

Kinematics of galaxies at intermediate redshift

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Galaxy evolution through cosmic time ?



Why studying kinematics ?



Explain the co-evolution of morphological and dynamical properties of galaxies

- ▷ main processes responsible for disc formation and settling ?
- ▷ impact of merging, inflows and outflows on these processes ?
- ▷ kinematics → rotation curve → dark matter and angular momentum (re)distribution ?

How ?

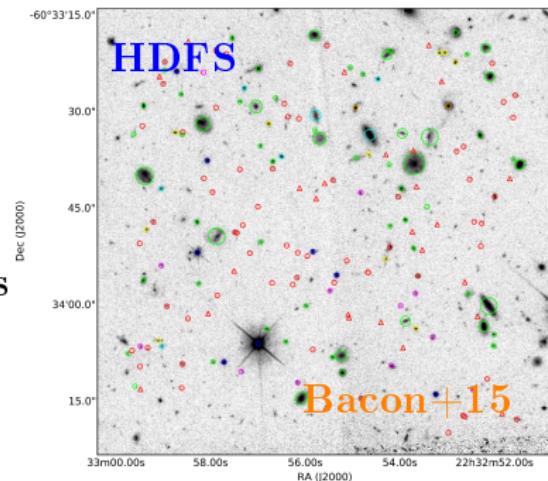
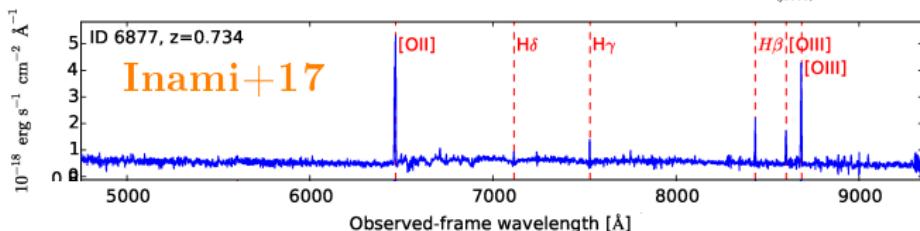
Kinematics data

With IFS (MUSE):

▷ **3D data cubes**

- (a) Measure galaxy redshifts
- (b) Select spatially-resolved galaxies at intermediate redshift
($0.4 \lesssim z \lesssim 1.4$)
- (c) Ionised gas kinematics with **bright** (rest-frame) optical **emission lines**
(H β , [OII], [OIII], etc.)

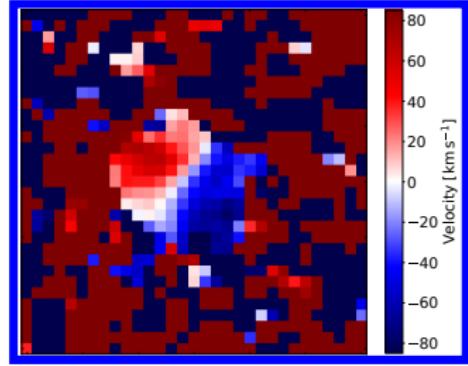
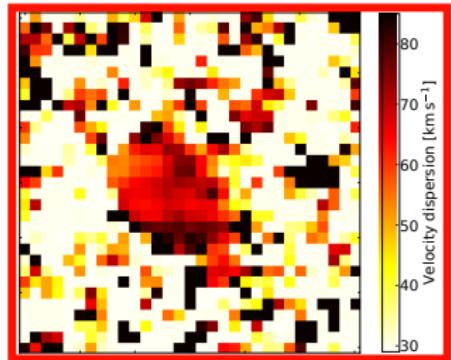
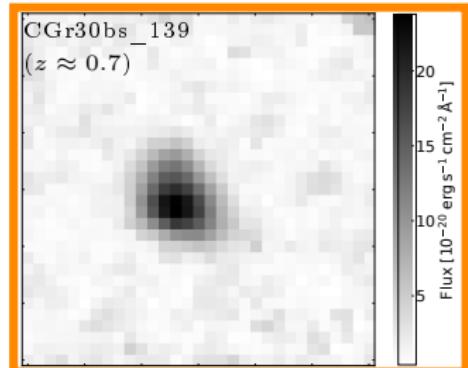
+ Stellar kinematics now achievable for the brightest ($m < 23$) galaxies
(Guérout+17)



How ?

