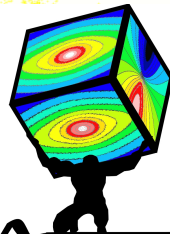# Stellar Populations of Early-Type Galaxies Inside and Outside of Virgo
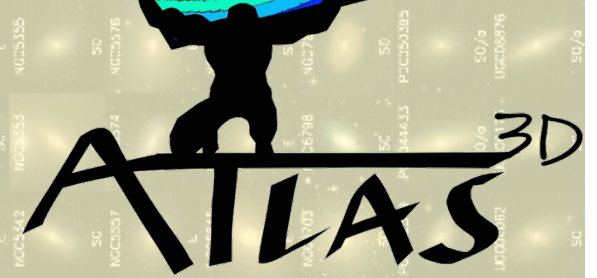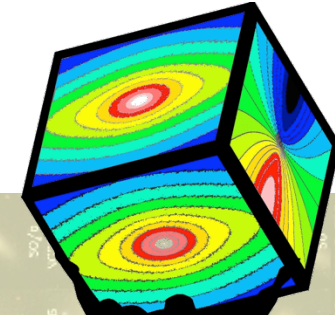
Richard McDermid

(Gemini Observatory)

and the ATLAS³ᴰ **team**

The Team

PIs: **Michele Cappellari, Eric Emsellem, Davor Krajnović, Richard McDermid**

Cols :

Katey Alatalo, Leo Blitz, Maxime Bois, Frederic Bournaud, Martin Bureau, **Roger Davies**, Tim Davis, **Tim de Zeeuw**, Pierre-Alain Duc, Sadegh Khochfar, **Harald Kuntschner**, **Pierre-Yves Lablanche**, Raffaella Morganti, **Thorsten Naab**, Tom Oosterloo, Marc Sarzi, **Nicholas Scott**, **Paolo Serra**, Lisa Young, Anne-Marie Weijmans, Jesus Falcon-Barroso, Estelle Bayet, Alison Crocker, Gijs Verdoes-Kleijn, Marie Martig, **Remco van den Bosch**, Glenn van de Ven
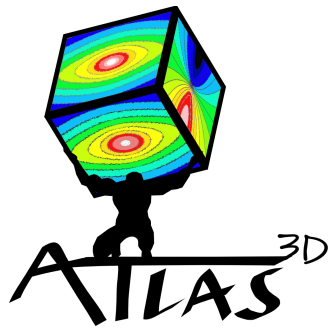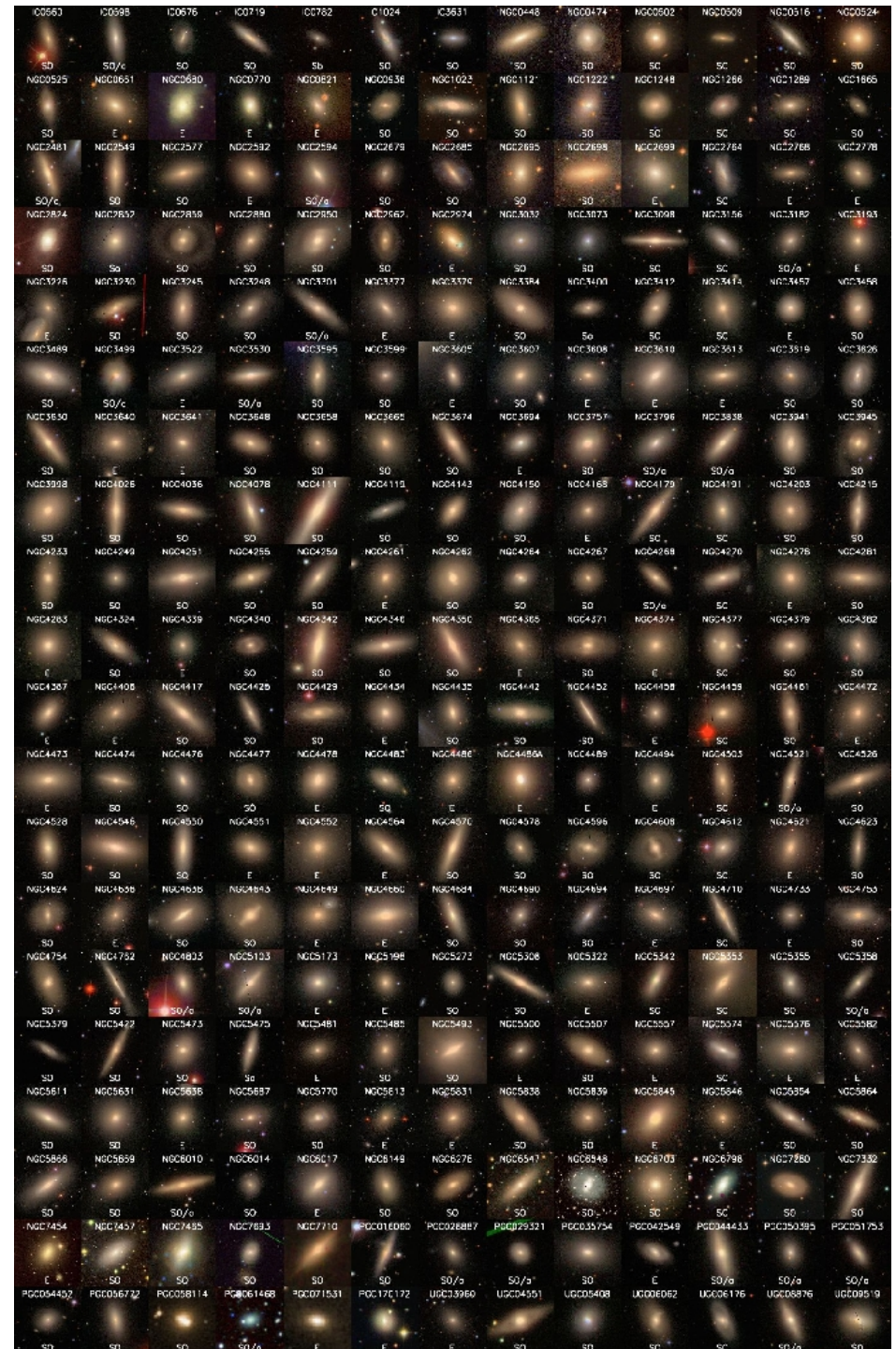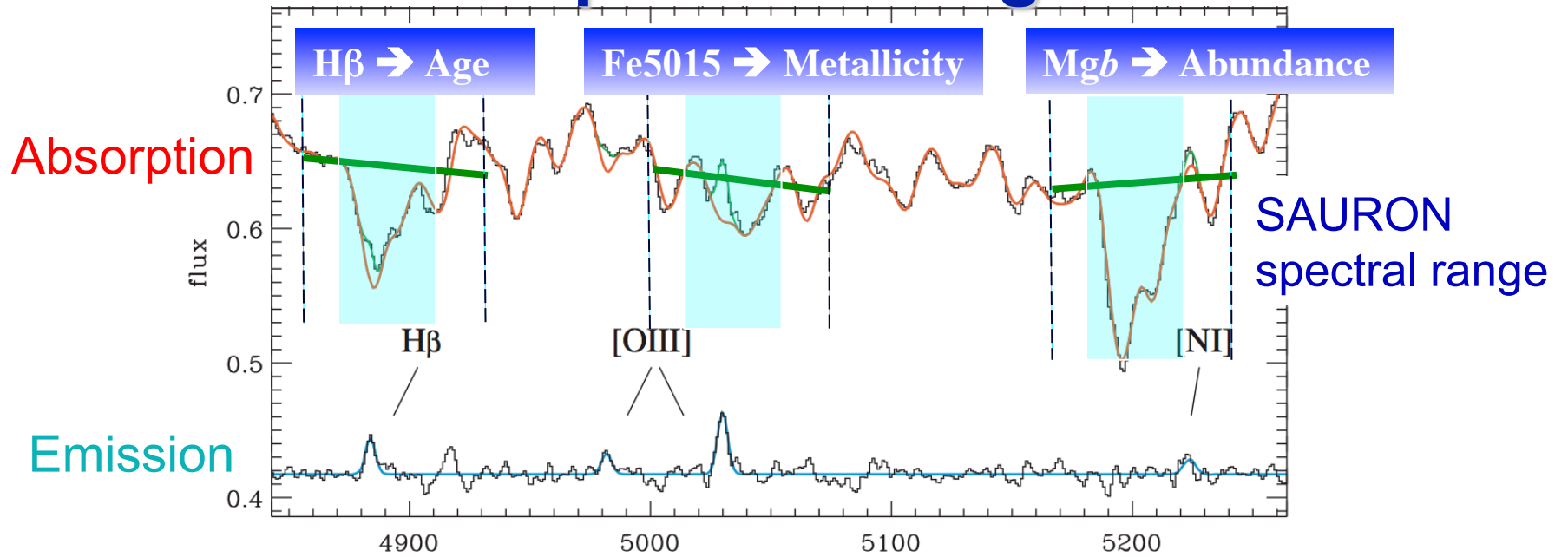
$M_K < -21.5$

