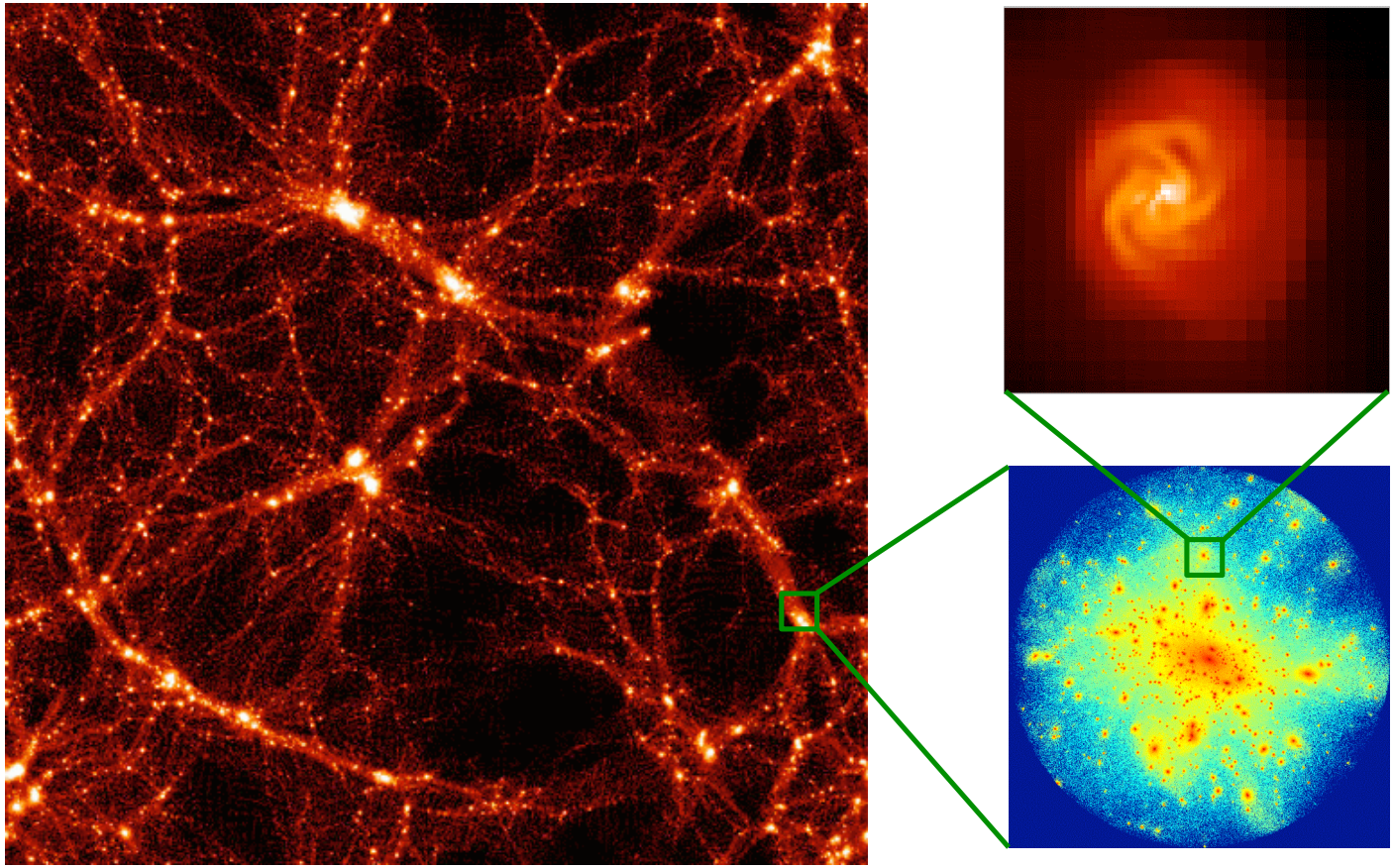
Projet Horizon: état des lieux



Alimi Jean-Michel
Arbey Alexandre
Athanassoula Lia
Aubert Dominique
Audit Edouard
Baek Sunghye
Blaizot Jeremy
Bonhomme Nicolas
Bournaud Frederic
Champavert Nicolas
Chevallier Loic
Chilingarian Igor
Colombi Stéphane
Combes Françoise
Courtin Jerome
Courtois Helene
Courty Stéphanie
Da Silva Antonio
Depardon Benjamin
Devriendt Julien
Dimatteo Paola
Dubois Yohan
Durier Fabrice
Elad Zinger
Emsellem Eric
Forero Jaime
Füzfa André
Gay Christophe
Grasseau Gilles
Guiderdoni Bruno
Honoré Pierre-François
Jablonka Pascale
Lambert Jean-Charles
Lavaux Guilhem
Le Fèvre Jean-Paul
Leborgne Damien
Legrand François
Leo Michel-Dansac
Melchior Anne-Laure
Ocvirk Pierre
Peirani Sebastien
Pichon Christophe
Pier Stefano Corasaniti
Prunet Simon
Rasera Yann
Revaz Yves
Rimes Chris
Roy Fabrice
Sauvageot Jean-Luc
Semelin Benoit
Slyz Adrianne
Sousbie Thierry
Stéphane Fay
Teyssier Romain
Thiebaut Jérome
Tiret Olivier
Tweed Dylan
Wozniak Hervé
Zidani Djilali

Outline

- **Projet Horizon: organisation et calendrier**
- **Génération des conditions initiales**
- **Simulations cosmologiques**
  - **La simulation Horizon**
  - **La simulation MareNostrum**
- **Simulations “zoom” (amas et galaxies)**
- **Simulations idéalisées (amas et galaxies)**
- **Catalogues en lignes: GALMER et GALICS**
- **Développement de codes, algorithmes**
- **Après Horizon ?**

Projet Horizon: organisation

5 partenaires

Labo	Co-I	Lieu
LUTH	J.-M. Alimi	Meudon
IAP	C. Pichon	Paris
LERMA	F. Combes	Paris
CRAL	B. Guiderdoni	Lyon
SAP	R. Teyssier	Saclay

Collaboration Horizon:
60 logins sur le site interne
Une vingtaine de permanents
10 thésards
5 post-docs et CDD

Site Web Horizon: un site interne et un site externe (en construction) avec un responsable technique et 3 responsables éditoriaux
http://www.projet-horizon.fr

Mini-grille: 6 serveurs localisés dans les labos interconnectés entre eux et avec la méso-machine HPC1 avec 3 responsables techniques.

Centre de calcul: demandes de temps collectives (IDRIS, CINES et CCRT) et soumission à des projets européens (DEISA, BSC)
http://www.deisa.org
http://www.bsc.es

Projet Horizon: hardware

Centres de calcul (CCRT, IDRIS, BSC)

Méso-machine HP

Post-traitement et
Archivage lourds

Soumission de jobs

Visualisation,
Post-traitement et
Archivage légers

Mini-grille

Paris Meudon Saclay Lyon Marseille

Projet Horizon: news (1/2)

Fév. 2004: soutien de l'ASSNA (label), du PNC et du PNG

Avr. 2004: soutien du Programme Astroparticules
Financement de la mini-grille 105 k€ (INSU + IN2P3)

Juin 2004: Plan Pluri-Formations de l'Université Paris 6
Financement 100 k€ jusqu'en 2008

Sep. 2004: Kick-Off Meeting: 1er Workshop Horizon

Fév. 2005: soutien de l'INSU, du PNC et du PNG
Financement de la méso-machine 120 k€ (INSU) + 30 k€ (CEA)

Sep. 2005: La méso-machine est hébergée sur le site HPC1 (HP France)

Oct. 2005: 2 post-docs CNRS (Saclay, Obs. Paris)

Oct. 2005: soutien de l'ANR Blanche
Financement 500 k€ jusqu'en 2008 (dont 3 post-docs)

Oct. 2005: Horizon sélectionné par DEISA avec 27 projets européens
Site de Barcelone de la "Extreme Computing Initiative"

Nov. 2005: 2ème Workshop Horizon

Projet Horizon: news (2/2)

Fév. 2006: la mini-grille Horizon est opérationnelle
http://grille.projet-horizon.fr/

Avril 2006: 3ème Workshop Horizon (CRAL à Lyon)

Octobre 2006: début de la simulation MareNostrum

Décembre 2006: 4ème Workshop Horizon

Janvier 2007: installation de la machine BULL au CCRT (43 Tflops)

Juillet 2007: début de la simulation Horizon 4Pi

Aout 2007: fin de la simulation Horizon 4Pi
70 milliards de particules jusqu'à z=0

Sept. 2007: fin de la simulation MareNostrum
150 millions d'étoiles jusqu'à z=1.5

Déc. 2007: la base de données GALMER est en ligne

Fév. 2008: installation d'une BlueGene à l'IDRIS (139 Tflops)

Conditions initiales

Mare Nostrum

by Teyssier Romain (Sunday 20 January 2008)

This is the set of initial conditions we use at Mare Nostrum.

$\Omega_m = 0.3$ $\Omega_\Lambda = 0.7$ $\Omega_b = 0.042$ $H_0 = 70$ km/s/Mpc $L = 50$ Mpc/h

WARNING ! These data are BIG ENDIAN Fortran binaries.

Particles	Density	X-velocity	Y-velocity	Z-velocity
N=64^3	ic_deltab	ic_velcx	ic_velcy	ic_velcz
N=128^3	ic_deltab	ic_velcx	ic_velcy	ic_velcz
N=256^3	ic_deltab	ic_velcx	ic_velcy	ic_velcz
N=512^3	ic_deltab	ic_velcx	ic_velcy	ic_velcz
N=1024^3	ic_deltab	ic_velcx	ic_velcy	ic_velcz

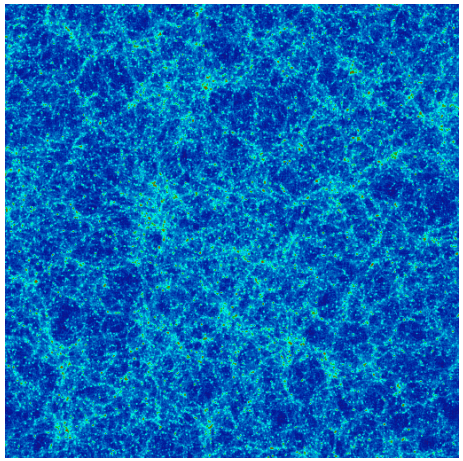
Click here for more informations about **the file format**

Click here to download **softwares for IC's manipulation**

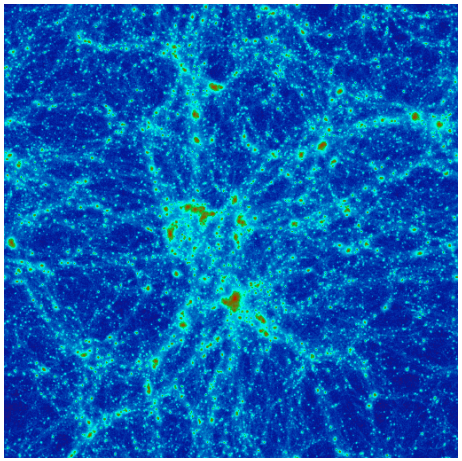
If you encounter any problem or need more information, please contact us

Simulations cosmologiques

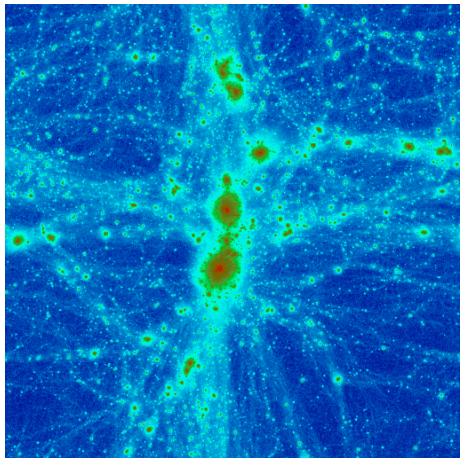
Simulations de références: catalogue GALICS
3 tailles de boîtes: 500, 100 et 20 h^{-1} Mpc
Un jeu unique de conditions initiales: 128^3, 256^3, 512^3,1024^3…



Horizon XL



Horizon L



Horizon S

Simulations avec quintessence: Fufza & Alimi (2006, 2007)

Simulation “Grand Challenge”
- **La simulation Horizon 4PI**
- **La simulation MareNostrum**

PROJET HORIZON

The Horizon 4Pi Simulation

We report on a 70 billions particles N-body simulation with 140 billions AMR cells for a 2 Gpc/h periodic box in a LCDM universe.