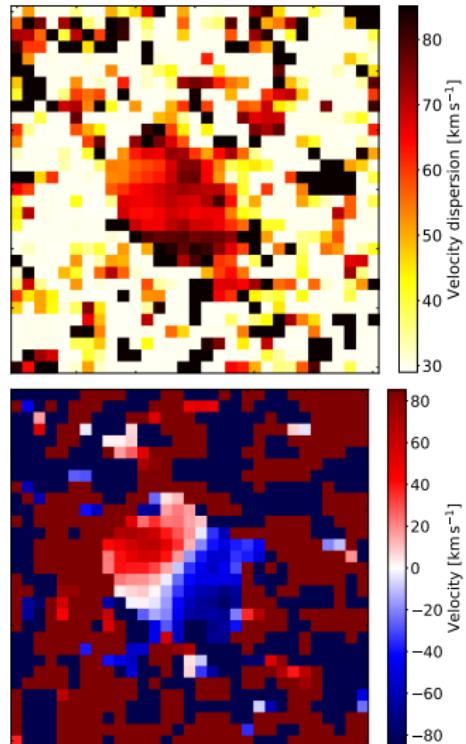
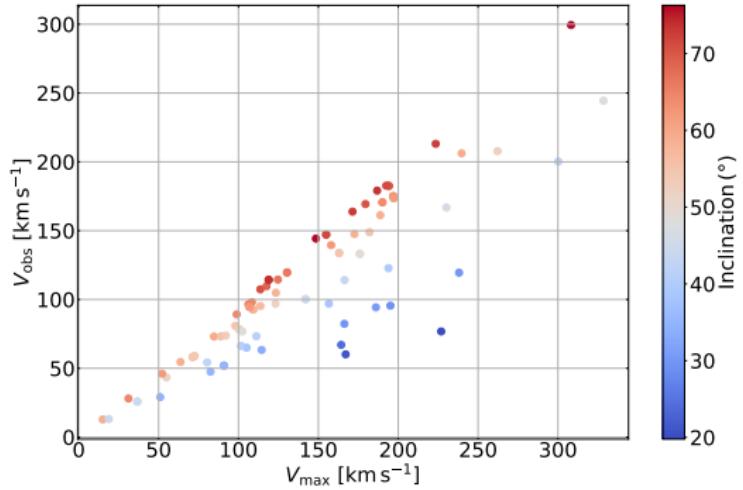
Kinematics data

- ▷ Extract **2D maps** (flux, velocity field and velocity dispersion)
- Gaussian fit and rest-frame Doppler shift give LOS velocity (centroid) and velocity dispersion (FWHM)



How ? Modelling

- ▷ σ_v overestimated → PSF and LSF must be taken into account (beam smearing)
- ▷ Need for ancillary data (high-res images, galaxies inclination and size, etc.)
 - inclination required for modelling
 $(V_{\text{obs}} \propto \sin i)$



2D fitting:

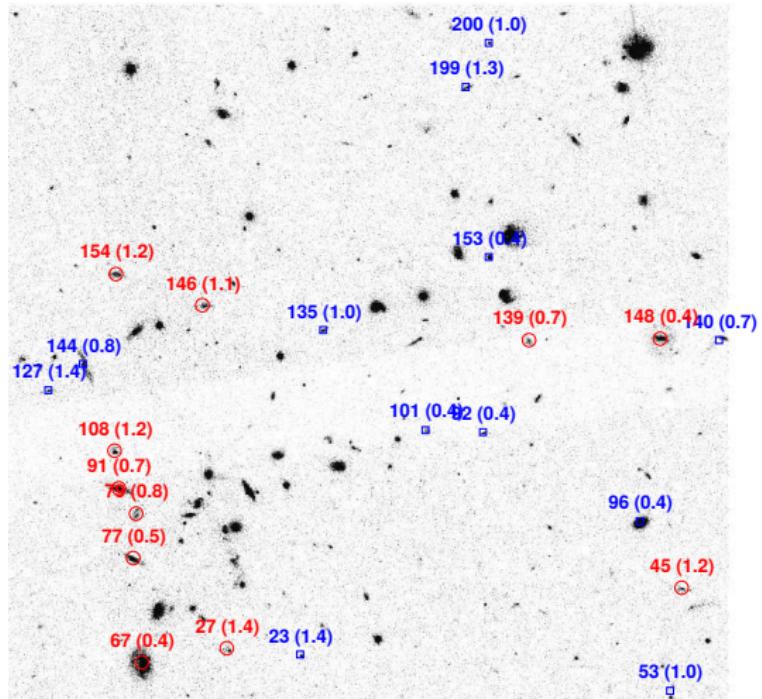
- ▷ Works with 2D velocity field and dispersion assuming either
 - (a) a **mass distribution** (can describe declining curves at large radius)
 - (b) a **fixed function** (arctan, **ramp model**, etc.) which describes the observed flattening of curves

3D fitting:

- ▷ Improvement for faint and compact galaxies
 - GALPAK^{3D} (Bouché+15)
 - ^{3D}BAROLO (Di Teodoro & Fraternali+15)