$D < 42$ Mpc

$|\delta - 29| < 35°$

$|b| > 15°$

❖ **Observe a complete volume limited sample of 260 ETGs**

❖ Parent sample:

   871 nearby galaxies

❖ Morphological selection:

   No spiral arms (DSS/SDSS)

❖ No colour cut

❖ Very close to mass-limited
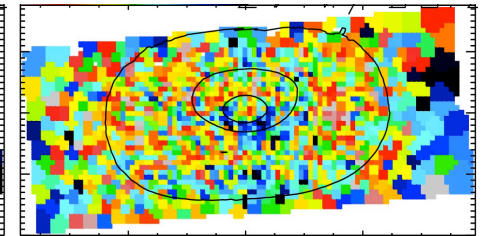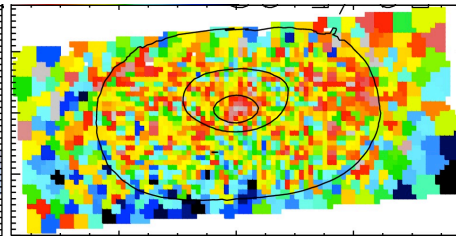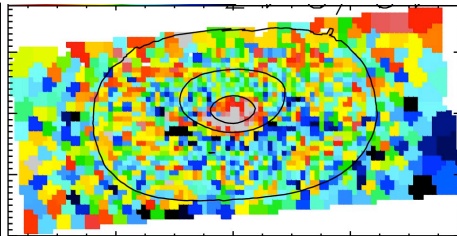
purl.org/atlas3d

Stellar Population Diagnostics

$H\beta \rightarrow$ Age   Fe5015 $\rightarrow$ Metallicity   Mg$b \rightarrow$ Abundance
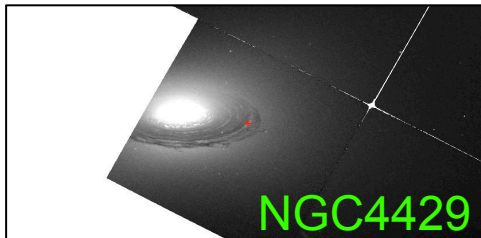
Absorption

SAURON spectral range

flux

Emission

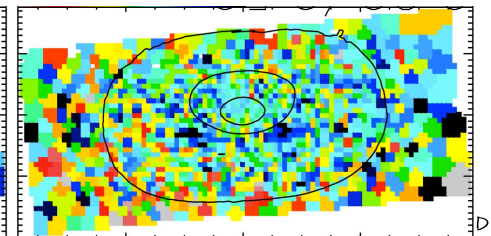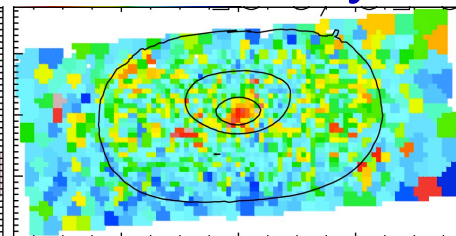Hβ [OIII]   [NI]

HST F606W   Hβ Fe5015   Mgb
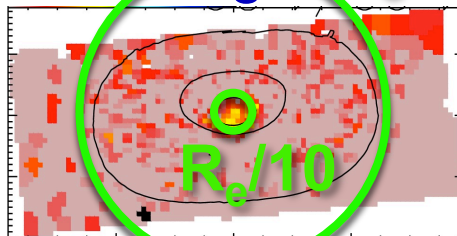
NGC4429

Stellar Velocity   Age   R$_e$ Metallicity   Abundance
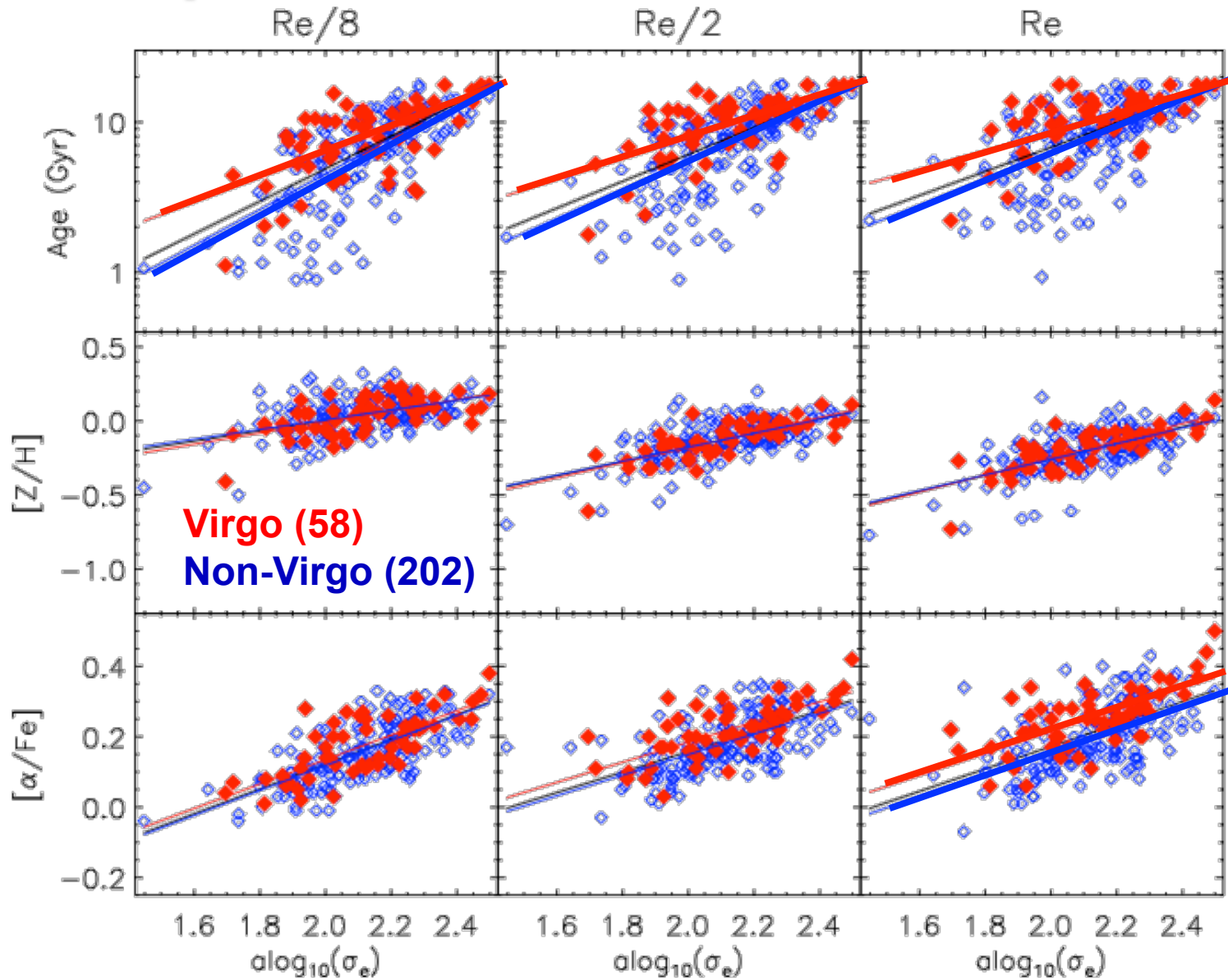
R$_e$/10
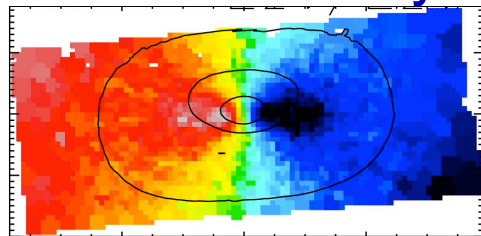
Populations versus Dispersion