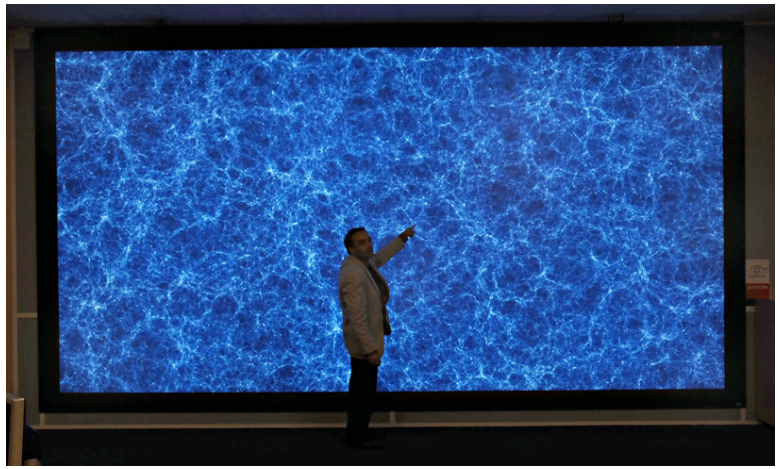
We use a new French supercomputer BULL Novascale 3045 recently commissioned at CCRT (Centre de Calcul Recherche et Technologie, CEA).

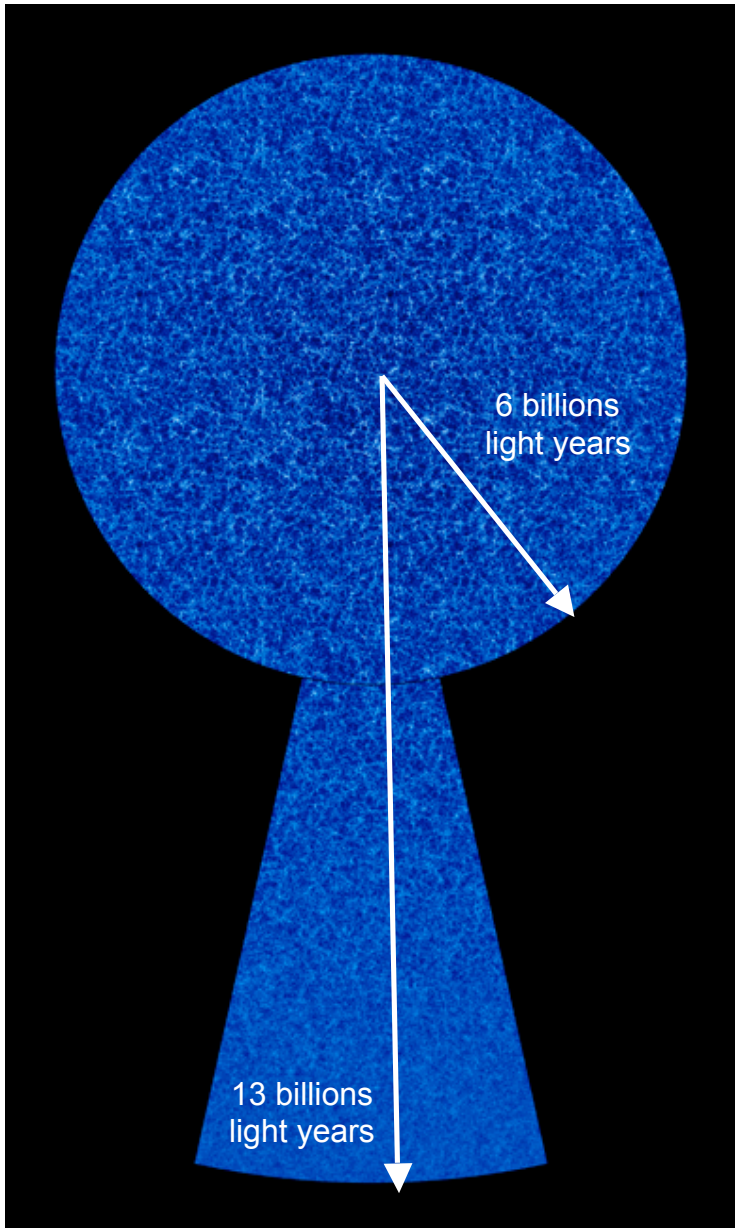
We ran RAMSES in pure N-body mode with 6144 processors for 2 months. Starting with a base grid of 4096^3 cells, we used 6 additional level of refinements for a formal resolution of 262144^3.

Using our light cone, we have computed a full sky convergence map for simulating future weak-lensing surveys like DUNE or LSST.

