the J= 4-3 (v= 0) rotational transition. The ratio of the peaks is about 20, this value characterizing the emission from primordial galaxies. The expected emission flux at the redshift of 1 +z $\sim$ 20 in the J= 2-0 (v= 0) line of H2 occurs at a rate $\sim$ 2 * 10^{-7} Jy, and in the J= 4-3 (v= 0) line of HD at a rate 8 * 10^{-9} Jy. The former has a frequency of 5.331 79 10^{11} Hz and the latter is at 5.333 88 10^{11} Hz, respectively. Because the frequency resolution of the Atacama Large Millimetre Array (ALMA) is about 40 kHz, the double peak is resolvable. While an individual object is not observable even by ALMA, the expected assembly of primordial star clusters on subgalactic scales can result in fluxes at the 2000-50 micro-Jy level. These are marginally observable. The first peak of H2 is produced when the core gas cools due to HD cooling, while the second peak of HD occurs because the medium maintains thermal balance by H2 cooling which must be enhanced by three-body reactions to form H2 itself.

Preparing for HIFI and PACS : Atomic Carbon and CO in the spiral arms of M83 and M51
Carsten Kramer, B.Mookerjea, J. Stutzki, M.Gerin, S.Garcia-Burillo, F.Israel, J.Wouterloot
(I. Physikalisches Institut, Universität zu Köln)
The major cooling lines of the interstellar medium in galaxies are those of CII, OI, CI, and CO. They stem from dense photon dominated regions (PDRs), but also partly from HII regions and the diffuse warm ionized medium. Preparing for velocity resolved CII and OI observations with the Herschel Space Observatory, we have for the first time observed atomic carbon at selected positions in the spiral arms of the nearby gas-rich galaxies M83 and M51. These observations at 12 arcsec resolution are combined with low- and mid-J CO lines. Here, we use the Kaufman-Wolfire PDR model to derive mean densities and FUV fields of the emitting regions. Combination with ISO/LWS CII and OI data allows to judge the relative importance of enhanced cosmic ray emission, FUV fields, shock heating, geometry, and clumpiness of the emitting regions. The results are compared with those obtained for Galactic star forming regions.

Mid-infrared selection of obscured AGN
M. Lacy, A. Sajina, Lisa Storrie-Lombardi
(Spitzer Science Center, Caltech)
Using data from the Spitzer First Look Survey, the Sloan Digital Sky Survey, and archival ISO spectra, we have developed a technique for identifying AGN
based soley on their mid-infrared colors. In particular, this allows us to
find candidate AGN whose optical/UV and X-ray emission is hidden by obscuring columns of dust and gas. We present the results of follow-up of a sample of AGN selected in this manner which suggests that around 50% of AGN with mid-infrared flux densities comparable to quasars are sufficiently obscured
in the optical to be missed by an optically-based quasar survey. We discuss the effectiveness of this selection technique in comparison to other methods for finding obscured AGN, and compare our inferred number densities of hidden AGN with the limits from estimates of the local mass density of black holes in galaxy nuclei.

Probing structure formation with far-infrared Background Correlation
G. Lagache, N. Fernandez-Conde, J.-L. Puget
(IAS)
In the near future far-IR and sub-millimeter telescopes will perform deep surveys over small areas, aimed at resolving a substantial fraction of the galaxy populations making the Cosmic Infrared Background (CIB). However, investigation of the clustering of these populations requires surveys over much larger areas. Complementing these observations, Planck and Herschel with their sensitivities and angular resolutions can produce unique maps of the CIB anisotropies. These anisotropies are mainly contributed by moderate to high redshift star-forming galaxies, whose clustering properties are currently unknown. Since the clustering strength depends on the bias at the relevant redshift range, fluctuation maps will allow, for example, a study of the typical masses of these star-forming halos.
Using an empirical model that predicts the correlated CIB anisotropies, we will show how Planck and Herschel can provide clues on the physical relations between dark matter and baryons when galaxies formed. We will also present the first constraints obtained on the bias on the far-IR galaxies using the ISOPHOT/FIRBACK measured angular power spectrum.

Mid-infrared selection of AGN
Christian Leipski
(Astronomisches Institut Universitaet Bochum)
During the scientific verification of the ISOCAM Parallel Survey at 6.7 micron we have discovered a population of high latitude objects with exceptional mid-infrared (MIR) emission. Their MIR colours are typical for nuclear dust emission of AGN. Optical spectroscopy of the sample shows AGN as well as extremely reddened emission-line galaxies which, in addition, have MIR/FIR flux ratios larger than for known pure starburst galaxies. Because of the high extinction, optical observations might not be able to see the true AGN or starburst nature of those sources.The talk addresses open questions arising from the suspected hidden AGN population for Herschel/ALMA.

Primordial Carbon and detection of the cosmological objects in molecular lines.
Lipovka Anton, Campos Julio, Saucedo Julio.
(EAS)
In this report the formation of primordial molecules in minihalos at redshifts $10<400$ is considered. The calculation of the abundances of these molecules has been made for Standard Big Bang Nucleosynthesis (BBN) as well as for the Non standard BBN (NBBN) which leads to considerable abundances of carbon and oxygen. It is shown that in this case the relative abundance of the molecule CH based on primordial carbon should be higher than $10^{\{} - 14\}$, whereas the molecular abundances of species based on primordial oxygen turn out to be insignificant. The optical depth for the primordial clouds in rotational lines of CH molecule is calculated.

Far IR properties of AGNs. The AGN-SB connection.
J. Masegosa, I. Márquez, D. Dultzin, O. González-Martín
(Instituto de Astrofísica de Andalucía)
LINERs galaxies have been considered as the low level end of the family of Active Galactic Nuclei (AGNs), but still a lack of consensus does exist on their AGN nature. With the main goal of investigating the AGN and/or Starburst nature of these galaxies, we have studied their FIR properties. Among the results we want to remark that LINERs appear to have larger far IR luminosities than the other type of galaxies, both Starburst and Seyferts. This result seems to be compatible with the belief that an obscured AGN reside on most of them

The 2 mm line survey of the starburst galaxy NGC253 : Sulfur chemistry.
J. Martin-Pintado
(Instituto de Estructura de la Materi (CSIC))
The results of the spectral line survey of the starburst galaxy NGC253 carried out with the IRAM 30-m telescope will be presented. The sulfur chemistry in the nuclear region of this galaxy will be analyzed in detail. While the fractional abundance of CS, SO, OCS, SO2 , H2CS, H2S and NS are of a few 10^{-9}, those of CS and OCS are larger by one order of magnitude. The abundance of these molecules in NGC253 will be compared with those observed in different prototypical galactic sources to establish the dominant mechanism driving the chemistry. The abundance of the different molecules will be also discussed in the context of the existing time-dependent sulfur chemistry models. Molecules like OCS are likely injected into the gas phase from the grain mantles by shocks.

Far IR properties of AGNs. The AGN-SB connection.
J. Masegosa, I. Márquez, D. Dultzin-Hacyan, O. Gonzalez-Martín
(instituto de astrofísica de andalucia)
LINERs galaxies have been considered as the low level end of the family of Active Galactic Nuclei (AGNs), but still a lack of consensus does exist on their AGN nature. With the main goal of investigating the AGN and/or Starburst nature of these galaxies, we have studied their FIR properties. Among the results we want to remark that LINERs appear to have larger far IR luminosities than the other type of galaxies, both Starburst and Seyferts.This result seems to be compatible with the belief that an obscured AGN reside on most of them.

Hydrocarbon dust absorption in Seyfert galaxies and ULIRGs
R. Mason, G. Wright, Y. Pendleton, A. Adamson
(NOAO Gemini Science Center)
We examine the 3.4um C-H bond stretch, a signature of hydrocarbon solids in interstellar dust, in several Seyfert galaxies and ULIRGS. The 3.4um band in these galaxies closely resembles that seen in the Galactic diffuse ISM and in newly-formed dust in a protoplanetary nebula. The similarity implies a common carrier for the carbonaceous component of dust, and one which is resistant to processing in the interstellar and/or circumnuclear medium. We also examine the mid-IR spectrum of NGC1068, because absorption bands in the 5-8um region further constrain the chemistry of the 3.4um band carrier. While weak features like those present in the mid-IR spectrum of diffuse dust towards the Galactic center would be undetectable in NGC1068, the strong bands found in the spectra of many proposed dust analog materials are clearly absent, eliminating certain candidates and production mechanisms for the carrier. The absence of strong absorption features at 5-8um is also consistent with the interpretation that the similarity in the 3.4um feature in NGC1068 to that in Galactic lines of sight reflects real chemical similarity in the carbonaceous dust.

Environmental Effects on Gaseous Disks of Virgo Spiral Galaxies
H. Nakanishi, N. Kuno, Y. Sofue, N. Sato, S. Onodera, F. Egusa, T. Tosaki, Y. Shioya, A. Hirota, K. Sorai, and N. Nakai
(IoA, University of Tokyo)
We present the results of ^{12}CO($J = 1 - 0$) observations of five Virgo spiral galaxies achieved with BEARS receiver equipped at Nobeyama 45 m telescope. We combined these CO data with the H {I} data to address the environmental effect on the gaseous disks. We investigated the relationship between the molecular fraction ($f\_\{mol\}$) and the total gaseous density (H {I} plus H_2 density, $\Sigma\_\{\{HI\} + \{H\}\_2\}$). We found that three of our samples displays unusually larger $f\_\{mol\}$ than that expected for the field galaxies, while the rest two galaxies show the normal $f\_\{mol\}$. It implies that the ram-pressure stripping occurs at the inner disks to result in unusually large $f\_\{mol\}$.

Tidally triggered star formation in the Sloan Digital Sky Survey
Bojan Nikolic, Harriet Cullen, Paul Alexander
(Cavendish Lab., Cambridge University)
We have investigated the connection between star formation and galaxy-galaxy interactions using a large (20K galaxies), volume-limited, sample drawn from the Sloan Digital Sky Survey. In particular, we looked at magnitude of tidally-triggered star formation as a function of separation to the nearest companion and how this depends on properties of both the galaxy under consideration and the companion. The properties considered include the morphological type (calculated using the concentration index) of the galaxies and the mass difference. I will present the results from this study, including a quantitative measurement of star formation enhancement in close pairs and strong statistical evidence that the star-formation is predominately triggered in nuclear regions.

SMBHBs as relics of galaxy encounters and merging : the 3C66B example.
F. De Paolis, A.A. Nucita and G. Ingrosso
(Universita' degli Studi di Lecce)
Supermassive black hole binaries (SMBHBs) may exist in the centers of galaxies and active galactic nuclei (AGN) and are expected to be fairly common in the Universe as a consequence of merging processes between galaxies. The existence of SMBHBs can be probed by looking for double nuclei in galaxy centers or, more easily, detecting periodic behavior in the observed radio light curves. Thus SMBHBs represent the relics of ancient galaxy encounters. An example of such an event may be the 3C66B galaxy. In a recent paper, Sudou et al. (2003) announced the first direct observation of an SMBHB. Using VLBI observations they found that the unresolved radio core of the radio galaxy 3C66B shows a well defined elliptical motion with a period of 1.05 ± 0.03 yrs, implying the presence of a couple of massive black holes in the center of the galaxy. Here, we study the astrophysical implications of the existence of such an SMBHB in 3C66B. In particular we focus on the information that can be obtained from detecting a signal periodicity either in the X-ray and/or γ-ray light curves as a consequence of the motion of the black holes. These observations could be used to extract further information on the physical parameters of the SMBHB and partially solve the system parameter degeneracy. The detection of the gravitational wave spectrum emitted by such system may be used to completely determine the physical parameters of the binary system.

Multiphase ISM in early-type galaxies
Pandey et al
(Ravishankar University)
Presence of various forms in ISM in nearby, bright early-type galaxies, and physical connection between them will be discussed based on multiband(optical and X-ray) data.

X-ray spectroscopy of dust along the line of sight to the Galactic X-ray binary GRS 1915+105
Andreea Petric and Frits Paerels
(Columbia University)
It has become increasingly clear that understanding astronomically significant processes at high and low redshif, such as galactic evolution, accretion onto supermassive black hoes, star formation, feedback of processed metal-rich material into the ISM and IGM, is not possible without a proper understanding of the physical properties of astrophysical dust. X-ray observations can complement well IR studies of dust ; in particular high resolution X-ray observations can provide a detailed picture of the structure of grains in high-energy environments through the detection and analysis of X-ray absorption fine structure (XAFS) features. Such features appear as a modulation in the photoabsorption transition probability and its exact shape is sensitive to the precise physical properties of the solid material such as the crystal structure, chemical composition, characteristic correlation length for charge transport through lattice. Here we present our investigation of these features in the X-ray spectrum of the microquasar GRS 1915+105 from archived Chandra data.

The baryonic Tully-Fisher relation revisited
Daniel Pfenniger & Yves Revaz
(Geneva Observatory)
We re-analyse the baryonic Tully-Fisher relationship with the same original data but with more sophisticated statistical tools and arrive to interesting clues about the amount of baryons in spiral disks.

The nature of the red disk-like galaxies at high redshift : dust attenuation vs. intrinsically red stellar populations

D. Pierini, C. Maraston, K. D. Gordon, A. N. Witt
(MPE)

We investigate the nature of the disk-like galaxies with red optical/near-IR colors (i.e. selected via R-K $>$ 5.3, or I-K $>$ 4, or J-K $>$ 2.3), found at high redshift (i.e. 0.7 $<$ z $<$ 3.2) in present deep near-IR surveys. We combine different models of the radiative transfer of stellar and scattered radiation in dusty media together with models of stellar population synthesis, including or not the thermally pulsating phase of the asymptotic giant branch (TP-AGB) stars. Our models of high-z disk-like galaxies explore a wide parameter space in terms of type and amount of dust, the structure of the dusty interstellar medium (ISM), the dust/stars distribution, the view angle of the system, the time dependence and the time scale of the star formation history, the metallicity of the stellar populations. They reproduce the red optical/near-IR colors of high-z red disk-like galaxies, contrary to other models in the literature. We show how reproducing the observations sets constraints on the dust/stars distribution and reveals the presence and the importance for the rest-frame visual–near-IR output energy of the TP-AGB stars at high z. TP-AGB stars are held to be fundamental contributors to the abundance of Policyclic Aromatic Hydrocarbons in the dusty ISM. Thus the latter result is consistent with the fact that the contribution of the PAH features to the infrared output energy of the Universe at 0.5 $<$ z $<$ 2 is prominent, as concluded from recent observations made with "Spitzer".

Global properties of ULIGs at different phases of merging and activity

P. Planesas, J. Gracia, L. Colina, L. Lara, A. Alberdi
(Observatorio Astronomico Nacional)

Our team has obtained the molecular gas mass and the CO profile characteristics for over fifty ULIGs with the IRAM 30m telescope, allowing us to compile a large sample, of about 80 objects, for which homogeneous data is available. The sample covers in a similar way the different phases of the merging process and the different types of nuclear activity found in ULIGs. Complementary data (infrared, radio continuum) have been gathered from the available literature, again stressing the goal of homogeneity in their measurement for the objects in the sample. Results on measured and derived properties will be given for the different merging/activity sub-samples, as well as trends found for the whole sample.

Modelling the spectral energy distribution of spiral galaxies from the UV to FIR/submm

Cristina C. Popescu, Richard J. Tuffs
(Max Planck Institut fuer Kernphysik, Astrophysics Department)

We present new calculations of the attenuation of stellar light and dust emission from spiral galaxies. We use geometries for stars and dust which can reproduce the entire spectral energy distribution from the ultraviolet (UV) to the Far-infrared (FIR)/submillimeter (submm) and can also account for the surface brightness distribution in both the optical/Near-infrared (NIR) and FIR/submm. The calculations are based on the model of Popescu et al. (2000), which incorporates a dustless stellar bulge, a disk of old stars with associated diffuse dust, a thin disk of young stars with associated diffuse dust, and a clumpy dust component associated with star-forming regions in the thin disk.

What we learn from the comparison between the 15 and 24 micron source counts.

Pozzi Francesca, Gruppioni Carlotta, Lari Carlo
(Dipartimento Astronomia Bologna)

The comparison between the new SPITZER source counts and the previous ISOCAM 15 micron observations is a key tool to constrain galaxy properties and evolution in the mid-IR up to z 2.5. We convert the ISOCAM 15-micron source counts to 24-micron by using a recent mid-IR phenomenological model for galaxy and AGNs based on 15-micron observation and able to reproduce all the 15-micron observables (source counts, z-distributions). The observed and the derived 24-micron counts agree well without any 'a posteriori' update of the model up to S 0.1 mJy. For lower fluxes, sources with high S_24/S_15 flux ratios (S_24/S_15$>$ 2-3) and high-z (z$>$1.5) start to dominate the counts. This high-z starburst population is a new mid-IR population since is not visible in the ISOCAM surveys due to the 15-micron k-correction, but contribute to the fainter end of the 24-micron source counts and up to 30% of the Cosmic Background at 24-micron.

Dense gas dynamics in the Galactic center

N. J. Rodriguez-Fernandez, F.Combes
(LERMA - Obs. Paris)

Most of the gas mass of the Galactic center (GC) is found in a few giant molecular clouds like Sgr A or Sgr B2 that are located in a nearly circular ring. These clouds are warm, dense and exhibit a rich molecular chemistry. The origin of this properties is not well-known but it could be related to the large scale dynamics of the Galaxy. Indeed, the GC gas dynamics are quite complex since in addition the dense circular ring, there is also a fraction of gas that exhibits high non-circular velocities. The kinematics of this gas are explained as due to an expanding molecular ring or to elongated orbits in the context of a bar potential. Regarding the physical conditions of the high velocity gas, they are not well known since it has only been observed in low density tracers as CO. We have undertaken a survey of dense gas (CS and SiO) in the different kinematic components of the GC with the aim of studying the physical properties of the high velocity gas and to investigate the possible links between the typical physical conditions of the GC clouds and the gas dynamics. We have detected dense gas in all the velocity components. The highest SiO/CS ratios are measured towards the Sgr D and the Clump2 complexes. We will discuss the implications of these findings in the context of the different models for the GC gas dynamics.

