Astronomy and Space Science

Kinematical misalignments in the EAGLE simulations

Paolo Serra

with ATLAS^{3D} and EAGLE teams

Atlas^{3D}: 260 ETGs, $M_\star > 10^{10}\ M_\odot$

IFU survey	**CO survey**	**HI survey**
WHT/SAURON stars and ionised gas $r<R_e$	IRAM+CARMA $M(H_2)\sim3\times10^7\ M_\odot$	WSRT $M(HI)\sim10^7\ M_\odot$ $N(HI)\sim3\times10^{19}\ cm^{-2}$
Cappellari+ 11 Davis+ 11	**Young+ 11 Alatalo+ 13**	**Serra+ 12, 14**

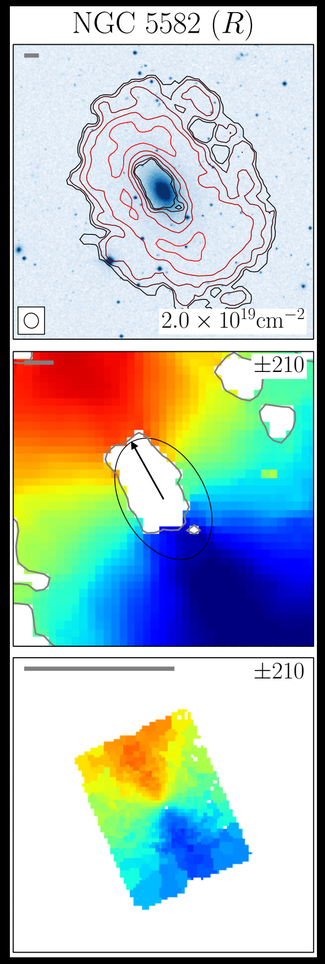
H_2 + HI detection rate ~50%

neutral gas mass ~10^7 - $10^9\ M_\odot$

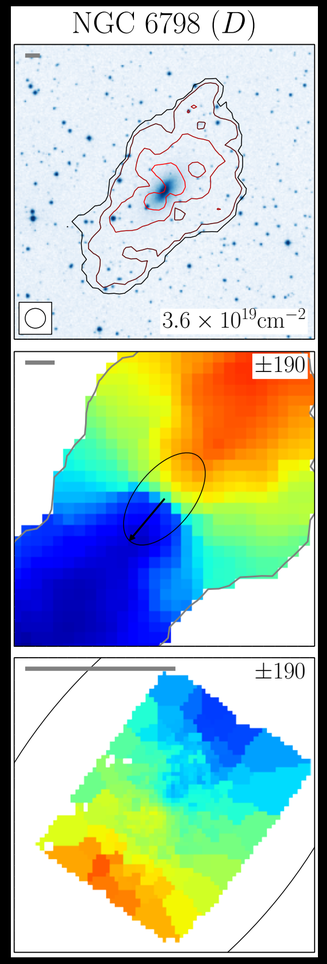
mostly gas discs and rings, ~50% misaligned from stars