Thomas et al 2005
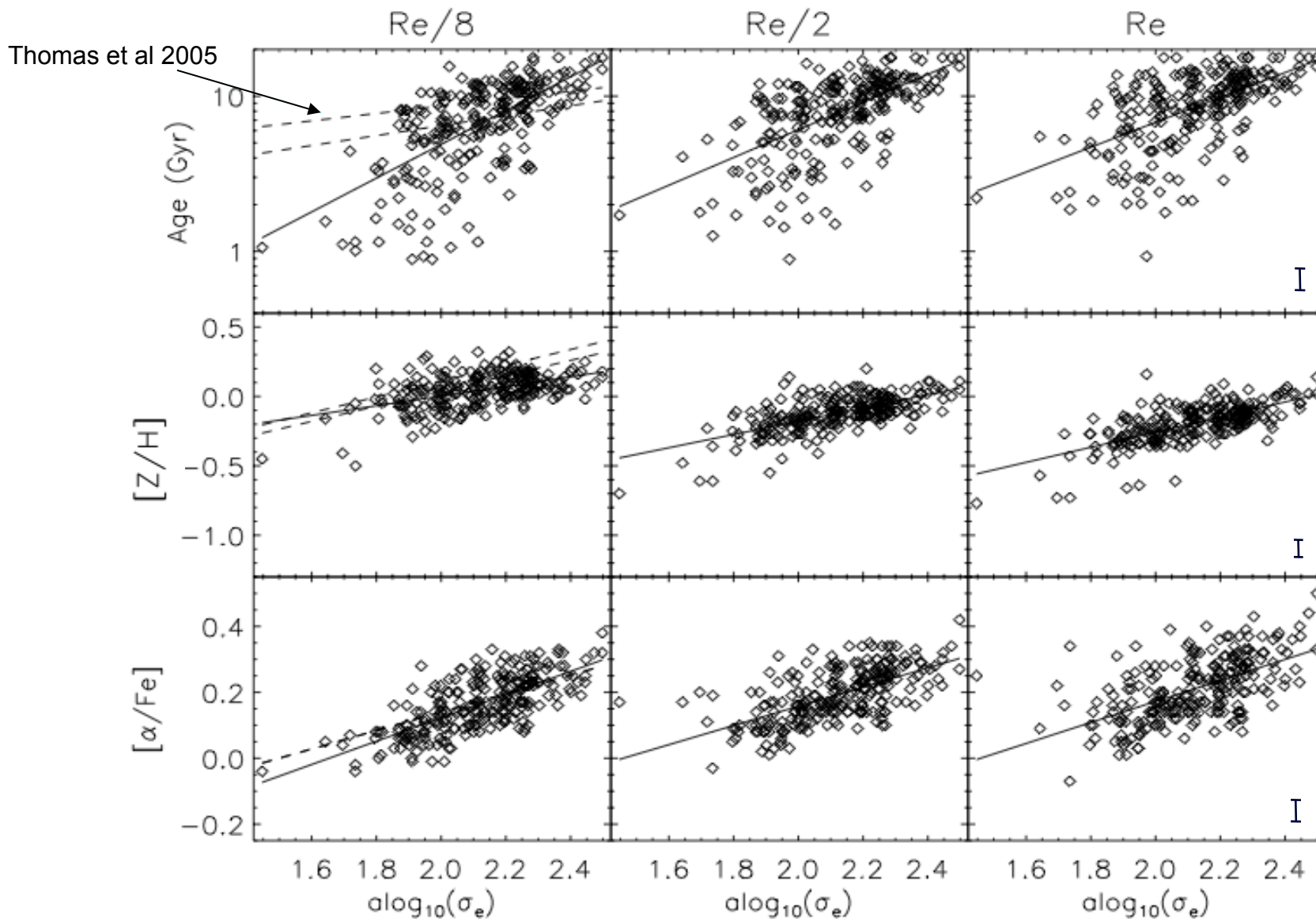
McDermid et al. in prep.
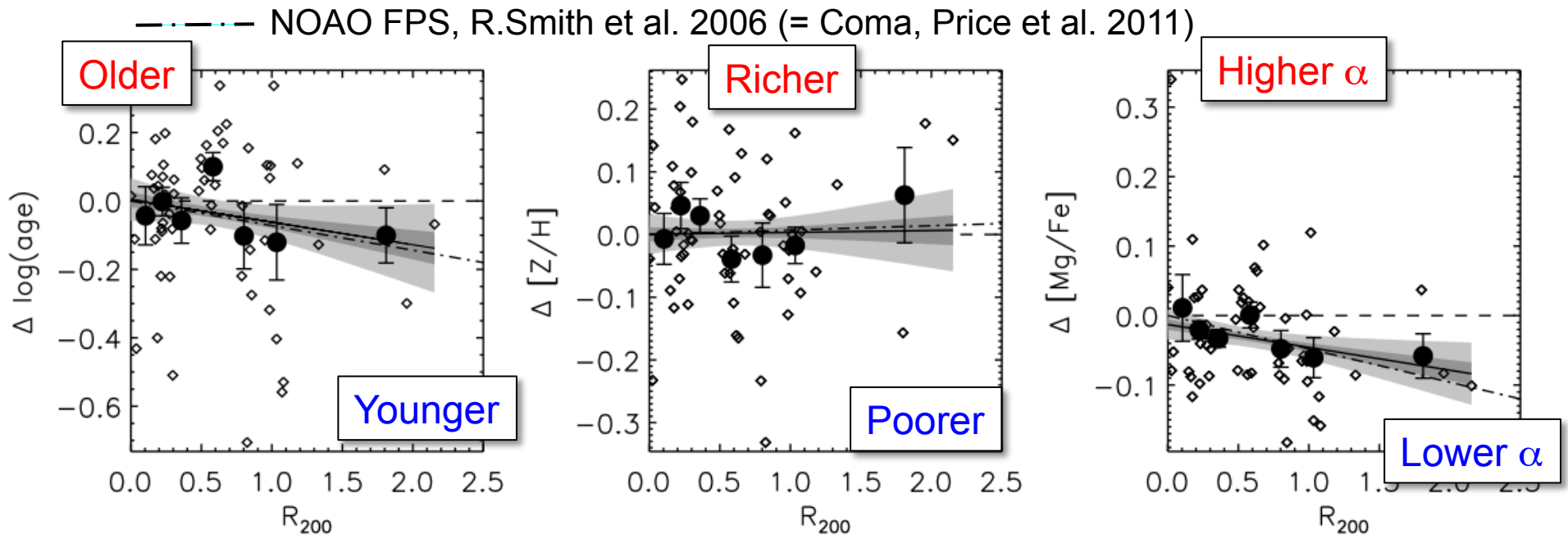
Populations versus Environment