The galactic center ISM as seen in the infrared

N.J. Rodriguez-Fernandez, J. Martin-Pintado
(LERMA - Obs. Paris)

We present ISO observations of the gas and dust in the Galactic center. On the one hand, the fine structure line emission from species with an ionization potential higher than 13.6 eV arises in a diffuse gas component which is ionized by radiation with an effective temperature of 35000 K. The [NeIII]/[NeII] line ratios measured in the GC sources are consistent with the results of the Thornely et al. (2000) model for a short burst of massive star formation less than 8 Myr ago. We have also found that the [NeII] to far-infrared continuum ratio measured for the GC sources is similar to that of external galaxies, supporting the idea by Sturm et al. (2002) that the far-infrared continuum in Active Galaxies is dominated by dust heated by stellar radiation rather than by the AGN. On the other hand, fine structure line emission from neutral species arises in PDRs in the interface between the diffuse ionized gas and the dense molecular clouds. However, the [CII] 158 and [SiII] 35 microns lines also have an important contribution from the ionized gas component. PDRs can naturally explain the discrepancy between the gas and the dust temperatures. However, these PDRs can only account for 10-30% of the total H2 column density with a temperature of 150 K. We will discuss other possible heating mechanisms for the rest the warm molecular gas.

Cold gas in the center of galaxy clusters

P. Salome & F. Combes
(IRAM)

Cooling flows in the center of galaxy clusters have long been a puzzle, since the gas phases at the various temperatures are difficult to observe. A complex picture (bubbles, cavities, cold fronts) has been unveiled by X-ray data from Chandra and XMM-Newton : the hot gas does not cool regularly and steadily with spherical symmetry, but the cooling flow certainly fuels a massive black hole in the central galaxy, triggers AGN activity which reheats the intra-cluster gas. We have recently detected cold gas emission in several cooling flow clusters with the IRAM-30m, and we have shown, through CO(1-0) and CO(2-1) interferometer maps, a possible association of the cold gas (at about 20K) with the cooling flow, in two clusters. Much more sensitivity and spatial resolution is required now to explore the cooling phenomenon, that will improve our knowledge on the galaxy formation scenarios.

Near to mid-IR spectra (and beyond ?) of starbursts at z 6 to 10

Schaerer, Daniel
(Geneva Observatory)

We present an analysis of the stellar populations of several lensed very high redhshift galaxies (z 6-10) based on detailed SED modeling. Interesting insight into properties such as stellar populations ages, extinction, SF histories, and the expected versus observed Lyman-alpha emission are obtained. Our analysis includes where possible observations from several facilities in the optical (ground-based, HST), and near-IR (ground-based, SPITZER) and makes predictions for these spectral ranges and up to the mid-IR domain. This work should also provide a basis to estimate the observational properties of z>6 galaxies at longer wavelengths.

The nature of the faint submJy radio population

Nick Seymour, Ian McHardy and Katherine Gunn
(Institut d'Astrophysique de Paris)

I will present the current deep radio source counts at 1.4 GHz which go to down to 50 uJy and show a significant upturn below 1 mJy similar to that seen in the MIR from new results with Spitzer. The faint source counts show variation at faint fluxes (eg the HDF is significantly underdense) which may be explained by large scale structure. The sub-mJy upturn is well modelled by the emergence of a population of medium redshift starforming galaxies which dominate at faint flux densities. The modelling is discussed in terms of direct identification of the faint populations, evolution of luminosity functions and comparison to the IR faint source counts.

Infrared space observations of radio-loud AGN

Ralf Siebenmorgen, Martin Haas, Endrik Kr"ugel, and Wolfram Freudling
(eso)

We present a survey of all 3CR sources imaged with ISOCAM. The sample consists mostly of radio-loud active galactic nuclei (AGN). In total, we detected 68 objects of the 3CR catalogue, at redshifts $z < 2.5$, and obtained upper limits for 17 objects. The one with the highest redshift is 4C+72.26 at $z = 3.53$. ISOCAM data are combined with other photometric measurements to construct the spectral energy distribution from optical to radio wavelengths. The MIR emission may include synchrotron radiation of the AGN, stars of the host galaxy or dust. Extrapolation of radio core fluxes to the MIR show that the synchrotron contribution is in most cases negligible. In order to describe dust emission we apply new radiative transfer models. In the models the dust is heated by a central source which emits photons up to energies of 1keV. By varying three parameters, luminosity, effective size and extinction, we obtain a fit to the SED for our objects. In the models, a type 1 AGN is represented by a compact dust distribution, the dust is therefore very warm and emission of PAHs is weak because of photo–destruction. In AGNs of type 2, the dust is relatively colder but PAH bands are strong. Our models contain also dust at large (several kpc) distance from the AGN. Such a cold dust component was neglected in previous computations which therefore underestimated the AGN contribution to the far infrared. However to constrain the cold component we await future HERSCHEL/ALMA photometry. The modelling demonstrates that an AGN heating suffices to explain the ISO broad band data. Starburst activity is not necessary but will be searched for by our IRS Spitzer Space Telescope program.

Interacting Galaxies as Seen by Spitzer-IRAC

Howard A. Smith, Z. Wang, G. G. Fazio, M. L. N. Ashby, J.-S. Huang, M. A. Pahre, S.P.Willner, W. J. Forrest, J. L. Pipher, and J. A. Surace
(Harvard-Smithsonian Center for Astrophysics)

We review IRAC's observations of interacting galaxies. IRAC's four-color images of these galaxies spotlight the areas of star forming activity throughout the interactions, while peering deep into obscured regions – in particular around the galactic nuclei. The short wavelength band emission shows numerous compact stellar clusters. At longer wavelengths, the bright, more amorphous and filamentary features correlate well with the known distributions of denser gas, warm dust, and HII regions ; IRAC also sees fainter, more diffuse components that pervade the interactions and extend into the tidal tails. Assuming that the non-stellar emission traces star formation, the IRAC data provide a view into the total underlying star forming activities unaffected by obscuration.

We will use IRAC images of the Antennae galaxies as an illustration. Non-stellar dust emission, which dominates the 5.8 and 8.0um images, accounts for as much as 79% of the light at 5.8um and 95% at 8um. Using the flux ratio of non-stellar to stellar emission as a guide, we can map the local star formation rate and compare it to similar measurements in both normal and infrared-luminous galaxies. The rate is found to be as high as those seen in starburst and some ultra-luminous infrared galaxies. The two galactic centers of the Antennae actually have lower star forming rates than the off-nuclear regions despite their abundant dense gas and dust.

Mid and far-IR spectroscopy of AGN and starburst galaxies

L. Spinoglio & M.A. Malkan
(IFSI-CNR)

The potential of infrared spectroscopy for the study of the two main processes at work in galactic nuclei, star formation and black hole accretion is illustrated, both in view of the recent satellite results and awaiting Herschel.

The composite UV to far-IR spectrum of NGC1068 : modeling the ionic and molecular emission
L. Spinoglio, M.A. Malkan, H.A. Smith, E. Gonzalez-Alfonso, J. Fischer
(IFSI-CNR)
The multiwavelenth 0.2-200 micron ionic emission line spectrum of the prototypical Seyfert 2 galaxy NGC1068 is modeled using a two component AGN plus starburst photoionization model. The agreement between the composite model and the observed spectrum is very satisfactory. Far-infrared OH emission lines have also been detected in NGC1068 with the ISO-LWS spectrometer. This emission has been modeled using a radiative transfer code for both the continuum and the lines. The origin of these lines from both the nucleus and the extended starburst is investigated and discussed.

Probing the obscuring dust in ULIRG nuclei
Henrik Spoon
(Cornell University)
The mid-infrared spectral range contains a great number of absorption and emission bands of molecules present in the diffuse and shielded ISM. Detailed analysis of these features gives insight in the local conditions of the interstellar medium and in the power sources at work.
Using the IRS spectrograph on board Spitzer, we have obtained mid-infrared spectra for a sizeable sample of Ultra-Luminous InfraRed Galaxies (ULIRGs). The new spectra indicate that ULIRG mid-infrared spectra are not just simple combinations of AGN and starburst spectra – as generally assumed since the ISO mission. Instead, some spectra reveal signatures of strong obscuration, indicative of a deeply obscured nuclear power source.
On this poster I will present some of our ULIRG spectra and discuss the complicated spectral properties of the sample.

The Nature of the Cold Dust Surrounding Gas-Rich Dwarf Galaxies in the Virgo Cluster
Richard J. Tuffs, Cristina C. Popescu
(Max Planck Institut fuer Kernphysik, Astrophysics Department)
We describe a combined ISOPHOT and MIPS investigation of the nature of extended cold dust emission discovered around gas-rich dwarf galaxies in the Virgo Cluster. This cold dust extendes beyond the optical body of these galaxies (by factors of up to more than 3.5), and usually has extremely high 170/100 flux density ratios. We use our data to distinguish
between different scenarios for the wider existence, origin and heating mechanisms of the extended cold dust.

The SCUBA Local Universe Galaxy Survey
Catherine Vlahakis, Loretta Dunne & Stephen Eales
(Cardiff University)
We present new results from the SCUBA Local Universe Galaxy Survey, the first large statistical submillimetre survey of the local Universe. Dunne et al. (2000) presented an initial survey of a sample of 104 IRAS-selected galaxies and we now present the results of a sample of 78 Optically-selected galaxies. Since SCUBA is sensitive to the large proportion of dust too cold to be detected by IRAS the addition of this Optically-selected sample allows us for the first time to determine the amount of cold dust in galaxies of different Hubble types. We derive local submillimetre Luminosity and Dust Mass functions, both directly for the Optically-selected SLUGS sample and by extrapolation from the IRAS PSCz survey (by extrapolating the PSCz galaxies out to 850 microns we probe a wider range of luminosities), and find them to be well-fitted by Schechter functions. We find excellent agreement between the two LFs and DMFs and show that, whereas the slope of the IRAS-selected LF at lower luminosities was steeper than -2 (a submm "Olbers' Paradox"), as expected the PSCz-extrapolated LF flattens out at the low luminosity end.

The 24micron mid-infrared properties of optical/near-IR selected EROs
Lin Yan, and the FLS team
(Caltech)
Optical/near-IR colors have been widely used by recent surveys for selecting galaxies with old stellar populations at $z \sim 1$. However, the relative contribution from the early type versus dust reddened systems to the total sample is not well determined by any of the previous data. We present the first, direct measurement of the dust enshrouded systems using the 24μm mid-infrared data from the Spitzer Space Telescope. Combining the deep Spitzer 24micron data with the Keck DEIMOS spectroscopy of a sample of (R - Ks>5.3) EROs, we discuss the physical nature of this population and the significant implication of our results to the studies of early type galaxies at z 1, and the measurements of evolution of mass functions out to z 1 - 2.

Primordial Molecules & Strategy for ODIN & HERSCHEL

R.Maoli,P.Chambaud,J.Y.Daniel,P.de Bernardis,P.Encrenaz, S.Masi,B.Melchiorri,F.Melchiorri,P.Rosmus & M.Signore.
(Observatoire de Paris)

The presence of a primordial molecular medium can give us the possibility to investigate the first phases of structure formation. The molecular lines produced by resonant scattering of the CMB photons are the most important signals coming from the "dark ages" of the post-recombination universe. Posibility to detect these lines with ODIN and Herschel satellites are investigated.

Session ISM

Early phases of star formation
Philippe Andre
(CEA Saclay - Service d'Astrophysique)
The study of the earliest stages of star formation in molecular clouds is one of the fields that should benefit most from Herschel and ALMA. Improving our understanding of these deeply embedded stages is crucial to gain insight into the origin of stellar masses, multiple systems, and protoplanetary disks. As prestellar cores and young protostars emit the bulk of their luminosity between 80 and 500 microns, the two Herschel imaging instruments SPIRE and PACS are uniquely suited for taking a census of such objects in the nearby cloud complexes of the Gould Belt ($d < 0.5$ kpc). The planned Herschel surveys will provide, for the first time, the mass and luminosity functions for complete samples of thousands of cold condensations down to the proto-brown dwarf regime. Thanks to their large spatial dynamic range, these surveys will probe the link between diffuse ISM structures and compact self-gravitating condensations, thereby setting strong constraints on possible core formation mechanism(s). They will also provide a unique database, including in the Southern hemisphere, for follow-up high-resolution molecular line/dust continuum studies with ALMA. In particular, ALMA will allow the detailed properties of statistically representative samples of multiple protostars to be determined (e.g. frequency as a function of separation, orbital motions), which will set unique constraints on viable mechanisms for the formation of binary systems.

Chemistry in Pre-Stellar Cores
Edwin Bergin
(University of Michigan)
Pre-stellar cores are unique laboratories for studies of the physical and chemical conditions that precede star formation. With a benign environment and well described physical properties these sources allow for strong constraints to be placed on the line of sight chemical structure. In this talk I will show that an knowledge of the chemical structure is a pre-requisite for the interpretation of optically thick molecular line observations that probe the kinematics. I will also discuss how pre-stellar core studies with ALMA and Herschel will greatly extend our knowledge of this important phase of the star formation process.

The dust cycle through the ISM phases
Francois Boulanger
(IAS)

Models for Interstellar Dust and Infrared Emission
Bruce T. Draine, Princeton University
(Princeton University)
I will discuss current modelling of interstellar dust, including scattering and absorption of starlight, and reemission of absorbed starlight energy at longer wavelengths.

Exploring the Interstellar Medium with SOFIA
E. Erickson
(NASA Ames Research Center)
SOFIA, the Stratospheric Observatory for Infrared Astronomy, is being developed to operate at wavelengths from 0.3 microns to 1.6 mm over a 20 year lifetime. Its 2.5 m effective diameter telescope will be diffraction limited (8.5 arc seconds FWHM at 100 microns) at wavelengths beyond about 5 microns. Its B747SP aircraft platform will allow coverage of the entire sky and observation of ephemeral events. Nine first-generation focal plane instruments are being built, and more will be added later. These attributes assure SOFIA a vital role in future studies of the interstellar medium (ISM), in addition to topics such as the solar system.
SOFIA observers will explore the gamut of ISM topics : star formation ; the Galactic Center ; debris disks ; recycling of materials through the stellar life cycle ; the origin and evolution of biogenic materials ; shock, photodissociation, and photoexcitation physics ; gas and grain chemistry. Imaging, spectroscopy, and eventually polarimetry covering much of the infrared spectrum will all be part of SOFIA's arsenal in the attack on these and other important problems. The talk will describe the observatory, its status, its science instruments and anticipated program.
SOFIA is a joint program of NASA in the U.S. and DLR in Germany. Broad participation by the international science community in SOFIA observations will be encouraged via annual proposal opportunities and user-friendly tools. Roughly 80% of the observing time will be granted by the U.S. and 20% by Germany. For further information, see http ://sofia.arc.nasa.gov.

Results from Spitzer Observations of the Milky Way
Neal J. Evans II
(Univ. ot Texas at Austin)
The Spitzer Space Telescope (SST) provides unprecedented sensitivity in the mid-infrared and far-infrared (3.6 to 160 micrometers). Observations with Spitzer will impact nearly all areas of Galactic science. I will focus in this talk on studies of star and planet formation. Regions of star formation contain many previously unknown protostars and young stars with disks. Some dense molecular cores, previously thought to be starless, appear to contain objects of low luminosity, possibly sub-stellar in nature. Infrared excesses around somewhat older stars can be seen ; systematic studies of these will constrain the timescales for planet formation. Spectroscopy of low-mass protostellar objects reveals a rich array of ices, confirming evidence from millimeter studies that many species are frozen-out from the gas phase.

The various phases of the diffuse interstellar medium
E. Falgarone
(LERMA/LRA Ecole Normale Superieure & Obs. Paris)
In addition to its well known thermally stable phases, the diffuse interstellar medium in our Galaxy harbours a significant fraction of its mass gas in a thermally unstable regime. It also comprises pockets of warm gas, out of thermal and chemical equilibrium. We will review the many existing observational supports of these findings and present the perspectives opened by Herschel/HIFI and ALMA in this field.

Molecular Clouds asnd Star formation
Y. Fukui
(Nagoya University)
I will review the recent observational results on molecular clouds and star/cluster formation in the Milky Way and the Magellanic system and discuss main goals ALMA can uniquely attain.

ALMA and ISM/Star Formation
S.Guilloteau
(L3AB, Observatoire de Bordeaux)

Protoplanetary Disks
Thomas Henning
(Max Planck Institute for Astronomy Heidelberg)

Astrochemistry in the gas and on dust particles
Eric Herbst
(The Ohio State University)
The major chemical processes that form and destroy molecules in the ISM will be reviewed. Recent advances in our knowledge of these processes and how they affect calculated molecular abundances in assorted regions will be emphasized. Among the processes which have benefited the most from recent experimental and theoretical research are : (1) ion-molecule deuterium fractionation reactions, (2) neutral-neutral reactions involving a stable species, (3) dissociative recombination reactions, and (4) the formation of molecular hydrogen via diffusive mechanisms on surfaces.

Dust Formation, Propagation and Survival in the ISM.
Ant Jones
(Institut d'Astrophysique Spatiale)
Dust formation in the interstellar medium (ISM) is predominantly associated with evolved stars, i.e., when low mass stars reach the red giant or asymptotic giant branch (AGB) phase of their evolution, or when massive stars explode as supernovae (SNe). The contribution of AGB stars to the galactic dust budget is important, in terms of the variety and quantity of dust, but that due to SNe is not yet well-determined. AGB stars, through their stellar winds, are known to inject amorphous and crystalline silicates, hydrogenated carbons, silicon carbide, graphite and other rarer materials into the ISM. However, not all of these materials are detected observationally in circumstellar regions or in the ISM. The lifetimes of the major dust materials (i.e., carbons and silicates) in the ISM, against destruction in SN shock waves, appear to be short compared to the time-scale for the formation of new dust around evolved stars. A grain lifetime problem is therefore evident. Apparently, it is necessary to re-form and grow grains in the ISM, through accretion and coagulation processes, in order to explain interstellar dust observations. However, SN-generated shock waves with velocities less than 200 km/s destroy, by erosion, less than half of the dust mass that they interact with. Therefore SN shocks can be an efficient means of propagating dust through the ISM.

