

# Molecular and ionized gas kinematics in nearby active galaxies: a view from Near-IR observations



UFSC

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# Project and Team

Data from the second Brazilian LLP at Gemini and the larger collaboration AGNIFS <https://sites.google.com/view/agnifs>

Nearby  $z < 0.015$  Seyfert galaxies with  $L_x > 10^{41.5}$  erg/s (Swift 14-195 keV)

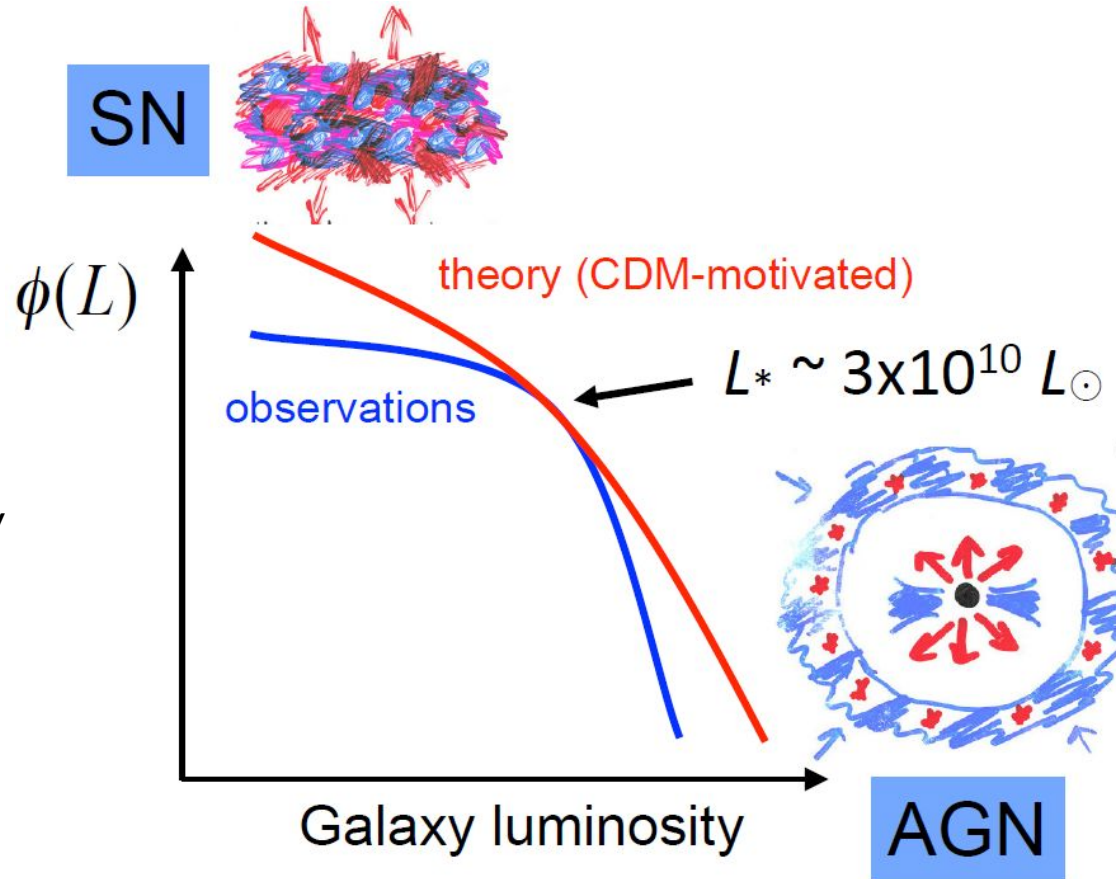
Works on the whole sample or including more than one galaxy: Riffel +17 (stellar kinematics), Riffel+18 (the sample definition and masses), Schonell+19 (gas distribution), Riffel+21 (gas excitation), **Bianchin+22 (gas kinematics)** in which this presentation is based and originally published at MNRAS vol. 510 Issue 1 pp. 639, Riffel+submitted (stellar populations).

