A DYNAMICAL VIEW OF THE BRIGHT CUT-OFF OF THE PNLF IN ANDROMEDA'S BULGE

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OUTLINE

- Detection of Planetary Nebulae
- Luminosity function bright cut-off
- Kinematics
  - Rotation of the two components
  - Comparison with the gas and stellar rotation
- Line ratios
- Conclusion: evidence of two stellar components in the bulge

SITELLE SURVEY ON ANDROMEDA'S BULGE

SITELLE = imaging Fourier transform spectrometer attached to the Canada-France-Hawaii telescope

Observation of a red (647-685 nm) data cube of the central region (11 arcmin × 11 arcmin) of M 31

→ Detection of 800 emission-line point-like sources (Martin, Melchior, Drissen 2018)

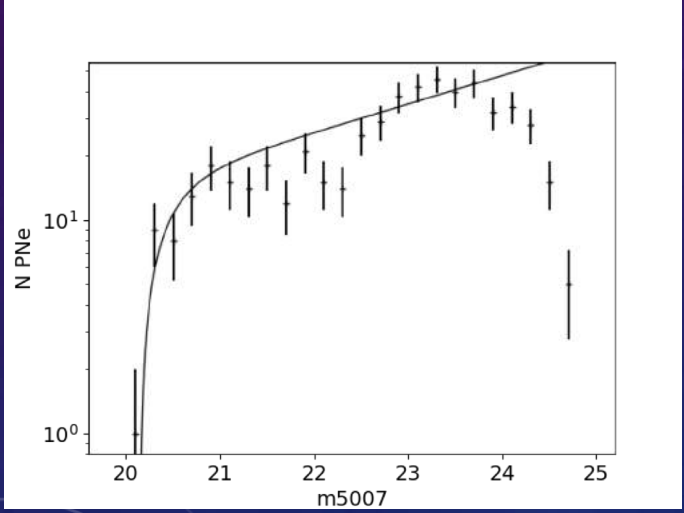
Extension to a blue (482–513 nm) data cube of the same region.

DETECTION OF PLANETARY NEBULAE IN THE BULGE

587 PNe candidates detected with 5σ in [OIII] and at less than 500km/s from the systemic velocity

318 are matching Merrett et al. (2006) catalogue

Luminosity function

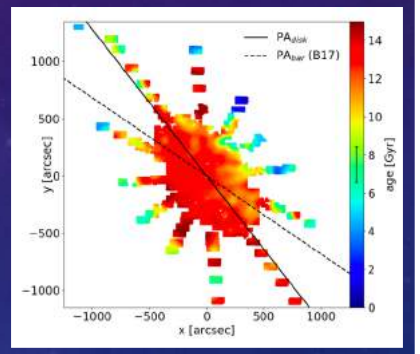


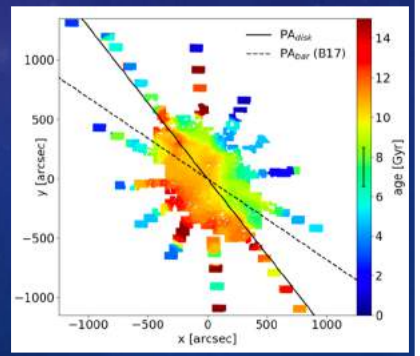
Bright cut-off : M_{5007} =-4.47 (Ciardullo et al. 2010)

Andromeda bulge is old:

80% >11-13 Gyr + metal-rich

20% are ~6 Gyr

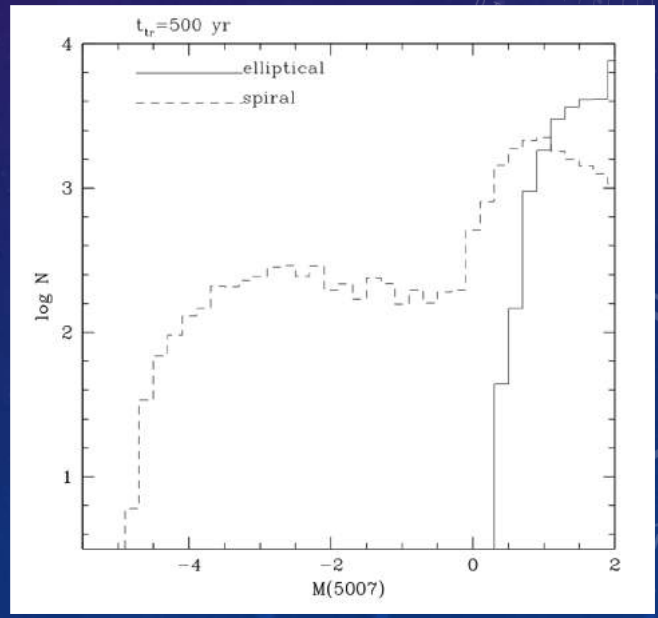




Saglia et al. (2018)

Age of the progenitors?