Shocks and line emission in PDR
J. Le Bourlot
(LUTH - Obs de Paris & Universite Paris 7)

Molecules in High-mass Star-forming Regions
Karl M. Menten
(Max-Planck-Institut fuer Radioastronomie)
Observations of dust and molecules provide the only information on deeply embedded high-mass protostars. Much current effort is, on the one hand, expended on extensive surveys of unequivocal signposts of high-mass star formation, such as tell-tale infrared spectral energy distributions and hot, dense molecular cores highlighted by maser emission in the methanol and water molecules. On the other hand, detailed studies of selected objects allow detailed analyses of their immediate neighborhoods. While surveys can be conducted using existing telescopes, high resolution, high sensitivity interferometry of thermal emission with the resolution necessary (better than a few hundred AU) has to await ALMA. In the meantime, VLA and VLBI observations of masers provide fascinating information on the dynamics close to the protostars. We shall give a summary of the results of such surveys and will discuss examples of current interferometer studies.

Scientific requirements of ALMA, and its capabilities for key-projects : Galactic
John Richer
(Cavendish Laboratory)
One of the key goals of ALMA is to provide images at very high spatial and velocity resolution, to allow the detailed kinematics of the star formation process to be observed in detail. I will outline the relevant design parameters of the array, and highlight its scientific capabilities, emphasising the area of star formation and protoplanetary disks.

Dust and ice spectroscopy
Alexander Tielens
(Kapteyn Astronomical Institute)

A chemical survey of low-mass protostars

E.F. van Dishoeck
(Leiden Observatory)

A brief summary will be given of a (sub)millimeter survey of the chemistry of a set of 18 low-mass protostars, covering the Class 0 and I phases. The multi-transition data are analyzed using accurate temperature and density structures derived from dust continuum observations combined with detailed line radiative transfer models. Systematic trends in the abundances with envelope mass are found. The best fits to both the low- and high-excitation lines are obtained with a 'drop-abundance' structure, in which the abundances are high in the inner and outermost regions. In the cold intermediate zone, the molecules are frozen out onto the grains. The importance of future high-angular resolution data with ALMA and high-frequency data with Herschel for testing these models will be emphasized.

Nearby Galaxies on the GMC Scale

C. Wilson
(McMaster University, Canada)

Nearby galaxies allow us to study the properties of the interstellar medium in environments which can differ significantly from those found in the Galaxy. Low metallicity galaxies have been found to contain surprisingly large amounts of very cold dust, while interacting galaxies contain extremely massive molecular complexes. I will review recent results for nearby galaxies with a focus on observations that probe the 100-pc scale of giant molecular clouds and discuss what observations with ALMA and Herschel will contribute in this area.

Chemical study of the envelopes of intermediate-mass YSOs

A. Fuente, R. Rizzo, R. Neri, P. Caselli, R. Bachiller
(Observatorio Astronónico Nacional)

Contrary to low-mass protostars, intermediate-mass (IM) young stellar objects (YSOs) have been very little studied thus far, specially young protostars. For example, out of more than 50 Class 0 sources detected so far, only about 10 have luminosities in excess of 40 Lsun (the precursors to HAeBe stars). IM YSOs (stellar masses between 2 and 10 solar masses) are not only an important link between low mass and high mass stars but they share many characteristics of high mass star formation (clustering, PDR/HII regions)
without the disadvantage of being too distant (distance less than 1 Kpc) or too complex. They are also important for the understanding of planet formation since Herbig Ae stars are the precursors of Vega-type systems. In a different scale, they dominate the mean UV interstellar field in our Galaxy.
We present a molecular survey of the Class 0 intermediate-mass protostar NGC 7129 – FIRS 2 and the Herbig Be star LkHa 234 carried out with the IRAM 30m telescope. The aim of this survey is to determine the chemical evolution of the envelopes of intermediate-mass IM YSOs. NGC 7129 – FIRS 2 and LkHa 234 are sources with similar luminosities and located in the same molecular cloud. This minimizes the chemical differences due to different stellar masses or initial conditions in the molecular cloud and makes them very good targets to study the chemical evolution in protostellar envelopes. We have observed a total of 17 molecular species (including rarer isotopes) selected to trace the different envelope components. Our results suggest an evolutionary sequence in which as the protostar evolves to become a visible star, the total column density of gas is decreasing while the amount of warm gas increases. The overall warming of the envelope produces a strong chemical differentiation during this phase.
In addition, we have mapped the Class 0 protostar NGC 7129 –FIRS 2 in selected species (CH3OH, CH3CN, D2CO, N2D+) using the Plateau de Bure Interferometer (PdBI). The interferometric data unambiguously show the existence of a hot core with a complex and rich chemistry in this IM Class 0 object.

Diagnostics in the Far-IR : from OH to carbon chains

J.R. Goicoechea & J. Cernicharo (DAMIR-IEM-CSIC, Madrid, Spain)
(DAMIR-IEM-CSIC)

The far-IR wavelength range covers the spectral signature of several interesting phenomena that are difficult to observe from ground-based telescopes. The Infrared Space Observatory (ISO) has proved that the far-IR domain contributes to a better understanding of the physics and chemistry of the interstellar medium (ISM). In this contribution, we will discuss the role of the far-IR spectrum of light hydrides such as OH as a diagnostic of the physical conditions prevailing in galactic and extragalactic sources. In addition, far-IR spectroscopy can also contribute to the detection of symmetrical molecules (without rotational spectrum) such as the pure carbon chains. We will discuss our efforts to detect C4, C5, and C6 in the interstellar and circumstellar media. However, the sensitivity and the spatial/spectral resolution of ISO's spectrometers was rather poor. HIFI and PACS instruments, on board HERSCHEL, will allow more detailed studies on the molecular content and physical conditions of many IR sources and will help to answer many of the topics that remain open after the end of the ISO mission.

Molecular Line Searches from the Odin Satellite

Ake Hjalmarson, on behalf of the Odin Team
(Onsala Space Observatory)

The Odin submillimetre spectroscopy satellite, launched on 20 February 2001, is equipped with four tunable Schottky mixers covering the frequency ranges 541-581 and 486-504 GHz, and in addition a fixed-tuned HEMT receiver at 119 GHz intended for O2 searches. Recent result will be presented, including some very low O2 limits, observations of H2O,$H^{18}O$, $H_2{}^{17}O$, NH3,and 15NH3 in emission towards Orion KL and multiple absorptions towards Sgr B2, and the first results from the ongoing "spectral scan" of Orion KL in bands around 555 and 570 GHz. The Odin project is a collaboration between scientists and space agencies in Canada, Finland, France and Sweden.

High-mass star formation in the Southern Hemisphere sky

Vincent Minier, Michael Burton, Cormac Purcell, Tracey Hill, Steve Longmore, Andrew Walsh
(CEA Saclay)

We report on a multi-wavelength (IR to cm) and multi-resolution (1 mas to 20 arcsec) exploration of high-mass star formation regions in the Galactic plane, at longitudes observable from the Southern Hemisphere. Our source sample was originally identified through methanol masers in the Galactic plane, which exclusively trace high-mass star-forming regions. (Sub)millimetre continuum and molecular line observations were carried out with SEST/SIMBA, JCMT/SCUBA and the ATNF/Mopra mm-wave telescope and have allowed us to identify massive (>20 Msolar) and luminous ($>10^3$ Lsolar) clumps in each star-forming region. We have also constrained the SED with additional archives IR data, the physical conditions (Td, L, M) and the chemical composition of each massive clump. Several types of objects were characterised based on the ratio Lsubmm/Lbol, the dust temperature and the molecular line properties, ranging from class 0-like YSO clusters (Lsub/Lbol>1%, Td=30 K) to hot molecular cores (Lsub/Lbol=0.1%, Td=40-200 K). Preliminary high-angular resolution observations for a subset of the sample with the ATCA at 3 mm, the VLA at 15, 22 and 43 GHz and Gemini in MIR have revealed that several (proto)stellar objects are embedded in the massive clumps : massive protostars, hot cores and hyper compact HII regions. We have thus identified protoclusters of massive YSOs, which are the precursors of the OB associations. This sample of Southern Hemisphere star-forming regions will be extremely valuable for the scientific preparation of ALMA and HSO observations.

Spitzer-IRAC Observations of Star Forming Regions and their YSOs

Howard A. Smith, S.T. Megeath, L.E. Allen, R.A. Gutermuth, J.L. Pipher, P.C. Myers, N. Calvert, L. Hartmann, J. Muzerolle, G.G. Fazio, P. D'Alessio, B. Merin, P. Barmby, M. Marengo, G. Melnick, and A. Marston
(Harvard-Smithsonian Center for Astrophysics)

Spitzer's IRAC camera has obtained four color images of numerous star forming regions, including DR21, Cepheus C, S171, S140, and NGC 7129. The images reveal the stellar sources, while IRAC photometry enables new diagnostics that identify many of the stars as having significant emission from circumstellar dust, or ongoing disk / envelope accretion. The images clearly trace the shocked gas in these regions, and reveal many small, very red nebulous objects. In this illustrated talk we will review the IRAC observations of star formation regions, and discuss the particular case of DR21 where we have discovered the dominant source IRS1 (previously misidentified) : a young, massive embedded O8 star still with a luminous, accreting envelope.

Star formation in high pressure environments : laboratory experiments of ISM dust analogs.
W van Breugel, E. Bringa, S. Kucheyev, T. Felter, Z. Dai, G. Graham (LLNL) A. Tielens (Kapteyn Inst.) (Univ. of California)
Dust grains control the chemistry and cooling, and thus the gravitational collapse of interstellar clouds. Energetic particles, shocks and ionizing radiation can have a profound influence on the structure, lifetime, and chemical reactivity of the dust, and thus on the star formation efficiency. This would be especially important in forming galaxies, which exhibit powerful starburst (supernovae) and AGN activity. How dust properties are affected in such environments may be crucial for a proper understanding of galaxy formation and evolution, in particular given the close connection between the masses of galaxies and their central, massive black holes. We will present the results of experiments at LLNL which show, for the first time, that irradiation of an ISM dust analog - forsterite - by high energy - 10 MeV - heavy particles amorphizes its crystalline structure, without changing its chemical composition, at fluences representative for the ISM in our own Galaxy. Such energetic processing may explain the observed absence of crystalline dust in ISM clouds.

Poster contributions

A study of the DR 21 Star Forming Region with Spitzer

A. Noriega-Crespo, A.P. Marston, W.T. Reach, J. Rho, H.A. Smith, G. Melnick, G. Fazio, G. Rieke, S. Carey, L. Rebull, J. Muzerolle, E. Egami, D.M. Watson, J.L. Pipher, W.B. Latter and K. Stapelfeldt
(Spitzer Science Center- Caltech)

We present new far and mid infrared images of the star forming region DR 21 obtained with MIPS and IRAC, the photometer and camera on board the Spitzer Space Telescope. The images cover an area of approximately 0.5 square degree and show with unprecedent spatial resolution and sensitivity this complex region.

A study of the stellar population of the galactic bar limits and the Scuttum's spiral arm

Amôres, E. B. (1,2), Annie C. Robin (2), Lépine, J. R. D. (1) (1) Instituto de Astronomia Geofísica e de Ciências Atmosféricas (2) Observatoire de Besançon
(Instituto de Astronomia Geof. e Ciências Atmosféricas - USP (1) - Observatoire de Besançon (2))

We present here a deep near-infrared survey using the infrared camera (CAMIV) at the telescope of the National Laboratory of Astrophysics (Brazil). The main aim of this project is to performe observations towards directions where we expect the bar ends at l + 23º and l -14º, and towards the tangential direction to the Scuttum's arm (l 30.14 to 31.14 for -0.5 < b < 0.5). The observations were taken in the filters J, H and K with resolution of 0.5 arc sec / pixel with a field of view of about 8 x 8 arcmin. The observed color-color and color-magnitude diagrams are compared with the results obtained from the Besançon Galaxy Model (BGM)in order to check the presence of a stellar overdensity at the bar ends, and to estimate distances from the color-magnitude diagrams.

Water masers in dusty environments

N. Babkovskaia, J.Poutanen, R. Szczerba
(University of Oulu, Finland)

Sources of strong water maser emission at wavelength lambda = 1.35 cm have been found in many astrophysical objects such as active galactic nuclei, carbon-rich stars, protostellar regions. Maser emission is a powerful tool for investigating the physical conditions in the emitting regions because of its high brightness as well as high sensitivity to the physical parameters of the medium in which the maser amplification takes place.
There are several mechanisms for the ortho-water 6_{16} - 5_{23} (lambda = 1.35 cm) maser pumping, but the most effective one believes to be a mechanism, based on the difference between the gas and dust temperatures. However, a question about physical processes leading to the gas and dust temperature difference is still open. We propose a new model of the water maser, arising due to the simultaneous presence of dust grains of various types, having different optical properties and, therefore, different temperatures. Since one dust type is heating the gas, while another is cooling it, the gas temperature takes an intermediate value. The dust temperature is determined only by the radiation from a central star, while the temperature of the gas only depends on interaction with dust grains. We construct a self-consistent model of the maser sources in the silicate carbon star V778 Cyg.

A highly collimated, extremely high velocity outflow in Taurus

R. Bachiller, M. Tafalla, J. Santiago, & D. Johnstone
(Observatorio Astronomico Nacional, Spain)

We present the first case of a highly collimated, extremely high velocity bipolar outflow in Taurus. It is powered by the low-luminosity (0.4 Lsun) source IRAS 04166+2706 and contains gas accelerated up to 50 km/s with respect to the ambient cloud both toward the blue and the red (uncorrected for projection). At the highest velocities, the outflow collimation factor exceeds 20, and the gas displays a very high degree of spatial symmetry. This very fast gas presents multiple maxima, and most likely arises from the acceleration of ambient material by a time-variable jet-like stellar wind. When scaled for luminosity, the outflow parameters of IRAS 04166 are comparable to those of other extremely high velocity outflows like L1448, indicating that even the very quiescent star-formation mode of Taurus can produce objects powering very high energy flows (L_mech/L* > 0.15).

Methanol and deuterium fractionation in pre-stellar cores

A. Bacmann
(Observatoire de Bordeaux)

The study of multi-deuterated molecules has revealed that their abundances can be enhanced over that of their hydrogenated counterparts by factors of as high as 10^8 with respect to the cosmic ratio. The enormous abundances of the singly, doubly and triply deuterated molecules questioned the available theoretical models of molecule formation. The fractionation is specifically high in the cold, dense pre-stellar cores. In order to better understand the deuteration found in pre-stellar cores, we have carried out observations of deuterated methanol in a sample of pre-stellar objects in which we had found very high deuterium fractionations in formaldehyde. Singly deuterated methanol CH2DOH was detected in all of the sample cores with deuterium fractionations ranging from about 5% to 30 %. These values are similar to the fractionations found in young low-mass protostars, as was also the case for formaldehyde. Moreover, we find a proportionality between the CH2DOH/CH3OH ratios and the D2CO/H2CO ratio across the studied cores, hinting at similar deuteration mechanisms in formaldehyde and methanol. We investigate the possibility that deuterated methanol forms by successive additions of D or H atoms from H2CO or HDCO, respectively.

The contribution of the submillimeter lines of CO and C in the cooling in the nearby galaxies.

Bayet, E. Gerin, M. Phillips, T.G. Contursi, A.
(LRA-LERMA)

We present here new observations of the {3}P_{1}-{3}P_{0} and the {3}P_{2}-{3}P_{1} fine structure transitions of the atomic carbon [CI] at 492 GHz and at 809 GHz (respectively), and the rotational lines of carbon monoxide {13}CO(J=2-1),(J=3-2), {12}CO(J=2-1), (J=3-2), (J=4-3), (J=6-5) and (J=7-6) in a sample of nearby galaxies (D<10Mpc) : Henize 2-10, IC 342, M 83, NGC 253 and NGC 6946.
Mixing the literature data and our dataset, and using LVG and PDR models, we deduced the physical properties in these galactic nuclei (the UV-field, the kinetic temperature, the density...).
For each galaxy nucleus, we computed the contribution of each lines to the total C and CO cooling. And we also predicted CO intensities lines up to {12}CO(J=15-14). The CO lines with J>7-6 are not yet easily detectable from the ground but will be accesible in few years with ALMA and HIFI in HERSCHEL satellite.
With this work, the study of more distant galaxies will become possible.

The role of gas/grain interactions in interstellar chemistry using PIRENEA experiment

Natacha BRUNELEAU, Celine NAYRAL, Christine JOBLIN
(cesr, cnrs)

Gas/grain interactions play an important role in interstellar chemistry, both in UV-irradiated regions and in the more embedded coldest areas of molecular clouds. However, their detailed study suffers from the lack of experimental data. The PIRENEA set-up combines the trapping capabilities of an ion cyclotron resonance (ICR) cell with cryogenic shielding to produce and isolate nano-objects of interstellar interest.It is also equipped with several photon sources and gas inlets that enables to probe gas/grain interactions in interstellar conditions. We will present the first results obtained for systems such as large Polycyclic Aromatic Hydrocarbons (PAH) and silica nanoparticles.

Gas dynamics and excitation mechanisms in dense star-forming molecular cores

G. Callejo, J.-L. Lemaire, F. Le Petit,G. Pineau des Forêts, D. Field
(observatoire de Paris, LERMA)

The fundamental difficulty to detect molecular hydrogen is ruled out if the gas is shock-heated or submitted to fluorescence processes. The behaviour of the subsequent emission lines is of fundamental importance, for the cooling of the gas as well as a diagnosis tool. The knowledge of this behaviour giving access through the use of models to the main physical conditions of the medium. In this work we make use of a detailed study of the H2 line formation in shocked ISM and in PDRs. The line intensities are discussed and the best observational diagnosis arising from this study are presented, focused on the discrimination of the excitation mechanisms in the medium. The general results have been used in the case of the Kleinmann-Low infrared nebula embedded in the Orion molecular cloud OMC-1. A spectroscopic study (using VLT observations) shows the importance of J-type shocks and allowed to rule out the C-shocks hypothesis, with important consequences on the physical conditions (density, dynamics, magnetic field...) in the nebula. The same study has been performed for PDRs, leading to new conclusions about the possibility for a radiative excitation.