Application to my internship

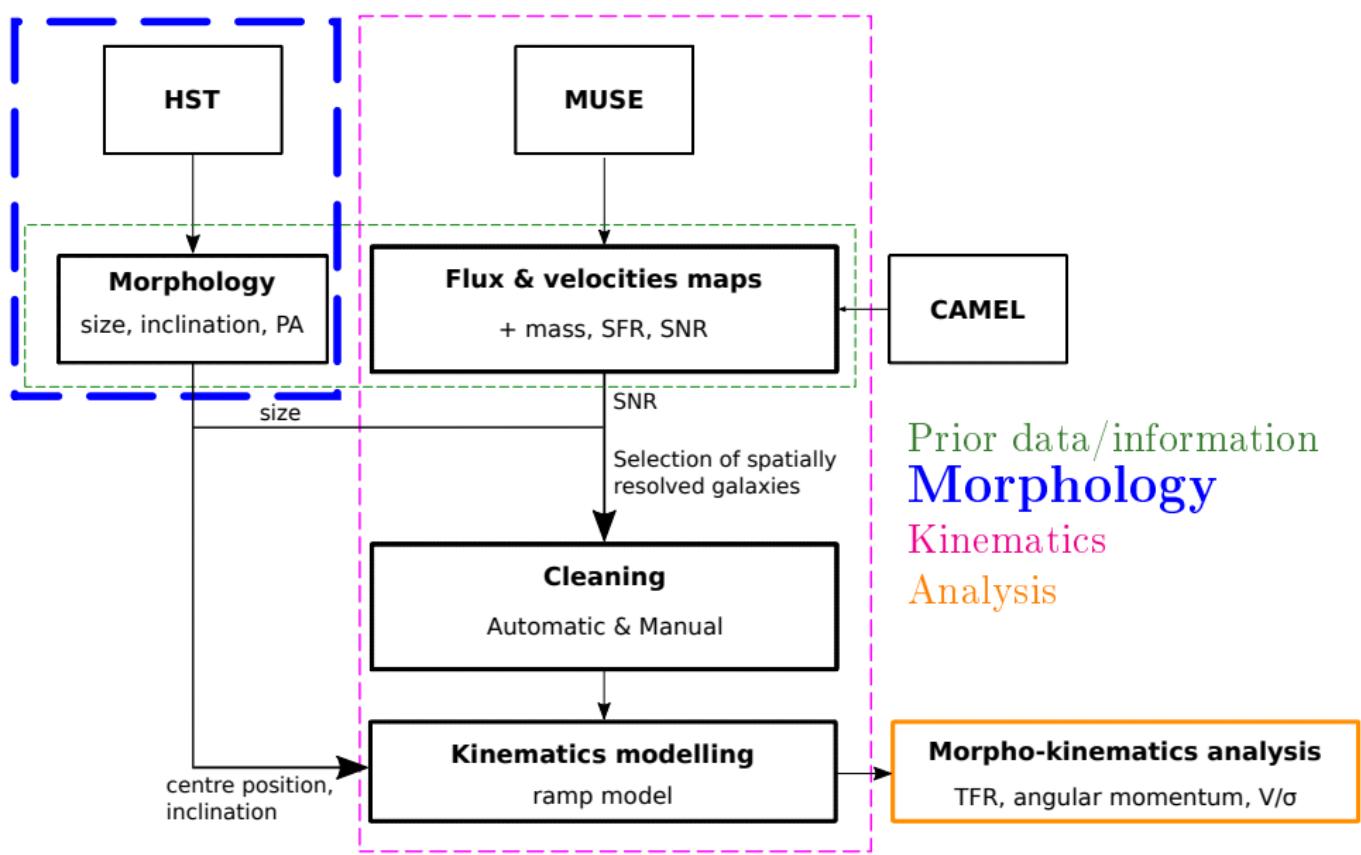
Initial sample



HST image of COSMOS group CGr30

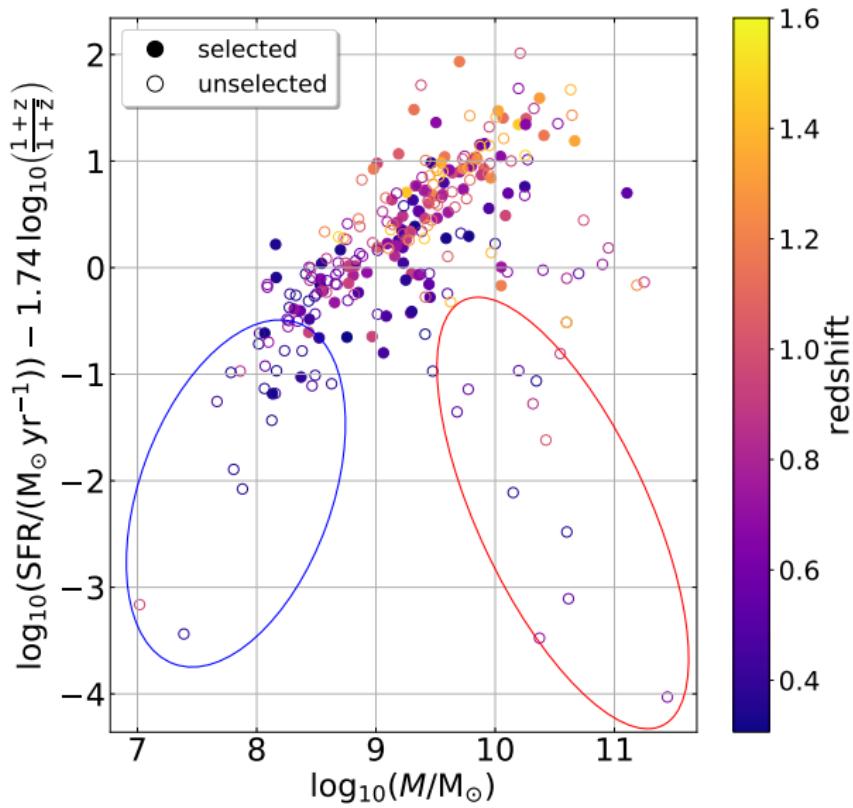
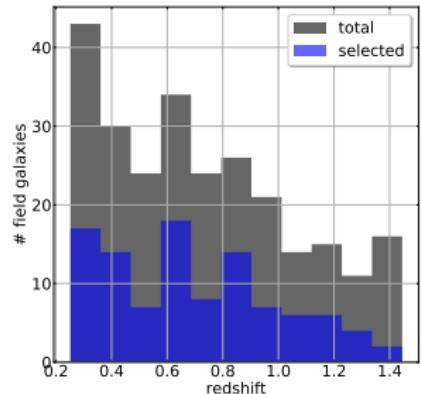
- ▷ 16 MUSE fields in COSMOS area
- ▷ exposures from 1 to 10 hr
- ▷ seeing-limited ($\text{FWHM} \lesssim 0.7''$) or AO ($\text{FWHM} \lesssim 0.5''$)
- ▷ ~ 500 field galaxies with [OII] detection
 - HST-ACS counterparts
 - $0.4 \leq z \leq 1.4$