HI - stars kinematical misalignments

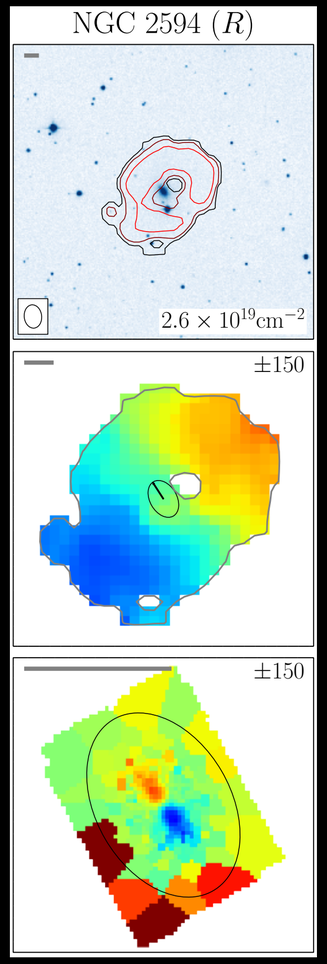
co-rotation



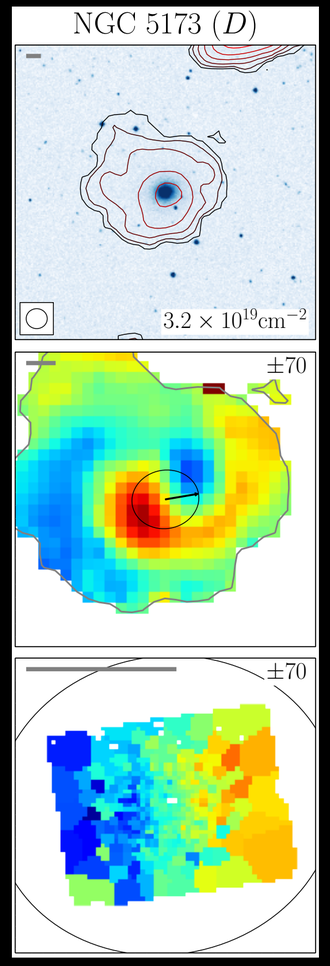
counter-rotation



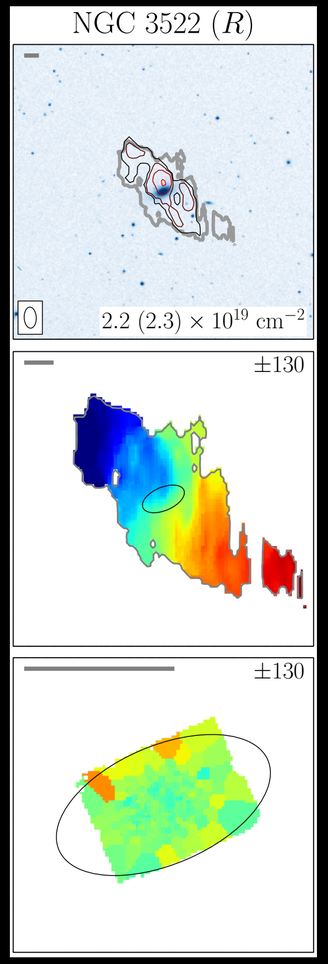
polar



warp/other



slow rotators



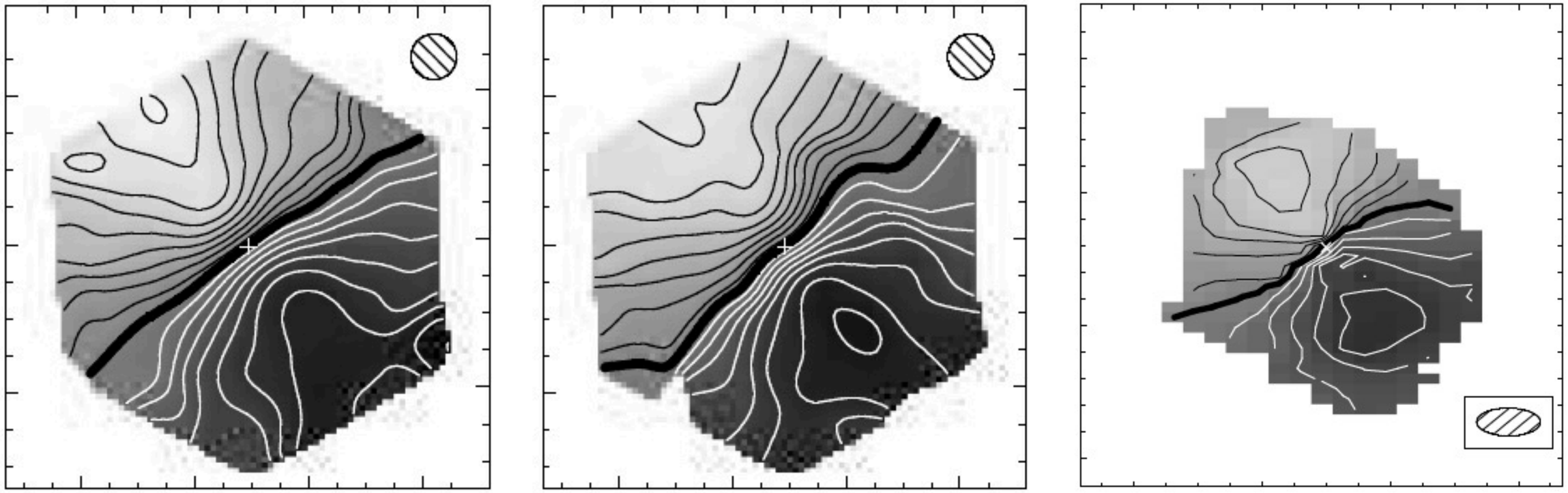
Serra et al. (2014)

