KROSS

sami galaxy survey

Durham University

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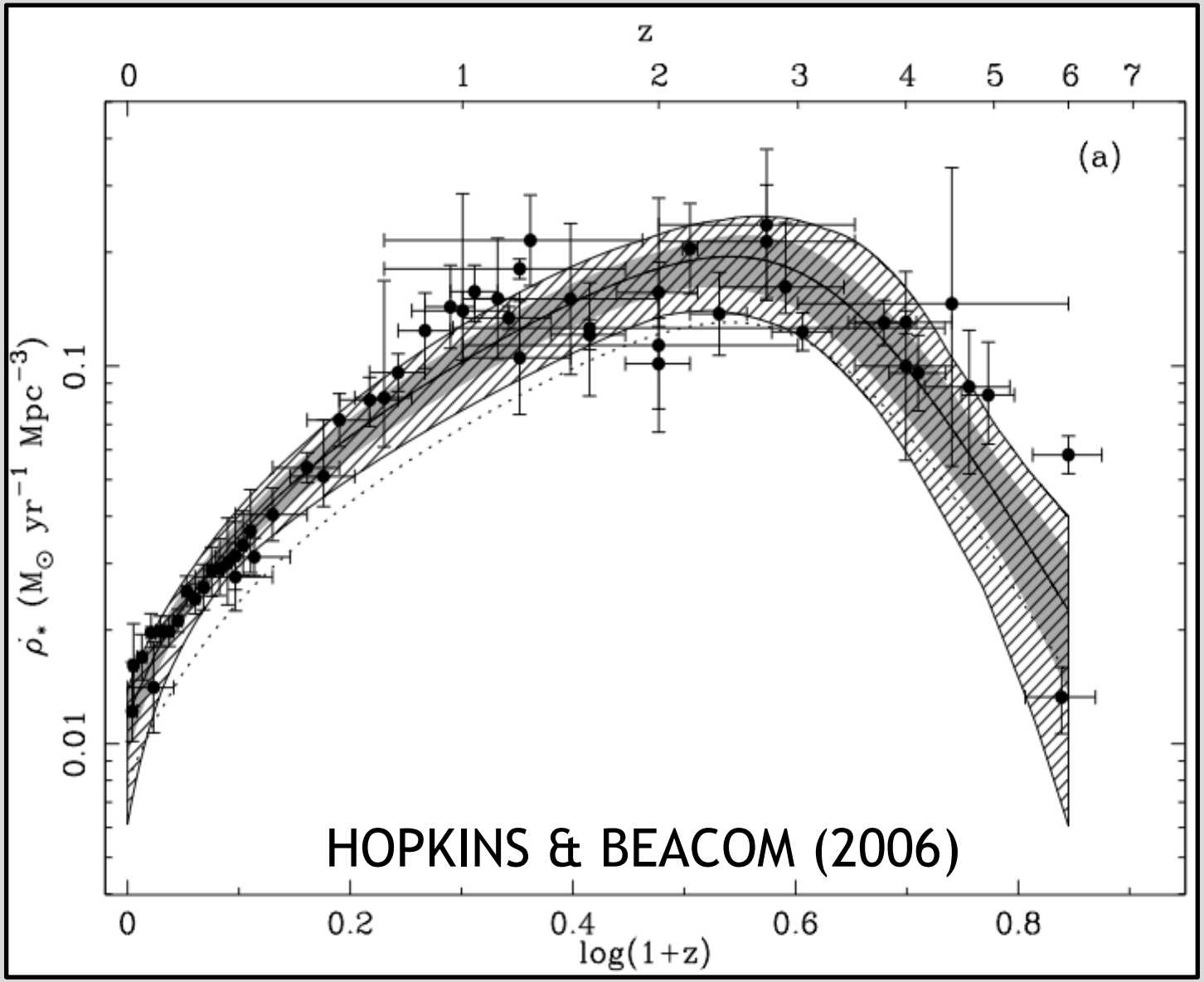
Tully-Fisher Relation: A DIRECT IFS COMPARISON OF GALAXIES ACROSS ~8 Gyr

