SINFONI stellar and gas kinematics comparison in local LIRGs: implications at high-z

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ABSTRACT

In this work, we present a spatially resolved IFS multi-phase kinematic study for a local sample of 10 LIRGs, based on H- and K-band SINFONI observations. We have obtained the stellar velocity and velocity dispersion maps of the inner ~2 kpc by fitting the stellar continuum. The stellar kinematics have been compared with those obtained from different gas phases (i.e. ionized and warm molecular) extracted from the same data-set. We found that whereas the gas appears to be in a dynamically cool state, confined in thin disks, the stellar component seems to be dynamically warmer. Despite their kinematic differences, we obtained compatible dynamical masses when using the gas and stellar kinematics as tracer of the gravitational potential. This result defends the use of the emission lines to probe the galaxy dynamics, which is specially important at high-z, where large integration times are needed to obtain the stellar continuum.

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CONTEXT

- Although stars are preferred to probe the gravitational potential, nebular lines are commonly used as tracers, specially at high-z, since they can be more easily observed than the stellar continuum in star-forming galaxies.

- However, the gas phases can be easily disturbed by merging processes, AGNs activity, outflows, etc.

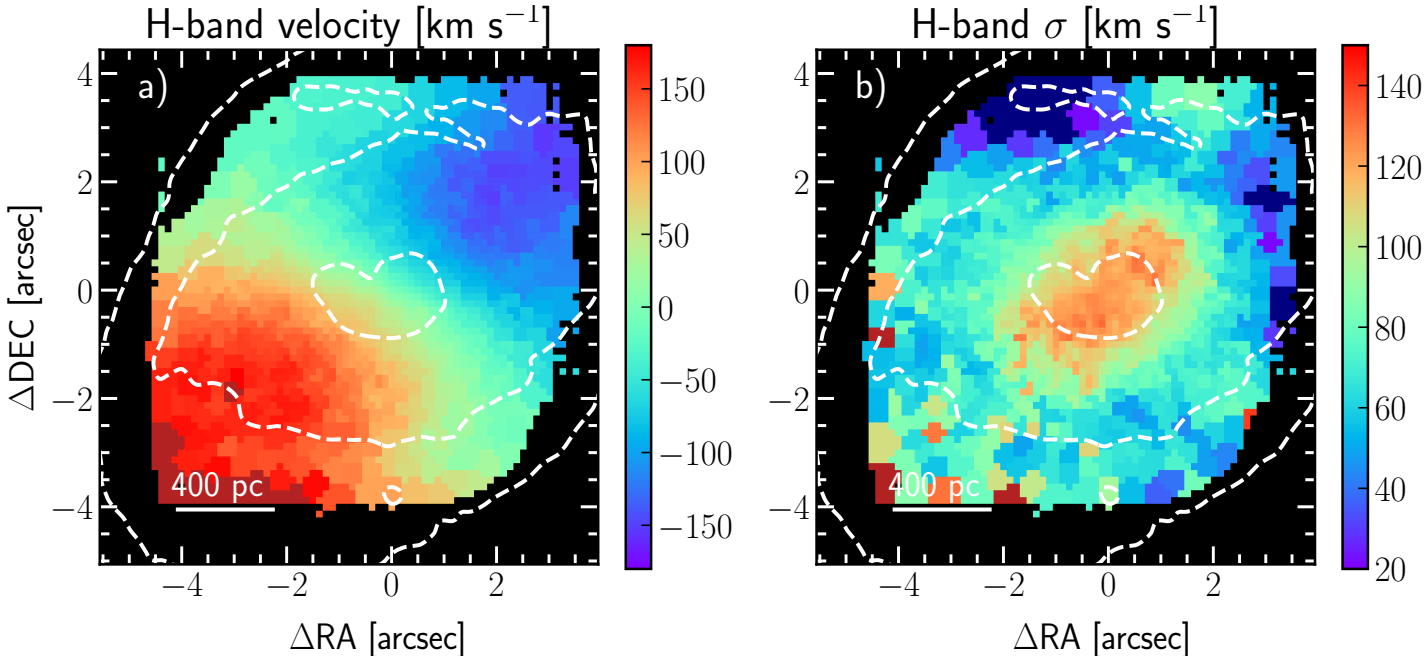
- Local U/LIRGs are seen as the nearby counterpart of the SFG population at high-z in terms of their mass and star-formation activity.

- Therefore, these local galaxies are ideal systems to perform spatially resolved kinematic studies on their gas and stellar components, and to understand their high-z counterparts.

- LIRGs stellar and gas kinematic comparison would help to discern if the gas is a reliable tracer of the gravitational potential at high-z galaxies.