Populations versus Radius in Virgo

— · — · — NOAO FPS, R.Smith et al. 2006 (= Coma, Price et al. 2011)
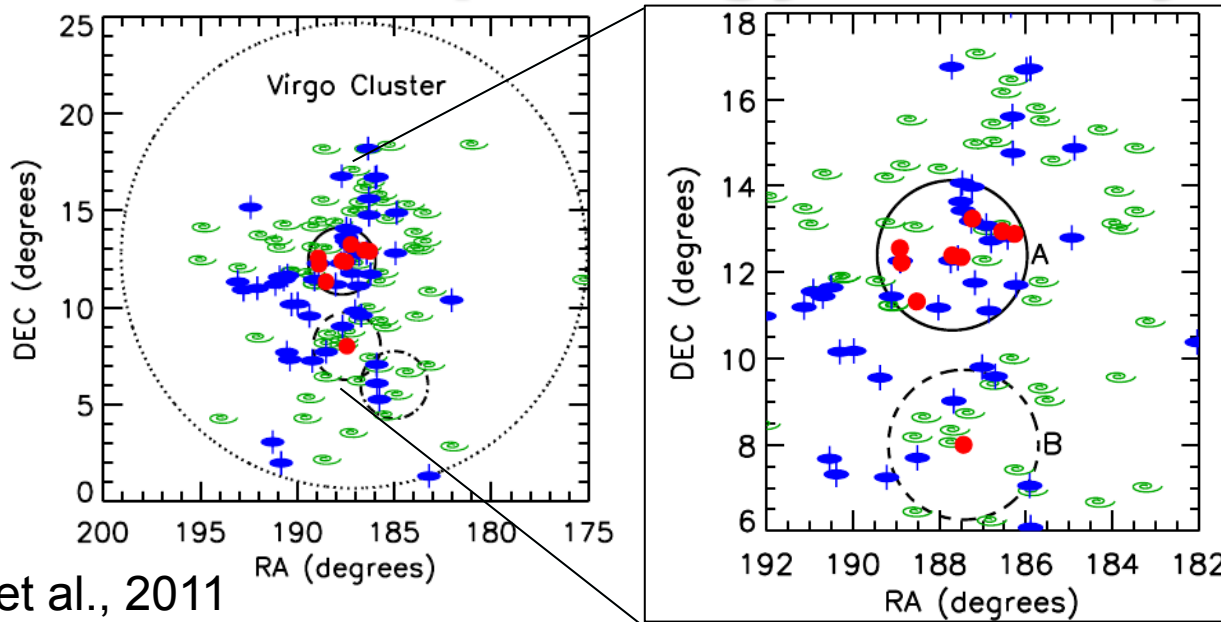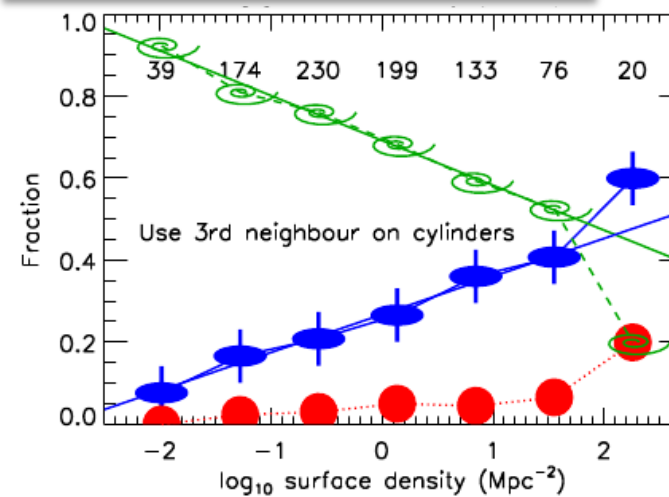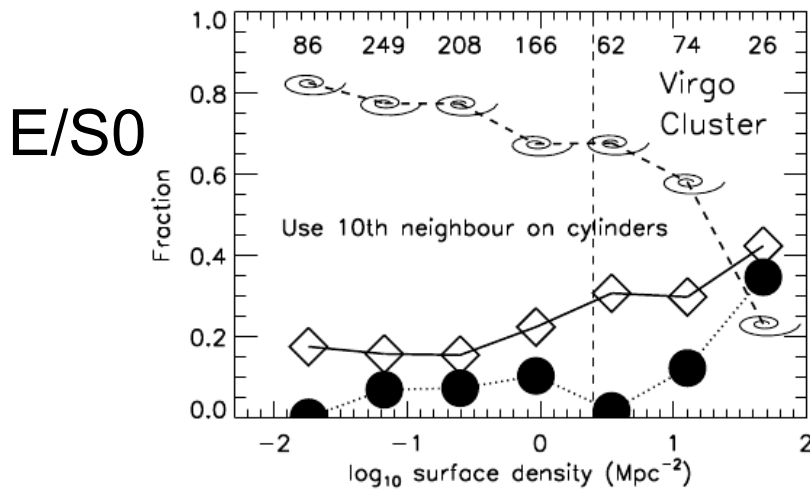
- ❖ Mass dependence is removed
- ❖ Residual radial trends are quite noisy
- ❖ Outer parts are younger and less α-enhanced
- ❖ No metallicity trend
- ❖ Remarkably consistent with other studies, inc. Coma
- ❖ Mass drives metallicity, environment drives SF