Kinematical misalignments in spirals

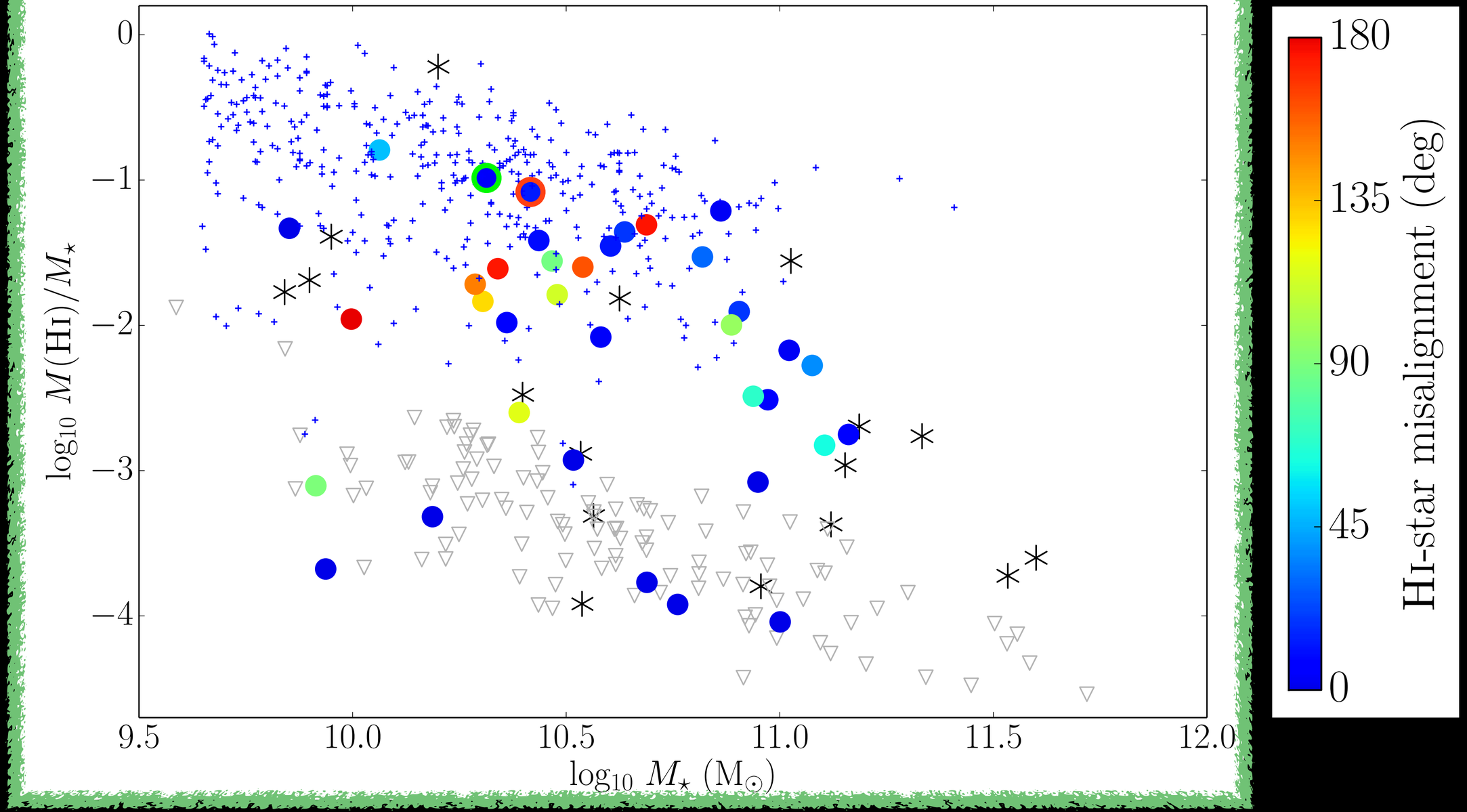
stars

OIII

HI



Ganda et al. (2006); Martinsson et al. (2013a,b);
Barrera-Ballesteros et al. (2014); Bryant et al. (in prep.)
TOTAL ~ 200 spirals; misalignment rate ~ 10%