Expected ≈1 Gyr old with an initial mass of about 2.5−3.0M_{sol}

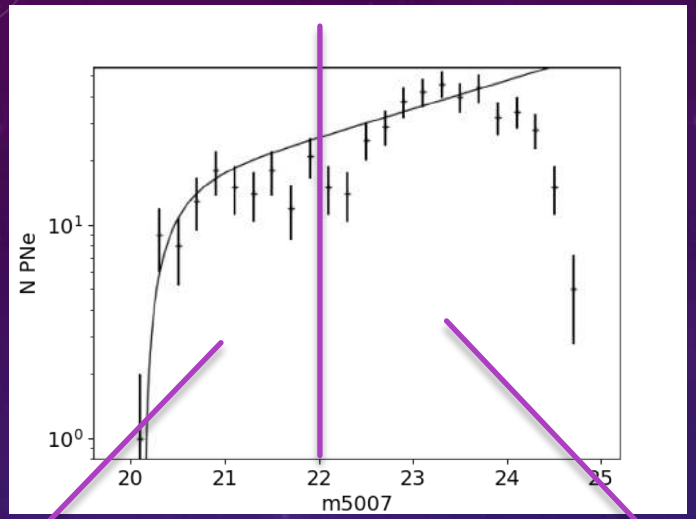


Marigo et al. (2004)

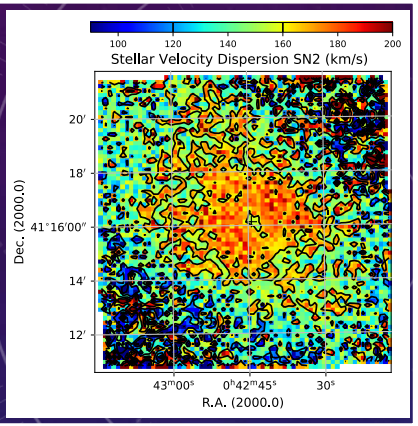
Planetary nebulae luminosity function

Invariance of the bright cut-off

Ciardullo et al. (2010)