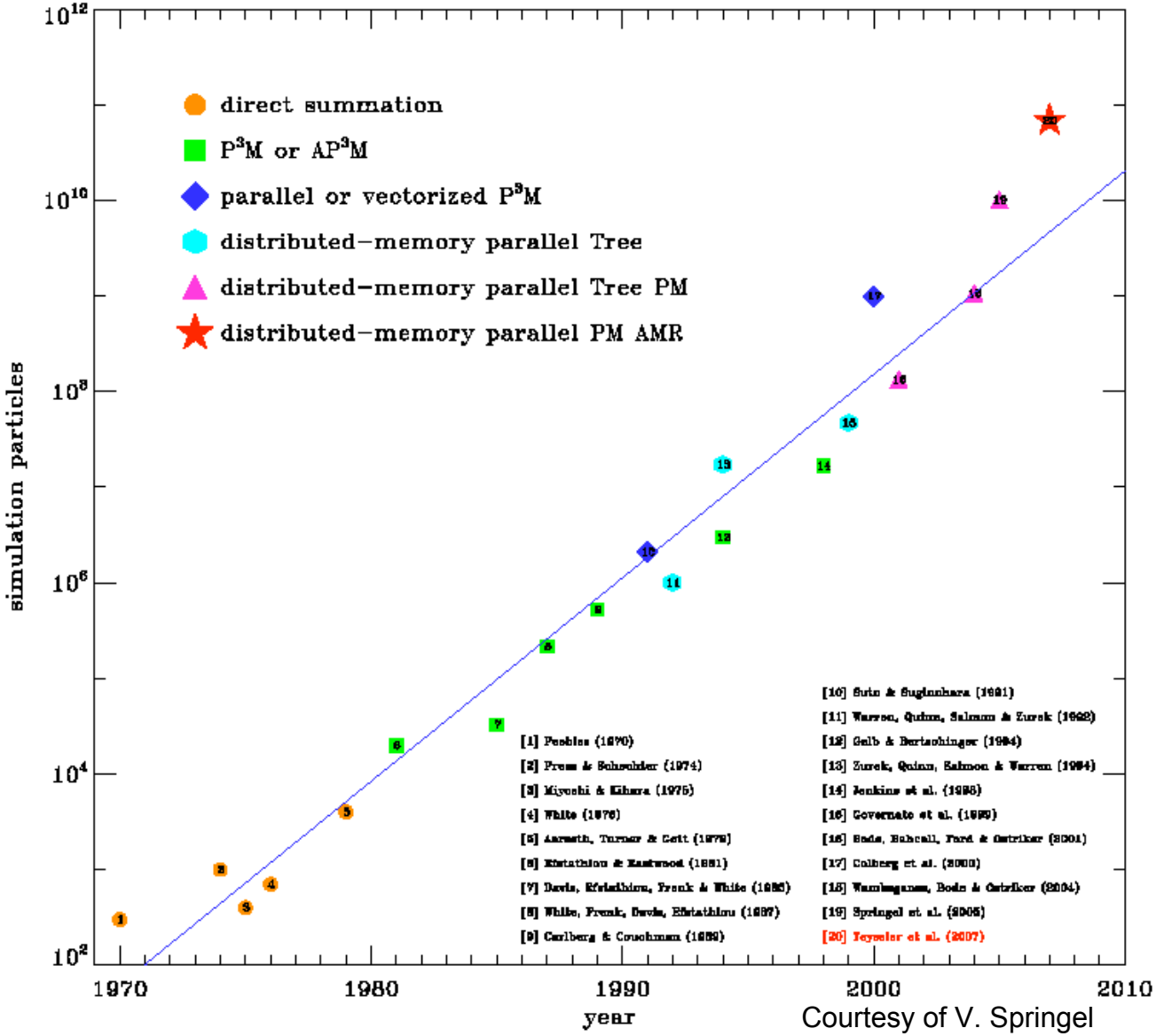
ccrt

BULL



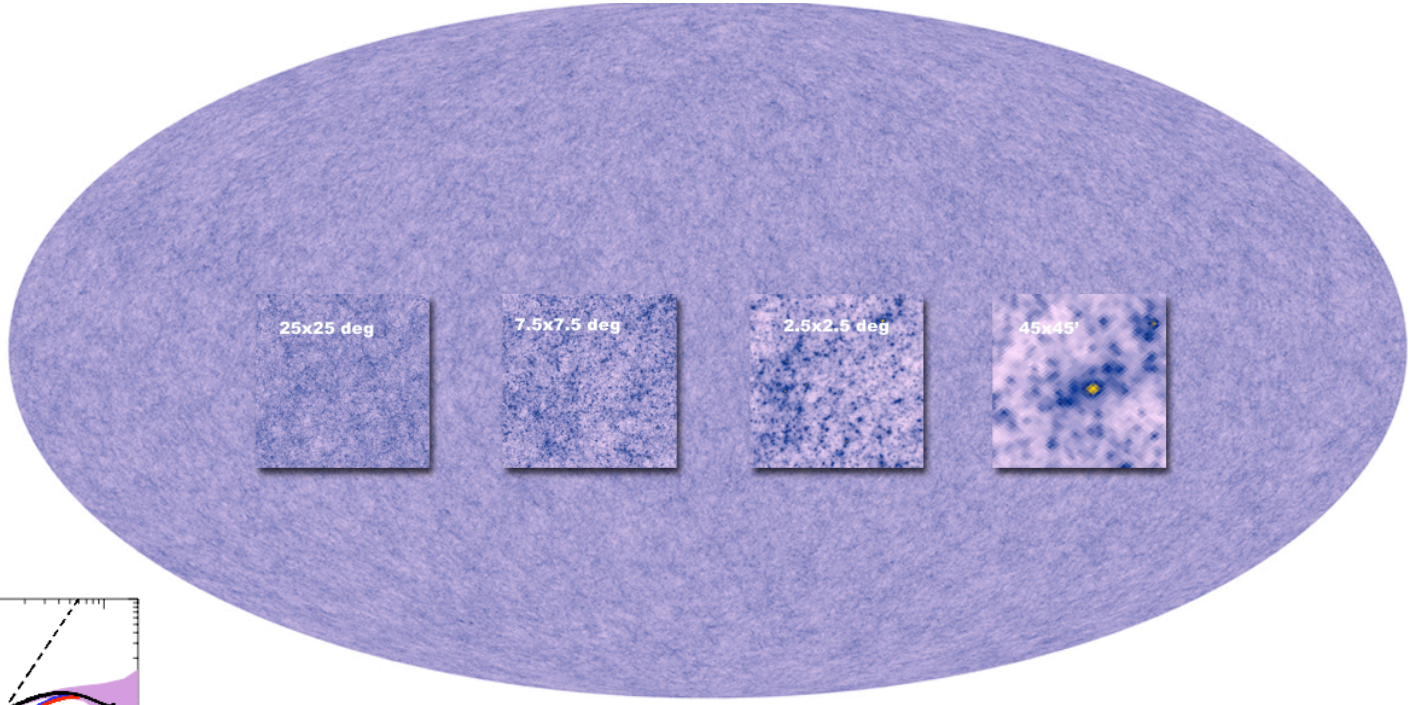


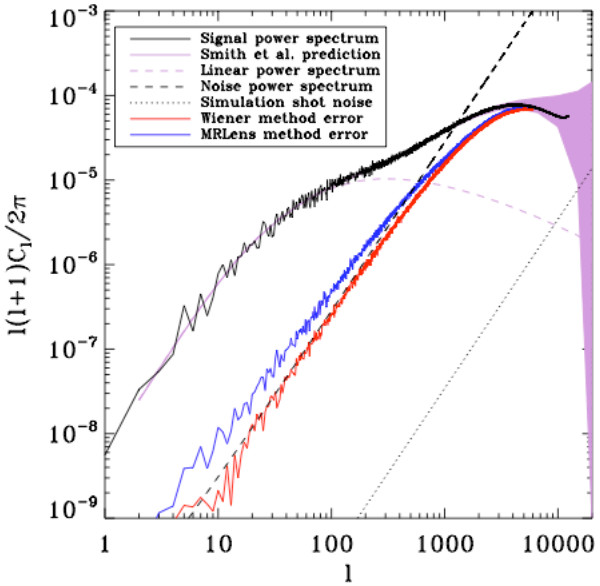
The Horizon 4Pi Simulation



Courtesy of V. Springel

The Horizon 4Pi Simulation





The first Full-Sky weak-lensing map with 0.9 arcmin^2 resolution : 4 decade in angular scales !!!

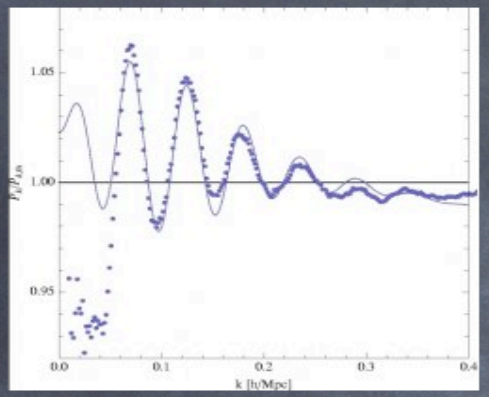
Preparation for cosmology surveys using wide field imaging in space

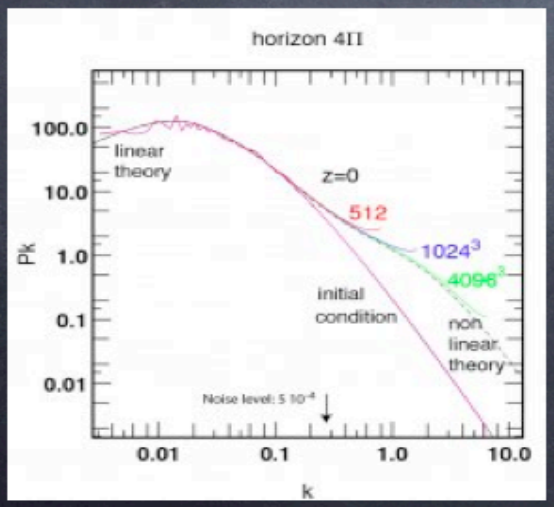
Teyssier et al., 2008 (submitted)

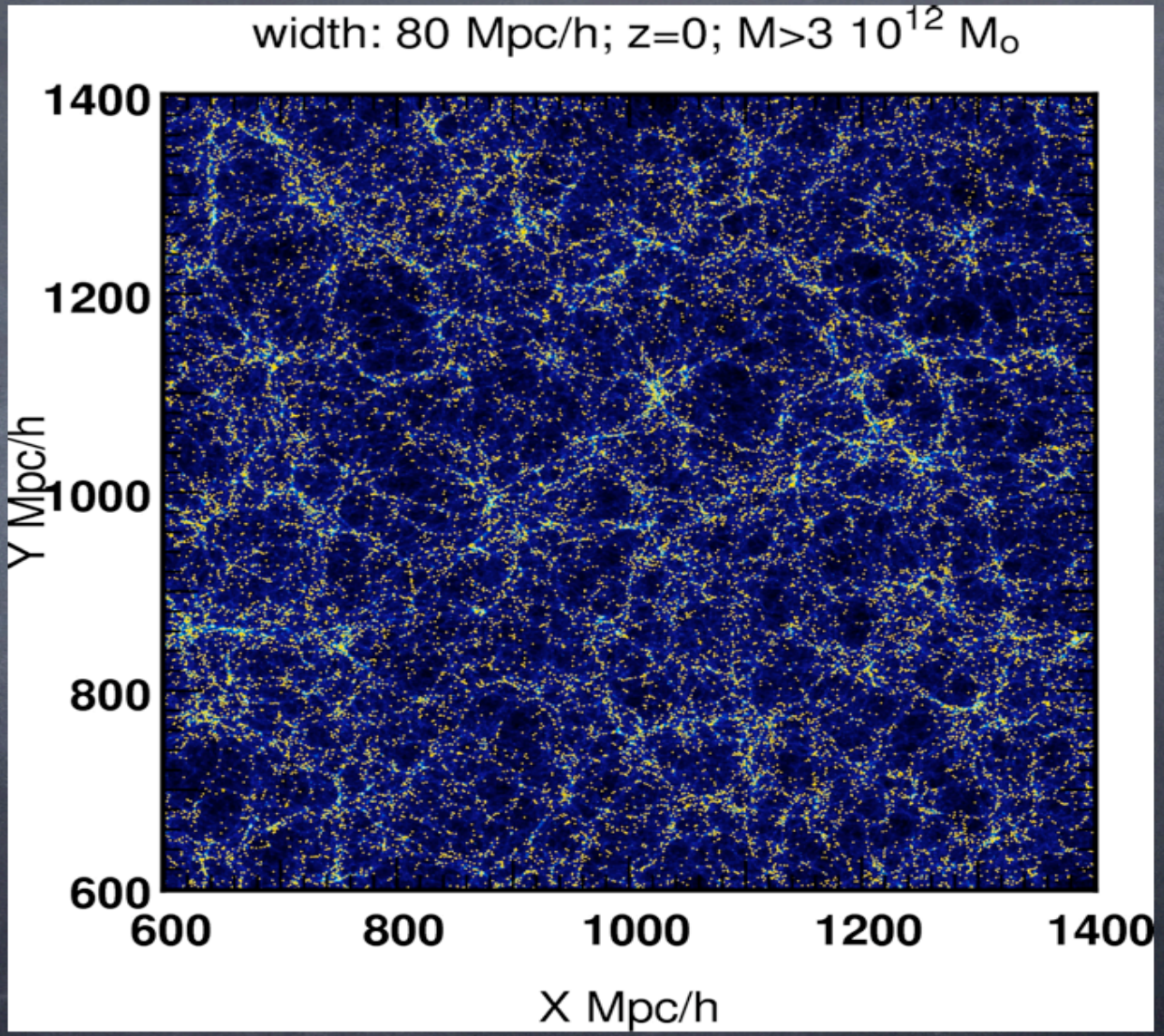
PROJET HORIZON

The Horizon 4Pi Simulation

Baryons Acoustic Oscillations using the Horizon halo catalogue.



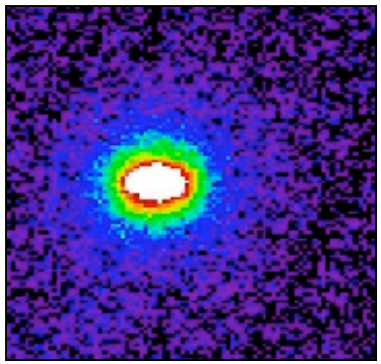


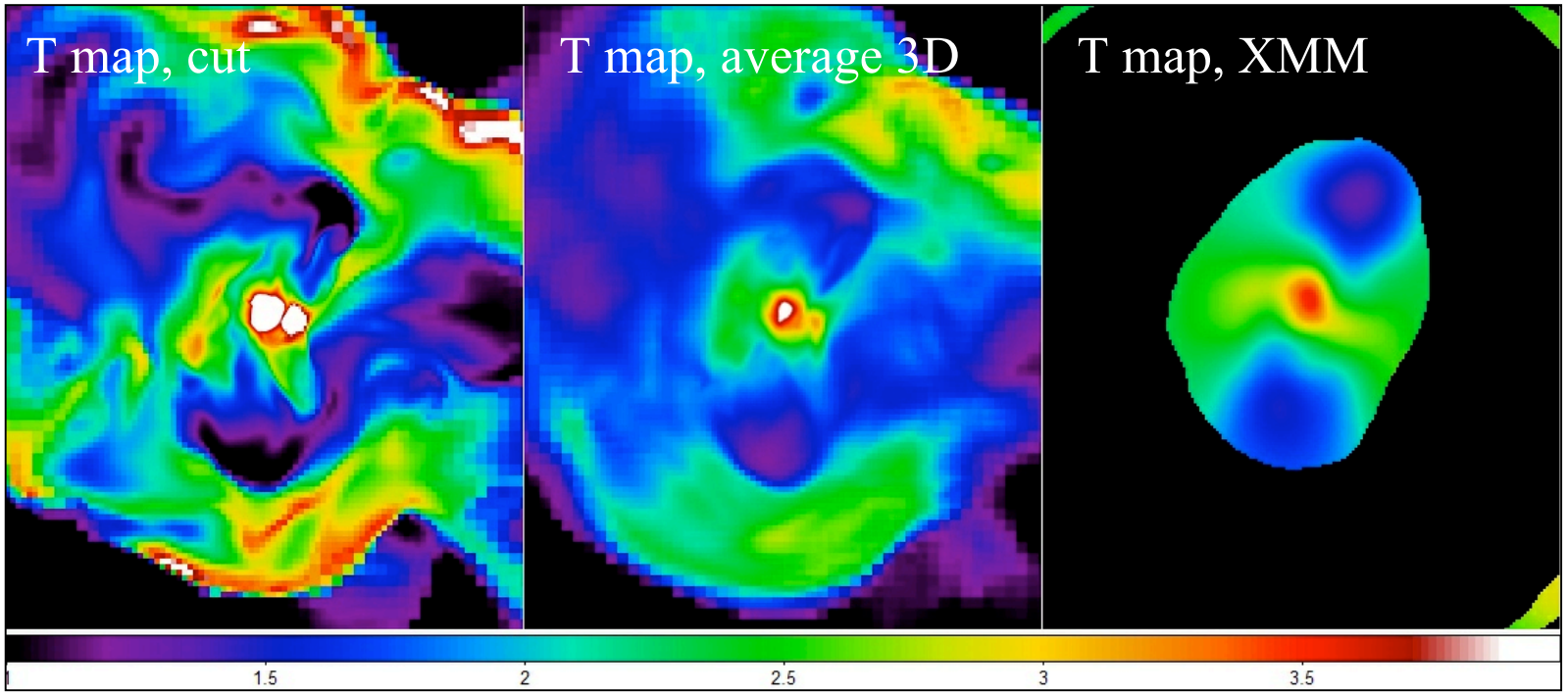


Simulations “zoom” des amas de galaxies

Using the XMM instrument simulator of J.-L. Sauvageot, derive mock X-ray images to assess feasibility of studying shock waves physics.