The role of formation pumping in the excitation of very high H2 rotational states
Casu, Silvia Cecchi-Pestellini, Cesare
(INAF-Osservatorio Astronomico di Cagliari)
Dust grains conventionally provide a surface for the formation of interstellar molecular hydrogen (H2). Although there is a general agreement about the process, the actual mechanisms is not completely understood and the internal energy distribution of the newly formed H2 molecule is still matter of debate. In this work we revisit the contribution of the formation pumping to the rovibrational level distribution of H2. A detailed comparison of different mechanisms both on dust surfaces and in the gas-phase is carried out. In particular, we show the dominant role of dust surface formation pumping in populating high rotational states. The results of this study play an interesting role in the interpretation of recent ISO/SWS results of the presence of a significant fraction of H2 in very high energy rotational levels observed towards OMC-1 Peak 1 (Rosenthal, Bertoldi & Drapatz, 2000, A&A, 356, 705)

Unbiased Spectral Survey of the Solar-Type Protostar IRAS16293-2422 from IRAM and JCMT
Caux et al.
(CESR)

HDO emission in the Solar-Type Protostar IRAS16293-2422
Caux et al.
(CESR)

Probing the outer cold midplane gas of protostellar disks
Cecilia Ceccarelli & Carsten Dominik
(Laboratoire d'Astrophysique de l'Observatoire de Grenoble)
Circumstellar disks around young stars are expected to be the sites of planet formation. When, and exactly how planets form depends on the evolution of the disks : the accretion properties, the dispersal of gas from the disk, and when and how dust coagulation proceeds. The bulk of the disk mass resides in the midplane, which is cold and dense, and where heavy elements bearing molecules freeze out onto the grain mantles. So far, the only detected molecule which presumably probes the disk midplan disk is the H2D+, which has the ground transition at 372GHz (Ceccarelli et al. 2004, ApJ 607, L51). Very likely, also the D2H+ ground transition at 692GHz can be used to probe the gas, and to constrain the ionization degree in the midplan gas. In this contribution we will discuss why it is important for ALMA to have the possibility to observe the 372GHz (which is at our knowledge not envisaged so far) and 692GHz lines, providing observational and theoretical arguments.

Infrared absorption spectra of crystalline plagioclase feldspar
H. Chihara, C. Koike, A. Tsuchiyama
(Osaka University)
We will report the far infrared absorption spectra of crystalline plagioclase feldspar. The members of the feldspar group of minerals are the most abundant constituents of the Earth's igneous rocks. In the context of astronomy and planetary science, in consideration of elemental solar abundance and equilibrium condensation sequence, plagioclase feldspar (NaCa)(AlSi)2Si2O8 is important. Actually in some types of meteorites and lunar rocks, this mineral species occured commonly. We will discuss the spectral variation depend on their chemical composition and astronomical implication.

Ro-vibrational Collisional Excitation Database : BASECOL

M.L.Dubernet (1) , B. Debray (2), F. Daniel (1), A. Grosjean (2), E. Roueff (3), D. Flower (4), A. Faure (5), P. Valiron (5), J. Cernicharo (6), N. Feautrier (1), A. Spielfiedel (1), T. Stoecklin (7) (1) LERMA, Observ. Paris ; (2) LAOB, Obs. Besançon ; (3) LUTH, Obs. Paris ; (4) Department of Physics, UK ; (5) LAOG, Obs. Grenoble ; (6) DAMIR, IEM-CSIC, Madrid, Spain ; (7) Université de Bordeaux I

(LERMA, Observatoire Paris-Meudn)

Numerical and bibliographical Databases in Atomic and Molecular Physics are essential for both the modelling of various astrophysical media and the interpretation of astrophysical spectra provided by ground or space-based telescopes. We will present the current status of a numerical and bibliographical database concerning collisional ro-vibrational excitation rate coefficients of molecules (basecol.obs-besancon.fr ou boum.obspm.fr/basecol). This is part of a EU effort towards the scientific preparation of the HIFI instrument of the Herschel Space Observatory (HSO) [1] and ALMA [2].

An identification of needs for data on collisional ro-vibrational excitation of molecules has been specified in a recent report [3]. These first steps have triggered different groups to carry out calculations on collisional ro-vibrational excitation of molecules and to build a related bibliographic and numerical database. This database, called BASECOL is devoted to collisional ro-vibrational excitation of molecules by colliders such as atom, ion, molecule or electron. We have constituted a international working group of molecular physicists involved in the calculations of ro-vibrational cross-sections, in order to ensure the continuity and the quality of the database. We are primarily focusing on collisional systems of interest for various astrophysical media. The database is composed of several parts : a bibliographic database (papers are read and associated to very precise keywords), calculated collisional rates or cross-sections, information on the molecular data used in the cross section calculations, various information on ro-vibrational excitation of molecules. For the systems of astrophysical interest, we will provide full information on the chain of errors of the data and give some recommendations. We will improve and enlarge the content of the bibliographic database and provide more collisional rates. Access is currently available via a classical WEB interface with an interactive query page for the bibliographic database. An interactive access to the collisional rates and cross-sections is underway. We are also addressing the issue of compatibility of the output of the database within the framework of the Virtual Observatories [4], in relation both with WEB tools for spectral analysis and with other databases [5,6].

References [1] http ://www.sron.nl/divisions/lea/hifi/ [2] http ://www.alma.nrao.edu/ [3] http ://www.lra.ens.fr/~ pcmi/herschel-alma.html [4] http ://www.ivoa.net [5] http ://www.rate99.co.uk/ [6] http ://www.ph1.uni-koeln.de/vorhersagen/

Narrow radio lines emission from dust.

Dubrovich V.K.

(SAO RAS)

The new mechanism of radio line emission based on the electron rotation around a dust grain is presented. Some astrophysical aplications of this mechanism is discussed.

A large scale view of molecular gas and dust towards cloud D of the Vela Molecular Ridge

Massi F., Elia D., Giannini T., Lorenzetti D., Nisini B.

(INAF - Osservatorio astrofisico di Arcetri)

We present large scale mm observations with the SEST both in the CO(1-0) transition and in the 1.2 mm continuum of an area (roughly 1 square deg) within the cloud D of the Vela Molecular Ridge. This region has been known to host several embedded young star clusters. The observations show a filamentary structure with a few dense molecular cores associated with the star clusters. Its turbulent nature is suggested by shell-like gas distribution evidenced both in the integrated emission line maps and in the velocity- position diagrams. A comparison with the location of 2mass sources unveiles diffuse star formation occurring within the filaments.

ISM dust feedback from Stars and Remnants

Falceta-Gonçalves, D. & Jatenco-Pereira, V.

(IAG-USP)

One of the most interesting tasks in Astrophysics is to discover the main source of the interstellar dust, which is detected both by light extinction and polarimetry. The ISM, generally cold and rarefied has dust growth timescales higher than the time of the Universe. In this sense, it is supposed that dust may be formed in stellar environments, regardless its evolutionary phase, and ejected to the ISM. In this work we present a semi-empirical calculation of the ammount of dust that comes back to the ISM in each stellar evolutionary phase, for each initial stellar mass. For that we considered a consistent evolutionary model, and a mass distribution function. As main results we show that stars of high masses are really important only in the beginning of starbust events, but in the current Galactic stage, stars with M $<$ 5 M_sun are the main source of dust.

Vibrational quenching of H2O in collision with H2

A Faure, L Wiesenfeld, M Wernli, P Valiron
(Laboratoire d'Astrophysique de Grenoble)

The water molecule has been observed in a great variety of astrophysical objects through pure rotational,ro-vibrational and maser transitions. Among the molecular data necessary to interpret the H2O spectra in molecular clouds, rate coefficients for collisional excitation of H2O by H2 are crucial parameters. We will report rate coefficients for the vibrational (de)excitation of the bending (010) mode of H2O by H2 using quasi-classical trajectory calculations based on the 9D potential energy surface of Valiron et al. (in preparation). The classical approach is chosen as an interesting alternative to exact but prohibitively expensive coupled-channel calculations. Preliminary results and limitations of the QCT method will be discussed.

Electron-impact excitation of interstellar molecules

A Faure, J Tennyson
(Laboratoire d'Astrophysique de Grenoble)

Electron-molecule collisions play a crucial role in astrophysical environments where the electron fraction is higher than about 10^{-5}, e.g. in the diffuse ISM, shocks or PDRs. We will present a review of our recent R-matrix calculations of rate coefficients for electron-impact rotational excitation of interstellar molecules (e.g. Faure, Gorfinkiel & Tennyson 2004). Our major result is the prediction of emission lines from higher rotational states than previously assumed. Rate coefficients for transitions with Delta_j>1 are indeed found to be significant and in some cases larger than those with Delta_j=1, the only ones considered previously. This reflects the importance of short-range interactions which are ignored in the standard Born and Coulomb-Born theories. Illustrative results will be presented for CH+, H3+ and H2O.

SCUBA-2 Surveys of the ISM

Fich, M. (and many Canadian and UK astronomers)
(University of Waterloo)

SCUBA-2 will be a next generation wide-field camera at 450 and 850 microns on the JCMT. It is expected that much of the JCMT observing time will be dedicated to surveys with SCUBA-2, once it begins operation in May 2006. Over the past year the communities in the JCMT partner countries have begun planning for these surveys. The current state of the plans for surveys of the ISM in the Milky Way will be presented in this poster.

Protostellar targets for ALMA and HERSCHEL : the case of IRAS08448-4343

T.Giannini, F.Massi, L.Podio, B.Nisini, D.Lorenzetti, A.Caratti o Garatti
(INAF-Osservatorio Astronomico di Roma)

The Vela Molecular Ridge is a nearby (∼700 pc) giant molecular cloud in the southern sky hosting many active star formation sites. These are valuable targets for future observations with ALM and Herschel. In particular, IRAS08448-4343 displays many signposts of star formation, such as different jets and a young cluster embedded within the associated molecular core. We have performed a detailed study of the region, covering a wide spectral range from the near IR to the mm-band, exploiting both imaging and spectroscopical ESO facilities in each spectral regime. A picture emerges of a dust structure which hosts a near IR cluster and multiple well collimated H2 jets ; these originate from different sources lying in a compact region at the cluster centre. The peak of the 1.2 mm map does not coincide with the IRAS peak, tracing a denser and colder region of dust emission with respect to that probed by IRAS. The mm peak is associable with the position of a red object, proposed as the driving source of the main jet in the field, which is extended along more than 0.3 pc. The driving source is resolved in at least six 2 micron peaks, being the reddest and coldest of them well aligned with the inner knots of the jet.
The spectral energy distribution of this source well resembles that of a low mass, Class I protostar.

Importance of Surface Morphology in Molecular Hydrogen Formation on Amorphous Solid Water and Implications for H2 formation in the Interstellar Medium

L. Hornekær,1,2, A. Baurichter,1, V. V. Petrunin,1, D. Field,2 and A. C. Luntz,1
(1 Physics Institute, University of Southern Denmark. 2, Institute of Physics and Astronomy, Arhus University.)

During the recent years a number of experimental groups have set out to try to answer the question of how molecular hydrogen is formed in the interstellar medium. The generally accepted belief is that the molecules are formed on the surface of interstellar dust grains.
Detailed laboratory experiments on the formation of HD from atom recombination on Amorphous Solid Water films, believed to be a good analogue of grain surfaces in dense interstellar clouds, show that this process is extremely efficient in a temperature range of 8 - 20 K [1], temperatures relevant for H2 formation on dust grains in the interstellar medium (ISM). These experiments also show that the morphology of the surface plays a dominant role in determining the partitioning of the 4.5 eV recombination energy between the surface and the molecular degrees of freedom [1]. We suggest that likewise, grain morphology rather than the detailed chemical nature of the grain surface might be most important in determining the energy content of H2 formed on interstellar dust grain surfaces and released into the ISM.
[1] L. Hornekær, A. Baurichter, V. V. Petrunin, D. Field and A. C. Luntz, Science 302, 1943 (2003).

Radiative transfer in 3D

M. Juvela, P. Padoan
(Helsinki University Observatory)

We will describe our work on radiative transfer modelling of interstellar clouds. In these studies magnetohydrodynamic simulations are combined with 3D radiative transfer calculations for continuum and line emission. We will also discuss our current work to create radiative transfer methods for models defined on hierarchical grids. These would allow modelling of structures extending many orders of magnitude in linear scale and as such would be very useful also in the analysis of observations of ALMA and Herschel.

Temperature effects on the spectra of olivine particles

C. Koike, H. Suto, H. Chihara, T. Naoi, H. Sogawa, A. Tsuchiyama, H. Okuda
(Kyoto Pharmaceutical University)

The spectra of olivine particles (forsterite, natural olivine, and fayalite) were measured in mid- and far-infrared region after continuously cooled down to 10K. The intensity and sharpness of each peak of these spectra became strong and narrow, respectively, after cooled down to 10 K. Further, new peaks appeared at low temperature. The peak positions can be the indicator of the dust temperature.

Dust and Windmodelling of born-again PNe Cores

Michaela F. M. Lechner
(University of Innsbruck)

I present a detailed study of the two young born-again cores V605 Aql and V 4334 Sgr (aka Sakurai's Object) specially focusing on their winds, mass loss and dust shells. As the central stars of these born-again PNe evolve much faster than normal objects in the transition from post-AGB to a full-blown PN, they provide a promising laboratory for "online" stellar evolution studies. By comparing high quality observational data to up-to-date evolutionary models I reveal whether the winds are massive, slow and cold (V4334 Sgr) or rather thin, fast and hot (V605 Aql) and how that effects their dust shells. Furtermore I present first snapshots of what will become a fully consistent 3D hydrodynamic code not forced into a certain geometry and modelling the evolution of the winds. At the current state it is already indicated that a slowly rotating star is quite sufficient to produce the common bipolarity structures as we see them e.g. in the hydrogen-poor PN A30 which is supposed to have undergone a born-again event in its past.

A comparative study of two globules from optical to far-infrared wavelengths

Lehtinen Kimmo
(Observatory)

We present observations of two morphologically similar globules, one of which has star formation, while the other has not. Optical and near-IR surface brightness observations, and extinction measurements of background stars are used to study the radial density distributions of the clouds. Far-infrared observations made with ISO are used to study the properties of dust in these clouds. Finally, these multi-wavelength observations are used to study the energy balance of the dust grains.

350 Micron Continuum Imaging of McNeil's Nebula
D.C. Lis (Caltech), K. M. Menten (MPIfR), and T. Stanke (IfA)
(Caltech)
A protostellar source in the L1630 molecular cloud, previously detected at (sub)millimeter wavelengths, was recently found to show dramatic variability in the optical regime by amateur astronomer J. McNeil. We present recent images of the 350 micron dust continuum emission in the vicinity of McNeil's Nebula obtained using the SHARC-II bolometer camera at the Caltech Submillimeter Observatory. A comparison with our earlier 1 mm and 350 mic observations of this source indicate a measurable increase in the 350 mic flux density since 1998. The source morphology also appears to have changed over the same period of time from an unresolved point source to spatially resolved emission with a FWHM source size of approximately 20".

First Detections of the Ground State Lines of Doubly Deuterated Ammonia in L1689N
D.C. Lis (Caltech). M. Gerin (LERMA), and E. Roueff (Obs. Paris)
(Caltech)
We report first detections of the 336 and 389 GHz ground state lines of doubly deuterated ammonia in the L1689N cloud using the Caltech Submillimeter Observatory. The hyperfine splitting is detected in both lines allowing the determination of the line opacity. The column density of ND2H derived assuming an excitation temperature of 5 K, is (1.2+/-0.6)e14 cm-2, implying an ND2H/ND3 abundance ratio of approximately (60+/-30) :1.

Synthetic rotational profiles of emission and absorption bands of interstellar PAHs
Malloci Giuliano, Mulas Giacomo, Joblin Christine, Toublanc Dominique & Porceddu Ignazio
(INAF-Osservatorio Astronomico di Cagliari)
The spectrometers on board Herschel will be able to resolve the rotational envelopes of far-IR emission bands of interstellar PAHs. We present here synthetic rotational profiles of low-energy vibrational modes of specific molecules, along with synthetic profiles of low-energy electronic transitions, for comparison respectively with the forthcoming Herschel observations and high resolution spectra of Diffuse Interstellar Bands. Such profiles were obtained through a Monte-Carlo model of the photo-physics of an isolated interstellar PAH, whose molecular properties were calculated using state-of-the-art quantum-chemical techniques. Upon successful identification of specific PAHs, comparison with observations will provide both useful information on the physical environment in which the molecule is embedded and be an indirect measurement of molecular parameters which are very difficult to obtain either theoretically or in terrestrial laboratories.

Methanol abundance in low mass protostars
S. Maret et al.
(University of Michigan)
Recent studies have suggested that low mass protostars harbor hot core regions similar to those observed in massive star forming regions. In these hot cores, grain mantle evaporates and the depleted molecules, among which methanol, are released in the gas phase. Once in the gas phase, these molecule can trigger the formation of more complex ones by gas phase chemistry. In this contribution we present JCMT and IRAM-30m observations of the methanol emission of sample of nine low mass Class 0 protostars. Using a radiative transfer model, we derive the abundance in the protostars envelopes and we show that the methanol abundance is greatly enhanced in the inner region of two protostars of our sample, most probably because of grain mantle thermal evaporation. These abundance are compared with grain mantle chemistry models predictions.

TRACING THE SHOCK PRECURSORS IN THE L1448–MM/IRS3 OUTFLOWS
I. Jimenez-Serra, J. Martin-Pintado, A. Rodriguez-Franco, N. Marcelino
(Instituto de Estructura de la Materi (CSIC))
We present the detection of the SiO and of the HCO lines at ambient velocities toward the molecular outflows in L1448-mm and L1448-IRS3. The HCO and the SiO lines shows the narrowest profiles. Toward L1448-mm, all lines except those of SiO and HCO, show two distinct velocity components. The SiO abundance in one of the components is one order of magnitude larger than in the other one. The HCO abundance behaves in just the opposite way. The SiO/HCO abundance ratio changes by more than two orders of magnitude between the two ambient components.The spatial distribution and the kinematics of the SiO emission toward L1448–mm suggest that the ambient SiO is associated with the molecular outflows. The origin of the large changes in the SiO and HCO abundance in the ambient gas will be discussed. It is proposed that the narrow line widths and the abundances of SiO in the ambient gas are produced by the interaction of the magnetic and/or radiative precursors of the shocks with the clumpy preshocked ambient gas.