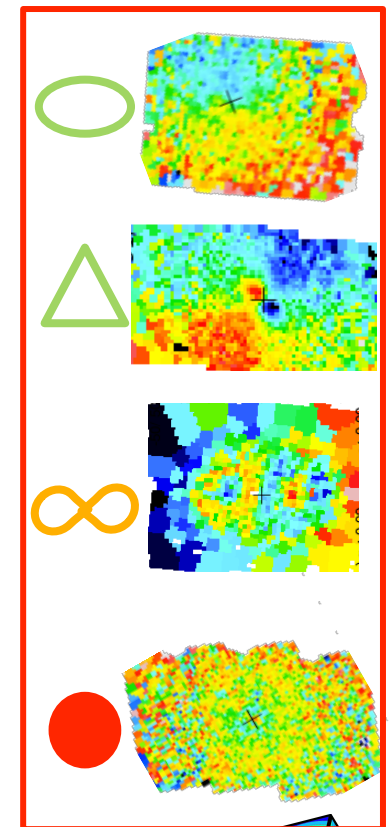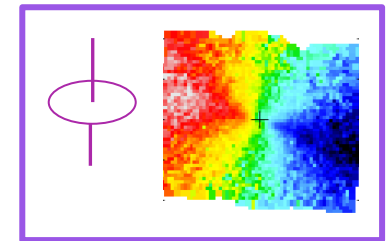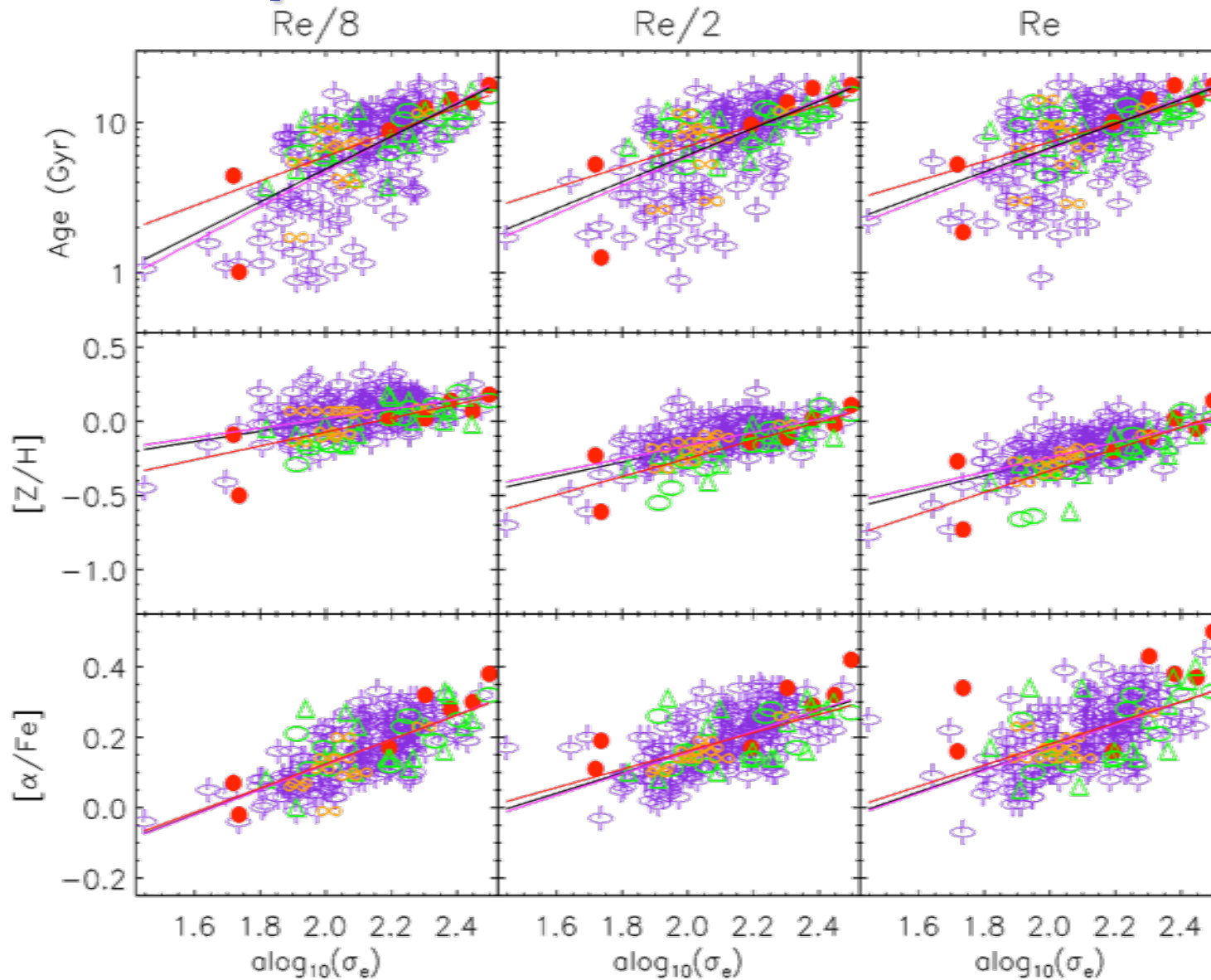# Kinematic Morphology-Density Relation

Cappellari et al., 2011

E/S0

Fast/Slow

❖ **Slow rotators dominate Virgo centre**
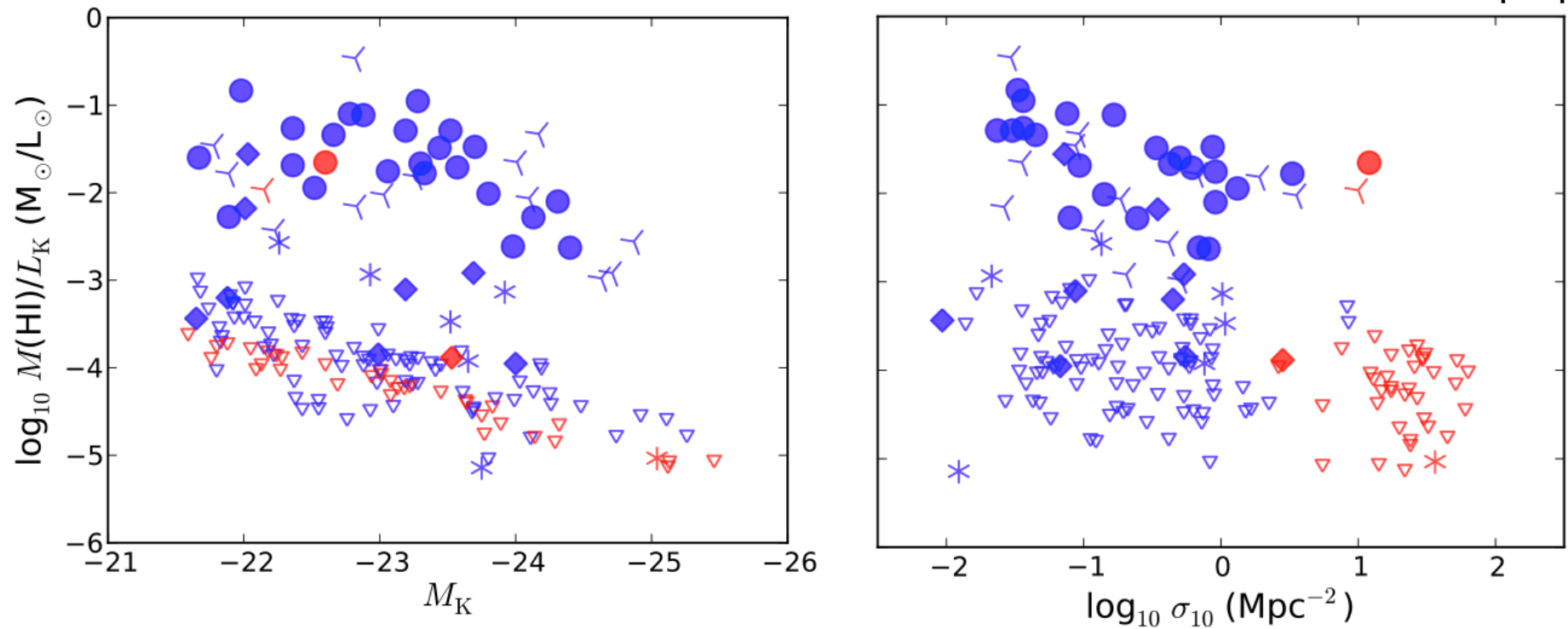
Populations and Kinematic Classes
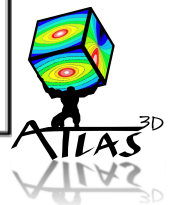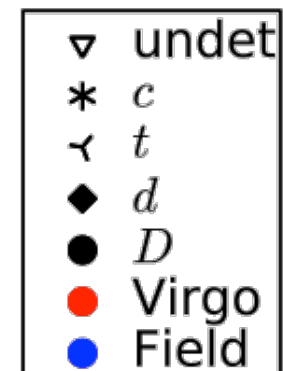
Cold Gas in ETGs: HI
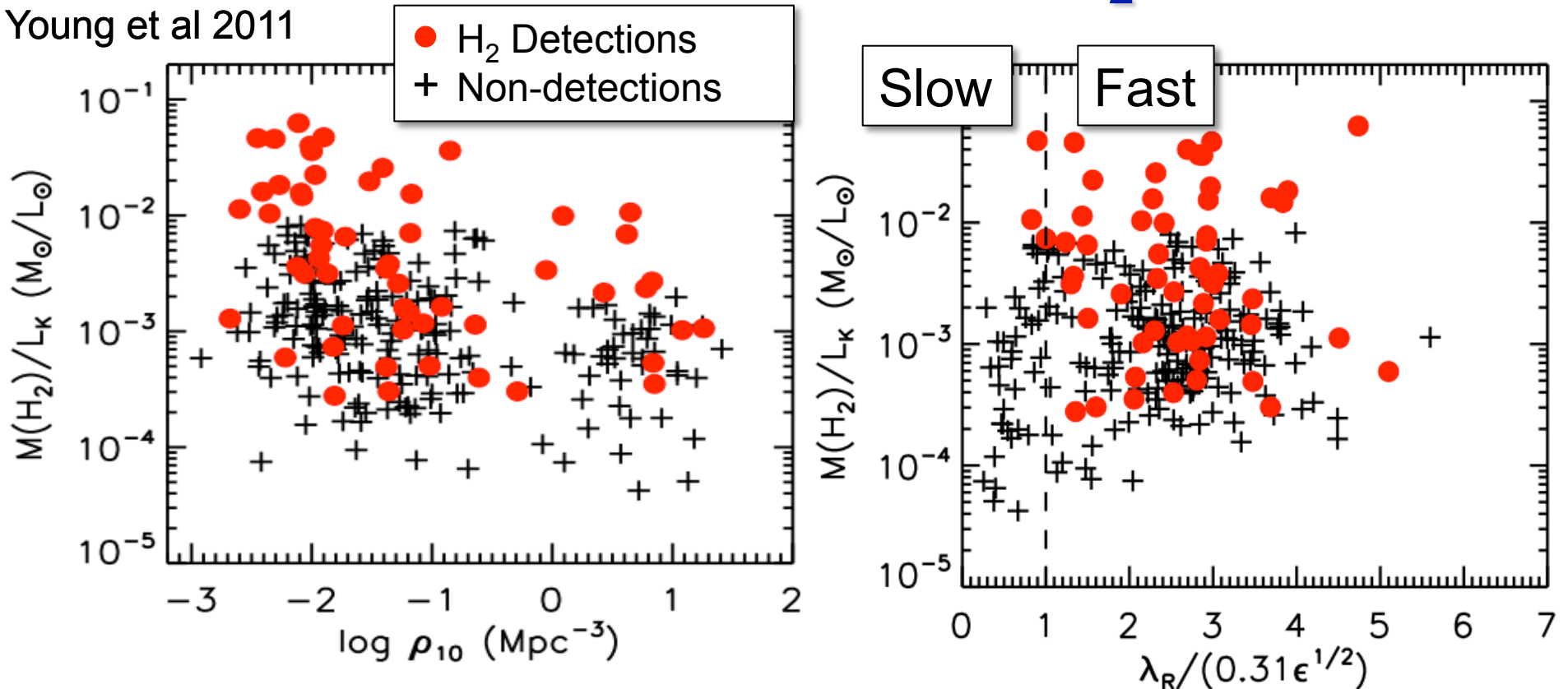
Serra et al. in prep.