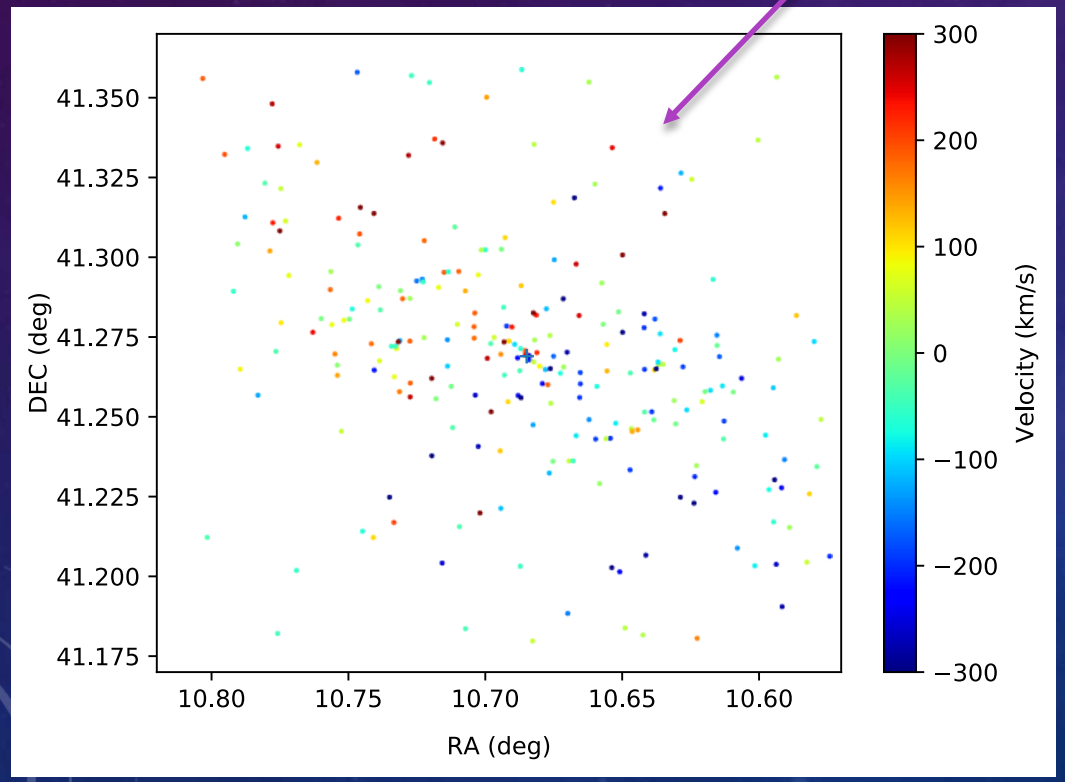


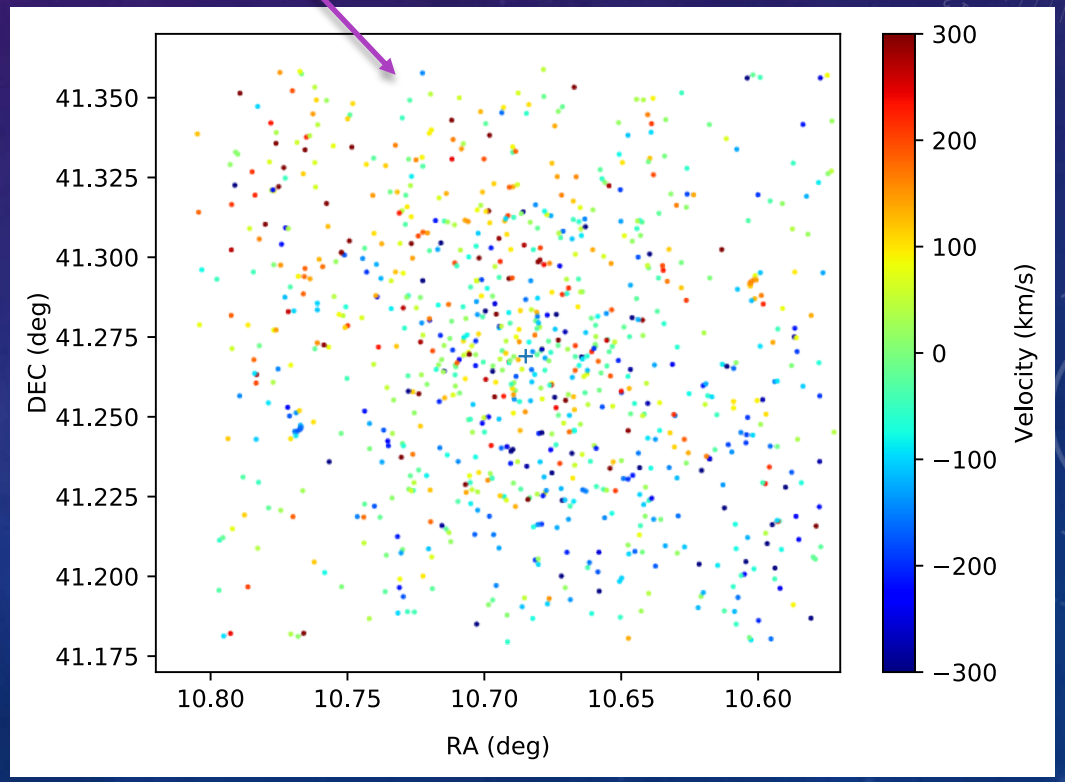
Stellar velocity dispersion:
> 150km/s



129 Pne (22%) with $m_{5007} < 22$
$-450 km/s < V_{rad} - V_{sys} < 434 km/s$

458 PNe (78%) with $m_{5007} > 22$
$-487 km/s < V_{rad} - V_{sys} < 408 km/s$

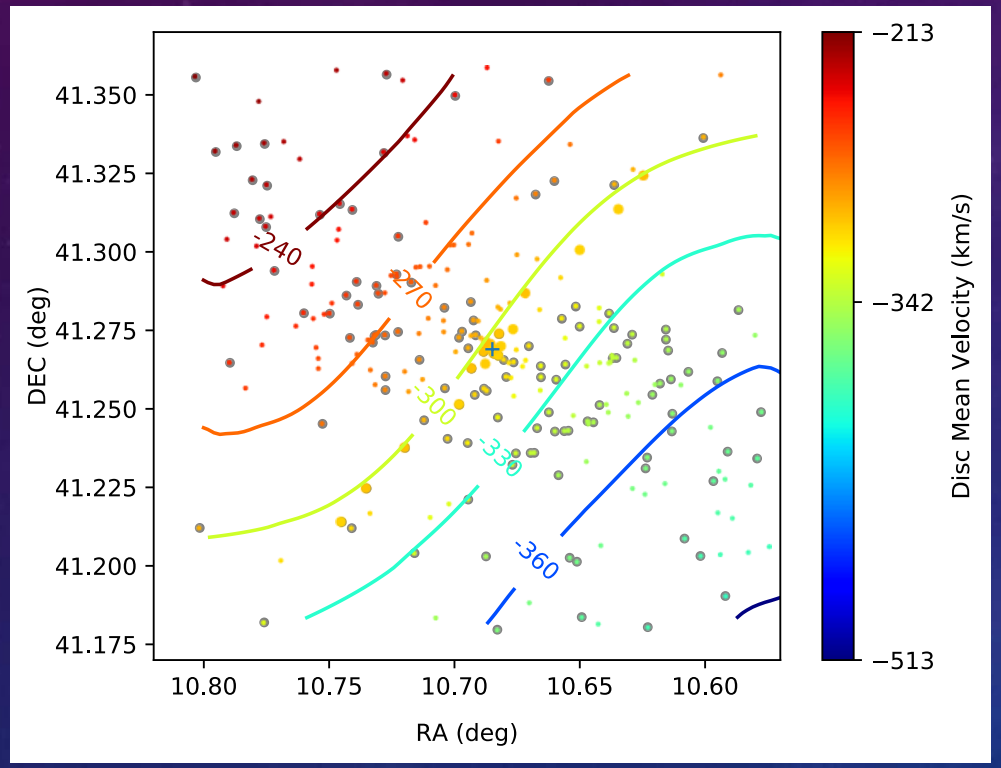


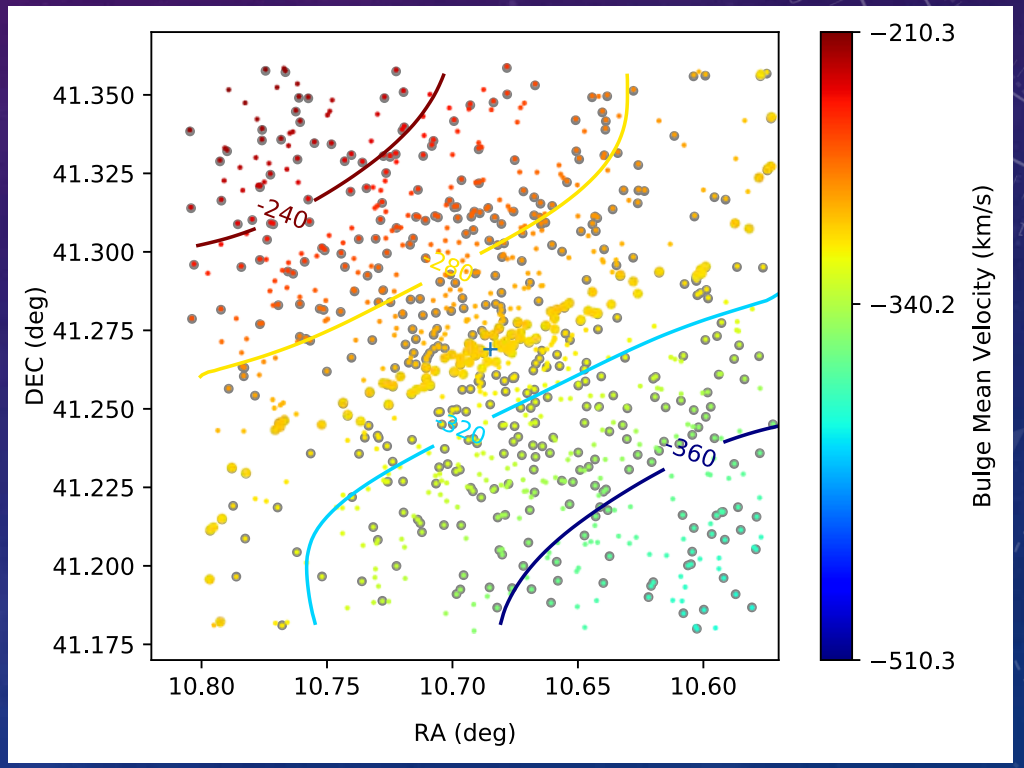