GALAXY EVOLUTION WITH REDSHIFT

Durham University



GALAXY EVOLUTION WITH REDSHIFT

Durham University

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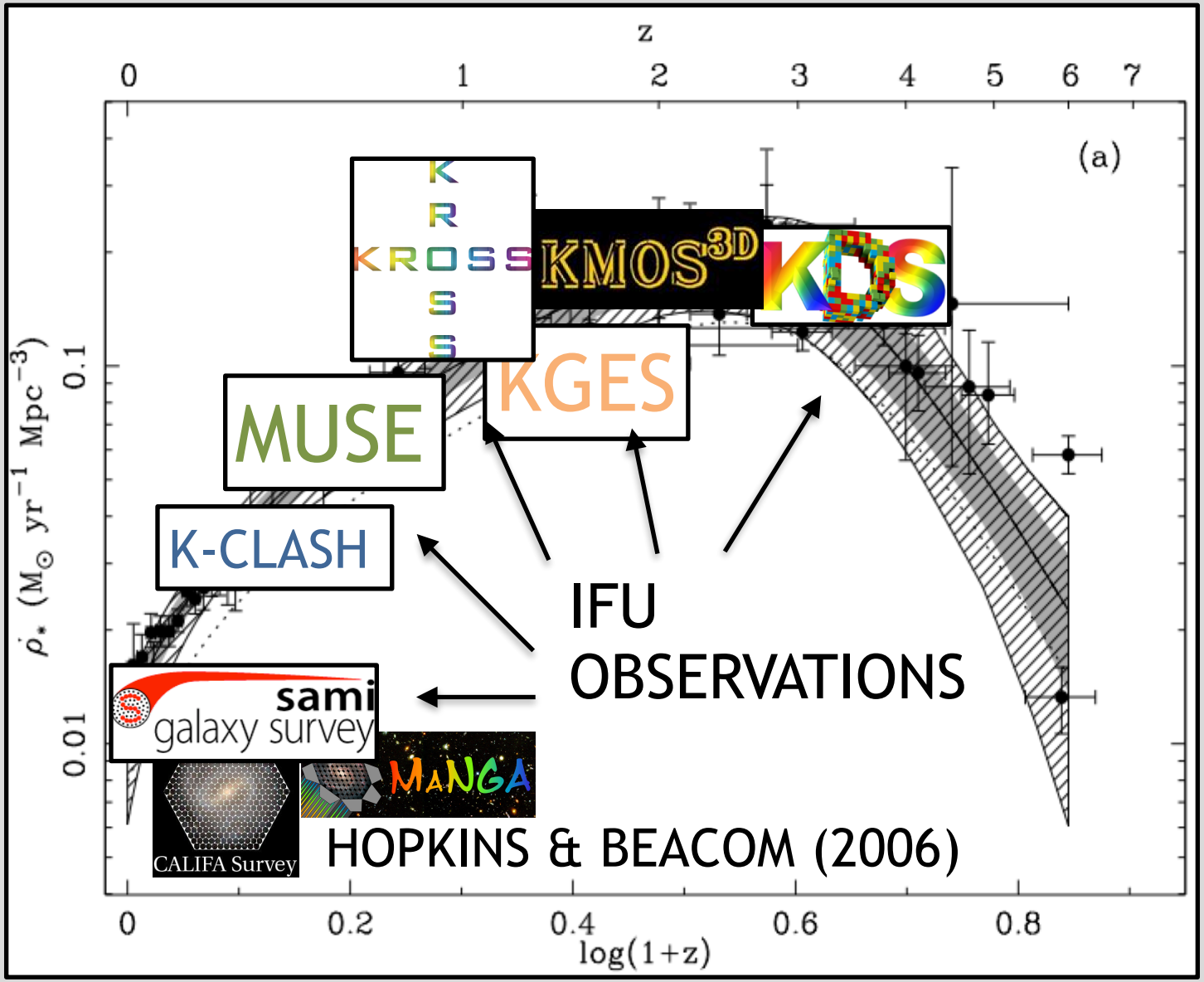

“DIRECT” COMPARISON?