❖ Weak trend of HI with mass

❖ No particular trend with λ_R

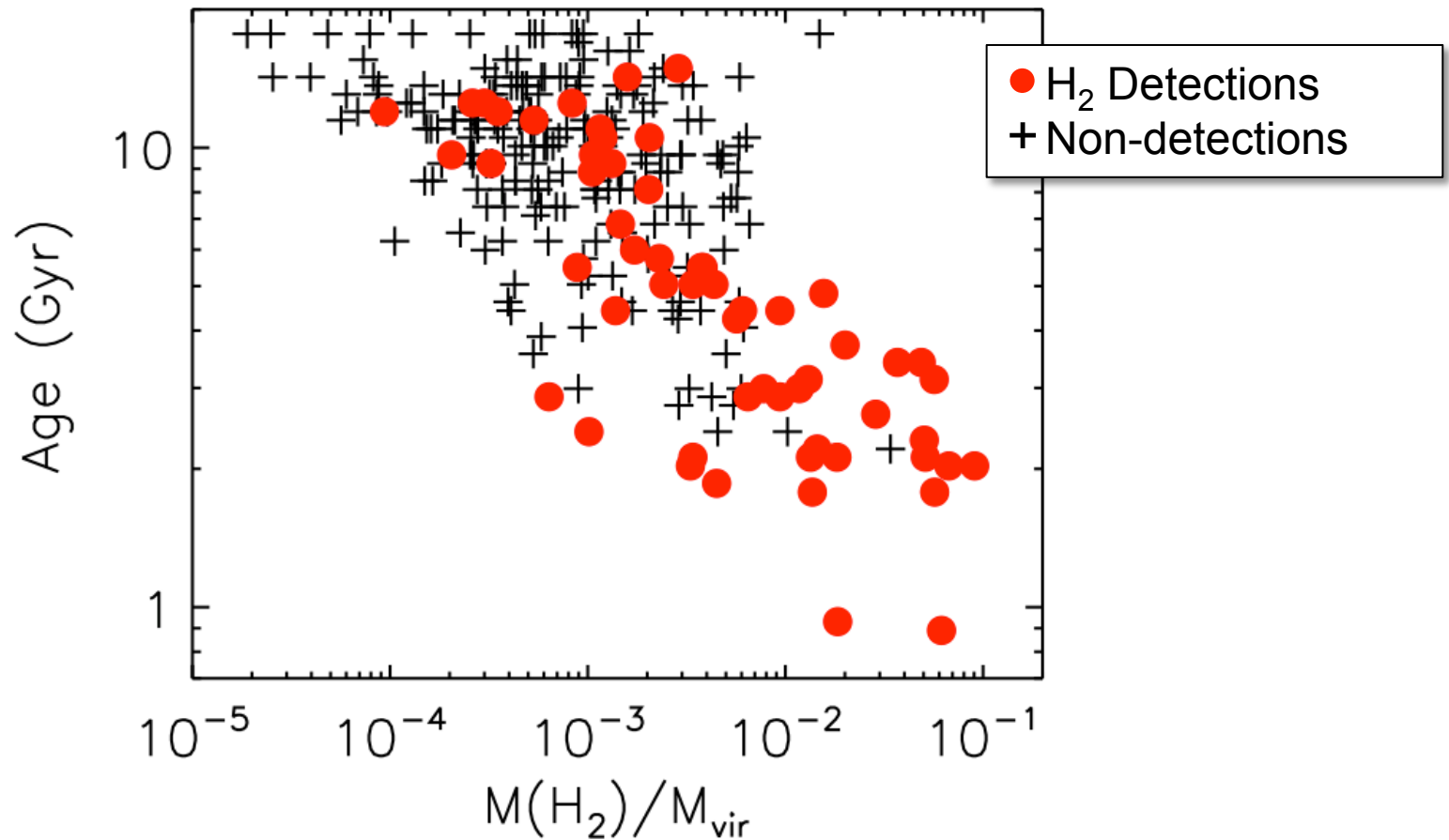❖ HI more sensitive to environment

Cold Gas in ETGs: H_2

Young et al 2011

Legend:
- ● H_2 Detections
- + Non-detections

Left panel axes: $M(H_2)/L_K$ $(M_\odot/L_\odot)$ vs $\log \rho_{10}$ (Mpc^{-3})