Symmetrisation and smoothing of the velocity field

Coccato et al. (2009)

Same kernel for both components (A=1.1 B=65)



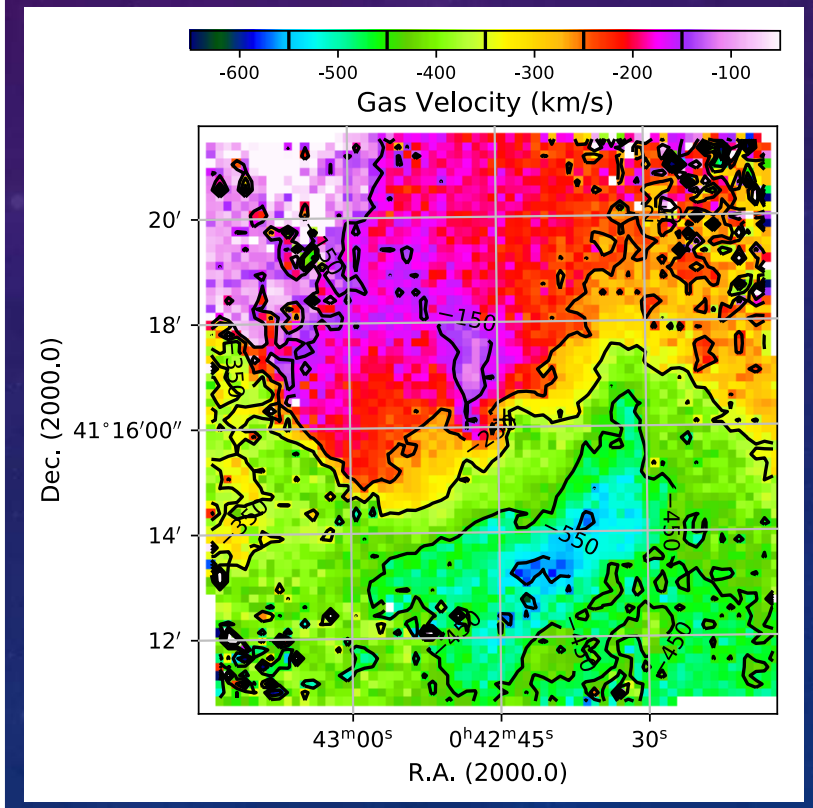


But the smoothing is reducing the velocity gradient, but the same way in both distribution…

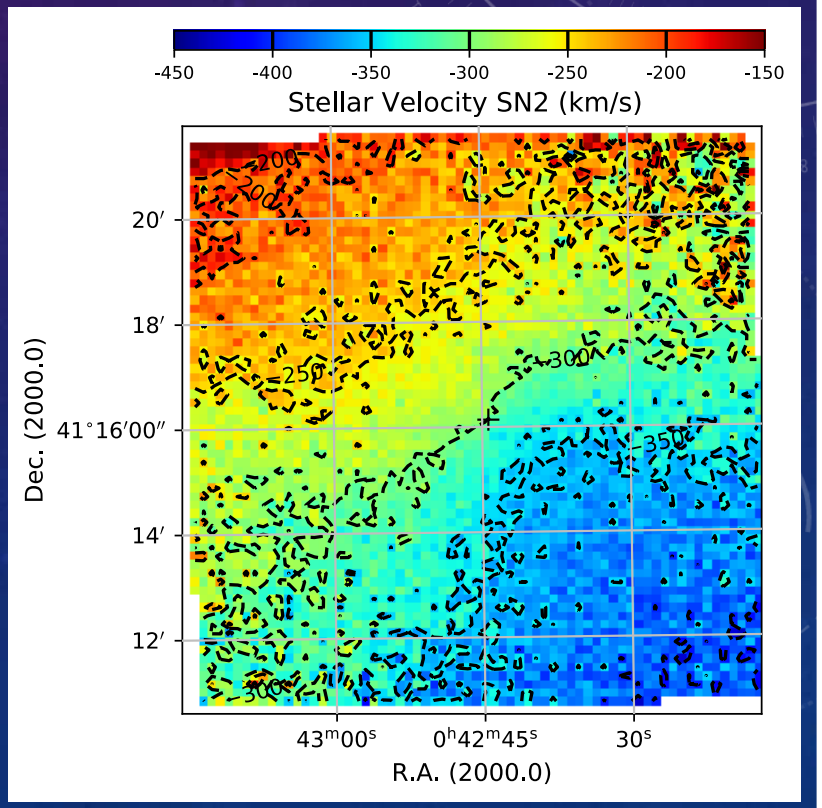
How to compare with the stellar and gas rotations?