Tracing the structure of diffuse interstellar matter using infrared continuum emission
Marc-Antoine Miville-Deschenes
(Canadian Institute for Theoretical Astrophysics)
One of the main challenges of the study of the ISM is to understand the exact three-dimensional structure of diffuse interstellar matter in relation with the dynamical processes involved (turbulence, gravity, shocks...). Dust emission from high-latitude diffuse clouds uniformely heated by the interstellar radiation field offers a unique opportunity to trace the density structure of the interstellar matter, independently of radiative transfer modelling. I will present several power spectrum analysis of continuum infrared emission obtained with Spitzer and IRIS, a newly reprocessed version of the IRAS data at 12, 25, 60 and 100 micron. In particular, the combination of Spitzer and IRIS data allowed us for the first time to detect a break in the power spectrum of the infrared emission which gives definite constains on the depth and the three-dimensional density structure of a molecular cloud. I will also discuss what will be the impact of Herschel and Alma on the characterization of interstellar structure and interstellar turbulence in general.

A Galactic Plane Survey with the Herschel Satellite
S. Molinari
(IFSI-CNR)
A 60-600microns 5 band, 4-40" diffraction limited beam FWHM, photometric imaging survey with Herschel of 1500 square degrees along the Galactic Plane, will be a very ambitious Herschel Key-Project with a promise of breakthroughs in many fields of Galactic astronomy. It will also provide the community with a publicly available, homogeneous and calibrated dataset of extraordinary legacy value for decades to come.
From diffuse interstellar cirrus to dense atomic and molecular clouds, from protostellar to post-AGB envelopes, from supershells to supernovae remnants, the equatorial plane of our Galaxy provides the ideal laboratory to carry out investigations of the global and integrated properties of the different phases of the Galactic ISM, its evolution and interactions. Further, results from the last generation of infrared observatories demonstrate that the warm and cold dust component is not only the main contributor to the overall energy budget of galaxies, but a most important and effective tracer of the structural, physical and evolutionary conditions of the material throughout the whole life-cycle of a galaxy.
The Herschel satellite offers the optimum and unique combination of spectral coverage, spatial resolution, and sensitivity to efficiently survey the entire Galactic Plane in the far-infrared and submillimeter. Such a survey, when combined with complimentary atomic and molecular gas surveys, will provide the definitive and statistically significant measurements of the properties of both the gas and the dust component of the ISM. This dataset is uniquely capable of addressing important and fundamental issues such as : what are the timescales for cloud formation and its evolution (e.g. transition from atomic to molecular clouds) ? What is the history of star formation in the Milky Way ? What is the star-formation efficiency and its variation with galactocentric radius and environment ? What is the life-cycle of dust, and how or why do dust properties evolve ? What, if any, are the conditions for triggering star formation and what is the relative importance of sequential vs induced star formation ? What is the timeline for the formation of massive stars ? What are the variations in the gas and dust ratio, and what factors govern these variations ?

86-115 GHz Spectroscopic Study of the Molecular Cloud associated with RCW106
B. Mookerjea, C. Kramer, M. G. Burton
(KOSMA, Univ. of Cologne, Germany)
We present the first results of a systematic chemical study of the 15 brightest dust emission cores detected in the 1.2mm continuum map of the molecular cloud associated with RCW106. The observations between 86 and 115 GHz, done using the MOPRA telescope have been recently concluded.

Some time-dependent results for PDR chemistry
O. Morata and E. Herbst
(Department of Physics, The Ohio State University)
Photon-dominated regions (PDR's) are surface layers of interstellar molecular clouds exposed to intense fluxes of far-ultraviolet photons. PDR models treat the radiative transfer from the outer regions to the inner and denser ones, and in particular take into account the self- and cross-shielding due to H2 and CO. Recently, observations of diffuse clouds and dense PDR's have found that there are some difficulties when gas-phase interstellar chemical models are used to explain the abundances of some important molecules. We will show the results of applying our time-dependent PDR code to the study of several of these problems : the formation of long carbon-chains in dense PDR's, the HCO+/HOC+ abundance ratio, and the abundance of N2 in diffuse clouds.

An atlas of synthetic far-IR emission spectra of specific PAHs for comparison with Herschel data
Mulas Giacomo, Malloci Giuliano, Joblin Christine, Toublanc Dominique & Porceddu Ignazio
(Istituto Nazionale di AstroFisica - Osservatorio Astronomico di Cagliari)
In the framework of the interstellar PAHs hypothesis, far-IR skeletal bands are expected to be a fingerprint of single species in this class. We developed a detailed model of the photo-physics of interstellar PAHs which provides a powerful tool for single-molecule identification. We here present synthetic far-IR emission spectra predicted by the above general approach, based on quantum-chemical calculations, for 20 PAHs and their respective cations, ranging in size from naphthalene (C10H8) to dicoronylene (C48H20), excited by a range of different radiation fields. The accuracy of these spectra is essentially the same as that of the quantum-chemical vibrational analysis, and can be refined using laboratory data, when available. Such spectra are suitable for direct, quantitative comparison with present (ISO) and forthcoming (Herschel) observations.

Dust and molecular gas properties of L1219 in the direction of the Ced201 reflection nebula
Silvana Nikolic and Maria Kun
(Departamento de Astronomia, Universidad de Chile)
Illuminated by the evolved Herbig Ae/Be star BD+69 1231 (Kun et al. 2000), the Ced 201 (VdB152) reflection nebula is situated at the SE edge of the L1219 dark molecular cloud. The distance to the cloud is estimated to 400 pc (Kun 1998). Ever since the unusual dust scattering properties of Ced201 were seen (Witt et al. 1987), the reflection nebula region itself has been extensively studied (e.g. Sellgren et al. 1996, Kemper et al. 1999, Cesarsky et al. 2000, Young Owl et al. 2002).
Here we present single-dish CO, CS, SO and HCO+ observations of L1219. Using the NICER method (Lombardi and Alves 2001) and the 2MASS data, we derived the cloud's optical extinction map and studied the distribution of cold dust (traced by the 60 and 100micron emission detected by IRAS). We combine all these data in order to sketch the physics and chemistry of the cloud at a distance of 0.3-0.5pc from BD+69 1231.

Physical conditions of molecular bullets along protostellar outflows probed through high-J SiO emission
B. Nisini, C. Codella, T. Giannini, R. Bachiller, J. Santiago Garcia, J.S. Richer
(INAF Osservatorio Astronomico di Roma)
We present the observations of SiO transitions from J=2-1 (86.85 GHz) up to J=11-10 (477.50 GHz), obtained at IRAM and JCMT telescopes, of several high velocity bullets associated with the collimated molecular outflows of three low mass protostars (HH211-mm, L1448-mm and L1157-mm). Such observations, spanning different excitation temperatures, have been analysed to derive the physical conditions pertaining to these dense and compact condensations. The gas responsible for the SiO emission turns out to be not only very dense ($n < 10^6$ cm-3) but also warm, with temperatures larger than 300 K for most of the bullets. Such high temperature reconciles the derived high SiO abundances with the presence of shocks strong enough to allow the release of silicon from the dust grains. Comparisons with other tracers of warm molecular shocked gas such as H2, high-J CO and H2O transitions observed by ISO. are also presented and discussed.

Non-spherical Models for the Spectral Energy Distributions of Massive Protostars.
Mayra Osorio, James M. De Buizer, Nuria Calvet
(Instituto de Astrofisica de Andalucia)
We develop radiative tranfer calculations to obtain the Spectral Energy Distribution (SED) of intermediate and high-mass protostars. Our calculations take into account non-spherical envelopes elongated either by rotation or by the natural elongation of the cloud. Since the mid-IR range of the spectrum is very sensitive to the degree of flattening and to the inclination of the cloud, we compare the results of our model with new narrowband mid-IR observations carried out at Gemini Observatory. Our results suggest that flattened envelopes can naturally explain the observed structure of some high-mass protostars without invoking large-scale circunmstellar disks.

The warm and dense interstellar medium observed with Herschel
V. Ossenkopf
(I. Physikalisches Institut der UNiversitaet Koeln)
The combination of HIFI and PACS observations provide a unique way to study the chemical inventory and the energy balance in dense interstellar clouds heated by UV radiation (photon-dominated regions - PDRs) or by shocks from massive stars. The wide spectral coverage of the instruments allows to observe the key species in the chemical network, like hydrides or H3O+, in their ground states. This will solve many of today's puzzles in the interstellar chemistry. With the spectral resolution of HIFI it will be possible to separate the role of shocks and PDRs, to study the dynamical structure of evoporating molecular clouds, and to resolve the three-dimensional abundance distribution of the different species. The combination of line and continuum observations will allow to test the available models on the energy balance in the interstellar medium and the systematic observation of many OH and water lines provides a clue to current contradictions in our understanding of the shock water chemistry. The Herschel observations have to be accompanied by ground-based observations for the CI lines, the submm continuum and many other species that can be detected through the atmospheric windows.

L183 (=L134N) Revisited
Pagani L., Apponi A.J., Bacmann A., Cabrit S., Cambresy L., Lagache G., Motte F. and Pardo J.R.
(Observatoire de Paris)
L183, a long-standing molecular cloud reference for astrochemists, has still fascinating features to reveal. Strong depletion is present for all species bearing C, N or O atoms on a large scale. It is also on its way to form prestellar cores. Indeed, 2 cores of similar mass are clearly revealed and identified with nearby molecular peaks. Several differences between the two cores point towards different evolutionary stages. Some evidence (absence of SO, lower N2D+/N2H+ ratio) indicates that the northern core is probably younger than the central core.

HDO modeled emission and HSO-HIFI observations in solar-type protostars.
B. Parise and C. Ceccarelli
(CESR)
We present theoretical predictions of the rotational line emission of deuterated water in collapsing envelopes of low-mass protostars. The model accounts for the density and temperature structure of the envelope, according the inside-out collapse framework. The HDO abundance profile is approximated by a step function, with a low value in the cold outer envelope and a higher value in the inner envelope where the grain mantles evaporate. The two abundances are the two main parameters of this model, along with the grain mantles evaporation temperature. We discuss the contribution of HSO-HIFI observations versus present ground-based facilities to constrain those three free parameters. We show that ground-based observations are able to contrain those parameters, and that no observations with HSO-HIFI are required.

Deuterated methanol observations and the need for interferometry.
B. Parise et al.
(CESR)

High massive star formation in the complex molecular cloud NGC6334
P.Persi,M.Tapia,M.Roth, M.Gomez, A.R.Marenzi
(IASF-CNR Roma)
We present an infrared study of the complex giant molecular cloud NGC 6334 including new broad-bands and narrow bands near-IR images taken at the 6.5m Clay telescope of the Las Campanas Observatory (Chile), equipped with the near-IR camera PANIC, and mid-IR images obtained with TIMMI2 camera at the 3.6m ESO (la Silla) Observatory. A search for possible hydrogen molecular jets is presented and a study of the young stellar population is reported.

A photometric tool to derive the evolutionary status of young stellar objects
S. Pezzuto
(CNR - IFSI)
The large amount of data provided by Herschel requires statistical tools to derive physical informations. In the case of star formation, an important issue is the evolutionary status of the observed sources. I present a tool that exploits the three photometric bands of PACS (but also one band of SPIRE can be used) and allows, in a single step, to easily derive the evolutionary status of all the sources.

Spectroscopy of Polycyclic Aromatic Hydrocarbons and Very Small Grains in Photodissociation Regions

Rapacioli, M., Joblin, C., Calvo, Boissel, P., Spiegelman, F. and Parneix, P.
(Centre d'Etude Spatiale des Rayonnements)

Polycyclic Aromatic Hydrocarbons (PAHs) have been proposed as the carriers of the Aromatic Infrared Bands observed in emission in many places of the interstellar medium. In order to better characterize the chemical nature of these species, we have analysed spectro-imagery data obtained with the camera CAM on board of the Infrared Space Observatory, applying the Singular Value Decomposition method. This work strongly suggests that PAHs are produced by photoevaporation of Very Small Grains, which could be PAH clusters. We have performed a Monte Carlo search method to obtain the structures of PAHs cluster, which minimize the potential energy. The photostability of these clusters in the interstellar medium is discussed. We are currently working on a molecular dynamic model combining a classical and a quantum (tight binding) approach to describe the evolution of the vibrational spectrum between isolated and clustered PAHs. This study could explain the IR spectrum attributed to the Very Small Grains.

Deuterium chemistry in the earliest stages of star formation.

H. Roberts, E. Herbst & T. J. Millar
(UMIST)

Observations of molecular D/H ratios in the ISM are used to probe physical conditions, such as temperature, ionisation fraction, and gas-grain interactions. In star forming regions, where ice mantles have evaporated releasing the products of grain-surface chemistry, deuterium fraction ation can provide valuable information on how species have been processed in the ice.
Several new detections of multiply deuterated species have been made over the past two years, and some mono-deuterated species have been observed with abundances greater than 10% of their non-deuterated analogues. Given the low underlying abundance of deuterium, this fractionation is extraordinary.
In this talk we will present models of interstellar deuterium chemistry and show how they can be used to interpret recent observations of molecules in prestellar and protostellar cores.

Star Formation in nearby clouds

Paolo Saraceno et Al
(IFSI/CNR)

The HIFI data simulator

J. Stutzki, F. Schmülling, V. Ossenkopf, M. Perault, F. Rabasse, E. Caux, C. Comito, P. Schilke, S. Lord
(I. Physikalisches Institut, Universität zu Köln)

The HIFI data simulator allows to perform simulated observations with HIFI including model source spectral and spatial distributions on the sky and instrument noise and drifts. The data are processed through the standard HIFI pipeline and the observations will, in the final implementation,be linked into the Herschel uplink command stream. The simulator is used to test and debug the data pipelines and to improve the understanding of instrument effects such as standing waves and the impact of their drift behavious with time. We will show first results simulating full frequency range line scans of spectrally rich sources, one of the important science targets of HIFI/Herschel.

X-ray Chemistry in the Envelopes Around Young Stellar Objects

P. Stäuber, E.F. van Dishoeck, S.D. Doty, J.K. Jorgensen, A.O. Benz
(ETH Zürich, Institue of Astronomy)

We have studied the influence of X-rays from a massive young stellar object (YSO) on the chemistry of its own envelope by extending the models of Doty et al. (2002) and Stäuber et al. (2004) to include a central source of high energy radiation. The models are applied to the massive star-forming region AFGL 2591 for different X-ray luminosities and plasma temperatures. Enhanced column densities for several radicals and molecular ions are predicted. Herschel-HIFI will be able to observe enhanced hydrides like CH and CH+ whereas ALMA is well suited to measure the size of the inner region of the envelope where enhanced emission of molecular ions is predicted. By comparing our model calculations to the observations we will be able to estimate the flux of the X-ray emission of YSOs that are still deeply embedded in their natal molecular cloud and therefore not directly observable in the high-energy spectrum.

Reflection spectra of forsterite crystal

H. Suto, H. Sogawa, S. Tachibana, C. Koike, H. Karoji, A. Tsuchiyama, H. Chihara, K. Mizutani, T. Naoi, J. Akedo, K. Ogiso
(Subaru Telescope)

The infrared reflection spectra of crylstalline forsterite (Mg2SiO4) were obtained for the temperature range 300 - 50 Kelvin between the wavenumber 5000 - 100 cm-1 (2 - 100 micron in wavelength). The spectra show significant temperature dependence, the reflection features become more intense, sharper in their width, and shift to higher wavenumber or shorter wavelength with temperature decreased.
Reflection spectra were fitted to the classical oscillator model to derive the dielectric constants of forsterite crystal that is a valuable standard in analyzing astronomical data of crystalline silicates in low temperature environment.

THE INTERSTELLAR FORMATION OF CO2

D. Talbi and G.S. Chandler
(CNRS)

Using state of the art methods of quantum chemistry, potential energy surfaces for the formation of CO2 (1Sg+) and CO2 (3B2) from respectively CO + O(1D) and CO + O(3P) have been studied. At the MRSDCI level, we show that the formation of CO2 (1Sg+) from O(3P) is strongly connected with the height of the barrier localized on the CO + O(3P) entrance channel. At the CCSD(T) level and using a large basis set we calculate this barrier to be 5.9 kcal/mol. Consequently we confirm that the gas-phase formation of CO2 in the interstellar molecular clouds from CO and O(3P) is inefficient. To mimic the formation of CO2, through the Eley-Rideal mechanism, on the water ice surfaces of the interstellar grain, we have extended our study considering the formation of CO2 in the presence of water molecules. We show, using density functional methods, that the barrier located on the CO + O(3P) reaction entrance channel is hardly affected by the presence of these water molecules. We therefore suggested that the CO2 formation, through the Eley-Rideal mechanism, on the water ice surfaces of the interstellar grains, should be inefficient too.

The photodissociation region Car I

M. Tapia, P.Persi, M. Roth, J. Bohigas, M. Gomez
(Instituto de Astronomia, UNAM-Ensenada)

Broad (JHK) and narrow band (including [SII], [OIII], Balmer and Bracket as well as molecular hydrogen lines) spanning from the blue to the mid-infrared of the dark cloud/photodissociation region Car I are presented. Filamentary molecular hydrogen emission is seen arising from large areas of the cloud, displaced from the atomic gas emission. A few observed knots are probably originated through internal shocks. A discussion on the embedded stellar population is also given.

Revealing the structure of Lupine darkness

Teixeira, P. S., Lada, C. J. and Alves, J. A
(Harvard-Smithsonian Center for Astrophysics)

How do filamentary clouds form evolve to produce stars ? We have obtained deep NIR observations of a dense, starless region of the Lupus cloud (ESO's NTT and VLT) in order to address this question by constructing a dust extinction map and examining the detailed internal structure of this prime example of a filamentary dark cloud.

Variations of the cyclic/linear form abundances of C3H2 across the Horsehead nebula Photo-Dominated Region.