Solovyeva et al. (2007, 2008)

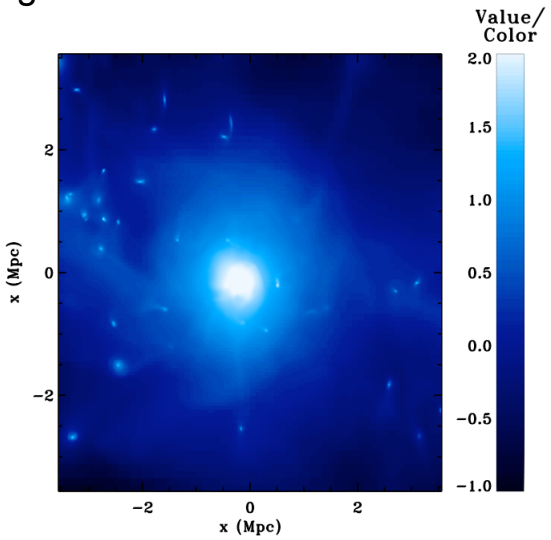


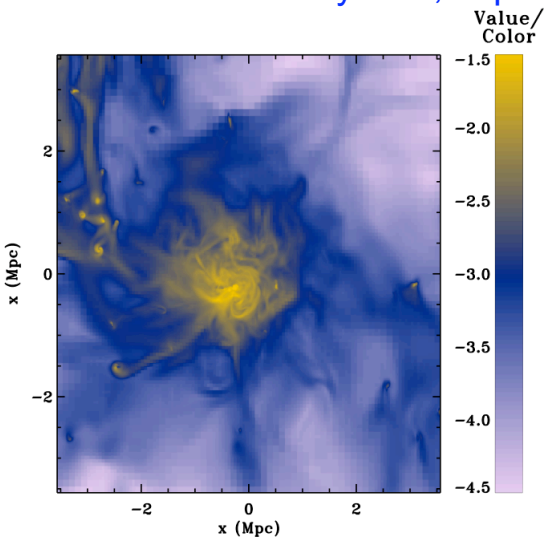


MHD simulations of X-ray cluster formation

Starting with a 10^{-11} G background field, fully MHD simulations of cosmological galaxy clusters with cooling and star formation

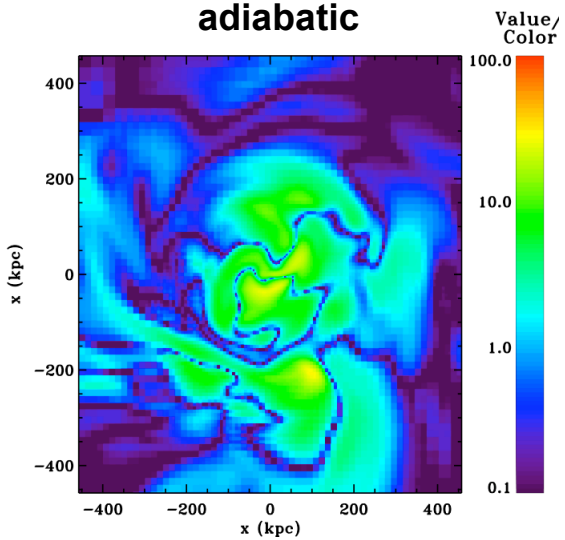
Dubois & Teyssier, in press



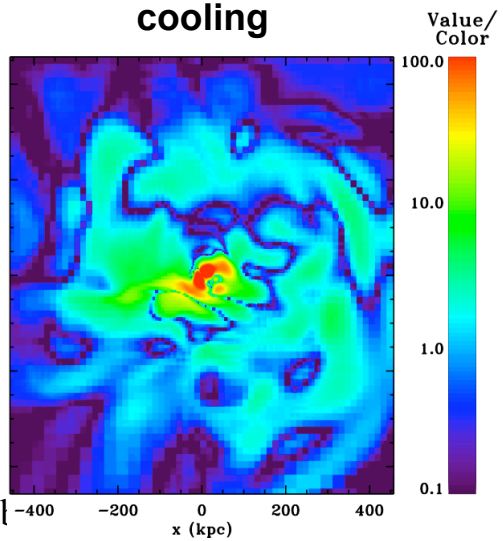


Faraday Rotation Measure maps:

adiabatic



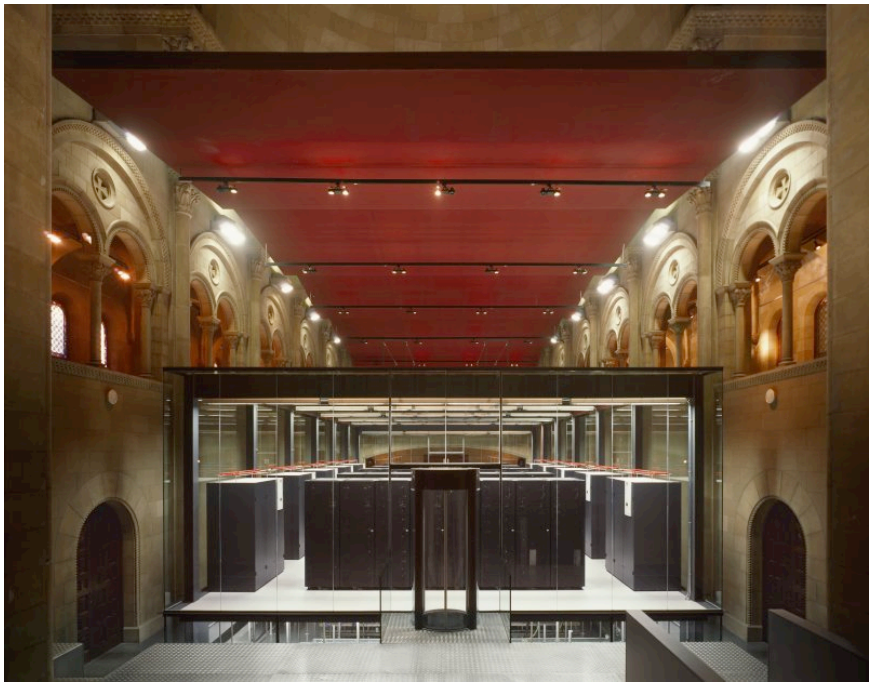
cooling

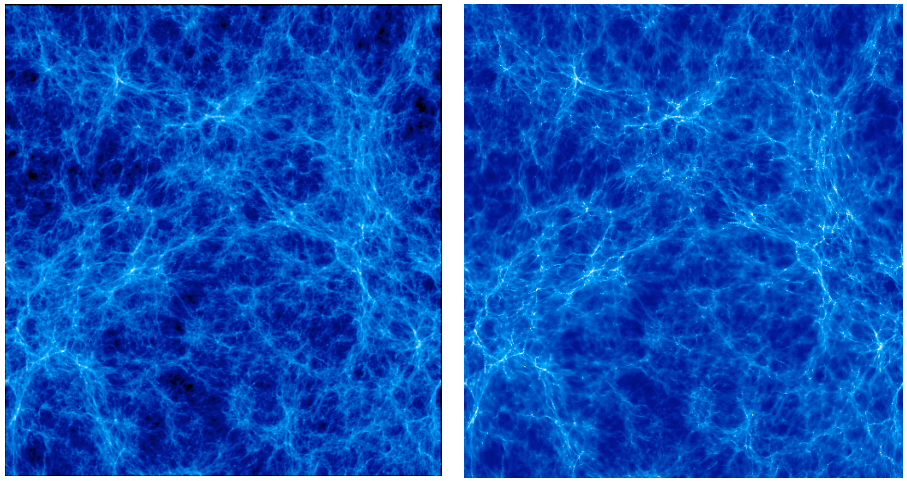


Dul

The MareNostrum simulation

50 h^{-1} Mpc box with 1024^3 particles and 4 billion AMR cells
1024^3 base grid +5 levels of refinement (smallest cell is 1-2 kpc *physical*)
N body + gas, cooling, star formation, polytrope, supernovae blast waves, metals
RAMSES run: 4 weeks (from sept. 2006 to sept. 2007): 1.5 Mhr with 2048 proc.

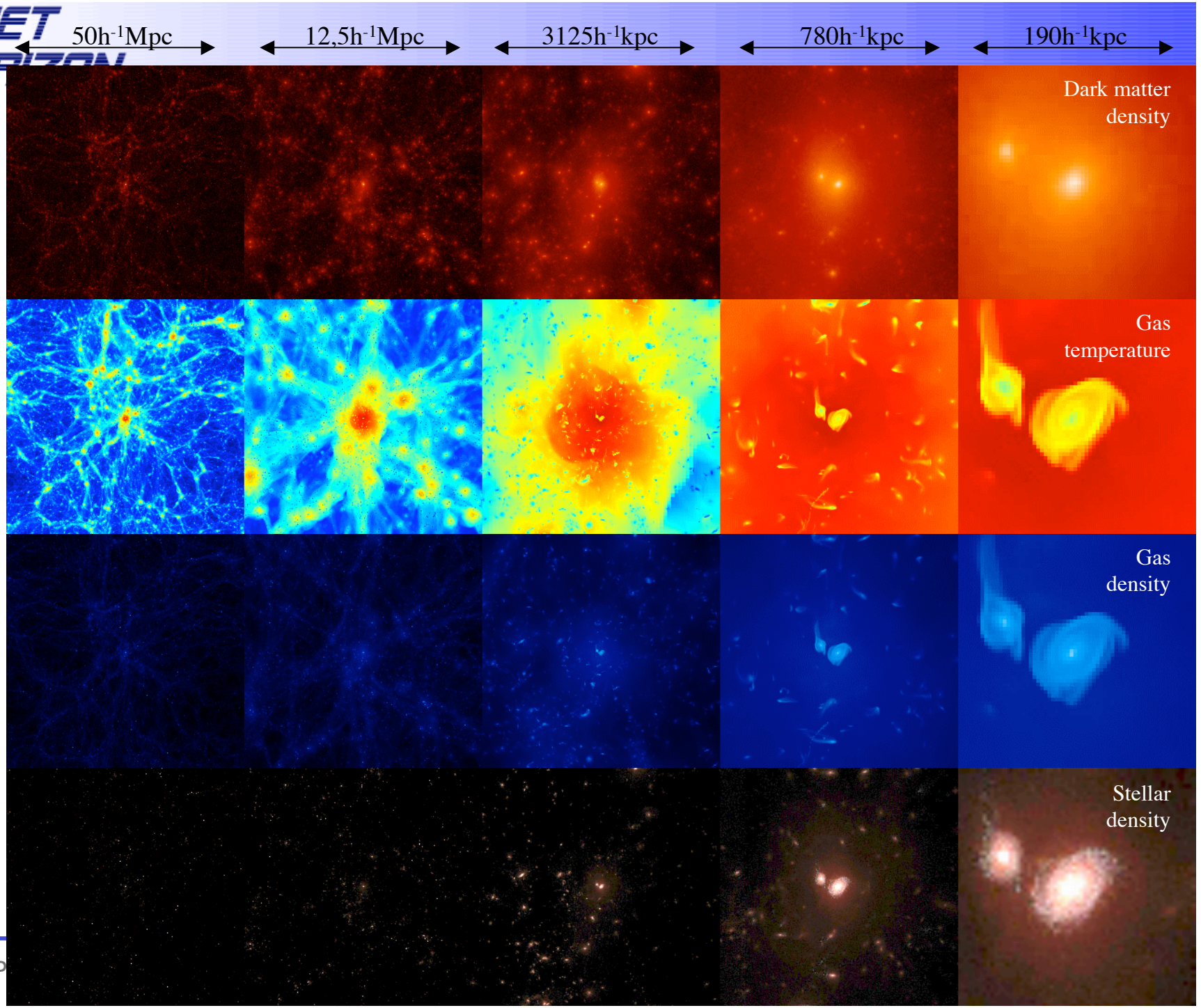




GADGET SPH **z=5.7** **RAMSES AMR**

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

GADGET team: G. Yepes, S. Goettlober, M. Hoeft, A. Khalatyan…
RAMSES team: R. Teyssier, D. Aubert, E. Audit, J. Devriendt, C. Pichon…
with strong support from BSC and IDRIS.