- **Beside the kernel, the smoothing is sensitive to the number of points**
- Simulate fake PN with velocities drawn from the gas and stellar velocity fields ; with same number of points
- Iterate 100 times (bootstrap)
- Smooth with the same kernel both distributions
- Compare Position Velocity along the major axis (PA = 55deg) with PNe

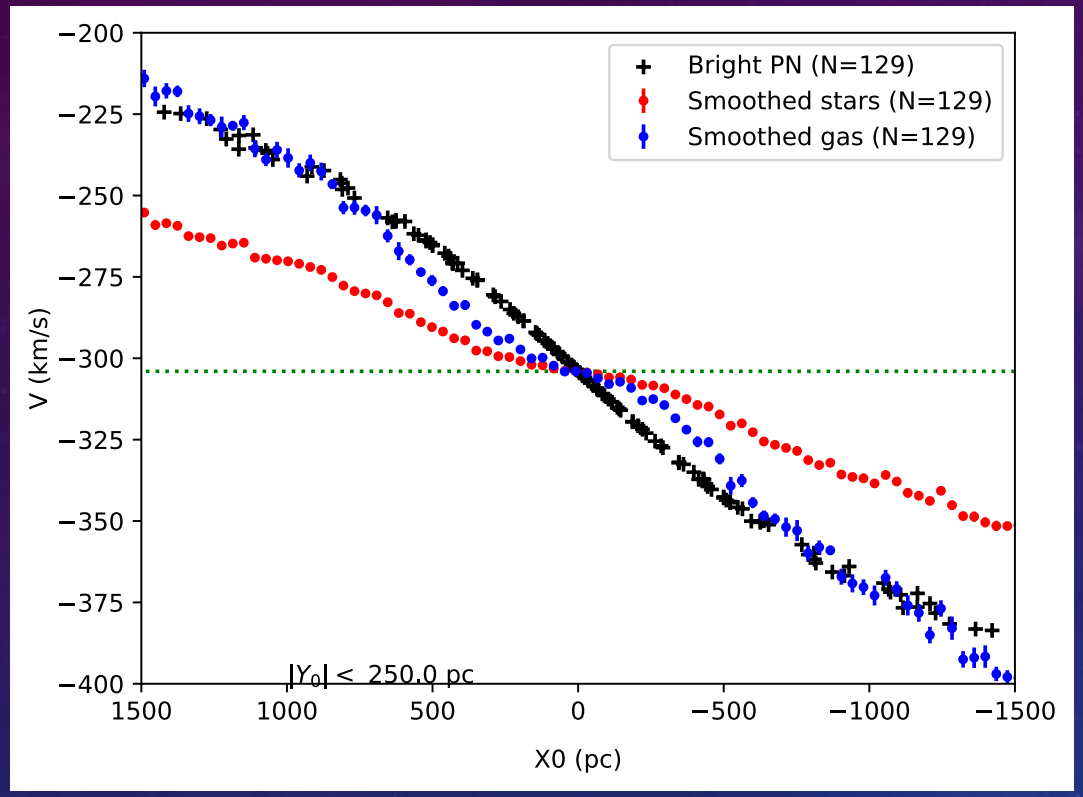
Preliminary SITELLE velocity fields



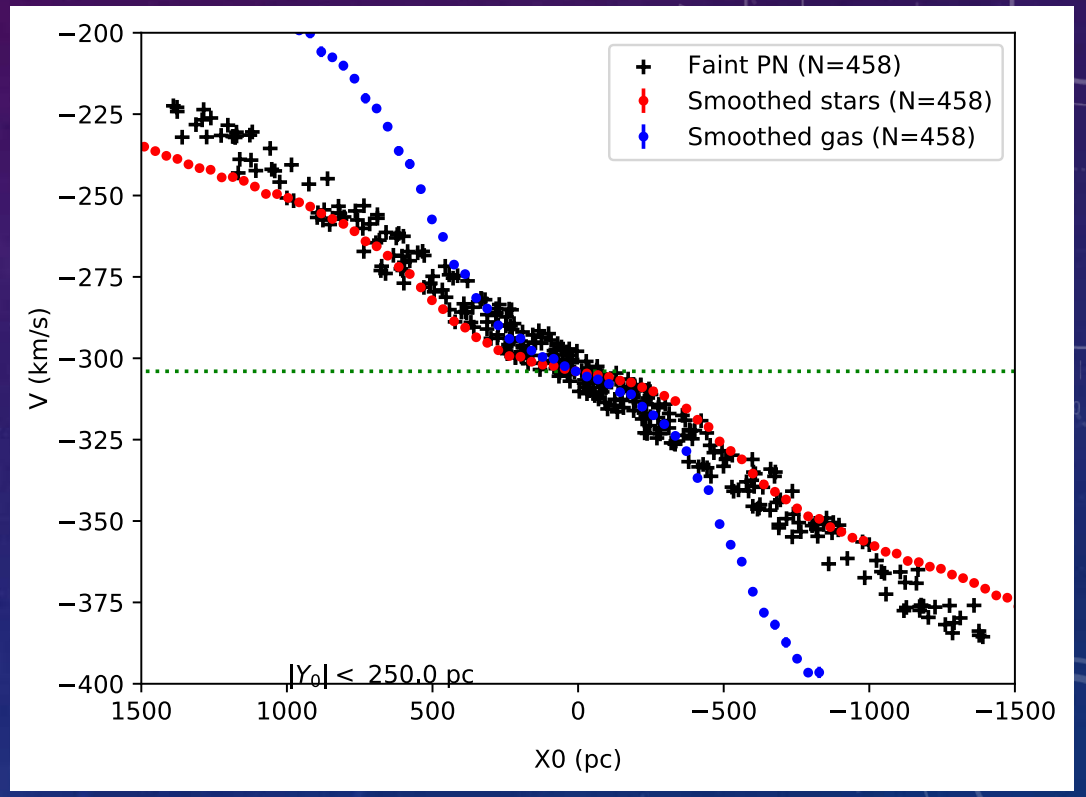
Gas velocity ([OIII])