D. Teyssier, P. Hily-Blant, M. Gerin, E. Roueff, J. Pety
(SRON Groningen / ESA)

We present an observational study of the abundance ratio of the cyclic and linear forms of the C3H2 hydrocarbon across the Photo-Dominated Region of the Horsehead nebula. This object offers a sharp edge-on PDR very well suited for comparison with chemistry models. The study of this ratio is of particular interest as models predict a strong dependence of the ratio with the electronic abundance : at the very border of the PDR, the cyclic form is expected to be efficiently destroyed by reactions implying ions, so that a low ratio [cyc]/[lin] of 3 is predicted. As one penetrates the densest layers of the molecular cloud, these reactions no longer rule and the [cyc]/[lin] ratio slowly increases to values of order 40 at visual extinctions of 10 magnitudes. Using the IRAM 30-m and the Effelsberg 100-m telescopes, we have observed cm and mm transitions of the two forms in order to retrieve molecular abundances along a cut crossing the PDR. The variation of the [cyc]/[lin] ratio is striking, showing a plateau at 3 +/- 1.5 in the diffuse region, and increasing by a factor of 7 over 20-25 arcsec. The absolute value of the ratio in the dense layers is however lower than predicted, setting around 20 +/- 5. This is not surprising since PDR models have been shown to under-estimate cyclic-C3H2 abundances (Teyssier et al. 2002) so that the ratio might very likely be affected by similar discrepancies. Using measurements of ions such as N2H+ and HCO+, we discuss the possible use of this ratio as a tracer of the electronic abundances in various media.

SCAMPS : the SCUBA Massive Precluster core Survey

Mark Thompson, Andy Gibb, Jennifer Hatchell, Friedrich Wyrowski
(University of Hertfordshire)

The overall picture of massive star formation is still unclear, which is in large part due to our ignorance of the initial conditions for the formation of massive stars. Recent targeted searches toward colour-selected IRAS sources and UC HII regions have resulted in large advances in our understanding of the massive protocluster phases, but the cold massive cores on the verge of forming massive stellar clusters (so-called precluster cores) are as yet unknown. Identifying these precluster cores is of high importance in revealing the initial conditions for massive star formation and in the evolution of stellar clusters. We have started a large survey campaign (SCAMPS) to locate a statistical sample of these massive precluster cores via their sub-mm continuum emission and to determine their physical and chemical properties. Here we present the results of the initial sub-mm continuum search carried out with the SCUBA bolometer camera on the JCMT.

Far-Infrared Mapping of Cassiopeia A with ISOPHOT

Richard. J. Tuffs, Cristina C. Popescu
(Max Planck Institut fuer Kernphysik, Astrophysics Department)

We investigate the content of circumstellar and ejected dust within the prototype remnant of the core collapse supernova Cassiopeia A as revealed by maps of the spatial and spectral distribution of IR continuum emission at 60, 100, 170 and 200 microns. By making use of our multi-wavelength coverage and the fact that the colour temperature of the emission from cold dust in Cas A differs from that of the confusing foreground clouds, we could achieve the first detection of thermal FIR emission from the remnant longwards of 100 microns. We find no evidence for the presence of 2-4 solar masses of cold dust in the remnant as reported by Dunne et al. (2004) on the basis of SCUBA maps. In addition to the cold dust, we detect small quantities of hot, collisionally-heated grains towards both the shocked X-ray-emitting ejecta and circumstellar medium, as previously detected in measurements by IRAS (Dwek et al. 1987) and in recent maps at 24 and 70 micron by Spitzer (Hines et al. 2004).

Kinematics of Low-Mass Pre-Stellar Cores

Floris van der Tak, Paola Caselli & Cecilia Ceccarelli
(Max-Planck-Institut für Radioastronomie)

The kinematics of the centers of pre-stellar cores are of great interest, especially the transition from spherical infall to disk-like rotation. Standard kinematical probes (such as CO) do not trace the centers of these cores, because of depletion onto dust grains. However, the recent discovery of abundant H2D+ in pre-stellar cores opens the way to study these important regions.

This paper considers the case of LDN 1544. The H2D+ line profile is double-peaked, with a peak separation similar to HCO+ and N2H+. This shape rules out static velocity fields and infall models that only consider ambipolar diffusion. Allowed solutions are : collapse models with high central infall speeds, shell-type distributions of H2D+, or, most likely, a disk-like velocity field.

References : Caselli et al 2003, A&A 403, L37 van der Tak et al 2003, Zermatt proceedings (astro-ph/0311125) Caselli et al 2004, A&A, in progress van der Tak et al 2004, A&A, in progress

Deuterium fractionation in the dense ISM : detection of D2H+

Charlotte VASTEL, T.G. Phillips, H. Yoshida
(Caltech)

The 692 GHz para ground-state line of D2H+ has been detected at the Caltech Submillimeter Observatory toward the pre-stellar core 16293E (Vastel et al. 2004). The derived D2H+ abundance is comparable to that of H2D+, as determined by observations of the 372 GHz line of ortho-H2D+. This is an observational verification of recent theoretical predictions (Roberts, Herbst & Millar 2003 ; Walmsley et al. 2004), developed to explain the large deuteration ratios observed in cold, dense regions of the interstellar medium associated with low mass pre-stellar cores and protostars. This detection confirms expectations that the multiply deuterated forms of H3+ were missing factors of earlier models. The inclusion of D2H+ and D3+ in the models leads to predictions of higher values of the D/H ratio in the gas phase.

Searching for sulphur polymers in young protostars with Herschel and Alma

V. Wakelam, P. Caselli, C. Ceccarelli, E. Herbst, J. Mascetti, A. Castets
(L3AB (Observatoire de Bordeaux))

Sulphur is a long-standing problem in the chemistry of the interstellar medium. This element is highly depleted on interstellar grains in dense sources but in an unobserved form. We have started to develop new clues regarding the form of the depleted sulphur using detailed modelling of the sulphur chemistry and comparisons with observations (Wakelam et al. 2004). This previous study underlined the possibility for sulphur to be depleted on grains in a polymeric form from S to S8 in complexity. Some of the lines of these species can be observed with Herschel and Alma. In this contribution we discuss how possible HSO observations could help to give constraints on the abundance of S-polymers. Finding these species would be an important step inthe understanding of the chemistry in both molecular clouds and protostars.

Far-infrared mineral spectra database for the analyse of future PACS/Herschel data

V. Wakelam, F. Selsis, O. Prieto-Ballesteros, M. Fernández-Sampedro, C. Ceccarelli
(L3AB (Observatoire de Bordeaux))

The signature of calcite (CaCO3) has been found in both protoplanetary disks of evolved stars and environment of low mass protostars (Kemper et al. 2002, Ceccarelli et al. 2003). Both carbonates and sulphates are present in primitive carbonaceous chondrites. On Earth, the formation of carbonates (CO32-) is usually associated with sulphates (SO42-). Although the formation of such species is obviously different in the interstellar medium than on Earth (where it usually involve liquid water), we propose to search for the signature of sulphates in the environment of young stellar objects using PACS. For that we have started the construction of a far IR database of experimental spectra of minerals including sulphates. This database will be a useful tool to study the mineral composition of interstellar dust. In this contribution we will present the preliminary results of these studies.

EVIDENCE OF METALLIC WHISKERS IN GALACTIC AND EXTRAGALACTIC SOURCES

N.C. Wickramasinghe, and J.T. Wickramasinghe
(Cardiff Centre for Astrobiology)

We report new calculations of the micrometer to millimeter-wave absorption coefficients of iron whiskers of diameters 0.02 ï m and lengths in the range 100 ï m to mm. Astronomical observations of high-redshift quasars and supernova remnants are modeled to show the presence of such whiskers around such sources or in their line of sight. The sources studied include the Crab SNR, CasA SNR, Kepler SNR and SN1987A. It is inferred that supernova ejecta are sources of metallic whiskers.

Dust in Supernovae : A Comparison of dust and 13CO images for Cas A
T. L. Wilson and W. Batrla
(ESO)
From a comparison of the distribution of the image of integrated J=1-0 13CO line emission with the image of dust emission from JCMT Dunne et al 2003 Nature 424, 285, we find positional agreement for 2 of 4 maxima. A quantitative comparison of masses made for those dust maxima coincident with the 13CO peaks shows agreement. There is also agreement between the dust temperature and the gas kinetic temperature from CO and NH3. We conclude that about one-half of the dust emission measured toward Cas A arises from interstellar clouds toward, but not inside the supernova remnant. For the remaining 2 dust peaks, there is no 13CO counterpart and apparently only a small amount of HI, so this dust may be inside CasA. Correcting for the masses in 13CO but not for HI, we find that the dust mass in the SNR is at most about 1.5 solar masses. This is one-half of the value reported by Dunne et al (2003 Nature 424, 285). From our data and the range of masses given by Dunne et al, the uncertainties are about a factor of three. Dwek (astro-ph 0401074v2) and Contini (astro-ph 0404262v1) propose different models of SNe dust emission. These could explain the sub-mm dust emission, but give much lower dust masses.

PROPER MOTIONS OF WATER MASERS NEAR IRAS04263+2426 (GV Tau, Haro6-10)
A. Wootten (NRAO), M. Claussen (NRAO), K. Marvel (AAS) and B. A. Wilking (U. Mo. - St. Louis)
(NRAO)
We have used the NRAO Very Long Baseline Array (VLBA) to image water masers associated with the low-luminosity, young stellar object (YSO) IRAS 04263+2426 (GV Tau, Haro6-10), a T Tauri-like binary with one component infrared-bright, at six epochs over a period of two months. Some masers are located within a projected distance of a few hundred AU from the origin of expansion, the position of GV Tau A.

New Mid-IR Spectropolarimetric Results
Chris Wright, Ralf Siebenmorgen, Alistair Glasse
(UNSW@ADFA, School of Physical, Environmental and Mathematical Sciences)
We will present new mid-infrared spectropolarimetric observations obtained with TIMMI2 and Michelle at La Silla 3.6 m and UKIRT respectively. These data, at a spectral resolution of over 100, represent the first new observations using this technique in a decade, and build upon the work of Smith et al. (2000). Mid-IR spectropolarimetry is a powerful tool in the investigation of dust properties, as well as magnetic fields, and we will examine such implications resulting from our recent work.

High deuteration towards a new sample of massive cold cores
Friedrich Wyrowski, Mark Thompson, Andy Gibb, Jennifer Hatchell, Thushara Pillai
(MPIfR Bonn)
At the current stage of massive star formation (MSF) research it is crucial to find objects prior to the formation of hot cores and ultracompact HII (UCHII) regions. The evidence for so-called pre-proto-cluster cores – cold condensations on the verge of or already collapsing – is still missing. If such cores can be identified, analyzing their physical and chemical state will give us clues about the initial conditions and earliest phases of MSF. This led us to use the BIMA interferometer and the SCUBA array at the JCMT to search for secondary, cold condensations in the fields toward known UCHII regions, since many of them are located in clusters and at least in some cases one expects to find earlier phases of MSF and the raw material out of which massive stars form in the vicinity of UCHIIs. The results so far are very encouraging and provide us with a unique new sample of massive pre/protocluster candidates, currently followed up in various line tracers. Here we report on the current status of the project with emphasis on the observed high deuteration towards many of the sources.

Signes of dust evolution at far-infrared wavelengths
Kiss, Cs., Abraham, P., Kiss, Z.
(MPIA, Heidelberg)
We trace the dust evolution at far-infrared wavelengths investigating several sky regions observed with the ISO/ISOPHOT instrument at 200um and with the help of visual extinction data. The differential tau200/A_V ratio seems to show increasing trend with decreasing colour temperature, suggesting changes in the optical properties of dust. Our results may indicate the generality of starting the dust evolution even in the moderately dense interstellar matter.

Cirrus structure and confusion noise as Herschel will (probably) see
Kiss, Cs., Klaas, U., Lemke, D.
(MPIA, Heidelberg)
We performed a detailed assessement of the far-infrared confusion noise seen by the ISOPHOT instrument aboard the ISO satellite. Based on these results we also give estimates for cirrus confusion noise levels at the resolution limits of current and future instruments of infrared space telescopes, especially for those of Herschel.

Massive Star Formation around HII region
Lefloch,B., Cernicharo J., Rho, J., Reach, W.
(LAOG)

Session Stars

AGB mass-loss and recycling
Le Bertre, Gerard, Winters
(LERMA, Observatoire de Paris)
Mass-loss from AGB stars is a highly variable process which renders the determination of its rate and of its balance as a function of the stars' evolutionary stage a difficult task. Several diagnostic tools can be considered. The most commonly used are the rotational lines of molecules, like CO or SiO, and the emission by dust at infrared wavelengths. However they are sensitive to only a part of the material, sometimes in limited regions of the circumstellar shells. Other tracers, which may be very useful like lines of HI and H2, should also be considered in order to get a more representative picture of these shells which extend out to the Interstellar Medium.
High spatial and spectral resolution, large fields of view and high dynamical range are all important to reveal the 3-D structure of the outflows and to identify the relevant driving process(es) involved, and finally to determine the mass-loss history for individual sources and the contribution of the AGB star population to the recycling of matter.

Dusty Debris Disks explored by ALMA and HERSCHEL
Jean-François Lestrade
(Observatoire de Paris - CNRS / LERMA)
Debris disks around main sequence stars are collections of planetesimals left over from planetary formation. Second generation dust is produced in the disk from collisions between these large bodies. This dust is observable in the IR/submillimeter
through its thermal emission and in the visible because of light scattered by its particles. About 60 debris disks have been discovered since 1984 but only a few have been studied in some details. Present IR and submillimeter facilities can detect debris disk with dust mass of about 1 lunar mass located at 10 pc but the Kuiper Belt, the debris disk of the Sun, has only 0.0001 lunar mass of dust. Using the 3461 main sequence stars of the Catalogue of Nearby Stars 3rd Edition by Gleise and Jarheiss (1991) (distance < 25 pc), we show how far ALMA and HERSCHEL can expand observations for a comprehensive study of debris disks including all dust masses till the Kuiper Belt limit. Finally, we shall discuss the astrometric capability of ALMA to track reflex motions of exoplanets around nearby stars.

Chemistry in PPN
Tom Millar
(UMIST)

Molecular abundances in AGB circumstellar envelopes
H. Olofsson
(Stockholm Observatory)
In this review the present status of molecules in circumstellar envelopes of AGB stars is presented. Emphasis is put on the determination of abundances, and estimates of their uncertainties, from an observational point of view. Despite an impressive number of circumstellar species detected, about 60, there remains much work before general conclusions can be drawn. In particular, sophisticated radiative transfer modelling of circumstellar line emission must be done. This requires a detailed knowledge of the stellar and circumstellar properties, as well as basic molecular physics data. Eventually, the full potential of circumstellar spectra can be used in the study of the central stars and the circumstellar medium.

Solid State features in the Herschel-PACS-Range

Kerschbaum, F., Posch, Th., Mutschke, H.
(Institut fuer Astronomie)

The Herschel-PACS instrument will enable spectroscopic observations of dusty environments in the 60–210 μm range with unprecedented sensitivity.
While the ISO misson opened the field of asteromineralogy at shorter wavelengths, Herschel-PACS will do this at longer ones. Already available
laboratory data are sometimes incomplete in the far infrared. Hence, the knowledge about the properties of potential carriers of FIR resonance bands
is limited.
A reliable inventory of solid state dust features is thus an essential ingredient for the preparation and and interpretation of Herschel-PACS observations. We present our efforts in that field and present examples of dust features at wavelengths larger than 60 μm, such as graphite, carbonates and silicates (forsterite and fayalite).

Production of Dust and Molecular Gas in Nebulae of the Most Evolved, Massive Stars

Pat Morris
(NASA Herschel Science Center, Caltech)

Stars born onto the Main Sequence with 25 solar masses or more evolve from core-H burning O stars to the advance core burning phases characterizing the Wolf-Rayet stars, before ending in supernova explosions. During post-Main Sequence evolution, the star may lose mass in one or more episodes, in slow dense outflow during the RSG phase, or in more sudden and violent outbursts characterized by such massive Luminous Blue Variable stars as eta Carina. The dust formed in these environments help trace the mass loss history of the underlying star, while the molecular gas (such as H2) are important tracers of shock physics in the interacting winds. We have undertaken a program to observe the dust and gas in the nebulae of several Wolf-Rayet and LBV stars, enriched from the byproducts of CNO-processing, and have discovered prodigious amounts of UIR/PAH bands (unexpected where the C/O ratio is less than 1), and H2 pure rotational infrared lines for the first time. We review these discoveries, which place evolved massive stars in new context as contributors to the total H2 luminosity in starburst galaxies, and in the formation of hydrocarbons in chemically advanced (H poor, C/O $<$ 1) environments.

Exploring the star formation in the Galactic Center : from ISO to ALMA

F. Schuller, F. Bertoldi, M. Felli, K. Menten, A. Omont, L. Testi
(Max Planck Institut fuer Radioastronomie)

The infrared to radio range is the best suited to study the early stages of star formation. Dense cores resulting from protostellar collapse first appear as (sub)millimeter sources, and can be mapped through the continuum emission of cold dust, or through emission lines from molecular tracers. When a protostar or protocluster has formed, the surrounding material gets warmer, and the emission moves towards the infrared. In this talk, I will show how large scale mid-infrared surveys (ISOGAL, MSX) can be exploited to roughly estimate the average star formation rate in the peculiar environment of the Galactic Center. I will then show how various follow-up observations will improve our understanding of the star formation in this region, from already planned projects with mid-term available telescopes (APEX, Spitzer) to future projects making use of major facilities, such as ALMA.

Poster contributions

Spitzer observations and analysis of the Class 0 source IRAS 23011+6126 and its outflow.
Alberto Noriega-Crespo, Amaya Moro-Martin, Sean Carey, Patrick W. Morris, Deborah L. Padgett, William B. Latter,and James Muzerolle
(Spitzer Science Center- Caltech)
We present a detailed analysis of the IRAS 23011+6126 class 0 source and its outflow (Cepheus E) based on data obtained with the three instruments on board the Spitzer Space Telescope. Surprisingly we found that this deeply embedded source is detected at short wavelengths (3.5 microns) due to the high sensitivity and spatial resolution of the IRAC camera.
The new Spitzer photometric measurements (3.5 thru 70 micron) are consistent with a spectral energy distribution dominated by a cold, dense envelope surrounding the protostar. The outflow itself (Cep E) displays a very similar morphology in the near and mid-infrared wavelengths and is detected at 24 micron with MIPS. The IRS observations of the North lobe of the flow confirm that most of the emission is due to the excitation of pure H2 rotational transitions arising from a relatively cold (Tex = 700 K) and dense (6.4e4 part per cc) molecular gas.