ETG HI disc/ring

spirals

ETG HI unsettled

ETG HI undetected

EAGLE simulations

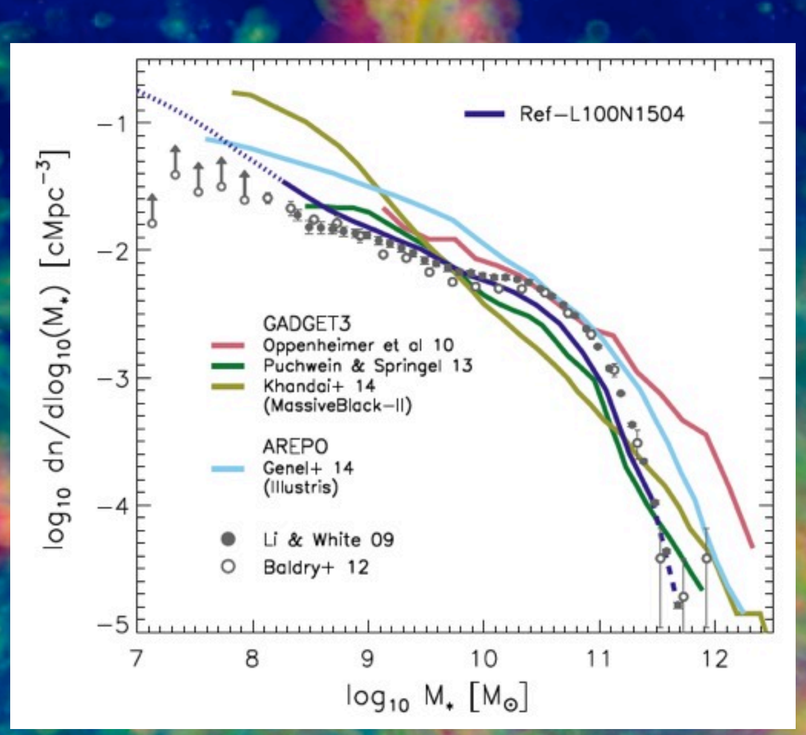
Schaye et al. (2015)