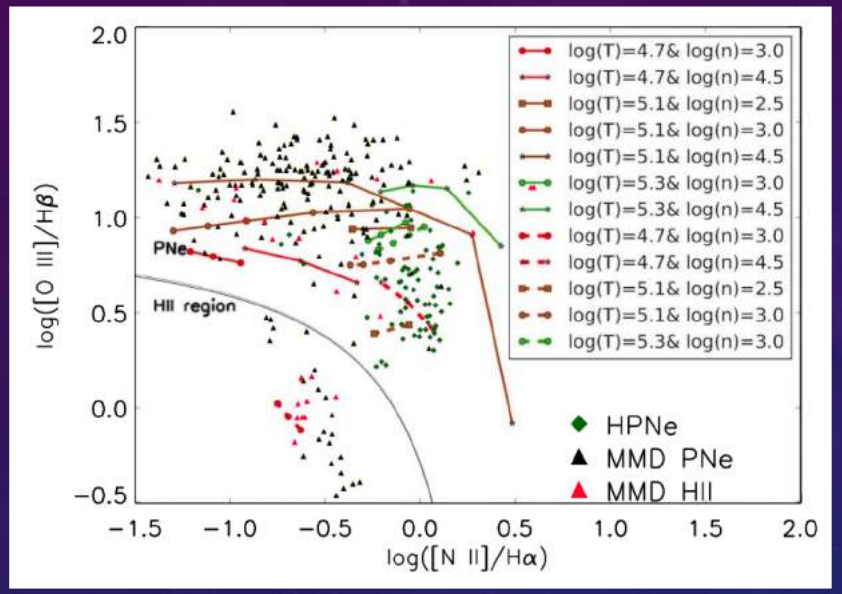
Stellar velocity (SN2)