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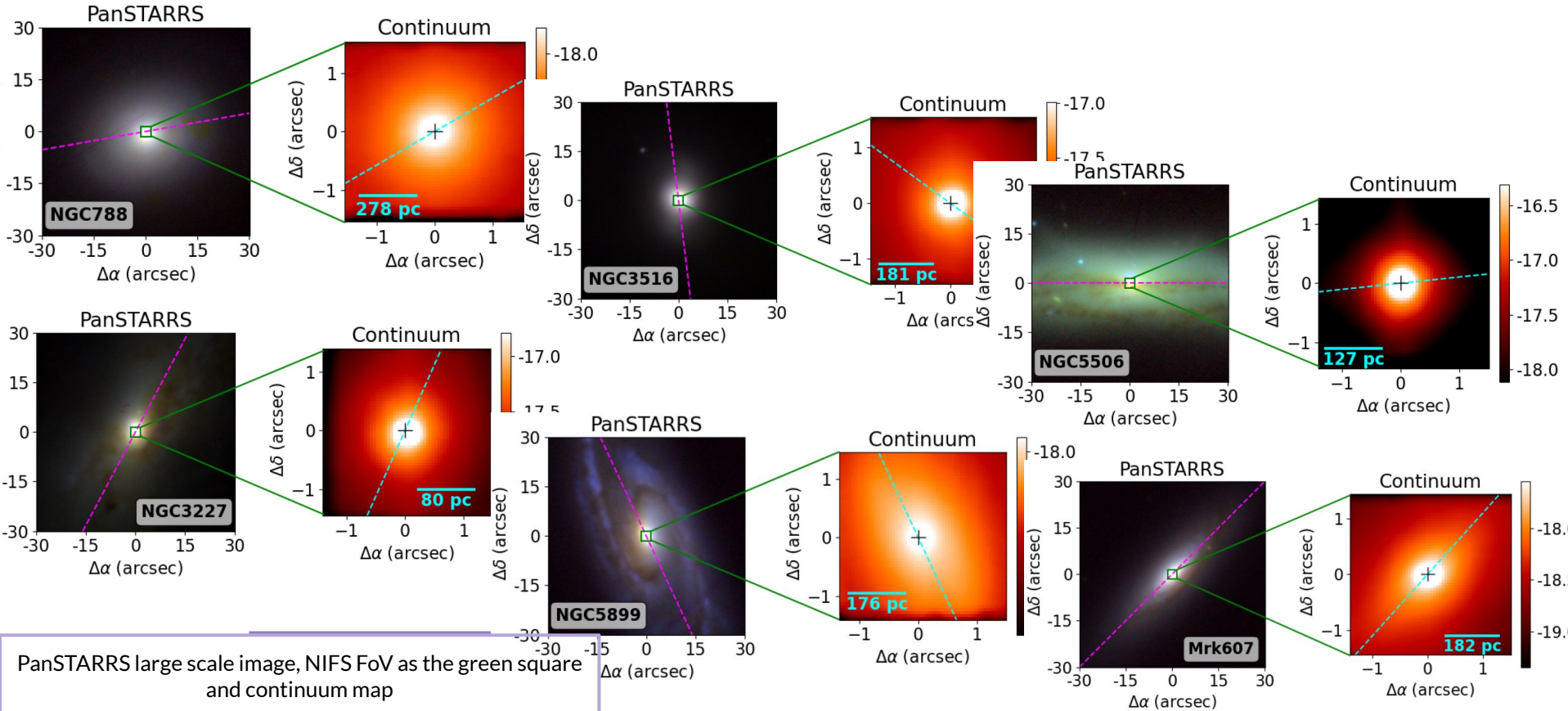
# Motivation

Luminosity function: number of galaxies at a given luminosity

- AGN feedback has a bigger impact on more luminous galaxies
- The AGN feedback is necessary to reproduce the properties of galaxies as observed today (e.g. Benson +03, Nelson+19)