Pitfalls in the identification of the 21 micron feature
Anja C. Andersen(1), Thomas Posch(2), Harald Mutschke(3) (1) NORDITA, (2) Vienna Observatory, (3) AIU Jena
(NORDITA)
The "21" micron emission feature is prominent in the spectra of some carbon-rich protoplanetary nebulae (PPNae) and two extreme carbon stars. The broad feature is positioned at 20.1 micron and has a full width half maximum larger than 2 micron. Observations indicate that a characteristic of the feature is that it only occurs in a short transitional phase of stellar evolution, i.e. in a very limited range of physical and chemical conditions. The stellar objects are all characterized by having C/O-ratio close to or greater than unity and a cool dusty environment with dust temperatures below 250 K. It appears that the 11.3 micron SiC feature, the 12+ micron plateau emission, and the "21" micron emission originate (approximately) in the same region, which indicates that similar physical and chemical conditions are required for the formation and/or survival of the respective carriers of the features.
A large number of potential band carriers have been presented and discarded within the past decade. The current most promising carriers of the "21" micron feature are oxidized SiC, FeO, SiS2, TiC clusters and carbonaceous macromolecules. From a spectroscopic point of view the oxides appear as the most likely band carriers ; however, it is difficult to conceive a scenario accounting for their formation in a carbon-rich environment. On the other hand, dust species which are usually predicted to form in carbon-rich environments, like carbon, carbides and sulfides do not match the observed "21" micron band profile, or their maximum abundance is too small for emitting the energy contained in the "21" micron feature.

The millimeter and submillimeter spectrum of CRL618
J. Cernicharo, J.R. Pardo, J.R. Goicoechea, A. Asension, T. Phillips, M. Guelin
(DAMIR. IEM-CSIC)
We present the millimeter and submillimeter line survey of the proto-planetary nebula CRL618. The survey has been carried out with the 30-m IRAM radiotelescope (80-115, 129-180, and 202-278 GHz) and the CSO telescope (around 100 GHz above 300 GHz). The line survey shows the rotational lines of several molecular species that are produced in the proto-planetary nebula phase and that are absent in the red giant IRC+10216. The systematic frequency coverage allows a extremely good modelling of the molecular emission and permits to derive the physical parameters of the inner disk of CRL618 at spatial scales below 1" thanks to the P-Cygni profiles shown by the HC3N and HC5N rotational lines. THe abundance of these species are enhanced by a factor larger than 100 relative to those found in red giants.

A thermal IR large scale survey from Antarctica
Epchtein N., Busso M.
(CNRS)
We describe a project to achieve a large scale, high angular resolution, ultra deep survey in the 2.3-10microns range from Dôme C Concordia station in Antarctica. It would extend the recently achieved 2MASS and DENIS surveys toward a still unexplored spectral range at large scale. A passively cooled 2.5 meter collector equipped with a mosaic of arrays would provide better spatial resolution and sensitivity than the IRAC camera on board Spitzer, providing new targets for the future millimetric and submillimetric observatories. A census of the most extreme mass losing AGB star populations and young stellar objects of the Magellanic Clouds, essentially missed by the recent 2 micron surveys, is among the main scientific objectives of the project.

Mid-IR imaging and polarimetry of dusty post-AGB stars

T.Gledhill, K Clube, K Lowe
(University of Hertfordshire)

The dusty circumstellar envelopes around post-AGB stars are a remnant of the heavy mass-loss that occurred earlier at the end of the AGB. During this phase, the outflow becomes asymmetric in nearly all cases. It is possible that the stellar magnetic field plays a role in generating the asymmetry. Here we use imaging polarimetry in the mid-IR to look for evidence of magnetic fields around these objects.

Solid State features in the Herschel-PACS-Range

F. Kerschbaum, H. Mutschke, Th. Posch
(Institute of Astronomy)

The Herschel-PACS instrument will enable spectroscopic observations of dusty environments in the 60 to 210 micron range with unprecedented sensitivity. While the ISO misson opened up the field of asteromineralogy at shorter wavelengths, Herschel-PACS will do this at longer ones.
Already available laboratory data are sometimes incomplete in the far infrared. Hence, the knowledge about the properties of potential carriers of FIR resonance bands is limited. A reliable inventory of solid state dust features is thus an essential ingredient for the preparation and and interpretation of Herschel-PACS observations. We will present our efforts in that field.

Time-dependent chemistry of the inner envelope of carbon-rich AGB stars.

Marta Pulecka, Miroslaw Schmidt, Ryszard Szczerba
(N. Copernicus Astronomical Center)

We present a new dynamical model of chemical evolution of the inner circumstellar envelope of carbon-rich AGB stars. We consider the effect of pulsation-driven shocks on the molecular content of the gas starting from the stellar photosphere, where the chemical composition is assumed to be at local thermal equilibrium. The chemical kinetic scheme is based on the silicon and sulphur chemistry network of Willacy and Cherchneff (1998).

CO line emission from circumstellar envelopes : towards higher-J transitions

D. Teyssier, V. Bujarrabal, H. Yoshida, T. Phillips
(SRON Groningen / ESA)

We present the results of a multi-transition CO observational program conducted on a sample of AGB and post-AGB stars envelopes. Using new observations of the CO line at 691 GHz at the CSO, we have collected maps and single pointing observations of these envelope in 5 rotational transitions ranging from J=1-0 to J=6-5. Such a set of mm and submm CO line was so far scarce and limited to the works of Groenewegen et al. (1996) on IRC+10216 and Kemper et al.(2002) on a sub-set of evolved stars. Using a simplified version of the model of Bujarrabal et al. 1989, we have conducted a systematic modelling analysis using the whole set of CO data collected on a sample of 12 sources. Our modelling approach simultaneously fits all five transitions, taking into account the spatial information provided by the maps. We find mass-loss rates in the range 1x10(-7) to 6x10(-5) solar masses per year, and envelope temperatures ranging from 20 to 400 at a radius of 10(16) cm. There seem to be a general anti-correlation between mass-loss rates and temperature, the high mass-loss rate AGBs having low temperatures, and vice-versa. We show that most AGBs data can be fitted using a single mass-loss rate, at least within the calibration uncertainties associated to the data collected at high frequencies. For some cases though (e.g. CIT6, R Hya, IK Tau), a change in the mass-loss rate history needs to be invoked to reconcile data at low and high-J respectively, a scenario already mentioned by Kemper to explain observations of WX Psc. However, firmer conclusions still await observations of higher-J transitions from spaceborne observatories, such as Herschel/HIFI, capable of unveiling the emission in the deepest layers of the stars with unprecedented accuracy.

Infrared Emission from Circumstellar Dust

D. B. Vaidya, B. G. Anandarao
(Physical Research Laboratory)

Recent studies indicate that the circumstellar dust grains are nonspherical, inhomogeneous (porous,fluffy)and are composites of many small particles There is no exact scattering theory to treat these inhomogeneous composite grains. We use discrete dipole approximation (DDA) to study the scattering properties of the composite grains. Using the DDA we calculate the absorption efficiency of the composite grain made up of a host silicate sphere/spheroid with graphite inclusions, in the infrared wavelength region 1.0mu and 100mu. In particular we study the absorption efficiency of the composite grains as a function of inclusion size and volume fractions. We also use the core-mantle grain model to calculate the absorption efficiency of the composite grains. Using the absorption efficiencies of the composite grains we calculate the emission flux in the wavelength region 1-100mu to interpret the observed IRAS data on the circumstellar dust around a few stars.

2D Models for the Winds of AGB Stars

P. Woitke
(Sterrewacht Leiden)

At the end of their lifetime, stars of low and intermediate initial mass (1...8 Msun) lose a substantial fraction of their mass on the Asymptotic Giant Branch (AGB) in form of massive stellar winds with mass loss rates 10^{-7}...10^{-4} Msun/yr, which drives them toward the planetary nebula phase.

According to the currently available spherically symmetric models (Winters et al.2000, A&A 361 :641, Andersen et al.2003, A&A 400 :981, Sandin & Hoefner 2003, A&A 404 :789), these winds are probably driven by a combination of stellar pulsation and radiation pressure on dust grains, which leads to the production of radial dust shells in more or less regular time intervals, even if the pulsation of the star is neglected (Fleischer et al.1995, A&A 297 :543). However, observations seem to tell another story here (e.g. Monnier et al.2004, ApJ 605 :436) with clear evidence for strong deviations from spherical symmetry.

In this contribution I will present new multi-dimensional models for the winds of carbon stars, which include hydrodynamics with radiation pressure on dust grains, thermodynamics with radiative cooling, equilibrium chemistry, time-dependent dust formation and strongly simplified grey radiative transfer.

This physical description (same as in Fleischer et al.1995) has been implemented in the frame of the publically available FLASH-hydrocode (finite volume, explicit, adaptive mesh refinement, MPI-based parallel) with implicit integration of source terms. In the current version, 2D spherical coordinates are used, i.e. we assume axi-symmetry.

These models reveal a much more complicate picture of the dust and wind formation as compared to the 1D models. Excited by instabilities, dust formation takes place from time to time in restricted parts of a radial zone close to the star. These clouds are accelerated outward by radiation pressure which creates gaps in the dust formation zone. These gaps are refilled not only by matter flowing in from the inside, but also by dust-free matter from the outside which falls back between the dust clouds. A highly dynamical and turbulent dust formation zone is created in this way, which – in turn – bears again a strongly inhomogeneous dust distribution. Further away from the star, flow instabilities (e.g. Rayleigh-Taylor) have time to modify and to shape the dust arcs/lanes/clouds produced in the dust formation zone.

see http ://www.strw.leidenuniv.nl/ woitke

Session Planets

Comets with ALMA

Nicolas Biver
(LESIA, Obs. de Paris)

Observations of comets with ALMA will bring a step forward in our understanding of cometary atmospheres. Key information on several topics will be obtained : (i) the relative abundances of molecules and isotopes which are key indicators of the origin of cometary material ; (ii) the comparison between the composition of comets coming from the Oort Cloud and those from the Jupiter
Family ; (iii) the imaging of gas jets and their relation with dust features ; (iv) the characterization of molecular distributed sources in the comae. In Single Dish mode ALMA will have a sensitivity over one order of magnitude larger than current best radio-telescopes. This will enable extensive chemical investigation and measurements of isotopic ratio (e.g. D/H, 15N/14N) in a number of molecules in comets not as exceptional as Hale-Bopp and of different origins. In interferometric mode, ALMA in compact and intermediate configurations will be able to map and monitor time variation of the strongest lines in several comets. This will enable us to "image" gas jets and follow their rotation with the comet nucleus. In addition several molecules (e.g H2CO, CS, SO) are known to be produced in the coma of comets and ALMA maps will provide information on their distribution and the nature of their parent source. Illustration with concrete examples of some bright comets expected in the next decade will be given.

Telluric planets with ALMA

Bryan Butler
(National Radio Astronomy Observatory)

ALMA will be able to map with unprecedented accuracy and fidelity the millimeter and submillimeter wavelength emission from the solid surfaces of the terrestrial planets (with the exception of Venus) and the larger icy bodies in the solar system, including jovian, saturnian, uranian and neptunian satellites, Pluto & Charon, and the larger of the TNOs. Such maps will provide us with information on the thermal and electrical properties of the surface and near-surface, as well as the surface texture. For the icy bodies, such measurements can potentially yield information on composition of the ice - of interest for constraining solar system formation scenarios. With the resolution and sensitivity of ALMA, maps of the volatile locations in the polar regions of Mercury can be made with relative ease, and resolved images (10's of pixels) of the uranian moons, Triton, and Pluto and Charon can be made. Even the largest of the TNOs can be imaged (Sedna is estimated to be 40 masec in diameter, while ALMA has a resolution of 12 masec at 345 GHz in the most spread out configuration). These are only a few examples of the ways in which ALMA could be used to observe the solid surfaces of larger solar system bodies, making it a powerful telescope for planetary science in the coming decades.

Comets and asteroids with Herschel

J. Crovisier (Observatoire de Paris)
(Observatoire de Paris)

This talk will discuss the prospects for the observations of small bodies in the Solar System with the Herschel Space Observatory.
Herschel, and especially its heterodyne instrument HIFI, is well suited to study cometary water, the evolution of its production, its kinematics, its excitation in relation with collisions and cooling processes. The D/H ratio of cometary water could be investigated in several objects to constrain the history of the Solar Nebula and of comets. Several other cometary molecules such as light hydrides and their ions could also be studied by HIFI. The good sensitivity of the instrument could allow us to search for very low levels of water outgassing in distant comets and in comet–asteroid transition objects.
Sensitive continuum observations with the PACS and SPIRE instruments, combined with visible photometry, could lead to the determination of the size and albedo for a variety of tran-Neptunian objects, Centaurs and asteroids.

Prospects for protoplanetary disk observations with Herschel

C. Dominik
(University of Amsterdam)

Planets with Herschel
Paul Hartogh, Emmanuel Lellouch and the HIFI Solar System Science Group
(Max-Planck-Institute for Solar System Research)
This talk will give a short overview about the capabilities of the Herschel Space Observatory (with focus on the Heterodyne Instrument for the Far Infrared, HIFI) in sounding planetary atmospheres. The HIFI performance will be compared with that one of former space borne submm sounders and the science goals as worked out in the HIFI solar system science group will be presented.

TNO, cometary nuclei and asteroids with ALMA
L. Jorda and O. Groussin
(Laboratoire d'Astrophysique de Marseille)
Continuum observations of cometary nuclei, asteroids and TNOs in the visible and infrared has allowed us to increase our knowledge of these bodies during the past 20 years. Although a few observations of Centaurs and cometary nuclei have been successfully conducted at millimeter wavelength in the past, they remain challenging because of the weak S/N achievable with the telescopes and instruments currently available.
ALMA will offer a unique opportunity to considerably extend the sample of objects detectable in the mm and sub-mm continuum to a large number of Centaurs and TNOs and to small cometary nuclei. We will discuss the new possibilities offered by ALMA. We will describe the physical quantities accessible from these measurements, and how they can help us to constrain thermo-physical models and in turn to better understand the (sub-)surface thermal properties of these bodies.

Planetary Atmospheres with ALMA
Moreno R.
(Observatoire de Paris-Meudon)

Signatures of planets in debris disks
Amaya Moro-Martin Renu Malhotra
(Steward Observatory)
Main sequence stars are commonly surrounded by debris disks, composed of cold far-IR emitting dust generated by a reservoir of undetected dust-producing planetesimals. In debris disks harboring massive planets, the trapping of dust in gravitational resonances with the planet creates a density enhancement in a ring-like structure outside the orbit of the planet, while gravitational scattering with the planet creates a clearing
of dust inside the planet's orbit. Massive planets, therefore, can create structure in the dust disk, and the study of this structure can help us survey a range of planetary parameters that are not detected by other methods. Spitzer will obtain spatially unresolved spectrophotometric observations of many of these systems. We discuss how the structure carved by massive planets affects the shape of the disk's spectral energy distribution (SED), and consequently how the SED may be used to infer the presence of planets. We show, however, that the SED modeling presents some degeneracies that can only be broken if spatially resolved images of the dust disks are obtained. ALMA's observations will be key for the interpretation of debris disk structure in terms of planetary architectures.

ALMA : Searching for Giant Planets in Circumstellar Disks
Sebastian Wolf Gennaro D'Angelo
(Max Planck Institute for Astronomy)
We investigate the possibility to detect giant planets that are still embedded in young circumstellar disks. Based on hydrodynamical models with different stellar, planetary, and disk masses, different evolutionary stages and different radial positions of the planet we analyze the resulting submillimeter appearance of these systems. We find that the influence of the planet on the continuum spectral energy distribution could not be distinguished from that of other disk parameters. However, dust reemission images of the disks show that the hot region in the proximity of a young planet, along with the gap, could indeed be detected and mapped with the Atacama Large Millimeter Array.

Poster contributions

CO observations of Martian atmosphere with NANTEN and ASTE radio telescopes

A.Mizuno, T. Nagahama, H. Maezawa (STEL, Nagoya U.), Y. Fukui, T. Onishi, N. Mizuno, H. Sasago (Nagoya U.), T Sekiguchi, R. Kawabe, S, Sakammoto (NAOJ), S. Yokogawa (Kobe U.)
(Solar-Terrestrial Environment Lab. Nagoya University)

Molecular spectroscopy of planetary atmosphere is one of the important targets of ALMA. We observed Martian atmospheric CO (J=0-1, 2-3) in September 2003 with two radio telescopes in Chile, NANTEN 4-m at Las Campanas and ASTE 10-m in Atacama. In this poster, we will present the retrieval results of the vertical temperature distribution of Martin atmosphere.

Young debris disks : grain size distribution and residual gas

J.C. Augereau, P. Thebault, A. Dutrey
(Sterrewacht Leiden)

The differential grain size distribution resulting from the collisional cascade in debris disks can be approximated by the classical Dohnanyi's grain size power law ($a^{-3.5}$). Numerical experiments have nevertheless shown that a lower cut-off grain size of a few micrometers in a disk (due for instance to radiation pressure) can result in a wavy size distribution that departs from the $a^{-3.5}$ law with an over-abundance of micrometer-sized grains and a depletion of submillimeter-sized particules (e.g. Thebault, Augereau & Beust, A&A, 2003). We investigate the impact of these numerical results on the observations of debris disks, and discuss the possible consequences for estimating the (sub-)millimeter flux of debris disks from infrared observations obtained for instance with the Spitzer Space Telescope.
We will also present the first resolved observations of a CO disk in keplerian rotation around a young Main Sequence star (HD141569, 5 Myr, PdBI observations). This star also possesses a well-structured optically thin dust disk in the visible and in the near-infrared, some of these structures being thought to be due to the presence of a Jupiter-like planet.

Spitzer spectroscopy of circumstellar dust disks

J.C. Augereau, V.C. Geers, E.F. van Dishoeck, and the "c2d" Spitzer Legacy team
(Sterrewacht Leiden)

The Spitzer Space Telescope (SST) Legacy program, "From Molecular Cores to Planet Forming Disks" (c2d), uses 400hr of observations to study the process of star and planet formation from the earliest stages to the epoch of planet-forming disks (Evans et al., PASP 115, 965). In this poster we present a first series of spectra of circumstellar dust disks obtained with the IRS spectrograph onboard the SST in the context of the c2d Legacy program.