Methodology

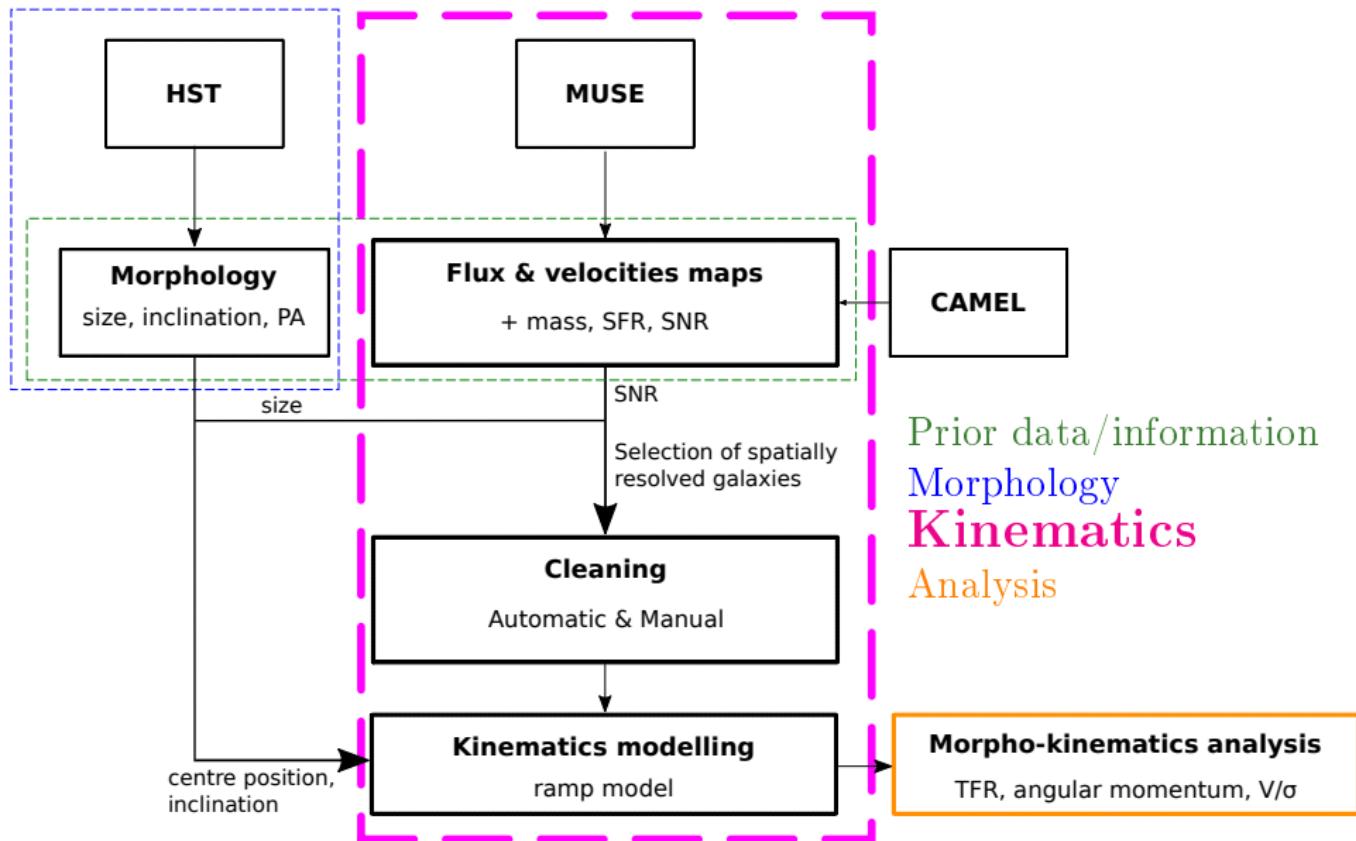


Selection of a sample of spatially resolved galaxies

- ▷ Most of our sample galaxies are on the main sequence
- ▷ **massive quiescent** (low [OII]) and **very low mass galaxies** (small size) are lost