Right panel axes: $M(H_2)/L_K$ $(M_\odot/L_\odot)$ vs $\lambda_R/(0.31\epsilon^{1/2})$ — Slow | Fast

❖ No clear correlation of H_2 with mass or environment

❖ Detection fraction similar between Virgo and non-Virgo

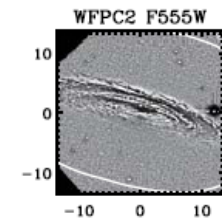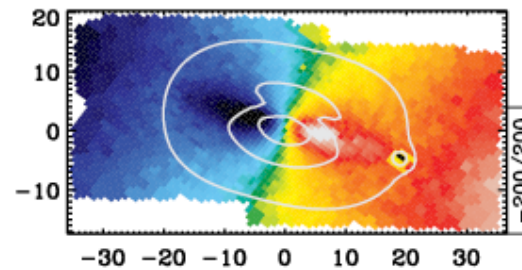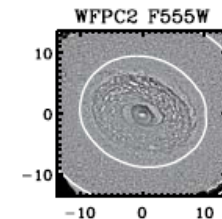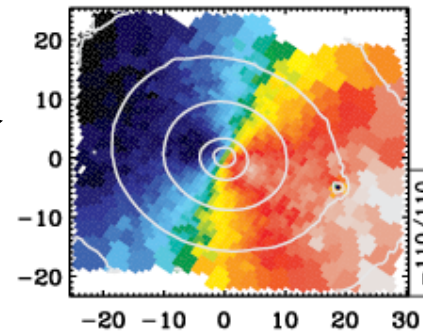❖ Strong drop in detections of Slow Rotators
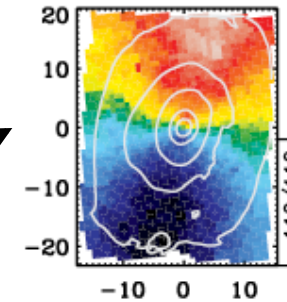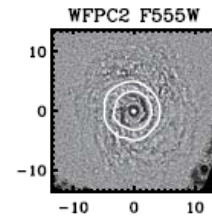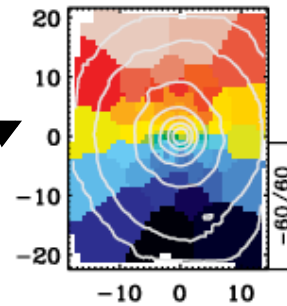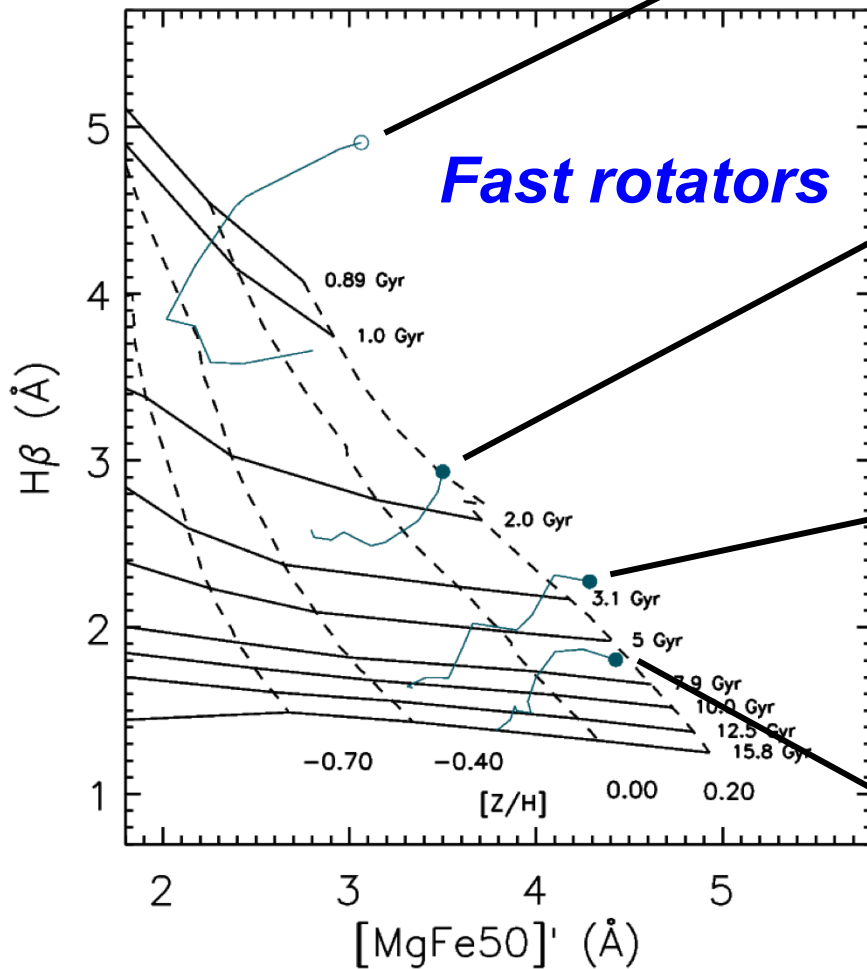
Cold Gas in ETGs: H_2

- ❖ Clear connection between H_2 fraction and SSP age
- ❖ Young ages reflect low-level star formation

Where are the young stars?

Fast rotators
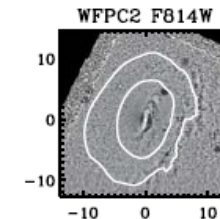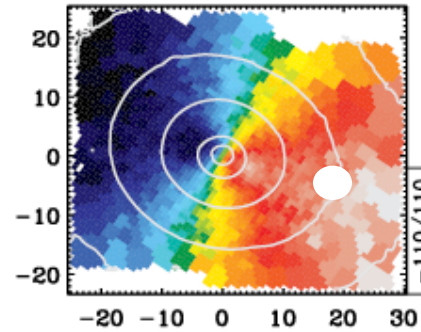
Kuntschner et al. 2010 – SAURON Survey