50h-1Mpc
12,5h-1Mpc
3125h-1kpc
780h-1kpc
190h-1kpc
Dark matter density
Gas temperature
Gas density
Stellar density

Bimodality: cold streams or hot shocks?

Hypothesis: the galaxy star formation history depends on the geometry of the diffuse accretion.

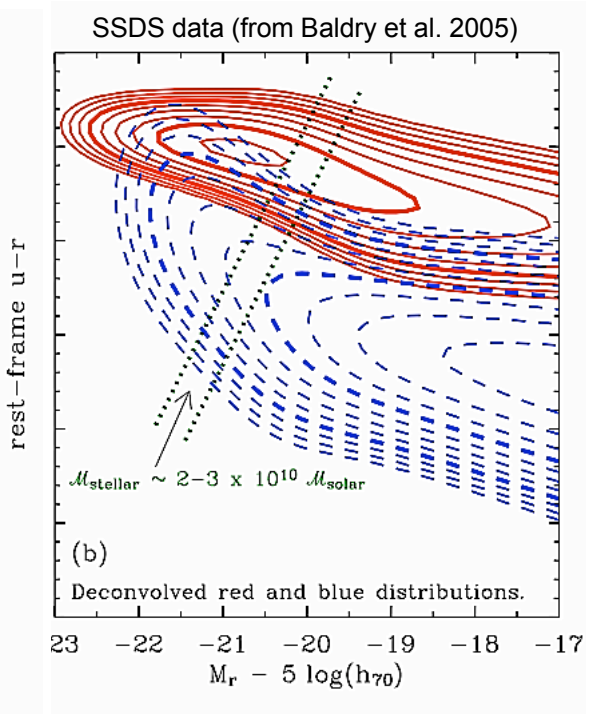
Filaments feed directly fresh gas into the disc.

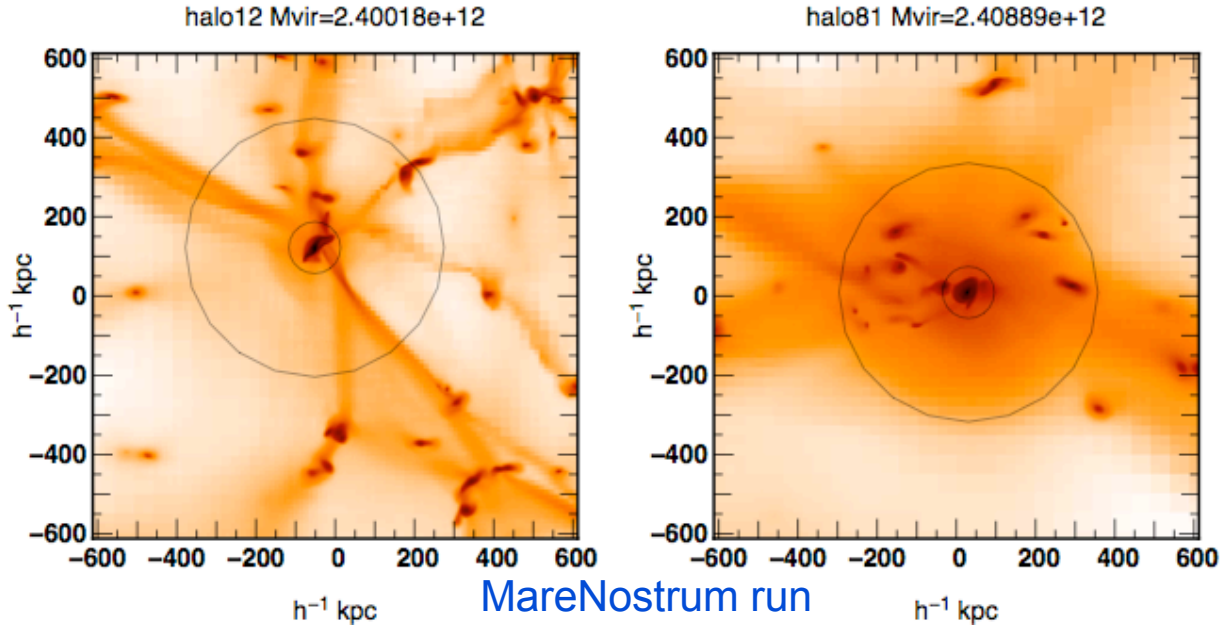
Hot shocks stop cooling and therefore gas accretion.

Shock stability: $t_{cool}(\rho_{vir}) \sim R_{vir}/V_{vir}$

Filament survival: $t_{cool}(\rho_f) \sim R_{vir}/V_{vir}$

Density enhancement: $\rho_f T_f \sim \rho_{vir} T_{vir}$





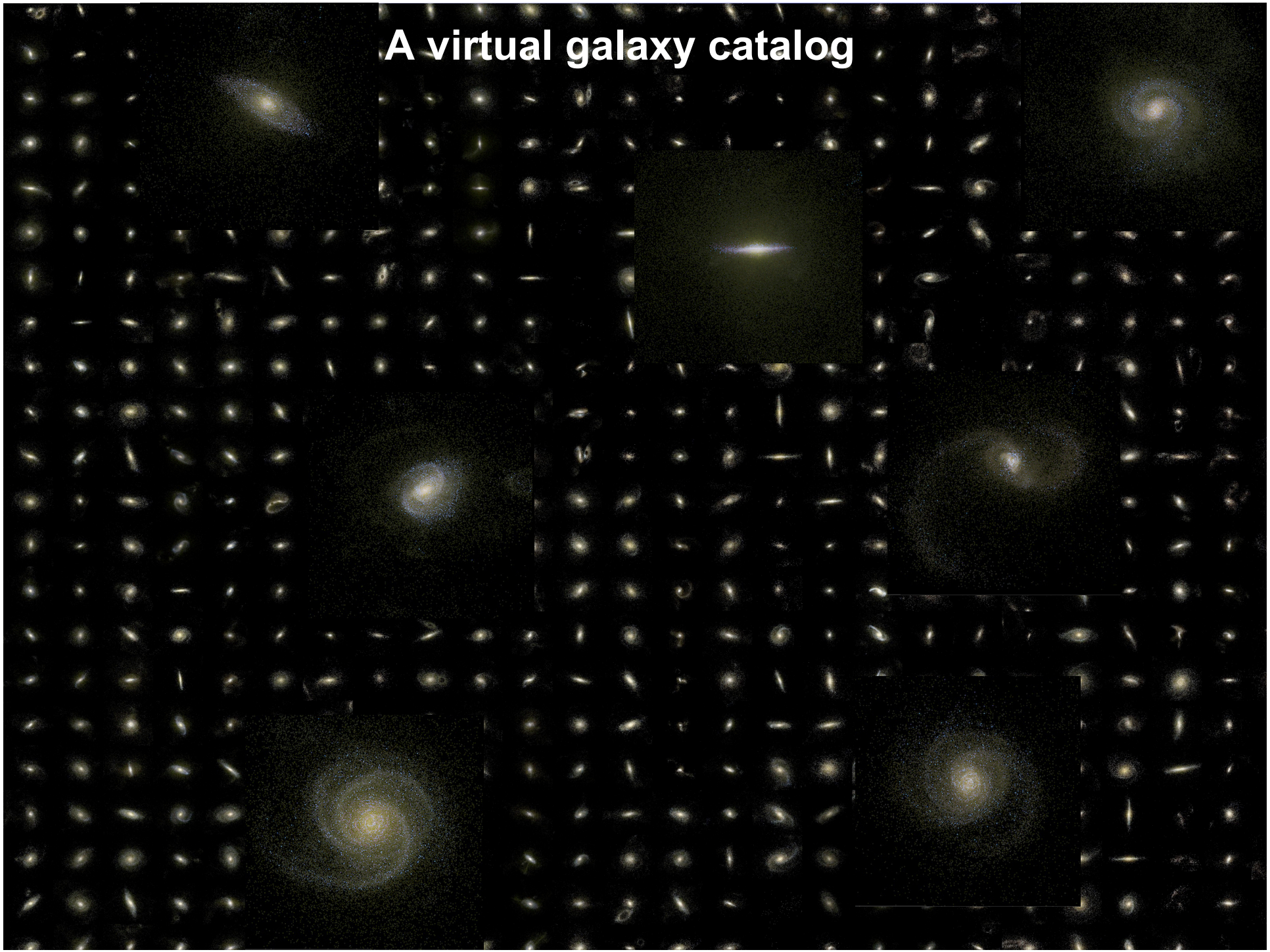
MareNostrum run

Birnboim & Dekel (2003)

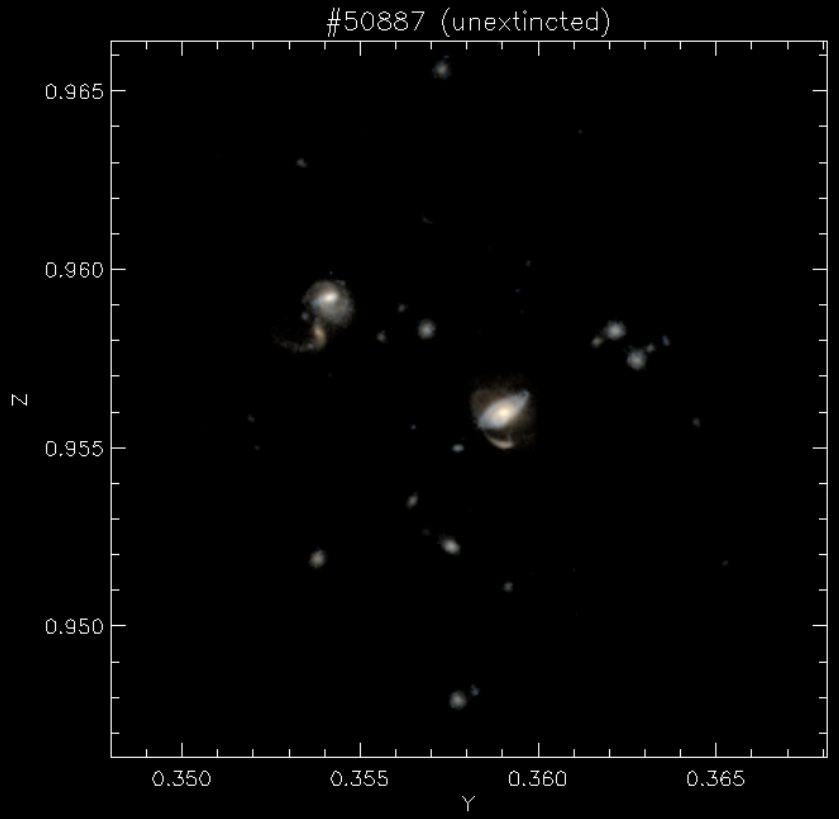
Kravtsov (2003)