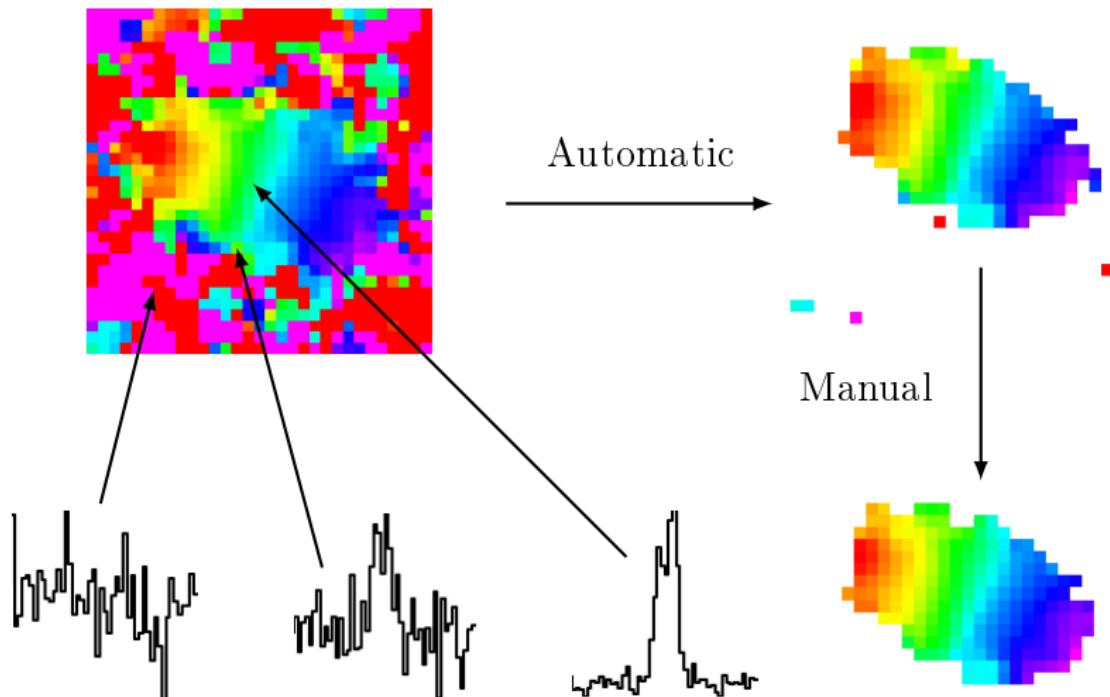


Methodology



Kinematical modelling

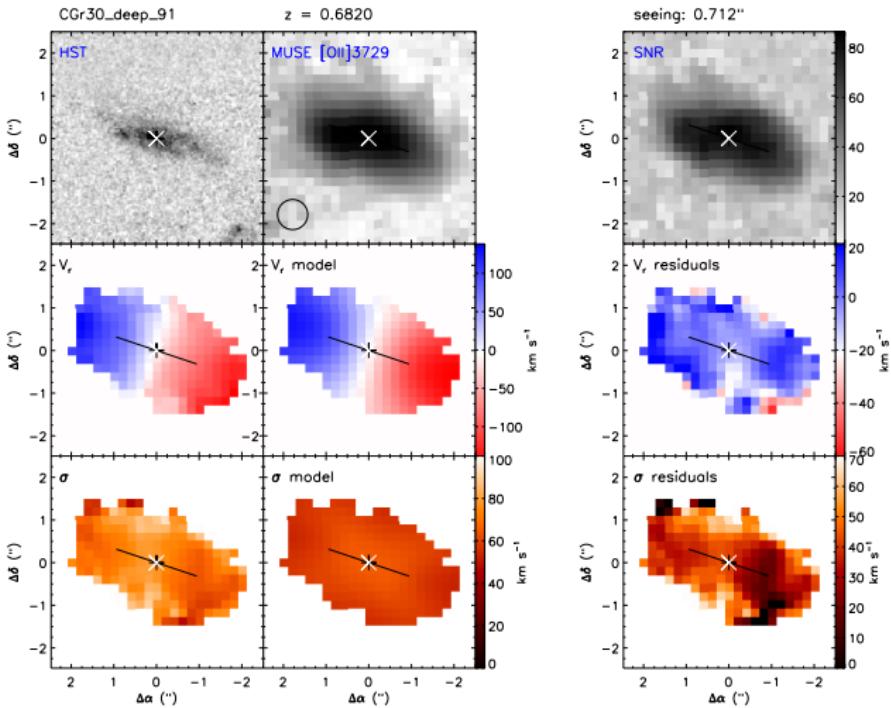
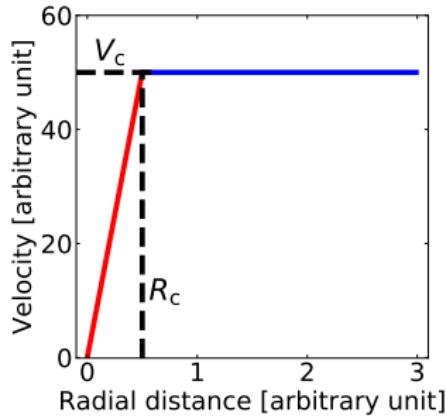