Young stars are in disks

Young

Age maps

Old

Mass

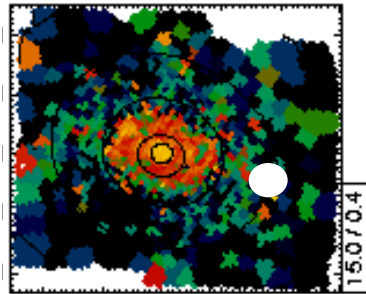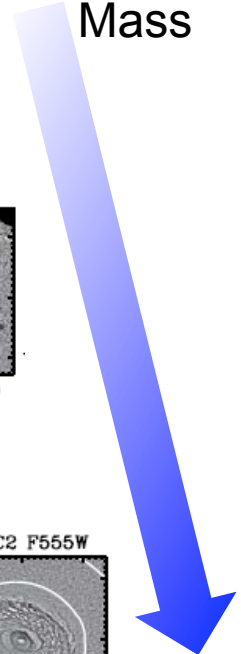Kuntschner et al. 2010 – SAURON Survey
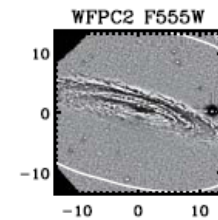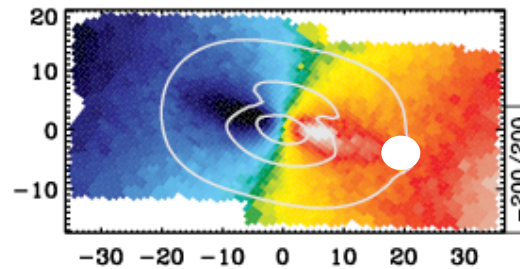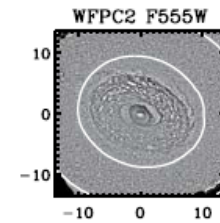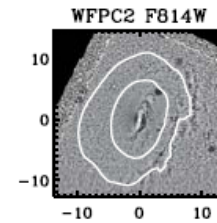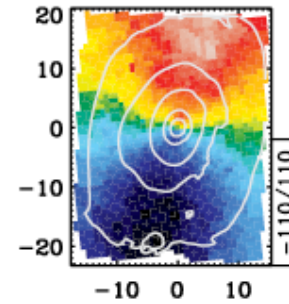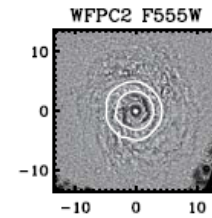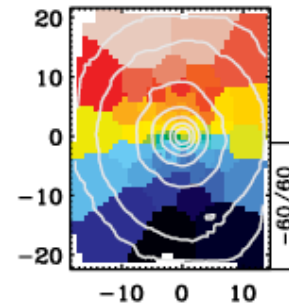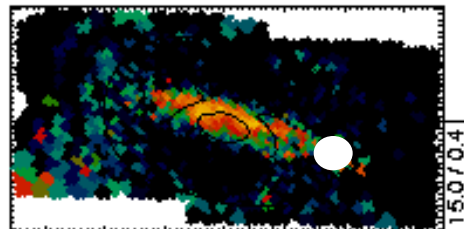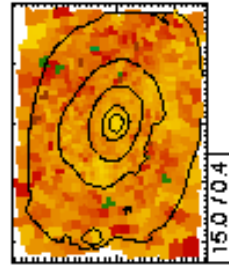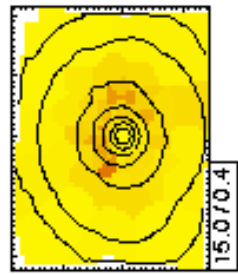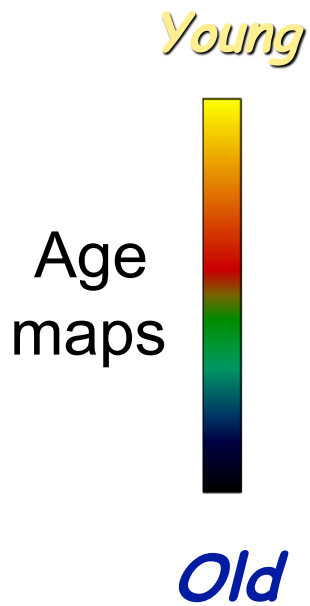
Conclusions

❖ *Environment plays an important role:* Virgo ETGs are older and α-enhanced w.r.t. field: truncated SF

❖ *Trends with cluster-centric radius:* Younger galaxies with extended SFH at larger radii

❖ *Kinematic classes show subtle links with populations:* Slow-rotators slightly older, mixed α-enhancement, but metal poor w.r.t. fast rotators

❖ *Molecular gas fraction linked to young ages:* Low-level SF, even in Virgo ETGs

Emerging Picture…
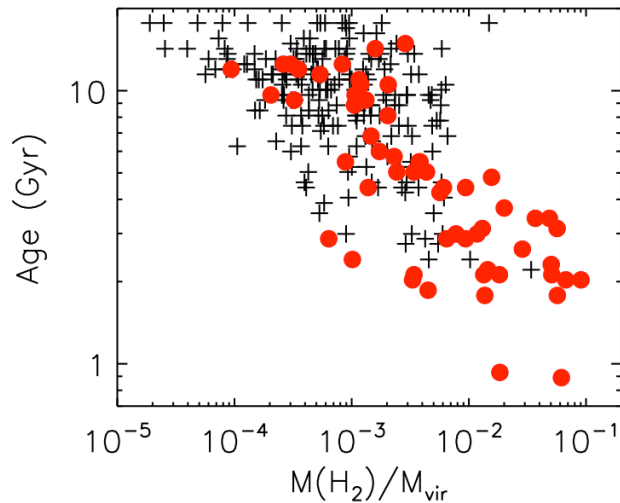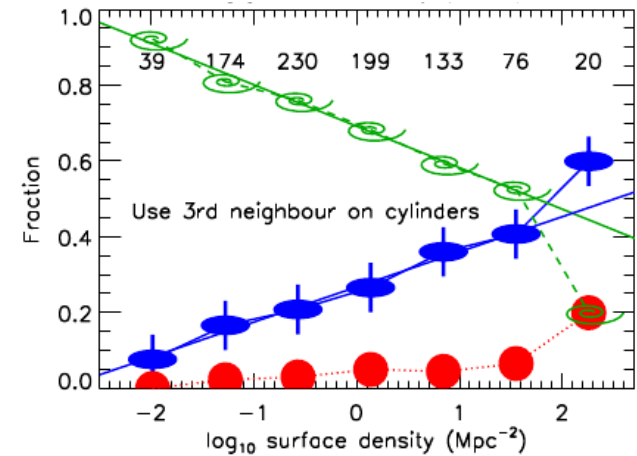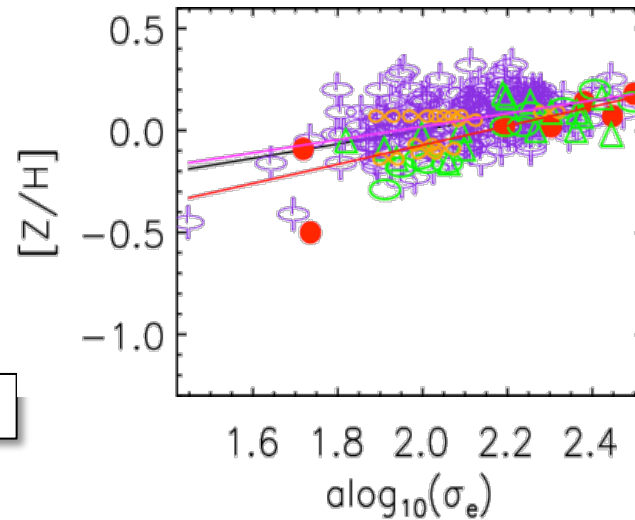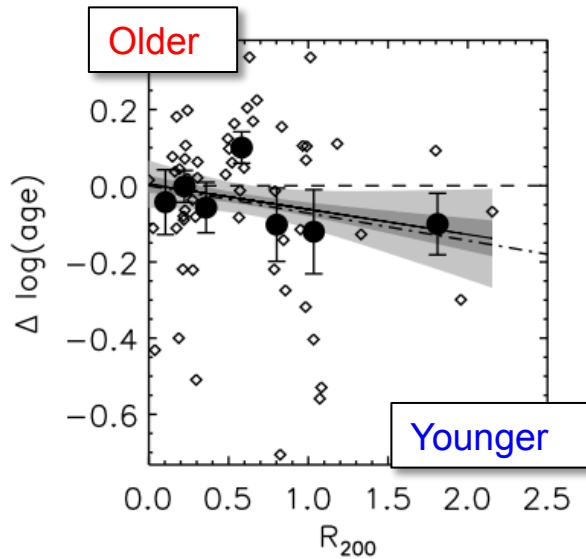
ETG mass sequence of properties are driven by smoothly varying competition between dissipational and dissipationless processes, where environment influences the balance via interaction history and availability of gas