# The sample



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# Data and Sample

- NIFS - Near-infrared Integral Field Spectrograph on Gemini North
- Angular and spectral resolutions of  $\sim 0.15$  arcsec and  $\sim 25$ km/s.
- Six Seyfert galaxies
  - $0.0039 < z < 0.0136$
  - J and K bands
  - 50% more luminous in the AGNIFS sample (Riffel +18)



Credit: Gemini Observatory/AURA image by Joy Pollard

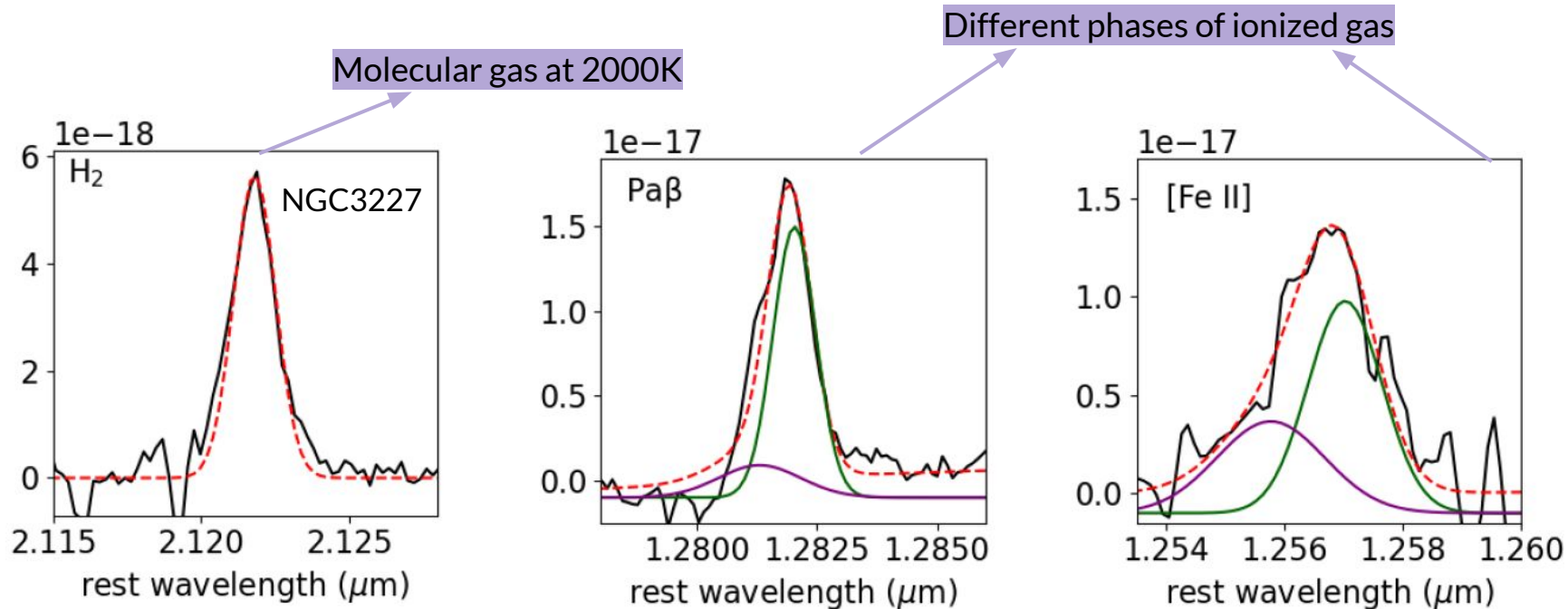
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# Method

Multiple Gaussians to the emission lines with IFSCUBE (Ruschel-Dutra & Dall'Agnol de Oliveira 20)