Cleaning galaxies



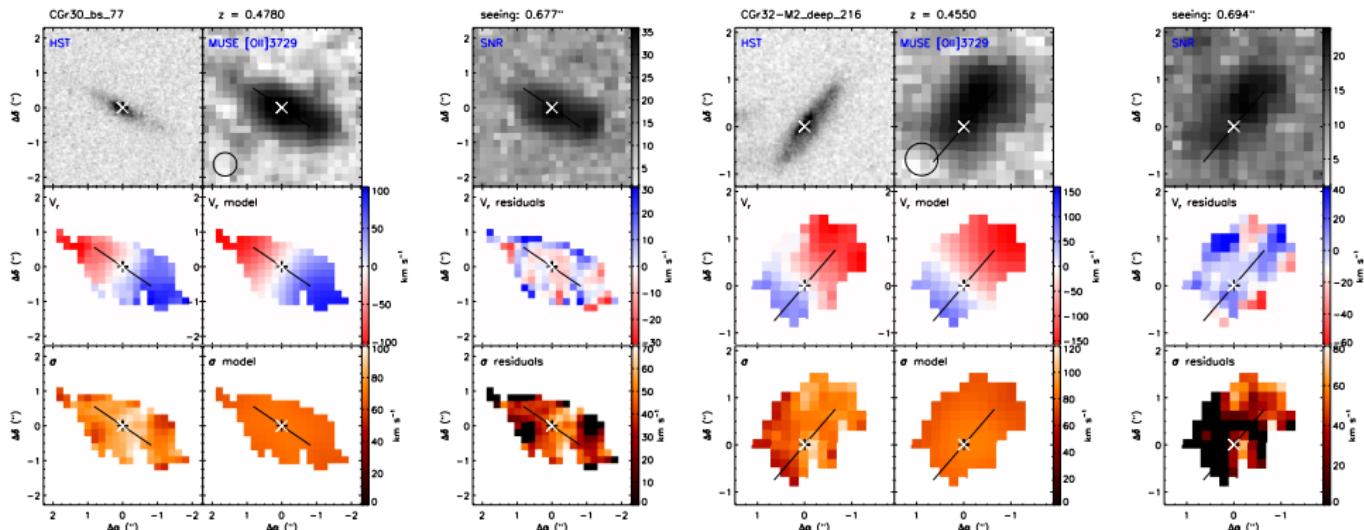
Kinematical modelling

Fitting a model

Use a ramp model
with a **linear internal variation**
and a **plateau**.