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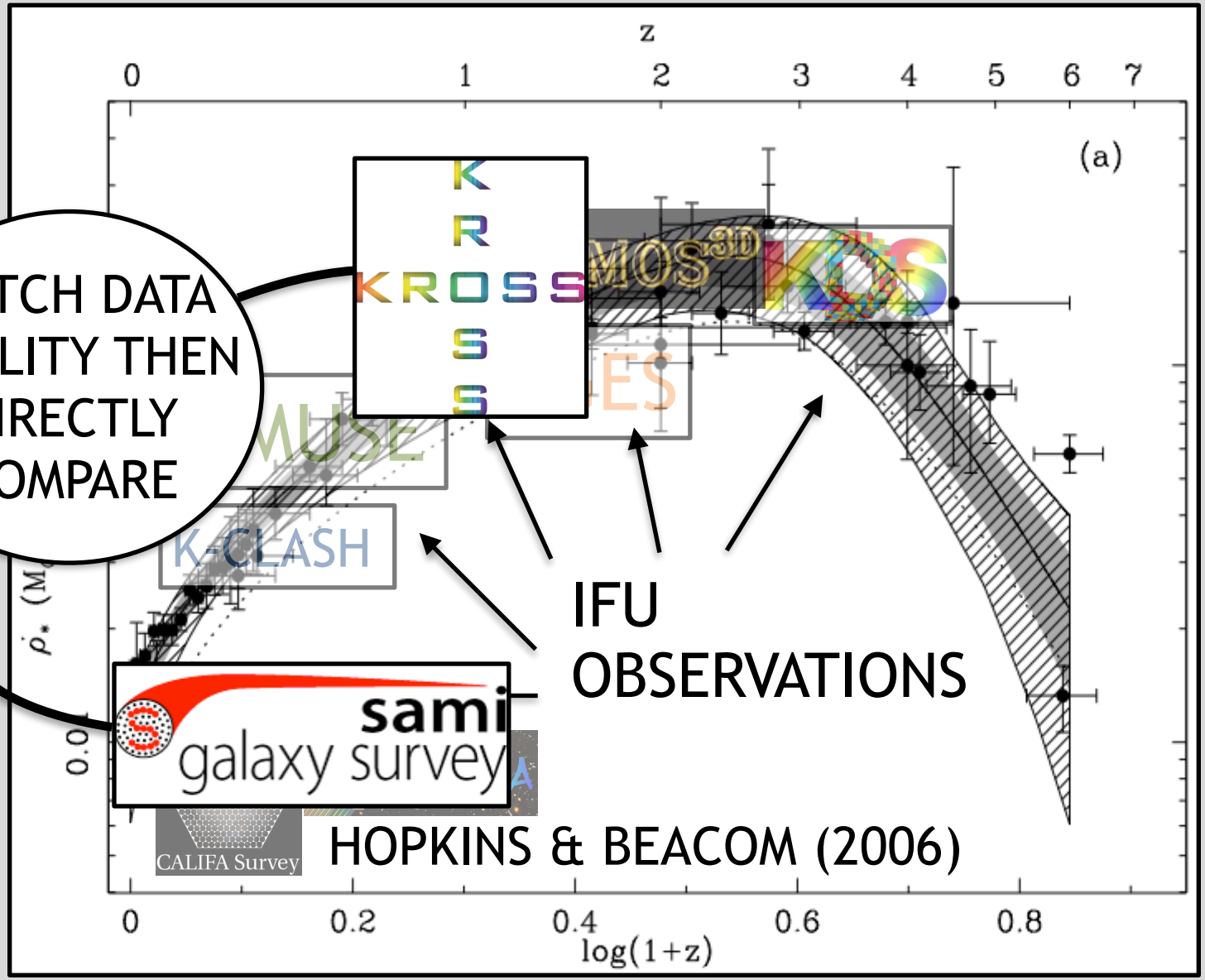

MATCH DATA QUALITY THEN DIRECTLY COMPARE

IFU OBSERVATIONS

KMOS Redshift One Spectroscopic Survey

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Durham: Richard Bower (co-PI), Mark Swinbank, Ian Smail, Ray Sharples, Helen Johnson