M_{res}~10^6 $M_\odot$, ε~0.7 kpc

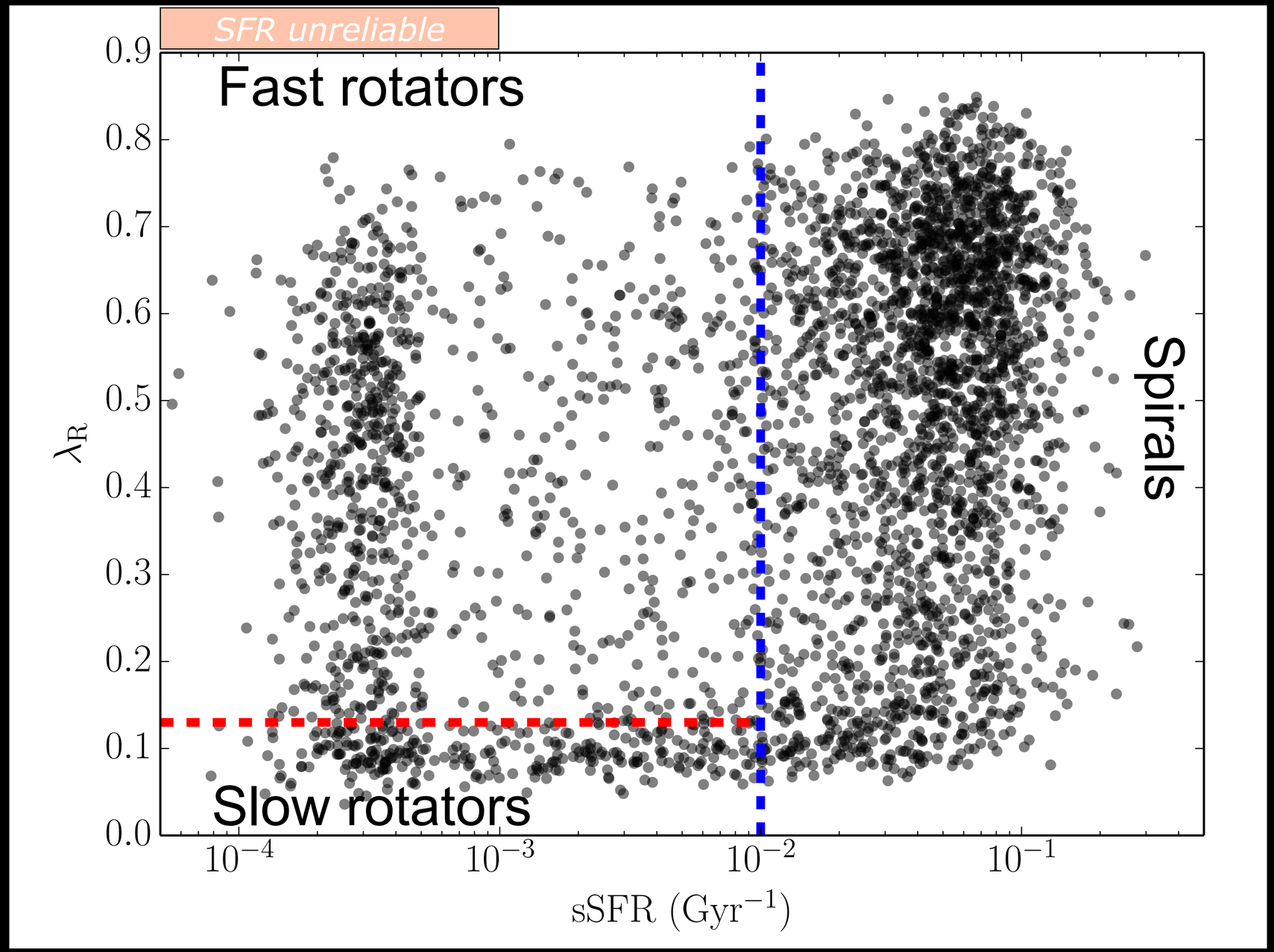
100 Mpc volume

~3500 galaxies with $M_\star$>10^{10} $M_\odot$

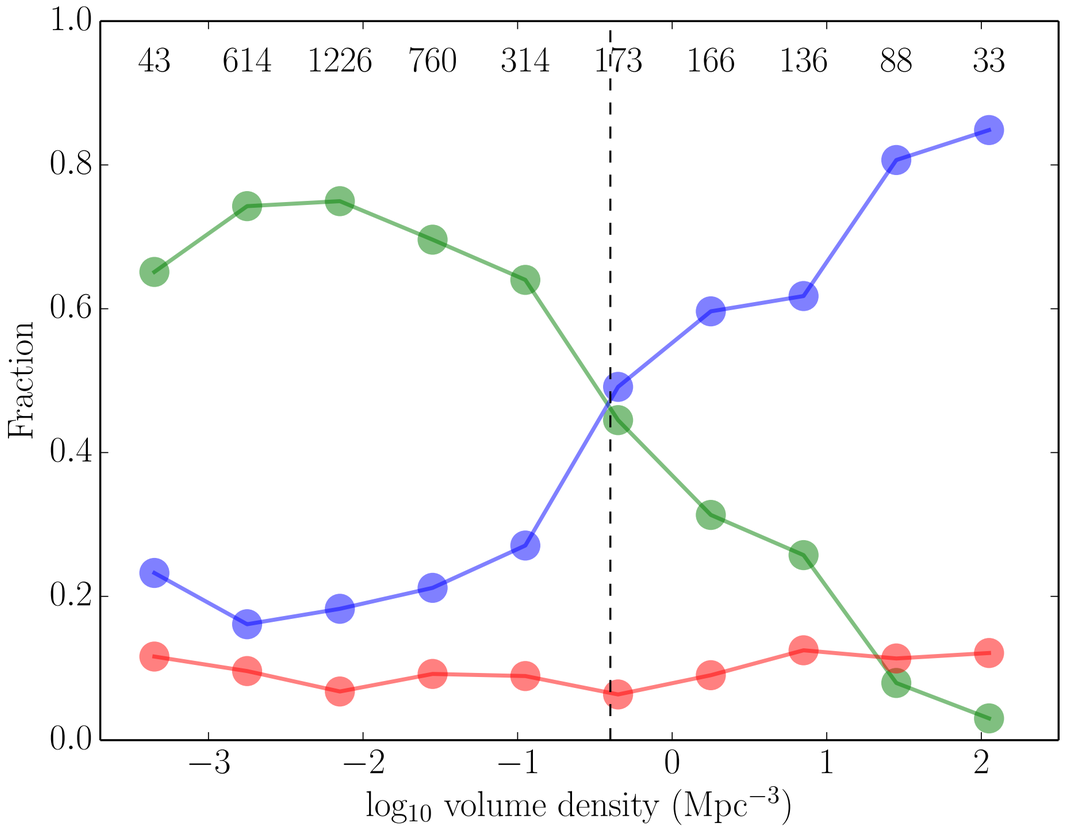