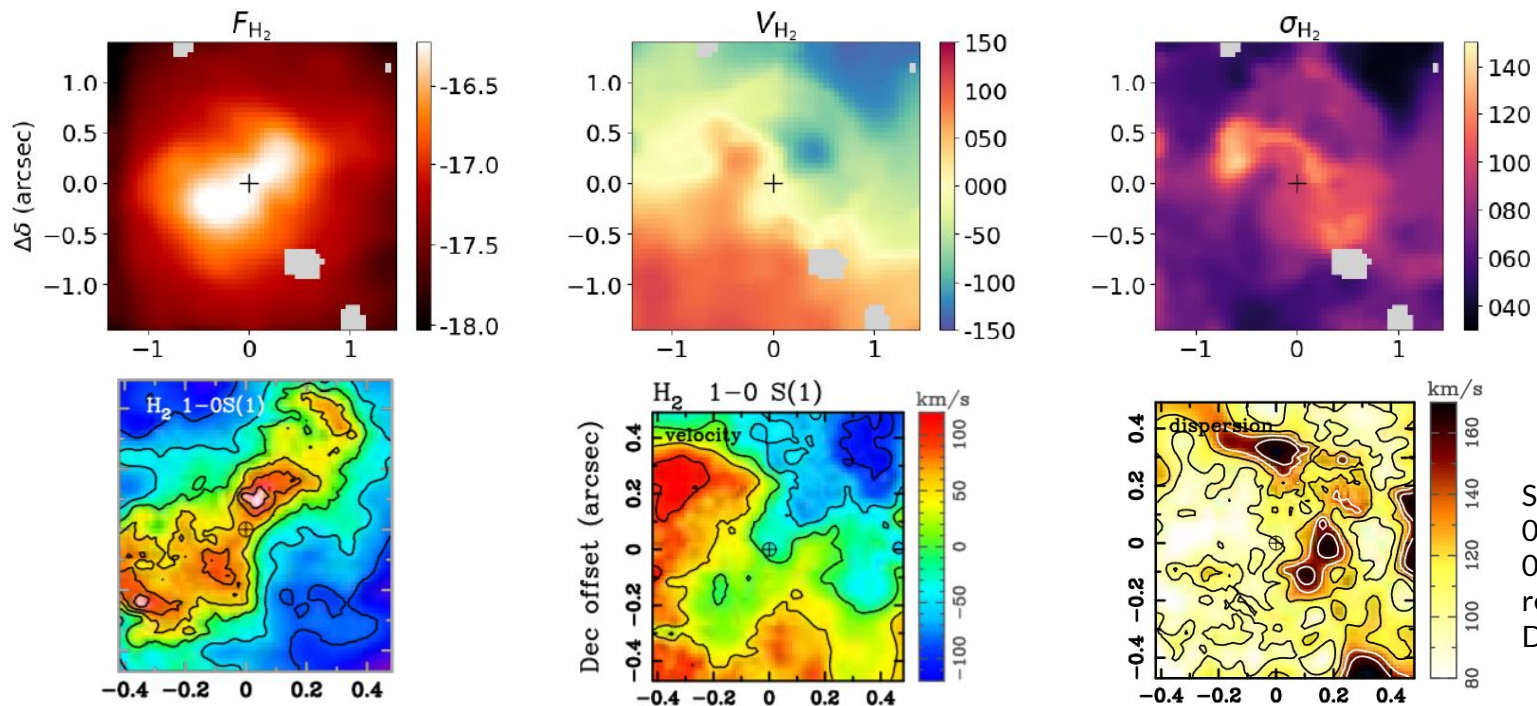
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BLR components from Sy1 are fitted but not analysed