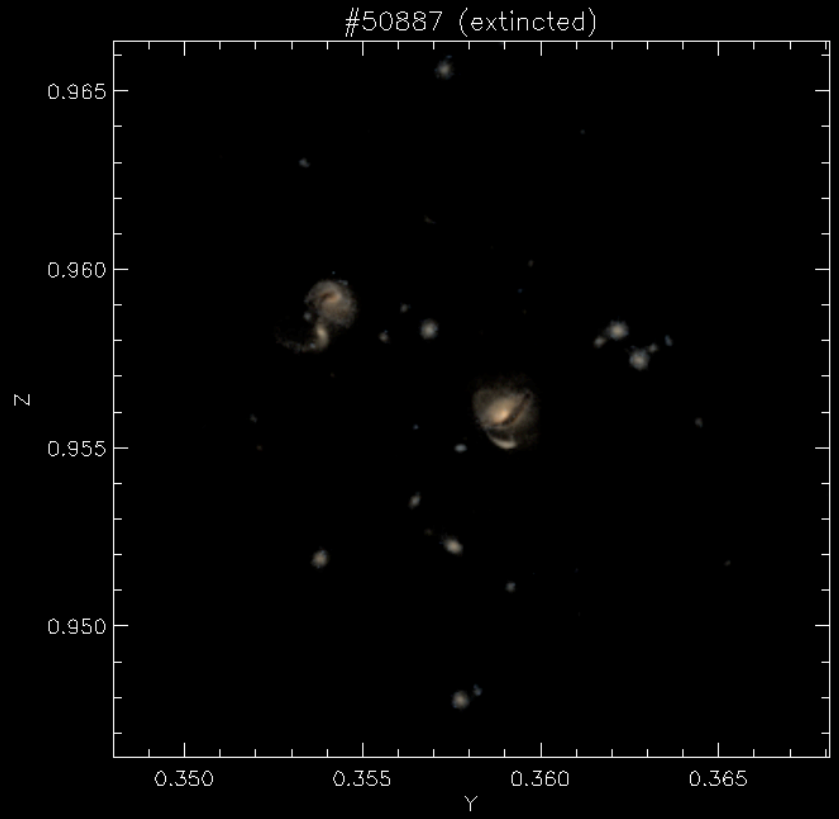
Keres et al. (2005)

Dekel & Birnboim (2006)

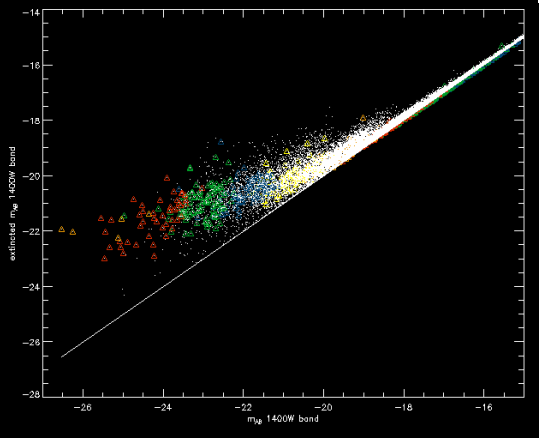

A virtual galaxy catalog

MareNostrum: Internal extinction of galaxies

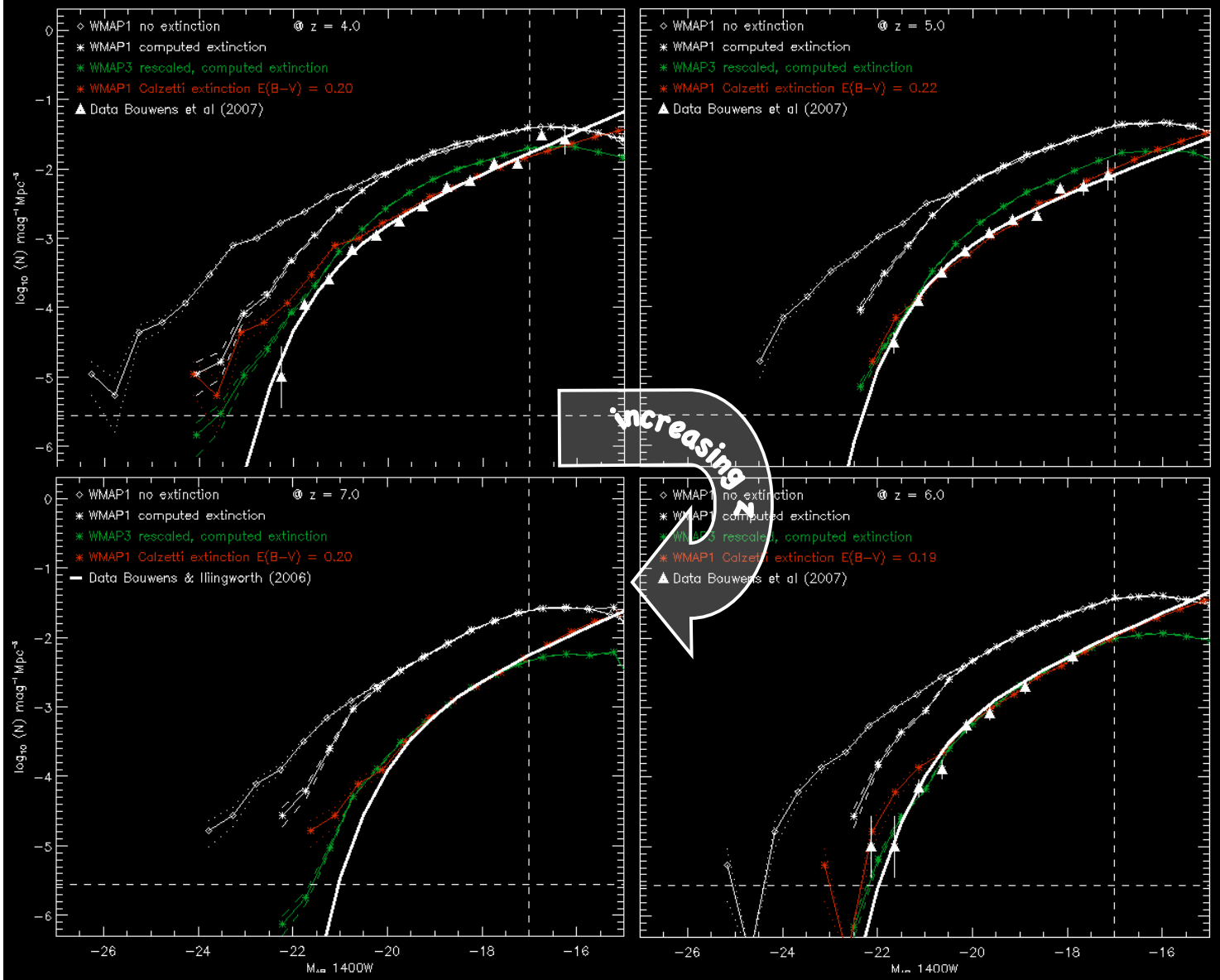




Projected images of galaxies in the Mare Nostrum (MN) simulation @ z=4. Left panel shows true color image for galaxies without dust extinction. Right panel is the same but with extinction calculated self-consistently along lines of sight in the simulation. Note the clear presence of dust lanes in spirals. Bottom right hand corner plot: UV restframe extinction (1400 A) for all MN galaxies @ z=4.



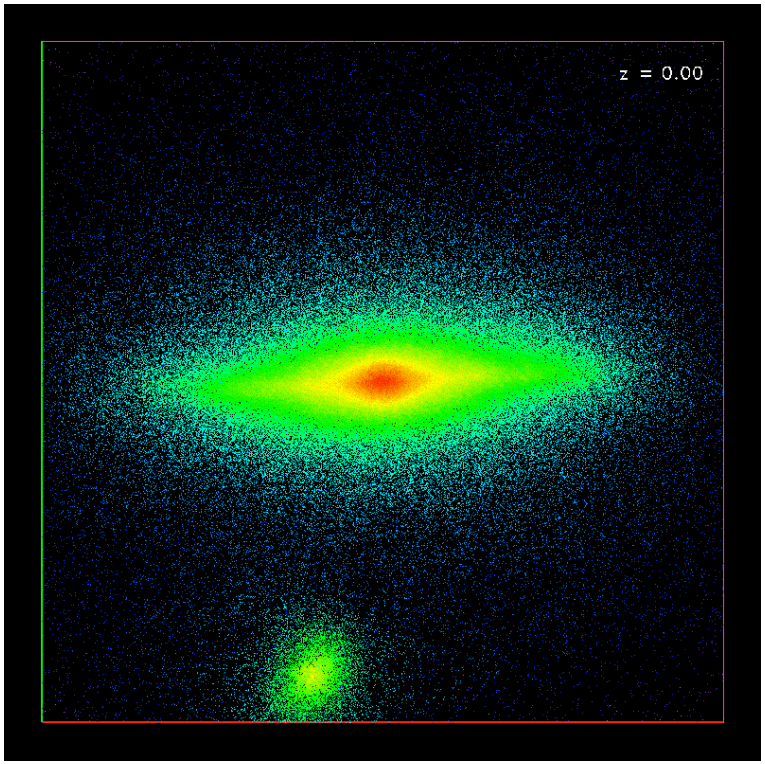
Luminosity Function evolution @ high z

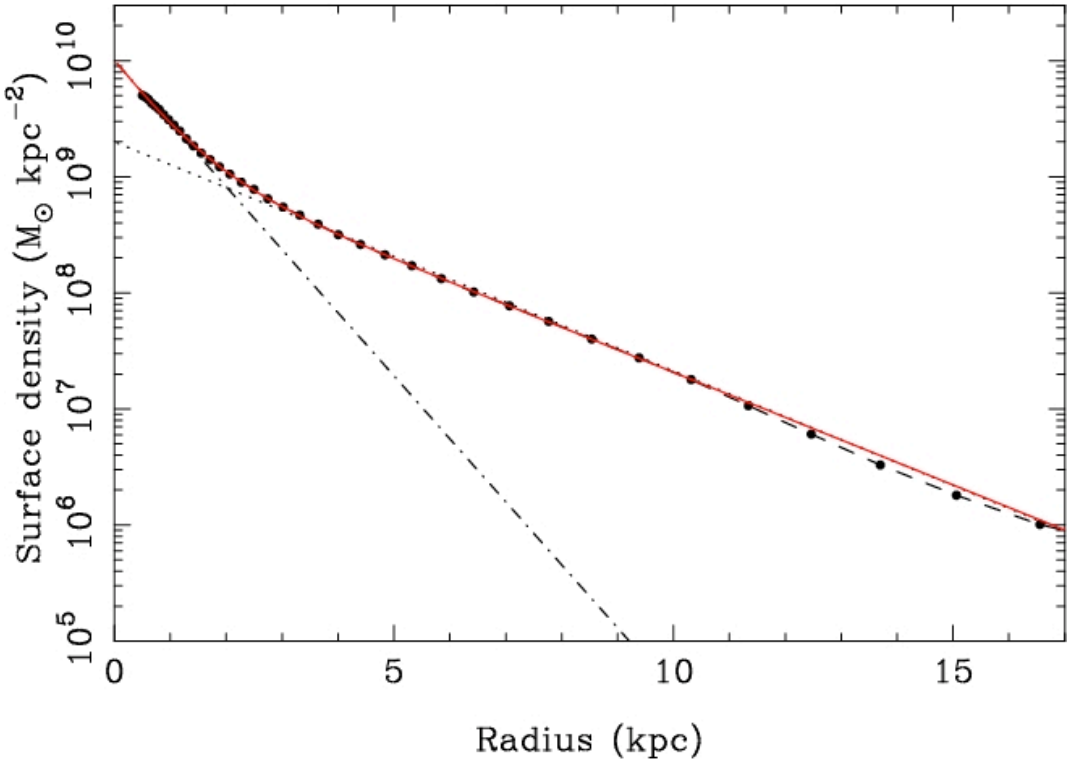


Devriendt et al., in prep.