SAMPLE and DATASET:

- 10 LIRGs at z<0.02
- Seeing-limited SINFONI H- and K-band observations
- R ~ 3800
- FoV ~ 9”x9”
- PSF (FWHM) ~ 0.6” (<0.4 kpc)



Example of the stellar kinematics maps (Crespo Gómez et al., in prep)

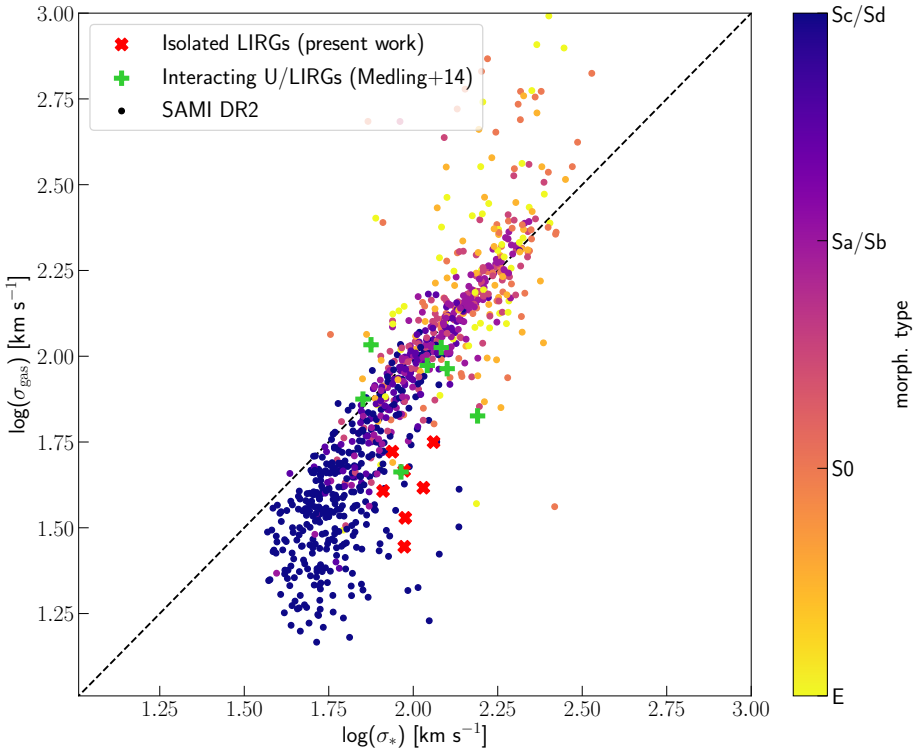
METHODOLOGY

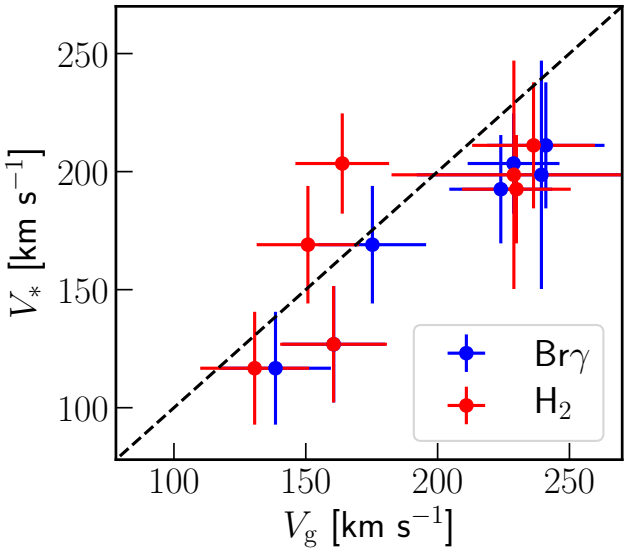
- Obtain the stellar kinematics using pPXF (V and σ maps)
- Extract the gas kinematics results from Piqueras López et al. 2012, based on the same dataset.
- Compare the velocity amplitude and integrated σ from the stellar and gas kinematics
- Compute dynamical masses using the stellar and gas kinematics

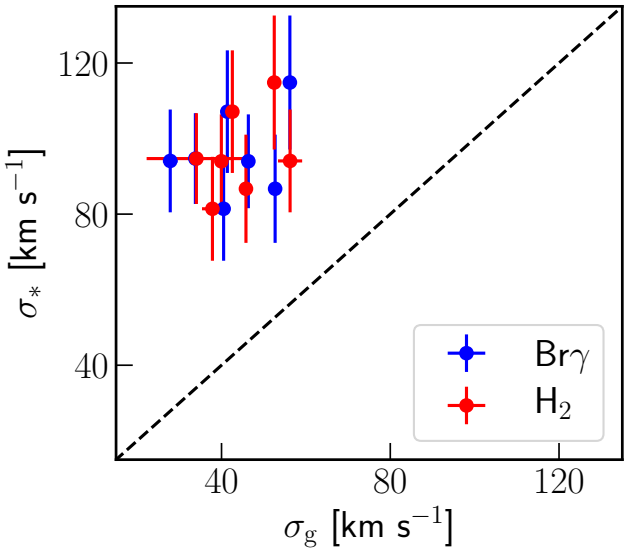
RESULTS

- Both the gas and stellar kinematics show rotation-supported dynamics (V/σ>1) within the inner ~2 kpc.