RAT4COM : A Radiation Transfer Model for Water in Comets

F. Bensch & E.A. Bergin
(U Bonn)

We present an improved version of rat4com, a radiation transfer model for water rotational line emission in cometary coma. The model is based on a spherically symmetric density distribution with a constant expansion velocity (Haser model) and the Monte Carlo radiative transfer code published by Hogerheijde & van der Tak (Astron. Astrophys., 362, 697, 2000). It includes the lowest rotational levels of water, which are the primarily populated levels in the rotationally cold gas of the coma. Line excitation of water molecules is considered to occur by collisions with water, electrons and by fluorescence of IR pumped ro-vibrational levels. The original model is limited to the rotational transitions of ortho-water for a comet with a constant water production rate (Bensch & Bergin, ApJ, in press). We present an improved version here that includes para-water levels. The impact of improved cross sections for H2O-electron collisional excitation is discussed. Additionally, we present results for a model where the water production rate is temporarily elevated – an initial attempt to model water rotational line emission for a comet undergoing an outburst. Using this model we study the prospects of H2O and H2(18)O spectral line observations in comets with present and future airborne and space observatories, including the ESA Herschel Space Observatory and the NASA/DLR Stratospheric Observatory for Infrared Astronomy, SOFIA.

The search for complex molecules in comets

J. Crovisier, N. Biver, D. Bockelée-Morvan, P. Colom (Observatoire de Paris), D. Despois (Observatoire de Bordeaux) and D.C. Lis (Caltech)
(Observatoire de Paris)

From radio spectroscopic observations of comets, more than 22 molecules, radicals and ions, plus several isotopologues, were detected, the majority of them being recently revealed in comets C/1996 B2 (Hyakutake) and C/1995 O1 (Hale-Bopp). Among them were acetaldehyde, formic acid, methyl formate... detected in radio spectra obtained at the IRAM 30-m telescope and Plateau de Bure interferometer and at the Caltech Sumillimeter Observatory in spring 1997 (Bockelée-Morvan et al., 2000, Astron. Astrophys., 353, 1101). In addition, upper limits were obtained for several species, including complex organic molecules such as ethanol, acetic acid, glycolaldehyde, glycine... (Crovisier et al., 2004, Astron. Astrophys., 418, 1141). Ethylene glycol (HOCH2CH2OH) was recently identified from about ten rotational lines in the archival spectra of comet C/1995 O1 (Hale-Bopp) (Crovisier et al., 2004, Astron. Astrophys., 418, L35). The identification was made just after the rotational lines of this molecule were included in the Cologne Database for Molecular Spectroscopy. The production rate of ethylene glycol is 0.25% that of water, making it one of the most abundant organic molecules in cometary ices. This detection strengthens the similarity between interstellar and cometary material. It outlines the possible role of cometary impacts in the origin of life by seeding the early Earth with prebiotic molecules. We may expect many new cometary molecules to be detected with the emergence of more sensitive instrumentation such as ALMA and large infrared telescopes.

H3+ as a trap for rare gases

Pauzat F., Ellinger Y.,
(LEME/LETMEX (USM 205) - Muséum National d'Histoire Naturelle)

The possibility of H3+ playing a role as a sink for noble gases has been investigated in the case of Argon. Elaborate quantum methods (ab-initio Coupled Cluster and density functional BHandHLYP levels of theory) have been shown to reproduce the rotational constants within 0.3% together with the only known IR frequency on the test case of Ar?D3+. Using the same levels of theories, structures, rotational constants and harmonic frequencies of Arn?H3+ (n=1-5) have been calculated. Dissociation energies of Arn?H3+ as a function of cluster size, i.e. 7.2 (n=1), 3.7 (n=2), 3.6 (n=3) kcal/mol, follow the pattern established experimentally for (H2)n?H3+.

Formation and Evolution of Planetary Systems : Placing Our Solar System in Context

M.R. Meyer, L.A. Hillenbrand, D.E. Backman, S.V.W. Beckwith, J. Bouwman, T.Y. Brooke, J.M. Carpenter, M. Cohen, U. Gorti, T. Henning, D.C. Hines, D. Hollenbach, J.S. Kim, J. Luine, R. Malhotra, E.E. Mamajek, S. Metchev, A. Moro-Martin, P. Morris, J. Najita, D.L. Padgett, J. Rodmann, M.D. Silverstone, D.R. Soderblom, J.R. Stauffer, E.B. Stobie, S.E. Strom, D.M. Watson, S.J. Weidenschilling, S. Wolf and E. Young.
(Steward Observatory)

Over the past 15 years abundant evidence has emerged that many (if not all) stars are born with circumstellar disks. While concensus is emerging concerning the the early evolution of accretion disks (tau $<$ 10 Myr) and the characterization of older debris disks (tau $>$ 1 Gyr) continues at a rapid pace, little is known about the transition between these two extremes thought to occur during the epoch of planet formation. The goals of our Spitzer Legacy Science Program are to trace the evolution of planetary systems from : (1) 3-10 Myr when stellar accretion from the disk terminates ; through (2) 10-100 Myr when planets achieve their final masses via coalescence of solids and accretion of remnant molecular gas ; to (3) 100-3000 Myr when the final architecture of solar systems takes form and collisions between remnant planetesimals produce observable quantities of dust. Our strategy is to use carefully calibrated spectral energy distributions and high-resolution spectra to infer the radial distribution of dust and gas surrounding a sample of 330 solar-like stars distributed uniformly in log- age over 3 Myr to 3 Gyr. This approach should provide insight into the diversity of planetary system architectures, contraining the range of possible outcomes of the planet formation process - thus helping to place our own solar system in context. We will report on the latest results from our program.

The Asteroid Preparatory Programme for HERSCHEL, ASTRO-F and ALMA

T.G. Mueller & members of the HERSCHEL Calibration Steering Group & members of the ASTRO-F calibration team

(Max-Planck-Institut fuer extraterrestrische Physik)

Celestial standards play a major role in astronomy. They are needed to characterise the performance of instruments and telescopes and they are an important prerequisite for accurate photometry. With the access to the far-IR, submm and mm wavelength range through satellites, airborne telescopes and sophisticated ground-based instruments, it became necessary to establish new calibrators for these wavelengths. The traditional far-IR/submm/mm calibrators, the outer planets, are too bright or cause nonlinearity problems for instruments on upcoming sensitive space missions like HERSCHEL or ASTRO-F. Stellar standards are quite faint in this range and pose problems of their own. The large flux gap between these two types of calibrators could be successfully filled and complemented by a set of asteroids, which was established during the ISO mission for the ISOPHOT instrument (Mueller & Lagerros, 1998, 2002, 2003). Here we present the status of the "Asteroid Preparatory Programme" which is currently conducted together with the HERSCHEL and ASTRO-F calibration teams. We investigate the physical and thermal properties of about 50 asteroids. All of them are large, almost spherical and belong the the main-belt, located between Mars and Jupiter. They cover the flux range between about 1 and several hundred Jansky at 100 micron, at 1 mm they still reach up to 10 Jy. Thermophysical model predictions (light curves, SEDs or monochromatic fluxes) are accurate on the 5-20% level, depending on the object, the observing and the illumination geometry.

Radiative transfer in protoplanetary disks

Sabine Richling

(Institut d'Astrophysique de Paris)

We calculate the change in the temperature and density structure of a protoplanetary disk by the presence of an illuminating planet inside a gap. The starting models are alpha-disk-models with constant mass accretion rate. First, continuum radiative transfer calculations and the equation of hydrostatic equilibrium are considered to obtain the new disk structure. Then, the influence of the planet on the appearance of the disk in emission lines is investigated.

Observing early stages of planet formation with ALMA : Large-scale Vortices in Protoplanetary Disks

Sebastian Wolf Hubert Klahr

(Max Planck Institute for Astronomy)

Large-scale anti-cyclonic vortices - resulting from global baroclinic instabilities - are considered as possible precursors of planet formation. To answer the question if these significant features in circumstellar disks can be indeed observed in the near future, we simulate ALMA observations of disks with large-scale vortices, based on hydrodynamically calculated disks and subsequent 3D radiative transfer simulations. We find that ALMA will be able to trace the theoretically predicted large-scale anti-cyclonic vortex and will therefore allow testing of existing models of this very early stage of planet formation in circumstellar disks.

Session General

The Herschel Heterodyne Instrument for the Far-Infrared

Thijs de Graauw, Emmanuel Caux, Tom Phillips, Juergen Stutzki, Nick Whyborn, C.K. Wafelbakker, F. Helmich, etc.
(SRON and Univ. Leiden)

The Heterodyne Instrument for the Far-Infrared (HIFI) is one of the three instruments to be put on-board of ESA ?s Herschel Observatory. The design has been optimised for spectral scans and spectral line surveys at very high spectral resolution with the widest possible coverage in the FIR. It is planned to cover a major part of the FIR and Sub-mm frequency range (480-1150 GHz ; 1410-1910 GHz) with resolving powers up to 10exp7. It thus allows studies of a wide range of scientific topics, ranging from star formation in galaxies to cometary tails. HIFI is a system with seven modular heterodyne receivers. It comprises a focal-plane unit (FPU) located inside the cryostat that contains relay optics, super-conducting mixers, low-noise IF-amplifiers, a focal-plane chopper, a calibration source, and a FPU control unit (FCU), located at the Service module (SVM). The local oscillator unit (LOU) is to be located on the outside of the cryostat and to contain 14 multiplier chains. It generates the LO signals which are coupled into the FPU via 7 windows in the cryostat wall. A local oscillator Source Unit (LSU) and a local oscillator control unit (LCU), both located in the SVM, contain the basic reference frequency source and control of the frequency of the local oscillator with a precision of 1 part in 108. Located in the SVM is also a wide-band spectrometer (WBS), consisting of a pair of 4 GHz-wide AOS spectrometers with a frequency resolution of 1 MHz for each of the two polarisations, and a high-resolution spectrometer (HRS), consisting of a pair of auto-correlators that will provide a combination of bandwidth and spectral resolution, ranging from 140 kHz to 1 MHz. An instrument control unit (ICU) will provide the overall instrument control and take care of the data handling. In order to achieve the aimed scientific capabilities the instrument requires a state-of-the-art implementation of a wide range of technologies. An overview of the planned scientific programmes and their relation to the instrument requirements and expected capabilities will be given and discussed.

SPIRE

Matt Griffin, Laurent Vigroux, Bruce Swinyard
(Cardiff University)

SPIRE, the Spectral and Photometric Imaging Receiver, will be an imaging photometer and spectrometer for ESA's Herschel Space Observatory. Its main scientific goals and design drivers are deep extragalactic and galactic imaging surveys and spectroscopy of star-forming regions in own and nearby galaxies. SPIRE comprises a three-band imaging photometer operating at 250, 360 and 520 microns, and an imaging Fourier Transform Spectrometer (FTS) covering 200-670 microns. The photometer has a field of view of 4 x 8 arcminutes which is observed simultaneously in the three spectral bands. The angular resolution is determined by the telescope diffraction limit, with FWHM beam widths of approximately 17, 24 and 35 arcseconds at 250, 360 and 520 microns, respectively. The spectrometerhas a field of view of 2.6 arcminutes and adjustable spectral resolution of 0.04-2 cm-1 (Lambda/Delta-Lambda = 20 - 1000 at 250 microns). The instrument design, operating modes, and estimated sensitivity will be described, and some examples will be given of the envisaged scientific programmes.

Herschel mission and observing opportunities

Göran L. Pilbratt
(European Space Agency)

The Herschel Space Observatory (formerly known as FIRST) is the fourth cornerstone mission in the European Space Agency (ESA) science programme. It will perform imaging photometry and spectroscopy in the far infrared and submillimetre part of the spectrum, covering approximately the 57-670 micron range.
The key science objectives emphasize current questions connected to the formation of galaxies and stars, however, having unique capabilities in several ways, Herschel will be a facility available to the entire astronomical community.
Herschel will carry a 3.5 metre diameter passively cooled telescope. The science payload complement – two cameras/medium resolution spectrometers (PACS and SPIRE) and a very high resolution heterodyne spectrometer (HIFI) – will be housed in a superfluid helium cryostat.
The ground segment will be jointly developed by the ESA, the three instrument teams, and NASA/IPAC. Herschel is scheduled to be launched into a transfer trajectory towards its operational orbit around the Earth- Sun L2 point by an Ariane 5 (shared with the ESA cosmic background mapping mission Planck) in 2007. Once operational Herschel will offer a minimum of 3 years of routine observations ; roughly 2/3 of the available observing time is open to the general astronomical community through a standard competitive proposal procedure.
I will give a status report, and introduce the mission from the perspective of the prospective user of this facility. My talk will also serve as an introduction to the additional Herschel instrument talks.

PACS
Albrecht Poglitsch
(Max-Planck-Insitut f. Extraterrestrische Physik)

Extragalactic Spitzer results
B. Thomas Soifer
(California Institute of Technology)
Spitzer extragalactic programs have ranged from imaging observations of the nearest galaxies to studies of the stellar populations in the most distant galaxy currently known, to spectroscopic studies of ultraluminous infrared galaxies. In this talk I will describe some of the most interesting, recent results emerging from these programs, emphasizing what is being learned about the distant, dusty universe through both imaging and spectroscopic observations.

Genesis of the ALMA project from the scientific visions of the European, North American, and Japanese communities
Paul van den Bout
(NRAO)
ALMA is a worldwide project, the synthesis of early visions of astronomers in its three partner communities, Europe, North America, and Japan, of three distinctly different millimeter and/or submillimeter arrays. The evolution of these concepts and their eventual merger into ALMA are discussed, setting the background for the talks which follow on the scientific requirements and expected performance of ALMA for extra-galactic and galactic research.

International Spectroscopic Database for Astrophysical and Planetary Applications
David Jacquemart
(CfA, Harvard)
The beginning of an International Spectroscopic Database for Astrophysical and Planetary Applications will be presented for the first time. This database will be dedicated to Virtual Observatory, and will contain line parameters (positions, intensity, broadening and shifting coefficients) for numerous molecules suceptible to be present in planets or stars. The spectral region will cover 0.1 MHz to 10 THz.
The first step consists in setting a homogeneous format for the parameters of the various molecules. Then the major spectroscopic databases (JPL catalog, CDMS, HITRAN and GEISA) will be gathered. After this, a huge bibliography work will be needed to update and complete all the spectroscopic information required for Astrophysic and Planetary applications.

Poster contributions

Analyses of the ISO/ISOPHOT database in preparation to the Herschel mission

P. Abraham, Cs. Kiss, Sz. Csizmadia, A. Moor (Konkoly Observatory, Budapest, Hungary)
(Konkoly Observatory)

Since 2001 a group at Konkoly Observatory is involved in the systematic reprocessing of selected data sets obtained with ISOPHOT, the photometer on-board ESA's Infrared Space Observatory. We have been producing far-infrared photometric catalogues as well as mid-infrared spectral atlases of compact sources. The results are available as Highly Processed Data Products on the ISO web (www.iso.vilspa.esa.es). In this contribution we present two examples how analyses of the reprocessed data could contribute to the preparation of the Herschel observations. The first study is related to the prediction of cirrus confusion noise for Herschel on the basis of ISOPHOT far-IR maps. We evaluated about 200 large ISOPHOT raster maps (typically 0.5 deg in size) and determined the confusion noise on them. The cirrus component of the confusion noise was extrapolated to the higher spatial resolution of the Herschel/PACS instrument with the help of simulated fractal maps. Based on these results all-sky cirrus confusion maps were constructed for 110 and 175 micrometer. The maps are available for the community now, and can be used for the preparation of PACS observations.
The second work concentrated on temporal brightness variations of young stellar objects at infrared wavelengths. Almost all young stars exhibit variability in the optical, and some of them also show flux changes at infrared wavelengths. Comparing flux values obtained with IRAS and ISO, we investigated a group of eruptive FU Ori-type
objects and found significant flux decay in the case of V1057 Cyg. The wavelength dependence of the fading places strong constrains on models of the circumstellar environment. Further studies on OO Ser (also an outburst star), on EX Lupi-type objects, and on UX Ori-type intermediate-mass variables are also in progress. The list of variable infrared objects are natural targets for Herschel, taking advantage of its long lifetime and high accuracy.

ESSPRIT, an Exploratory Submm Space Radio-Interferometric Telecope

Th. de Graauw, J. Cernicharo, A. Bos, J-W den Herder, M. Gerin, S. Guilloteau, A. Gunst, F. Helmich, B. Jackson, G. de Lange, H. Langevelde, P. Maat, J. Martin-Pintado, J, Noordam, A. Quirrenbach, P. Roelfsema, L. Venema, W. Wild, P. Yagoubov.
(SRON and Univ. Leiden)

Abstract :
We present a mission concept for a free-flying FIR imaging interferometer using radio heterodyne techniques. The ultimate goal is to reach a Hubble ST-equivalent angular resolution for the FIR wavelength range. The main scientific objectives are : A) imaging in the water and molecular ions emission lines (H2O, OH, OH+, CH, CH+, CH2+, CH3+, etc.), B) imaging in important atomic fine-structure lines (CII, NII, OI, etc.) and C) imaging in high excitation lines of CO, HCN, HCO+, etc., of star forming regions and proto-stellar/proto-planetary systems with emphasis on disks. The facility will be the FIR complement of the ground-based ALMA, without any atmospheric attenuation and any disturbance in phase. It will be a follow-up mission of ISO-LWS, SWAS, ODIN, SIRTF, ASTRO-F ; Herschel-PACS and -HIFI and of JWST-MIRI.
The aimed characteristics are : – Telescope sizes : >3.5 meter ; off-axis – Number of elements : N >6 ; free-flying – Proj. Baselines : ∼ 7- 200- 1000 meter – Frequency coverage : in the 0.5-6 THz range (600 to 50 microns) – Spectral Resolution : 1 Km/s at 100 microns. (0.1 goal) – Spatial Resolution : 0.02" at 100 microns – F.O.V. : 6" – Pointing Requirements : - accuracy : 0.2" ; - knowledge : 0.1" – Image Dynamic range : > 100 – Spectral Dynamic range : > 1000 – Tsys : 1000 K – IF bandwidth : > 4 GHz
We will present the results of studies covering the scientific objectives, instrumentation, interferometer configuration, delay lines and correlation techniques. From the inherent narrow band capability of heterodyne techniques, the substantial advantages for path length difference compensation and tracking will be elaborated as well as the expected detection and imaging sensitivity.

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