Luminosity functions of MN galaxies in the rest-frame UV measured in the simulation volume at different z & with different prescriptions for extinction (calculated vs averaged Calzetti law). Also shown is an attempt to rescale to WMAP3 cosmology. Note the degeneracy between extinction and cosmology.

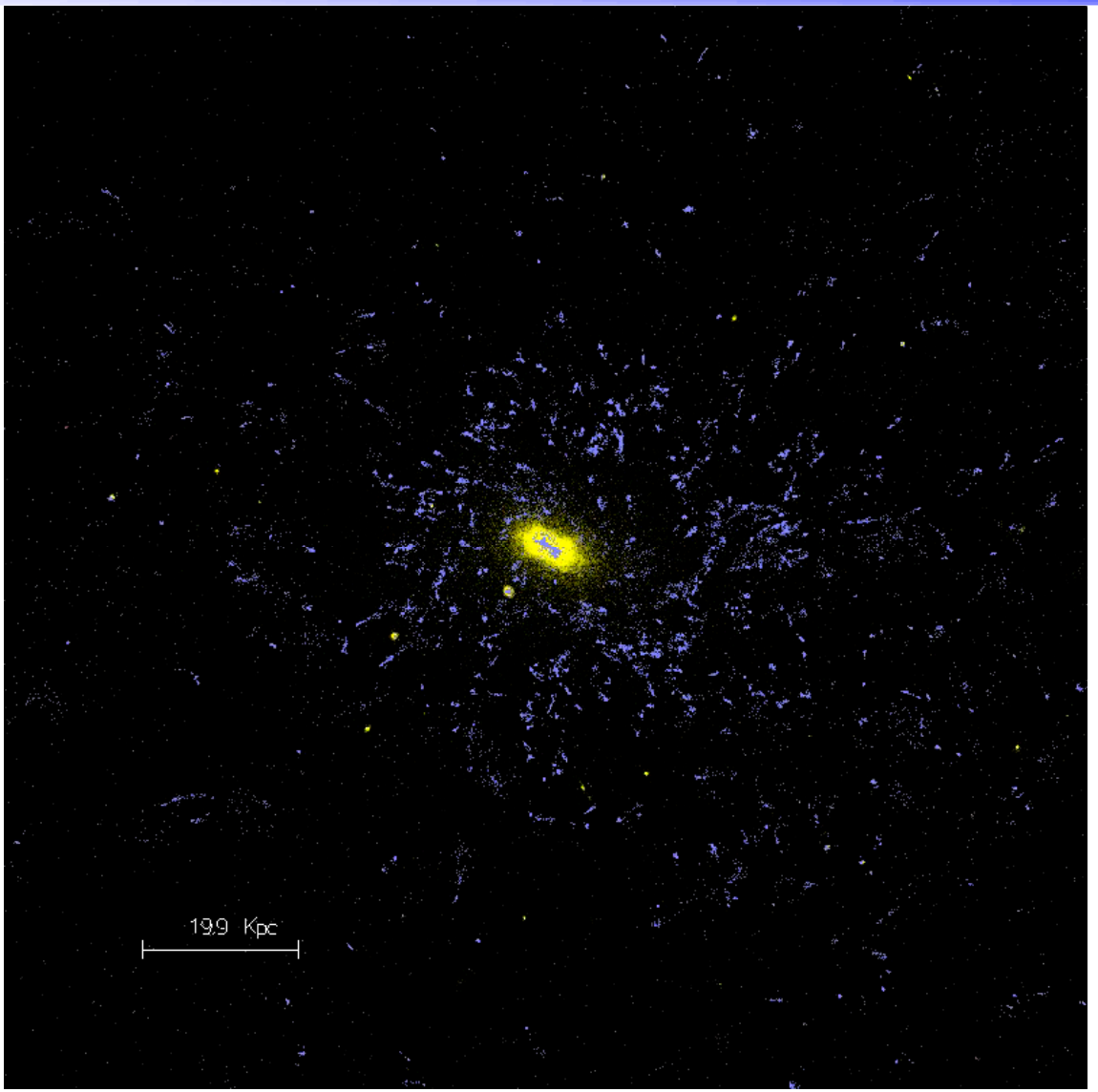
Simulations “zoom” des galaxies





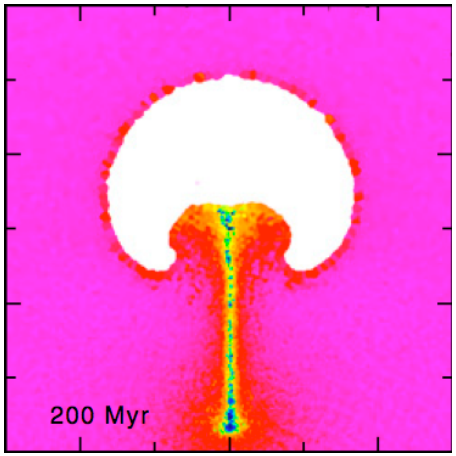
Simulation RAMSES réalisée par Stéphanie Courty:
Première simulation AMR de disque cosmologique jusqu’à z=0

Simulations “zoom” des galaxies



Simulation MULTIZOOM
réalisée par Benoit Sémelin

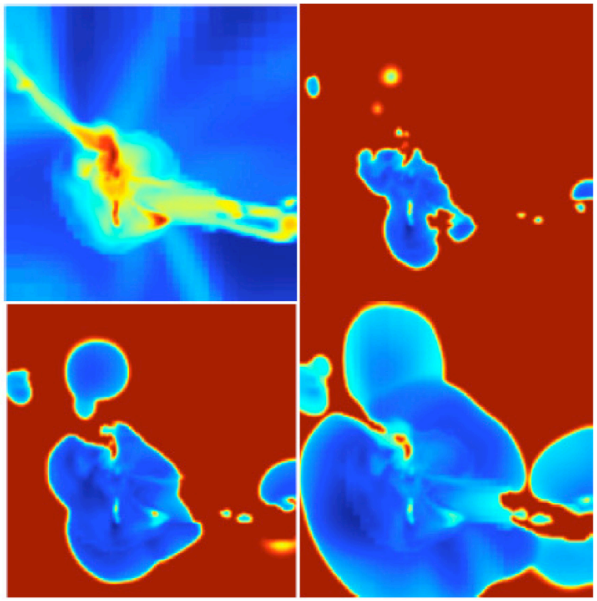
Nouveaux algorithmes, nouvelles méthodes



AGN feedback:

Cattaneo et Teyssier (2007)

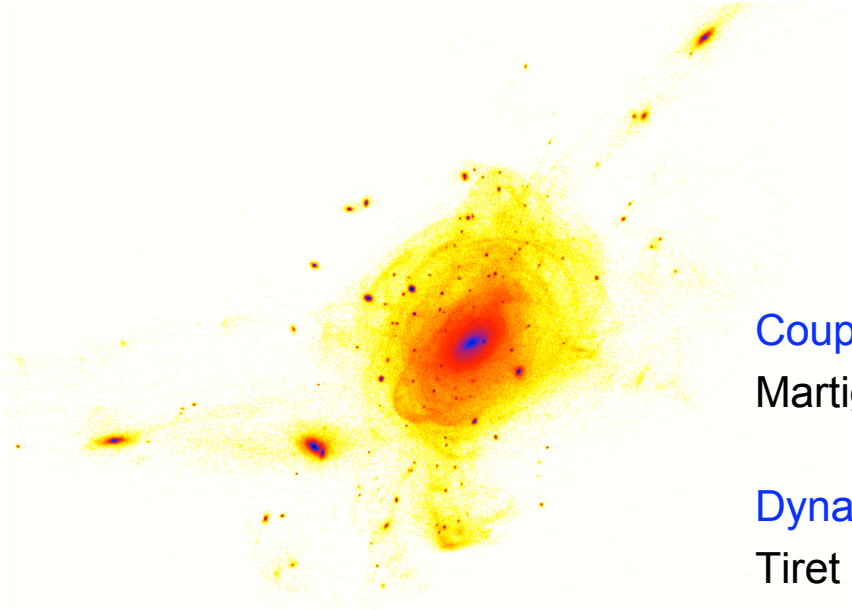
Revaz, Combes et Salomé (2008)



Transfert radiatif et réionisation

Sémelin, Combes et Baek (2007)

Aubert et Teyssier (2008)



Couplage d'échelles et couplage de codes

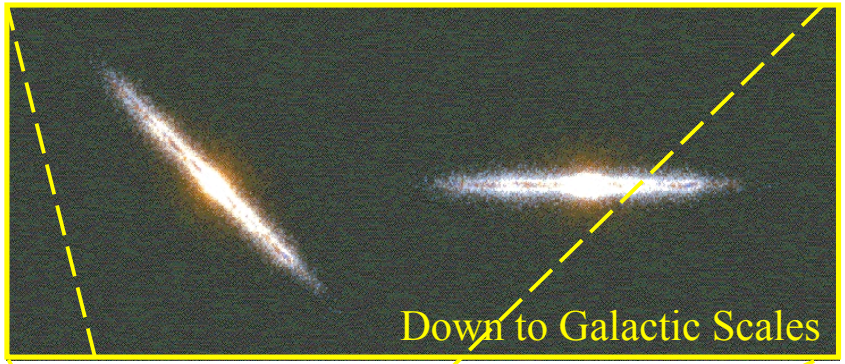
Martig et Bournaud (2008)