- Gas is rotating faster (V_*~$0.8V_{gas}$) and less disturbed (σ_*~1.5-2 σ_{gas}) than the stellar component.







- Similar results have been observed in the LTGs from SAMI DR2.

- Our LIRGs show larger differences between the stellar and gas σ.

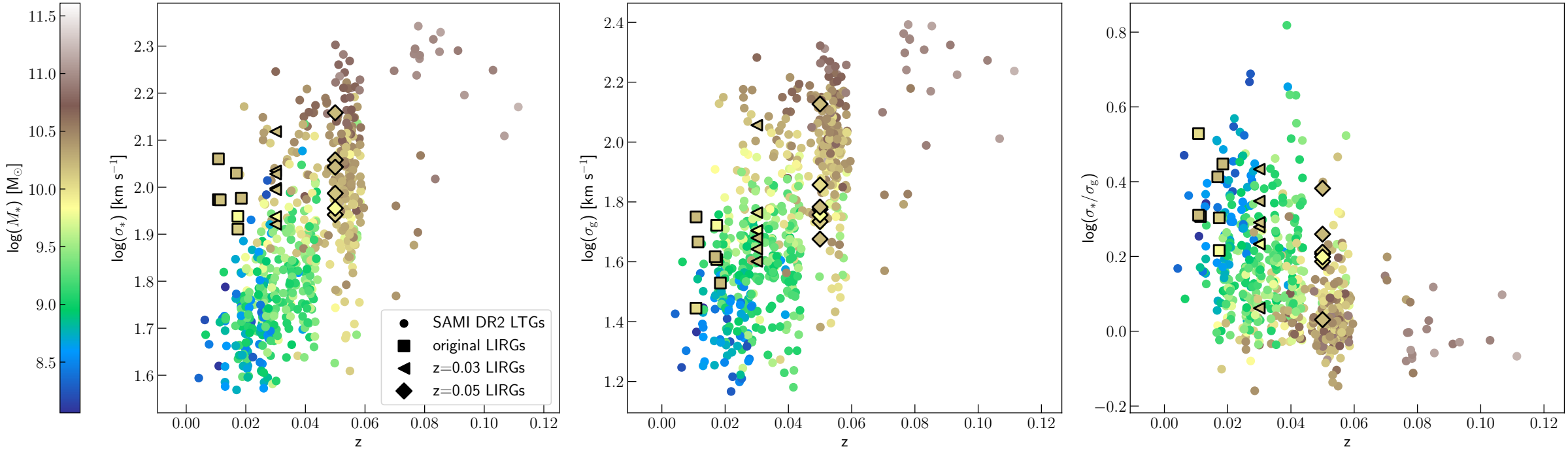
- Interacting U/LIRGs (Medling et al. 2014) do not present differences between the stellar and gas kinematics.

- These differences can be explained if the gas is located in thin rotating disks, while stars populate warmer orbits (i.e. thicker discs).

- The dynamical masses computed using the gas and stars as tracers, considering both the rotation and dispersion components of the circular velocity (e.g. Bellocchi et al. 2013), are compatible, despite the differences found between their kinematics.

- Simulating our SINFONI data at z=0.05 revealed that our galaxies would present σ values compatible with the SAMI LTGs with similar stellar masses.

- These simulations show how the beam-smearing increases the velocity dispersion, being able to blur the differences found in our spatially-resolved study.



IMPACT AND PROSPECTS FOR THE FUTURE

- This spatially-resolved kinematic study revealed that there are significant differences between the gas and stellar phases at the nuclear regions for a sample of local LIRGs. These differences are compatible with the gas rotating in a thin disk, whereas the stars populate warmer orbits.

- These results have been observed in local isolated LTGs but not in interacting U/LIRGs, probably due to the highly disturbed gas phases produced by the gravitational interaction.

- Despite their kinematic differences, the stellar and gas phases of our rotation-supported LIRGs yield compatible dynamical masses, supporting the use of the gas phases as tracer of the gravitational potential at high-z.

- Understanding the impact of the beam-smearing in the stellar and gas velocity dispersion is key when analyzing high-z galaxies, as this effect can remove the differences between the stellar and gas kinematics found in local LIRGs.