Oxford: Martin Bureau (co-PI), Andy Bunker, Matt Jarvis

ESO: Chris Harrison

Copenhagen: Georgios Magdis

Lancaster: John Stott, David Sobral

Others: Philip Best, Owen Turner

KROSS

KROSS

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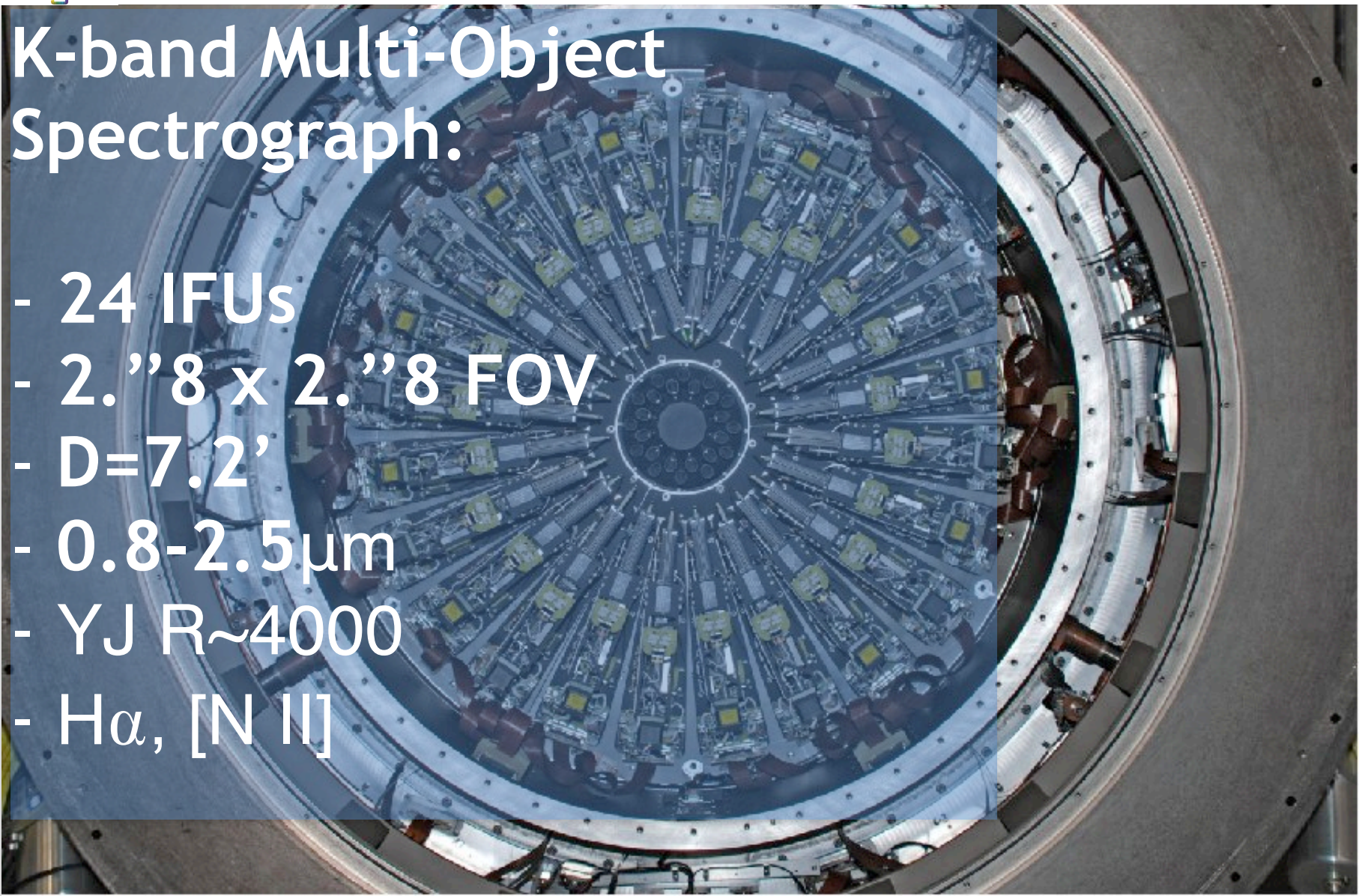

K-band Multi-Object Spectrograph:

- 24 IFUs
- 2.”8 x 2.”8 FOV
- D=7.2’
- 0.8-2.5μm
- YJ R~4000
- Hα, [N II]