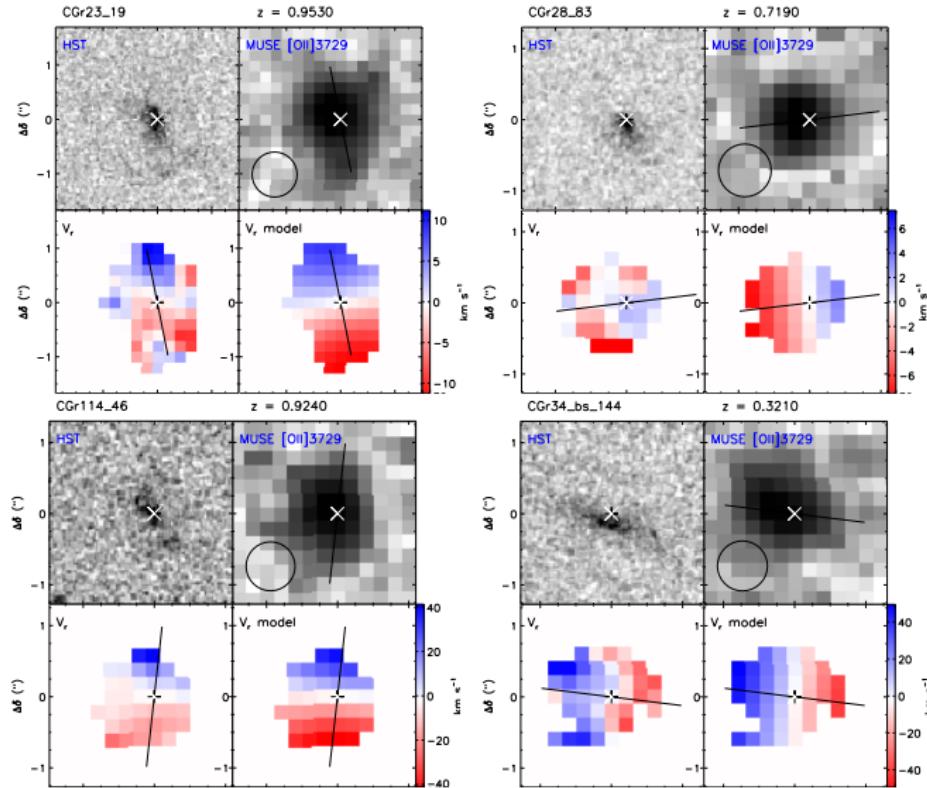
Kinematics of edge-on galaxies



$$i \approx 74^\circ$$

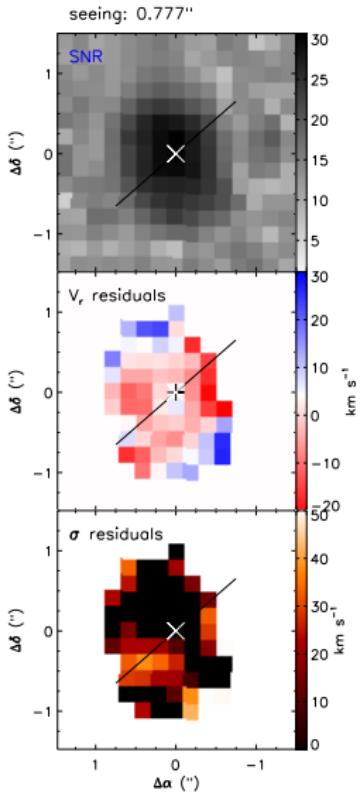
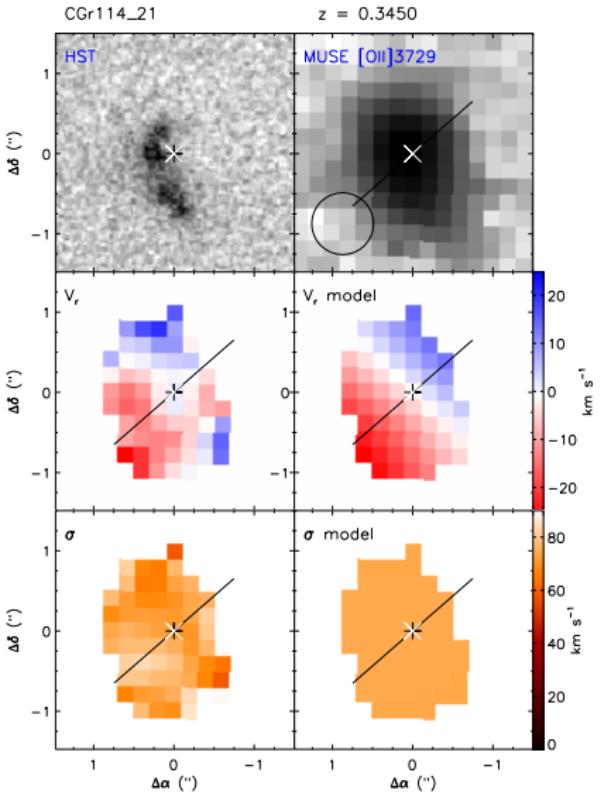
$$i \approx 72^\circ$$

