The Physics and Mass Assembly of Galaxies

(DRM Demo Case)

P.Rosati & A.Cimatti - ELT meeting - Jan 19th 2007

Science Goals

- Spatially resolved spectroscopy of a sample of ~1000 massive galaxies at 2<z<~5 (redshift range when the first third of the stellar mass is known to be assembled in the Universe)
- Target selection from future large area optical-nearIR surveys
- Observations will yield:
  - direct kinematics of stars and gas in the first generation of massive galaxies in the range $0.1<M_{star}<5\times10^{11}\ M\odot$
  - dynamical masses, ages, metallicities
  - differential evolution of disk and spheroidal components as a funct. of z
  - assess importance of dynamical processes (e.g. merging, outflows) which govern galaxy evolution
  - study the onset and evol. of well-known scaling relations at low redshifts
  - witness the gradual shift of star formation from the most massive galaxies in the highest density regions to less massive galaxies in the field

Blurb: **provide the ultimate test of galaxy formation theories**

Requirements

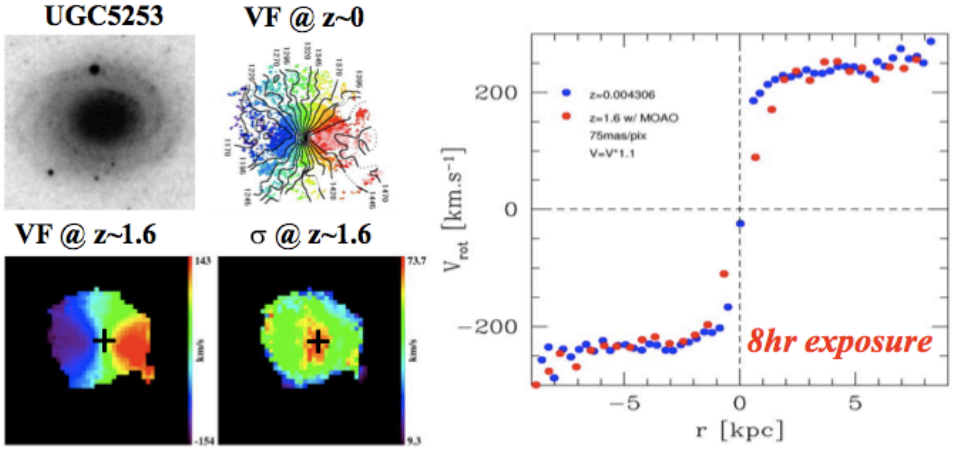
- ~1000 targets at 2<z<~4 to properly sample galaxy diversity, mass, z
- z = 1.5, 3, 4 → K^*_{AB}= 22-25 → Σ(gals/arcmin^2) = 10, 2, 1
  M_{lim}= 0.1-a few M*
  - ➡ FoV = 25-100 arcmin^2 , Multiplex = 10-50, R~3-5000 (for OH removal)
    - ⇨ deployable IFUs (MOAO) or large monolithic IFU (LTAO)
- R_E=[0.1-0.3] arcsec ⇨ at least 50 mas spatial sampling
  - ➡ AO performance critical (LTAO, eventually MOAO)
- Mapping physical properties (SFR, metallicity) and dynamics requires mostly near-IR coverage, but to cover standard diagnostic lines, [OII]3727, [OIII] 5007, $H\beta$, $H\alpha$, over the entire z range [1-4] one needs
  - ➡ wavelenght range: 0.8-2.5μ (trade-offs with AO performance)
- Exposure times: 10-50 hrs to achieve full range of science cases (?)
- No break points in telescope size are apparent

3D spectroscopy simulator + AO required to assess science cases

Case 1: 75mas/pix @ z=1.6 ➔ can we recover the Rotation Curve?

$EW_0(H\alpha)$=50Å, H_{AB}=22.5 Erb et al. 2006

D_{gal}~2.0'' Ferguson et al. 2004; Dahlen et al. 2006

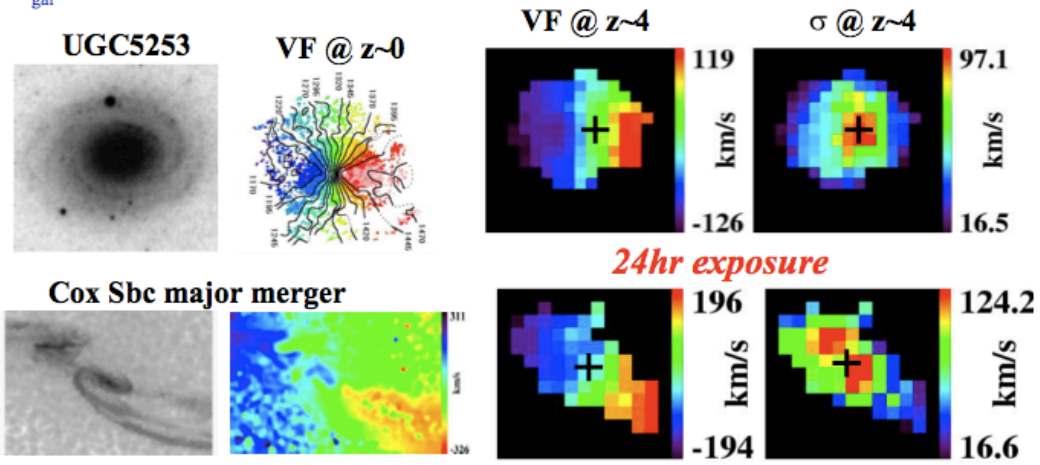


Case 2: 75mas/pix @ z=4 ➔ can we identify a rotating disk?

EW_0([OII])=30Å Hammer et al. 1997

H_{AB}=24.5 Steidel et al. 1999, 2003

D_{gal}~0.8'' Bouwens et al. 2004



Puech et al.
ELT simulations
(Marseille conference)

- End-to-End
- VF model →IFU+O →Obs
- Simulations "zerod' on Flames and Sinfoni 3D observations

DRM case: some issues..

- 3D Spectroscopy simulations to finalize specs (Puech et al. method)
  - **complex trade-off:** spectrum of science cases ↔ w.l. range ↔ AO
    - ➡ come up with effective figures of merit (challenging for this SC)
    - ➡ final scientific diagnostic diagrams ? FP, Tully-Fisher relations..
    - ➡ come up with a specific list of targets distributed over mass, redshift, galaxy "type" to drive the DRM
- Instrument specs overlap/differences with "first galaxies" science case
- PR value of this DRM ?
- Synergies with JWST