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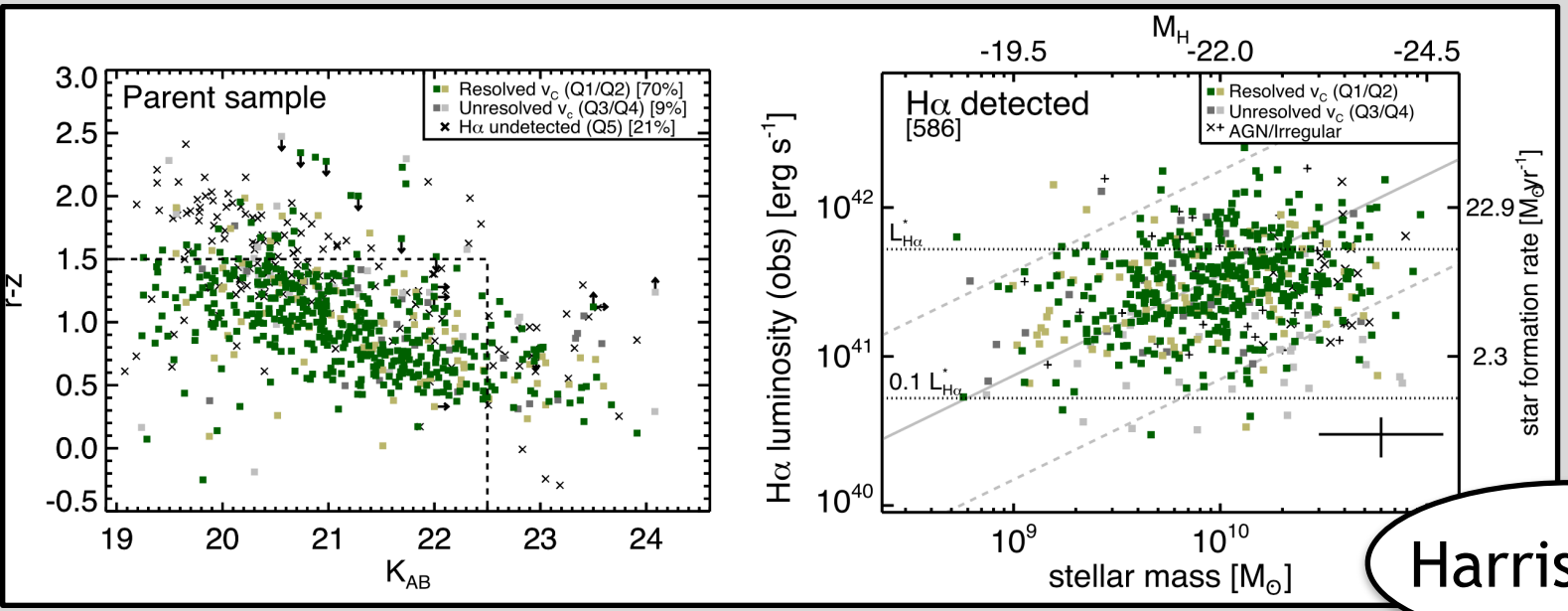