Dynamique galactique avec MOND

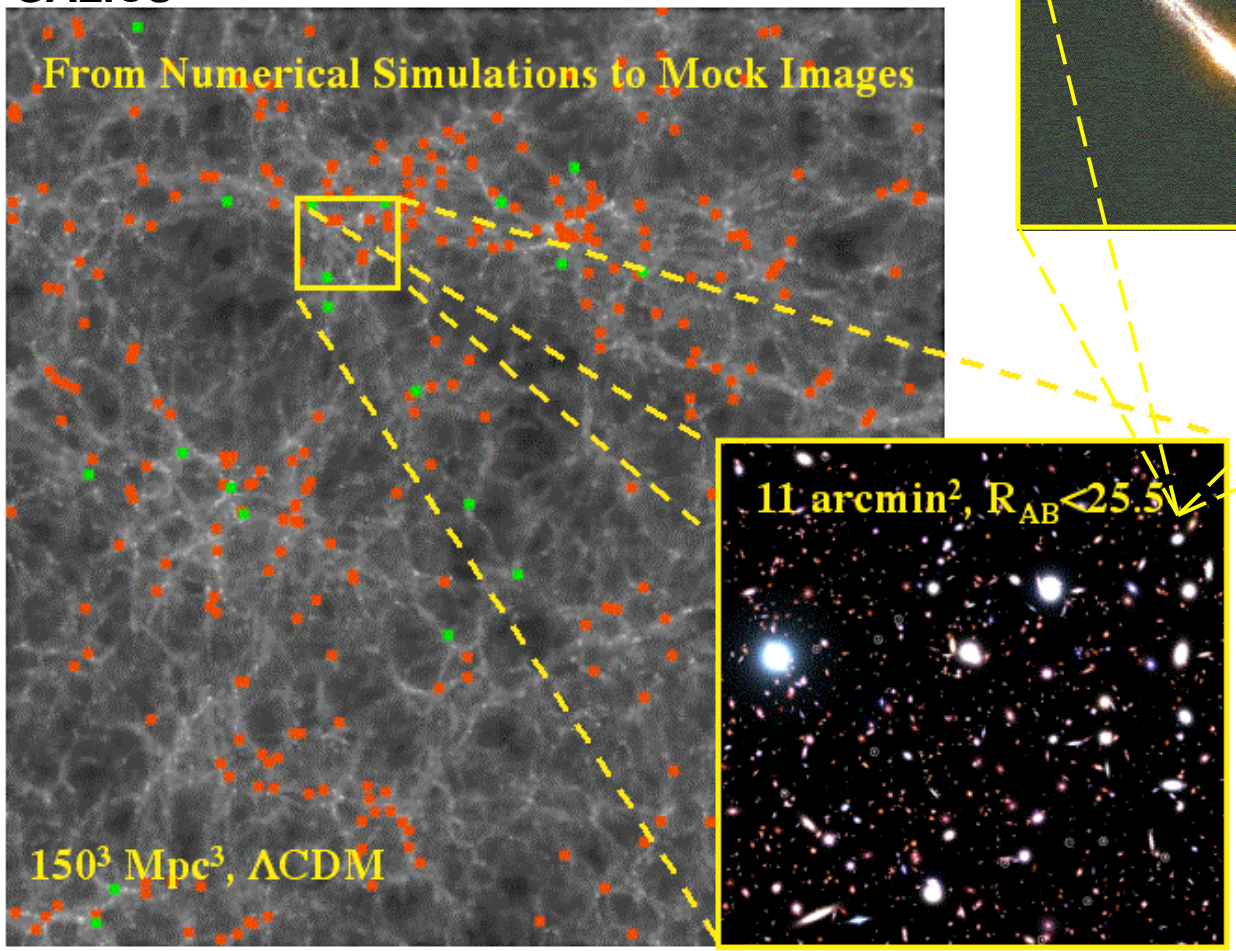
Tiret et Combes (2007)

Catalogues en lignes

GALMER



GALICS



Mise en ligne de catalogues, d'images (all-sky ou patch), de spectres **en lien avec des projets observationnels**.

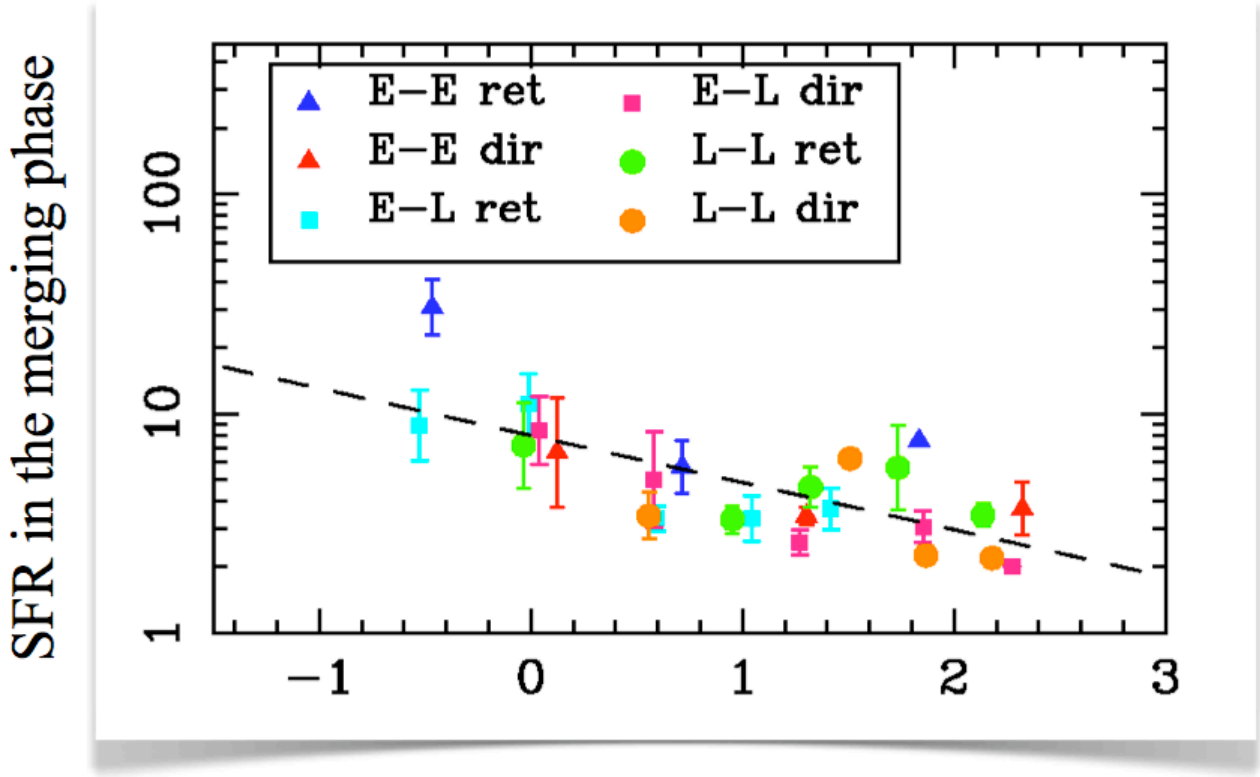
Utilisation des standards "Virtual Observatory" ?

GALMER est en ligne !

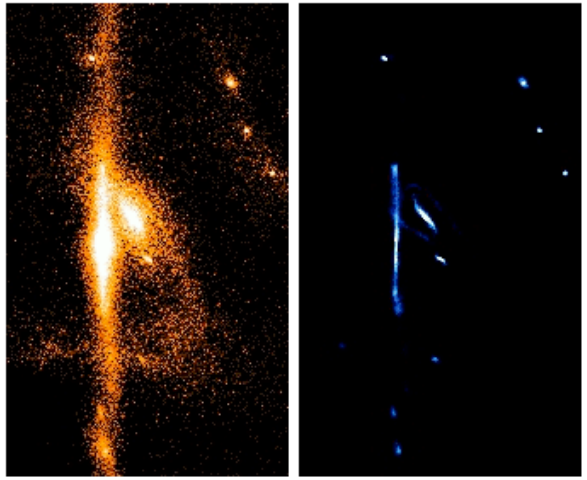
GalMer

HORIZON PROJECT

DB Query | Query Results | Experiment | Snapshot | Description



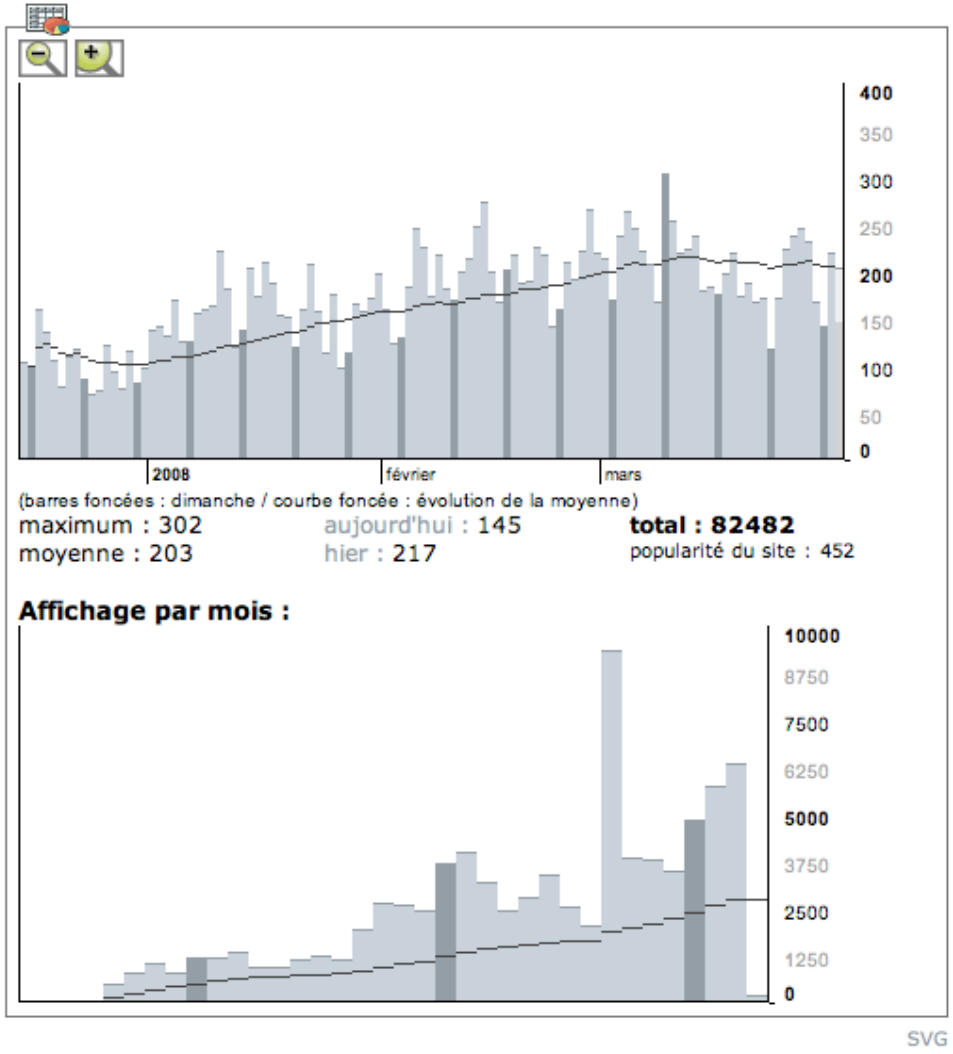
Tidal effects at pericentre passage



Last modified: 09/Dec/2007

I. Chillingarian, P. di Matteo, A.-L. Melchior, B. Sémelin, F. Combes

Fréquentation sur le site http://www.projet-horizon.fr



D'accord, et après ?

Projet Horizon: mettre en avant les techniques de simulation pour fédérer la communauté, obtenir plus de moyens et rattraper son retard.

Reste à mettre en ligne le catalogue GALICS.

Meeting de fin de projet en Novembre 2008.

Après Horizon: remettre la physique au premier plan.

"Horizon Legacy":
- **Demande annuelle unique de temps de calcul auprès de GENCI**
- **Maintien du site Web externe et interne**

D'autres suggestions ?

Fin du diaporama