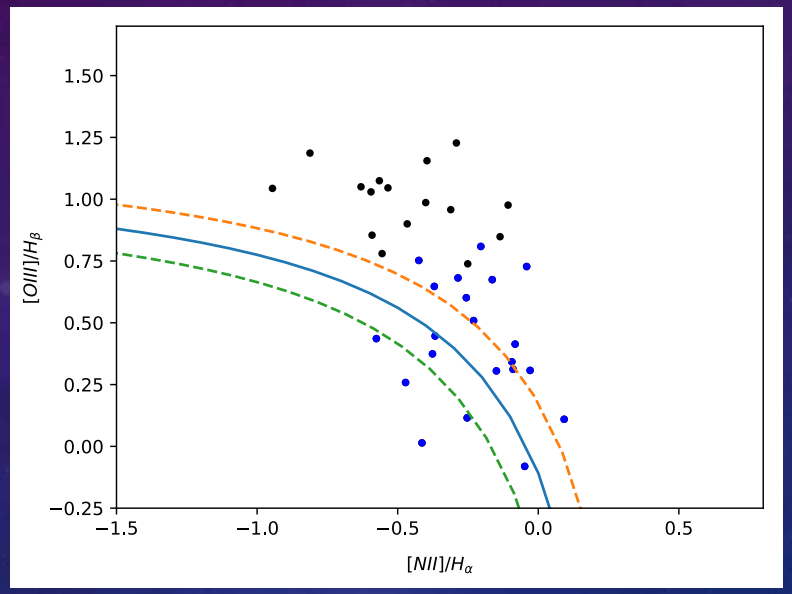


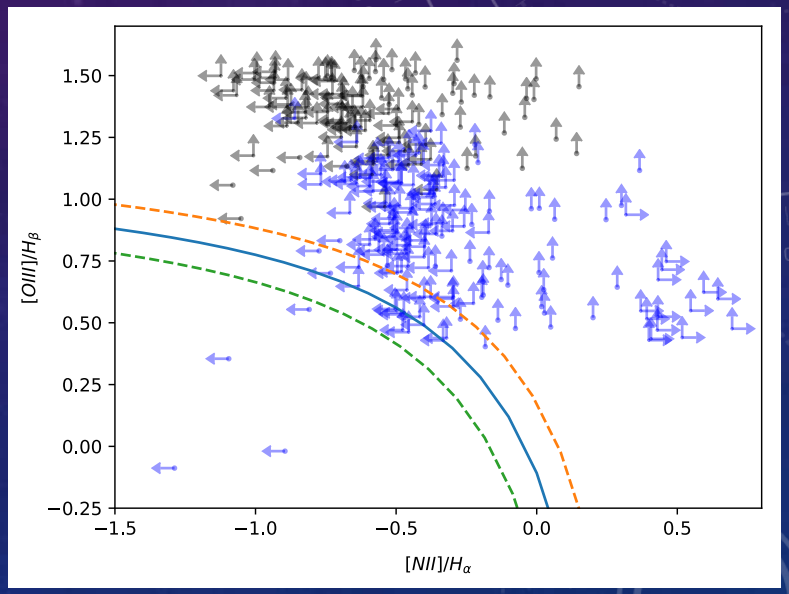
The bright component is compatible with the gas rotation

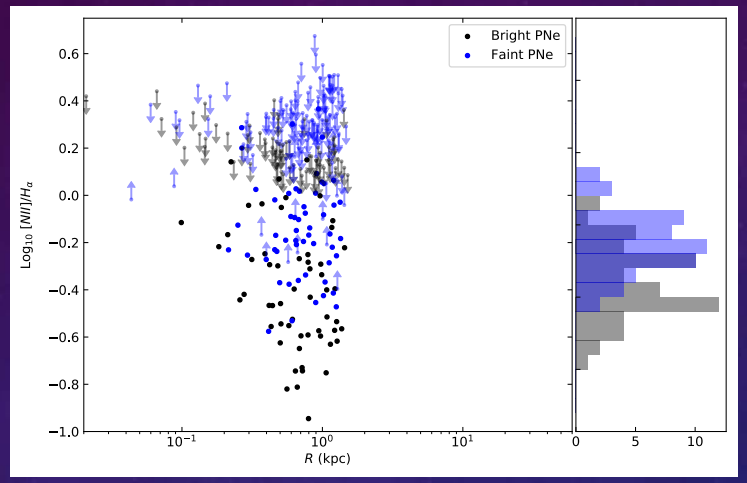


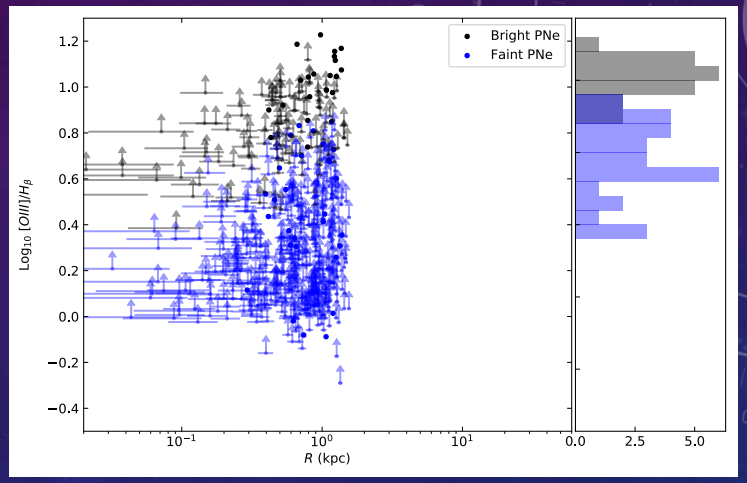
The faint component is compatible with the stellar rotation