environment from voids to ~Coma/3



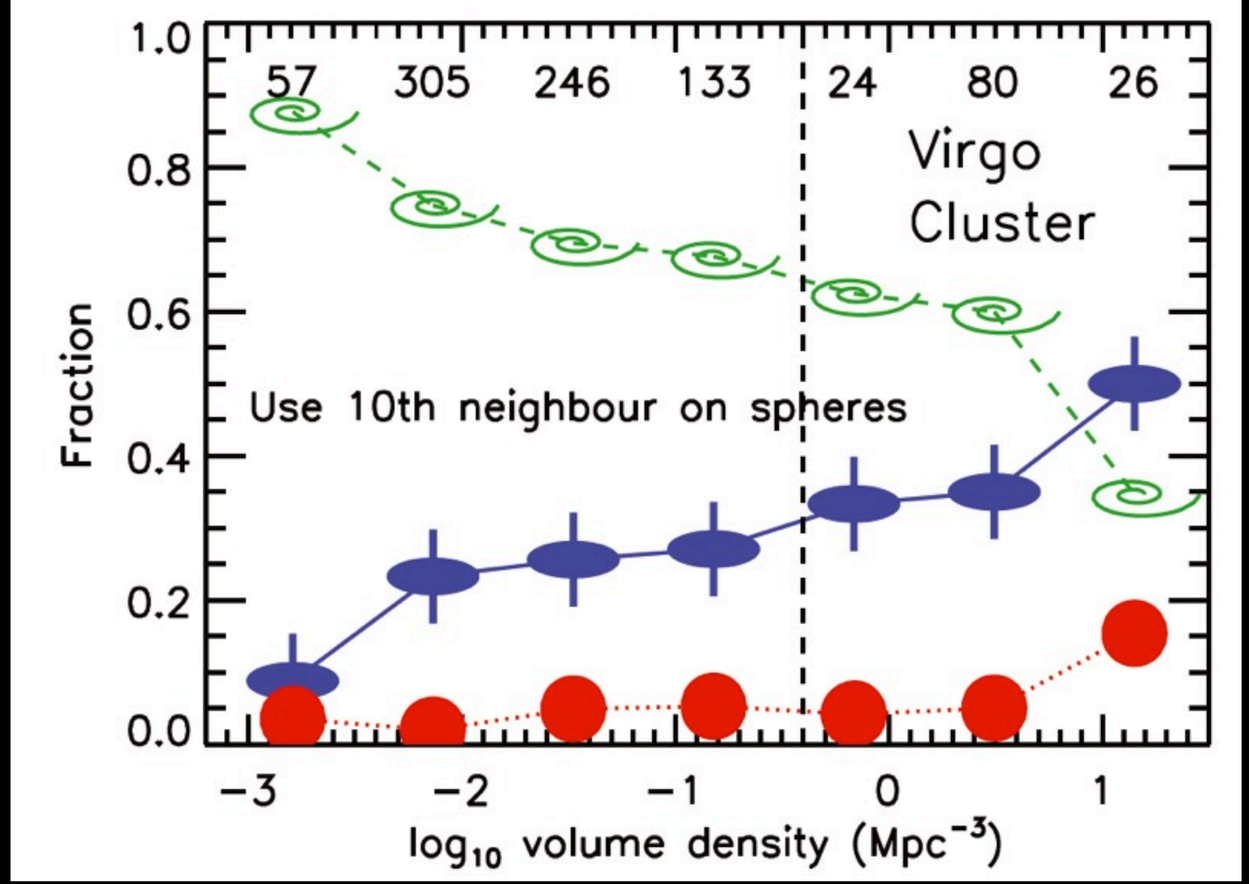
Selection of Spirals, FRs, SRs



EAGLE volume (env. dens. courtesy of Marasco)