Limitations for small galaxies



- ▷ Small and low SNR galaxies tend to have perturbed kinematics

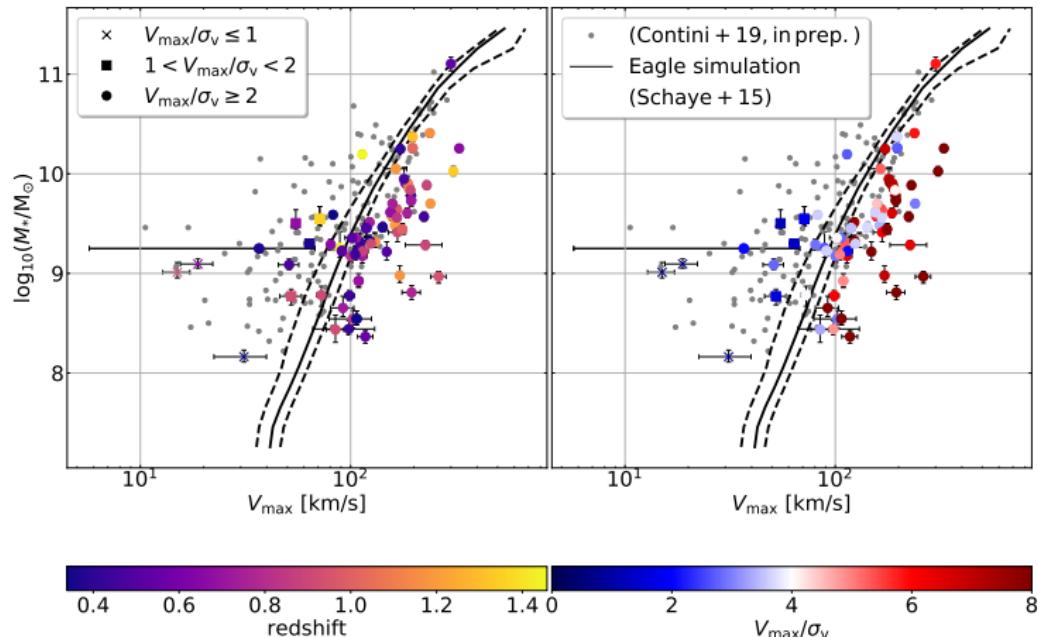
Interacting galaxies ?



- ▷ Clumpy structure is lost in MUSE image
- ▷ But **velocity field is highly perturbed**
- ▷ Clumps separated by $\approx 3\text{kpc}$
- ▷ Interacting galaxies ?

A few preliminary results

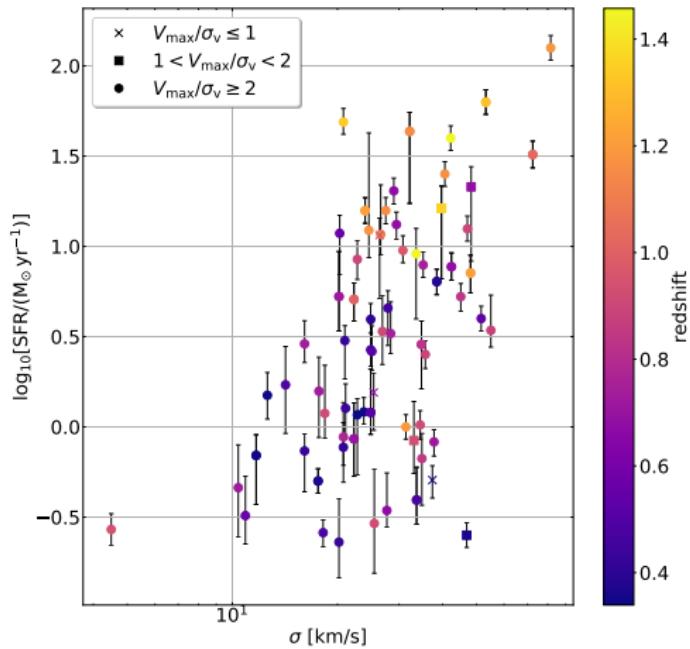
Tully-Fisher Relation



- ▷ **higher V_{max}** than in MUSE sample in HUDF of Contini et al. (2019) and EAGLE simulation
- ▷ **no** evolution with redshift found

A few preliminary results

A correlation between SFR and σ_v ?



Correlation between SFR and

- (a) **redshift** → consistent with mass-SFR relation
- (b) **velocity dispersion**

Origin ?
According to Lehnert et al.
(2013), energy injection from
star-formation.

- ▷ better selection + larger sample (x10)
- ▷ Improve morphological modelling
- ▷ Angular momentum evolution ?
- ▷ Dark matter vs. luminous mass ?
- ▷ **Very deep** observations + **stacking**
 - explore dark matter distribution at large radii