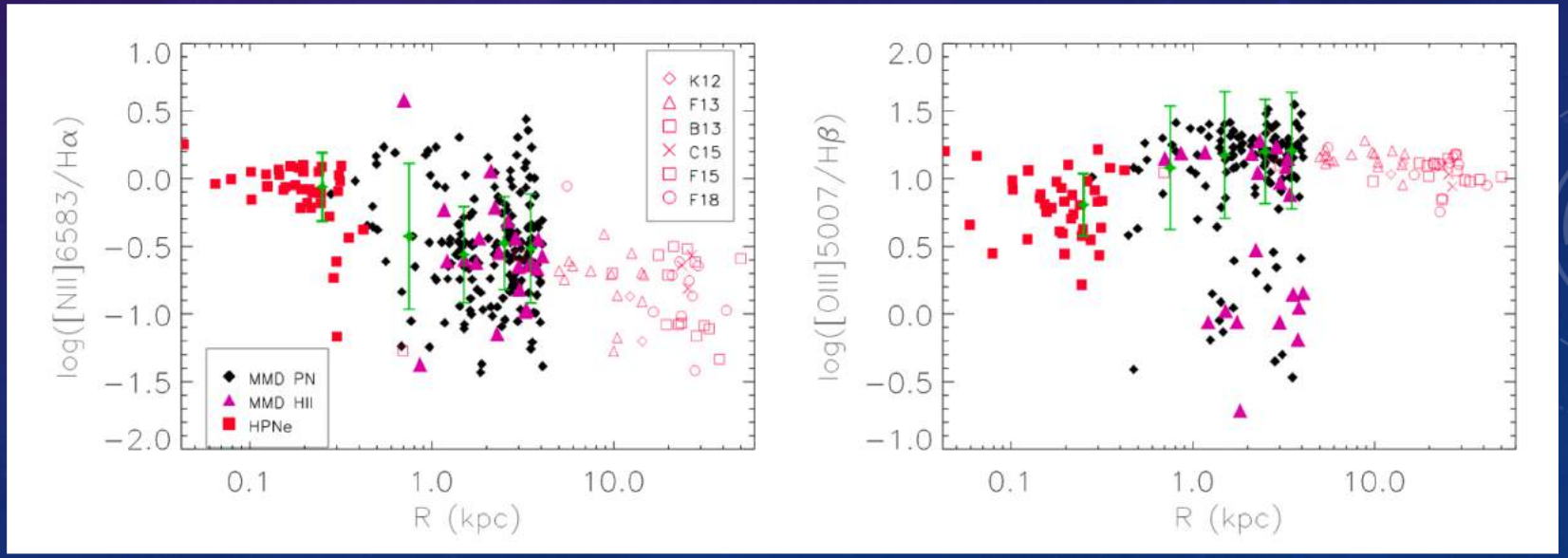

log(T)=4.7& log(n)=3.0
log(T)=4.7& log(n)=4.5
log(T)=5.1& log(n)=2.5
log(T)=5.1& log(n)=3.0
log(T)=5.1& log(n)=4.5
log(T)=5.3& log(n)=3.0
log(T)=5.3& log(n)=4.5
log(T)=4.7& log(n)=3.0
log(T)=4.7& log(n)=4.5
log(T)=5.1& log(n)=2.5
log(T)=5.1& log(n)=3.0
log(T)=5.3& log(n)=3.0
PNe
HII region
HPNe
MMD PNe
MMD HII
log([O III]/Hβ)
log([N II]/Hα)

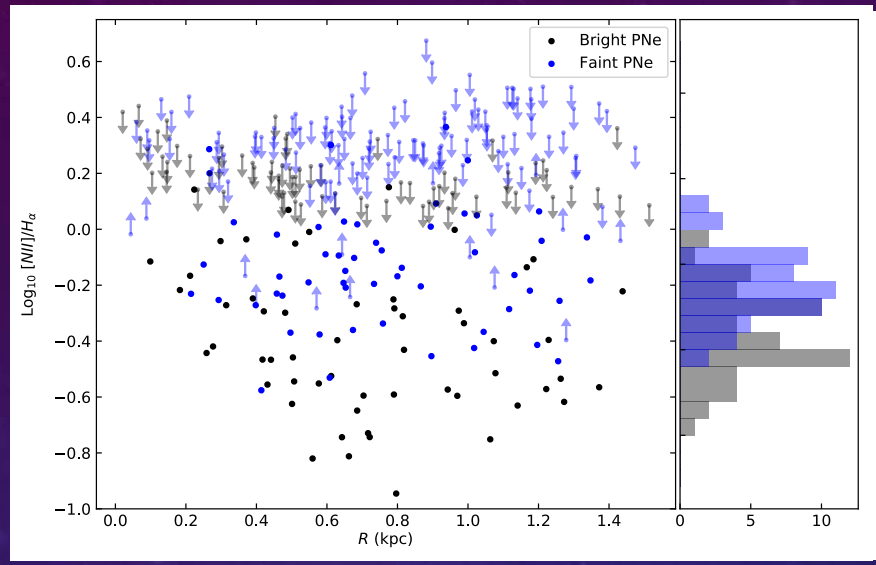

[OIII]/Hβ
[NII]/Hα

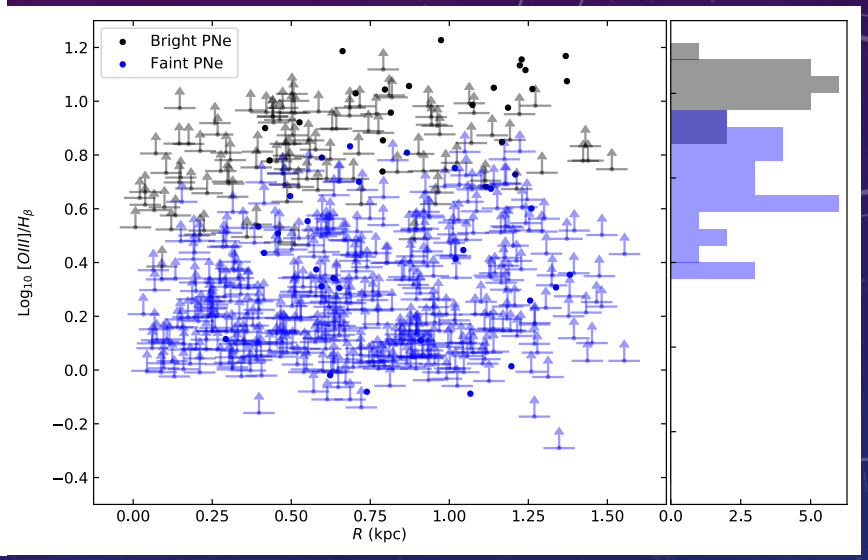

[OIII]/Hβ
[NII]/Hα


Bright PNe
Faint PNe
Log10 [NII]/Hα
R (kpc)


Bright PNe
Faint PNe
Log10 [OIII]/Hβ
R (kpc)


K12
F13
B13
C15
F15
F18
MMD PN
MMD HII
HPNe
log([NII]6583/Hα)
R (kpc)
log([OIII]5007/Hβ)
R (kpc)


Bright PNe
Faint PNe
Log10 [NII]/Hα
R (kpc)


Bright PNe
Faint PNe
Log10 [OIII]/Hβ
R (kpc)