Atlas^{3D} volume (Cappellari et al. 2011)



spirals

slow-rotating ETGs

fast-rotating ETGs

90° 60° 30° ← 0° ↑ 30° 60° 90°

stars

gas overlay

3.0×10^{19} cm^{-2}

velocity field gas

±130

velocity field stars

±70

HI-stars kinematical misalignments

co-rotating

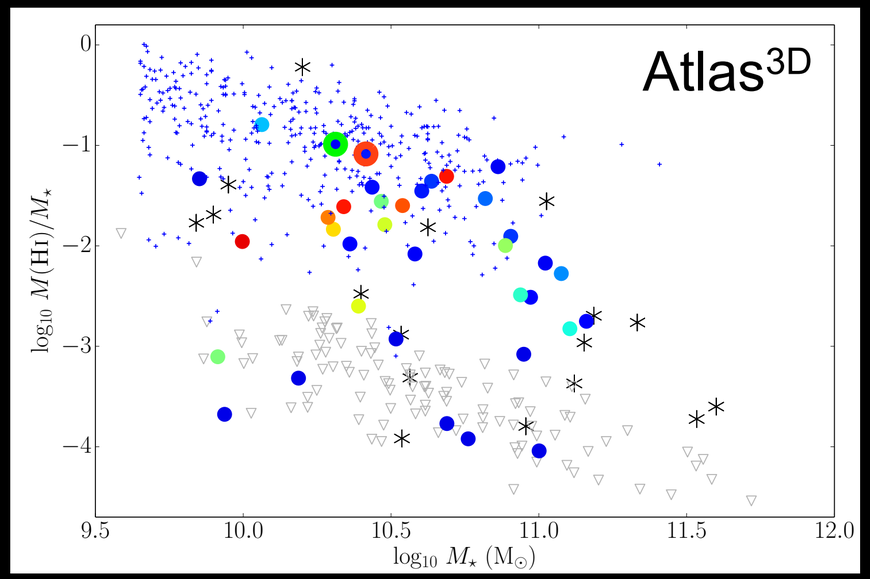
polar

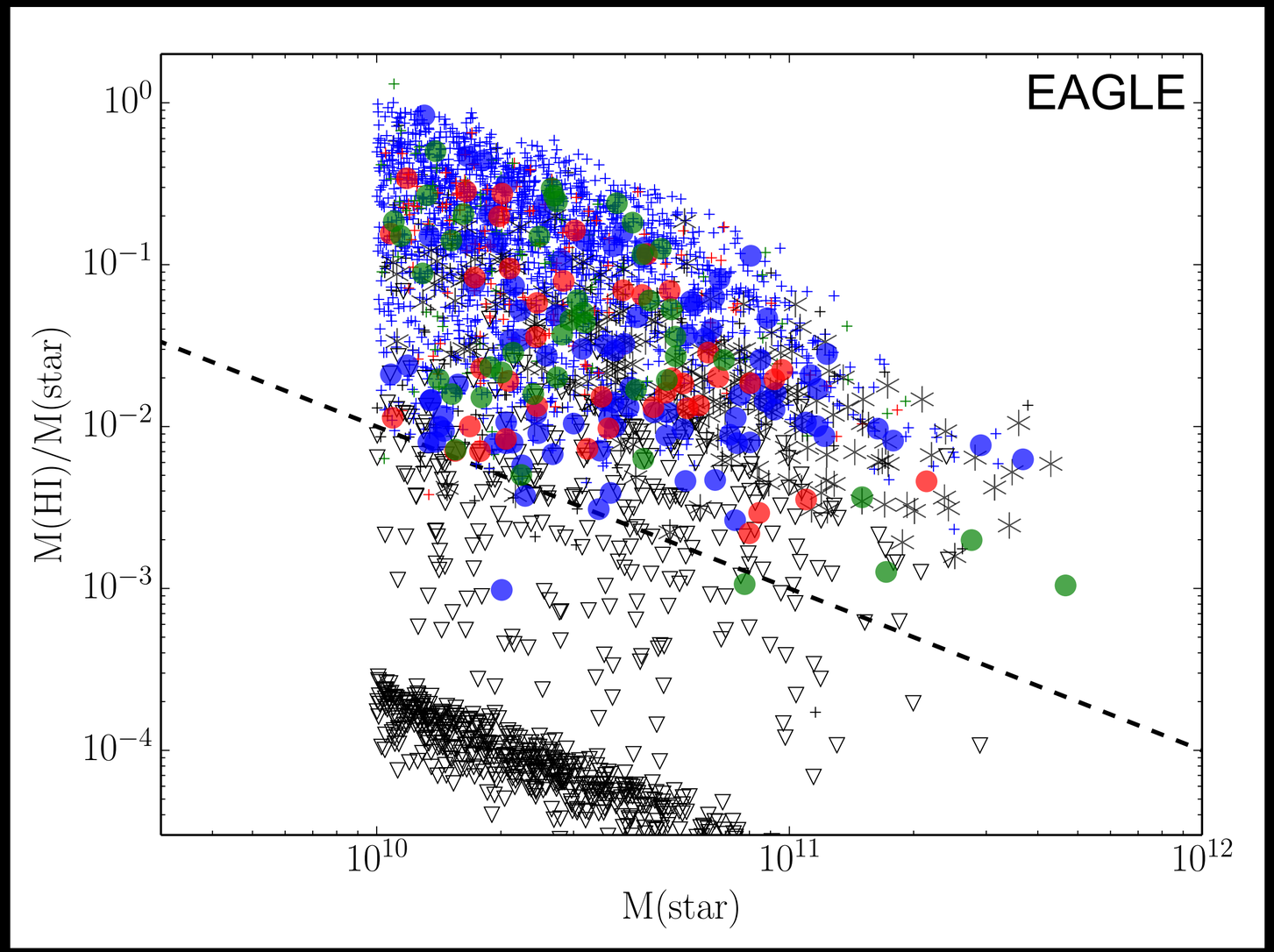
counter- rotating

0°

90°

180°





ETG HI unsettled

ETG HI undetected

ETG HI disc/ring

spirals

Some numbers from Atlas^{3D} and EAGLE (outside clusters)

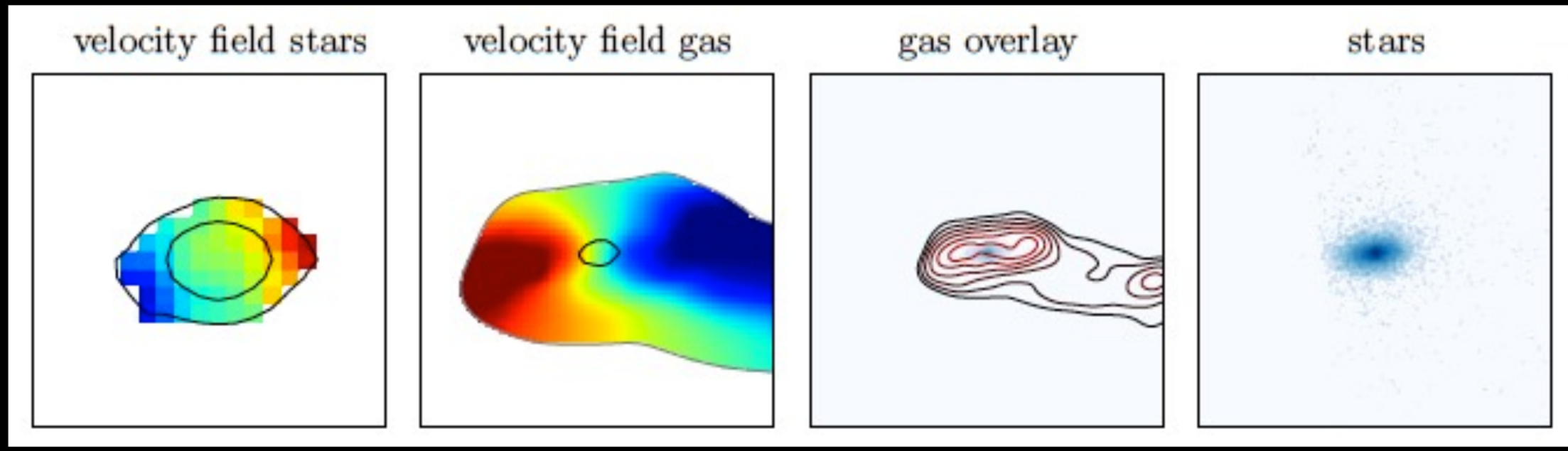
	Spirals	Early-type's	Fast rotators	Slow rotators
Nr galaxies	1936	827 127	583 111	244 16
HI det rate	99%	44% 39%	40% 37%	54% 50%
HI disc rate	94%	20% 25%	20% 25%	19% 25%
corotating fraction	89%	51% 45%	50% 50%	53% 0%

Possible problems with EAGLE

- Too many SRs
- Morphology-density relation not perfect
- Misaligned fraction of SRs

(Nearly) successes of EAGLE

- Can make gas-poor ETGs
- HI detection rate and mass of spirals, FRs and SRs
- HI disc rate of spirals, FRs and SRs
- Misaligned fraction of spirals and FRs
- (HI trends with environment about right)


velocity field stars
velocity field gas
gas overlay
stars