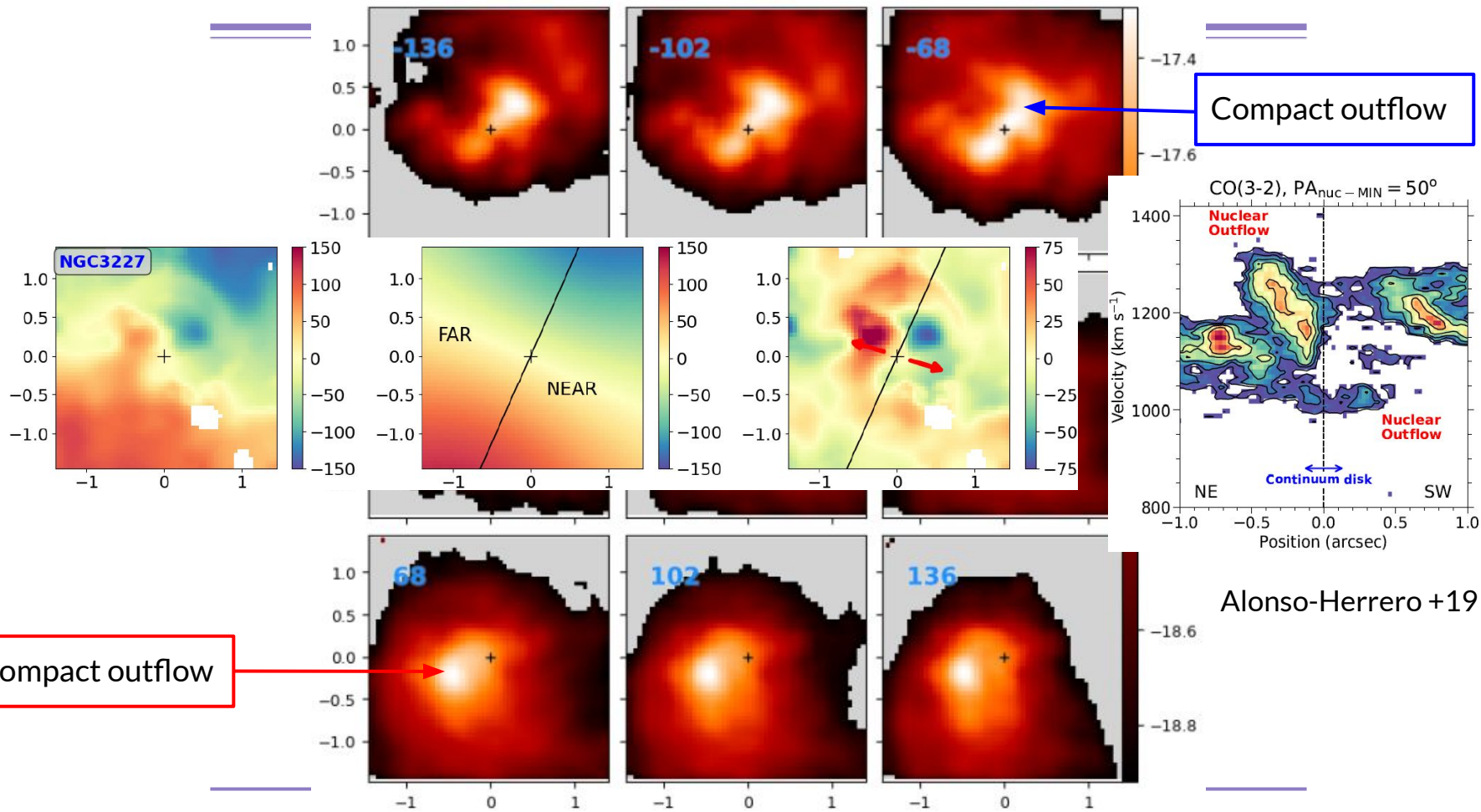


# An example: NGC3227

Complex  $H_2$  kinematics compatible with previous SINFONI observations

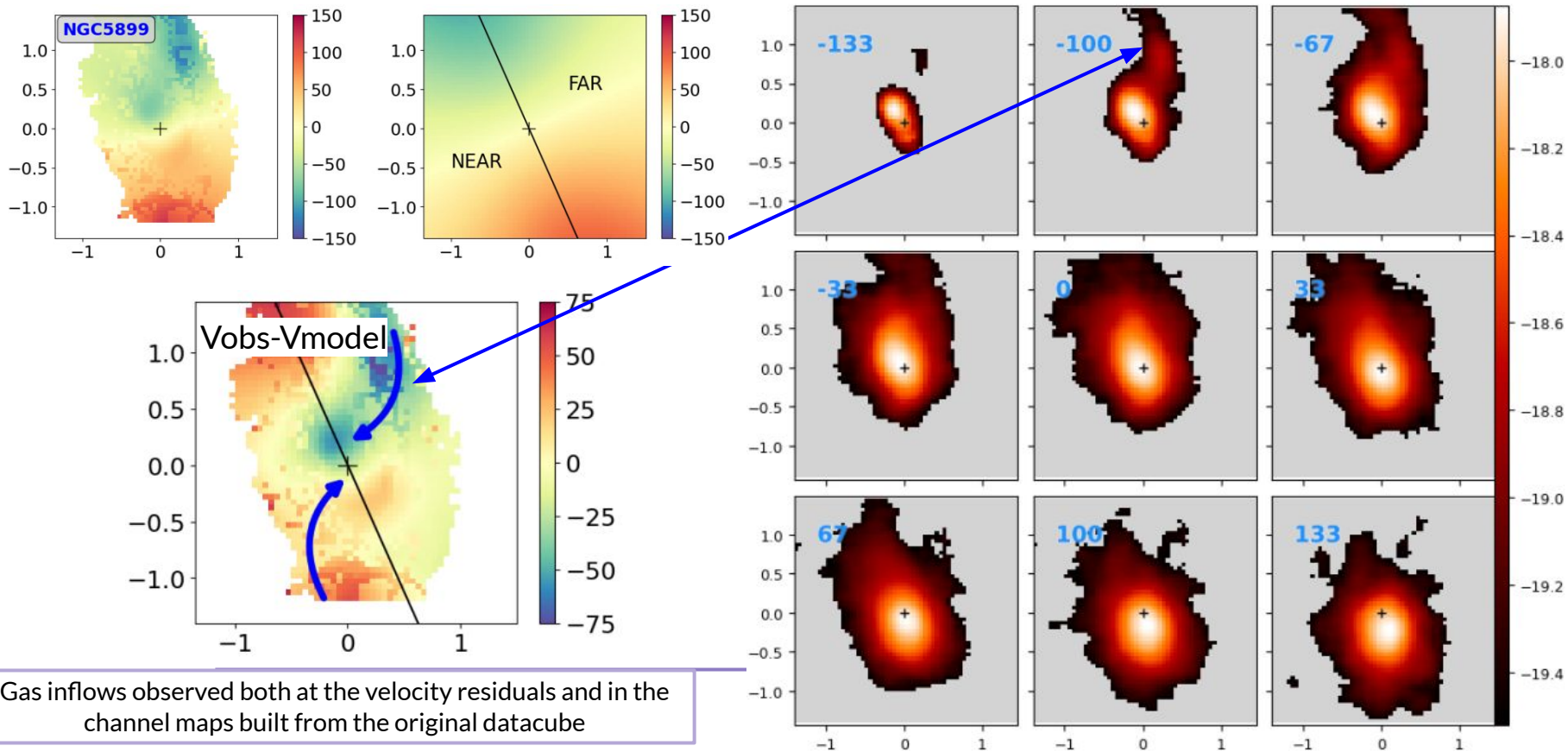


SINFONI  
0.80"x0.80" with  
0.085" (7 pc)  
resolution  
Davies +06



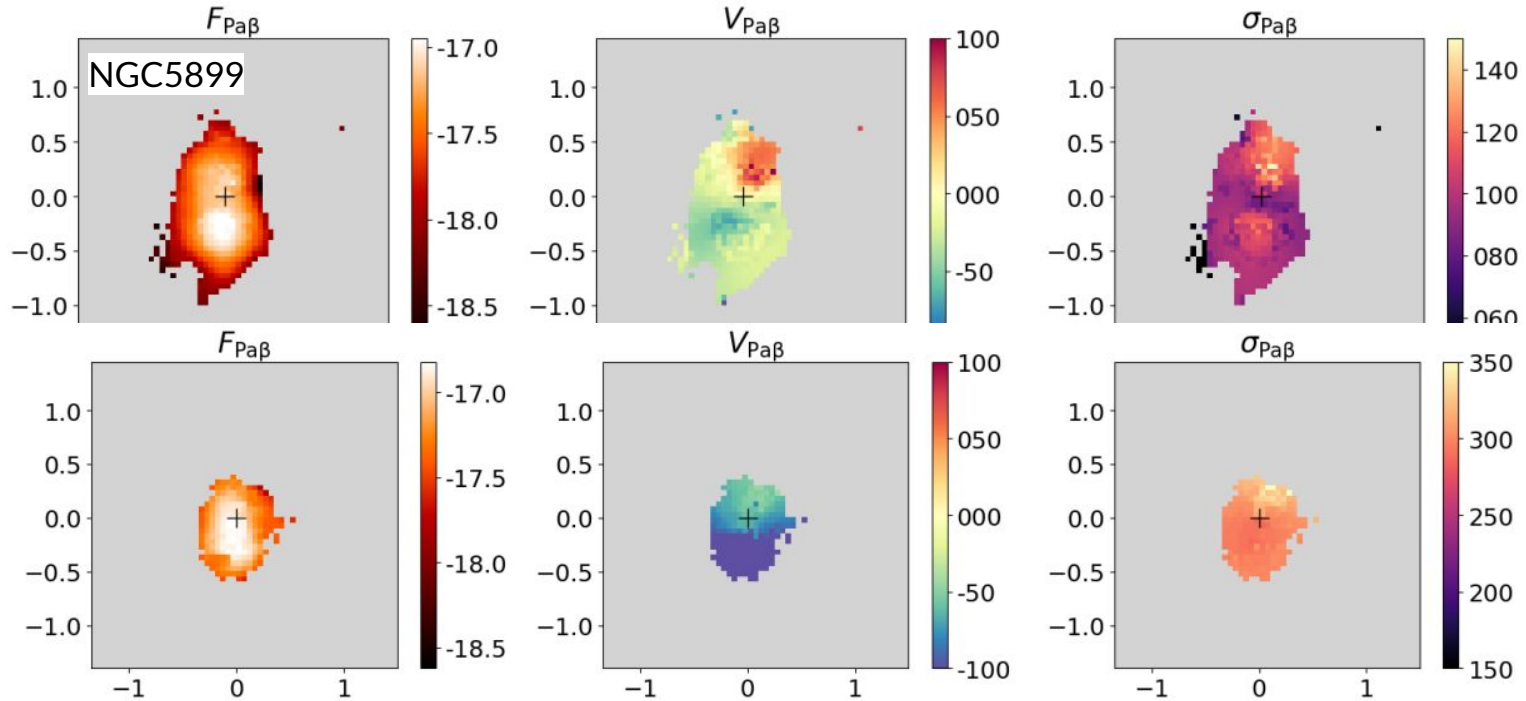


# Signatures of gas inflows



Gas inflows observed both at the velocity residuals and in the channel maps built from the original datacube

# Fraction of ionized outflows



Within the inner 100pc of NGC5899 all the ionised gas is outflowing  
Fractions for the others with a broad component: NGC5506 84%; NGC3227 46% and Mrk607 42%

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# Summary and Conclusions

- Ionized outflows (broad component) in three galaxies
- Molecular outflows in four galaxies: two identified from the non-rotational components and two from the residual velocity
- Gas inflows in three galaxies
- Mass inflow rates lower than the accretion rate: not enough to feed directly the AGN
- Mass outflow rates (ionized) higher than the accretion rate: the ionized gas is disturbed in the central kpc.
- The kinetic power of power of molecular outflows is 4 orders of magnitude smaller than the ionized outflows powers.

## POINTS TO REMEMBER:

Only the mechanical contribution of the outflows are estimated, i.e. radiation effects are not considered.

We are not observing the more massive cold gas reservoir.

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# The future

- NIFS will be decommissioned from Gemini North but a new IFU will be installed in GNIRS
  - NIRSpec at JWST will provide similar angular resolution as NIFS with ALTAIR
  - MIRI MRS (IFU) will provide information about the distribution and kinematics of the warm  $H_2$  in the center of galaxies
  - GMTIFS - GMT integral field spectrograph - based on NIFS
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**Thank you!**

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