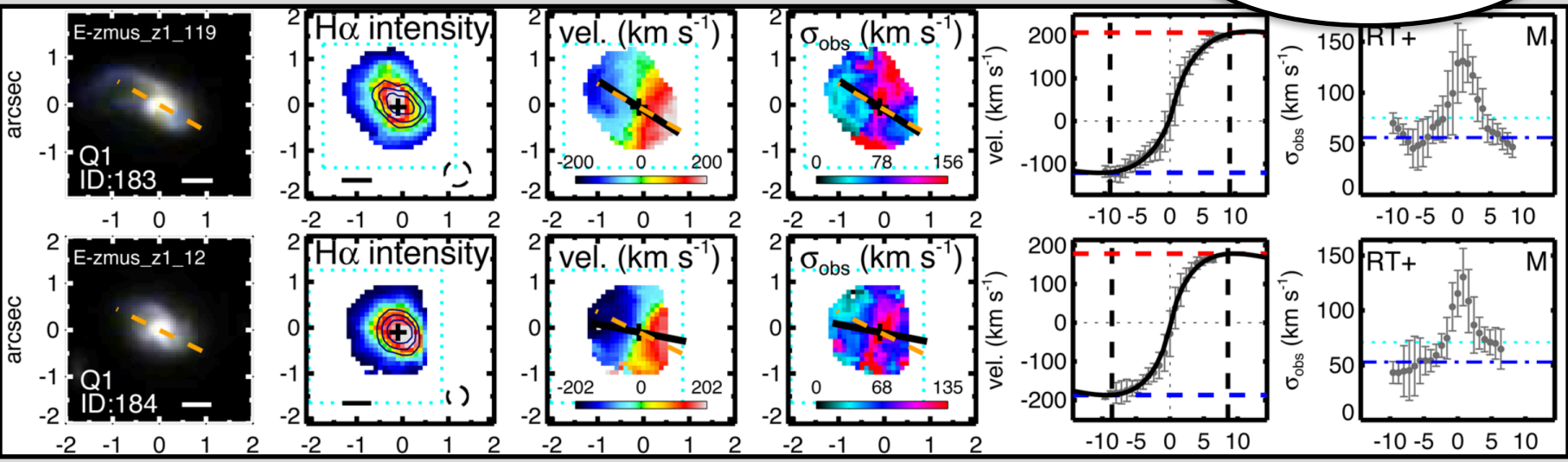

SAMI

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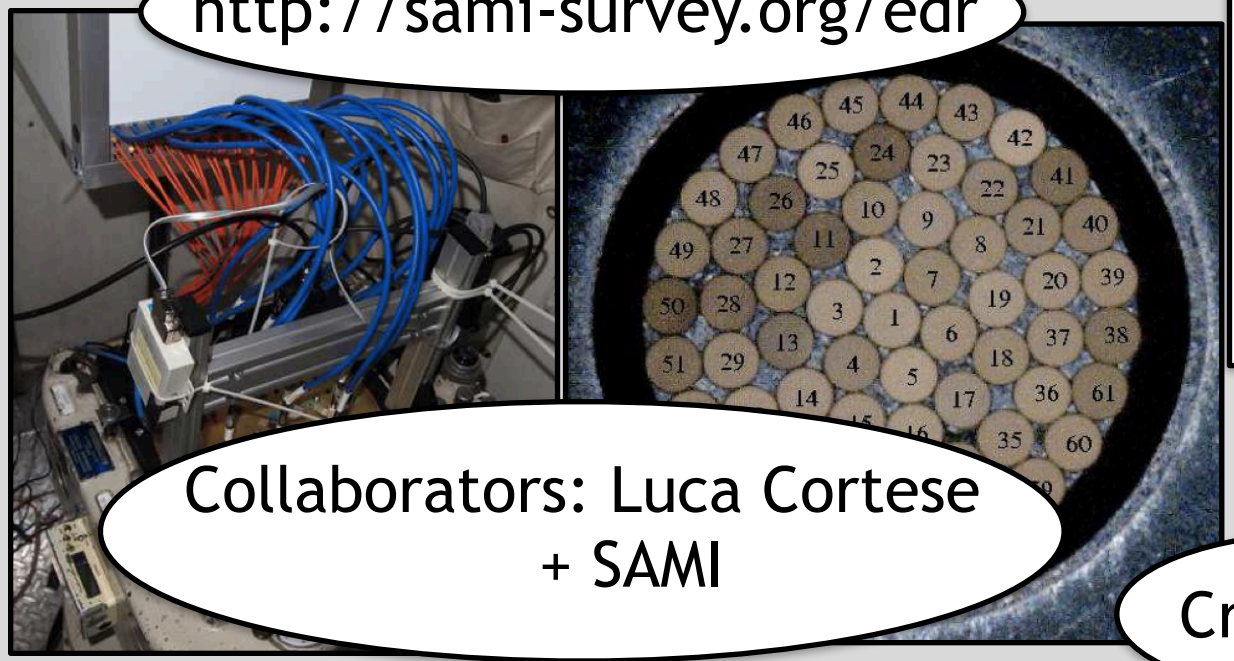
SDSS image	SAMI Flux	SAMI velocity

http://sami-survey.org/edr



Collaborators: Luca Cortese + SAMI

- 12 x 1.”6 “hexabundles” of 61 fibres
- 0.”5 spaxels
- D = 14.”7 FOV
- Red ~630-740nm

Croom+12

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SAMI

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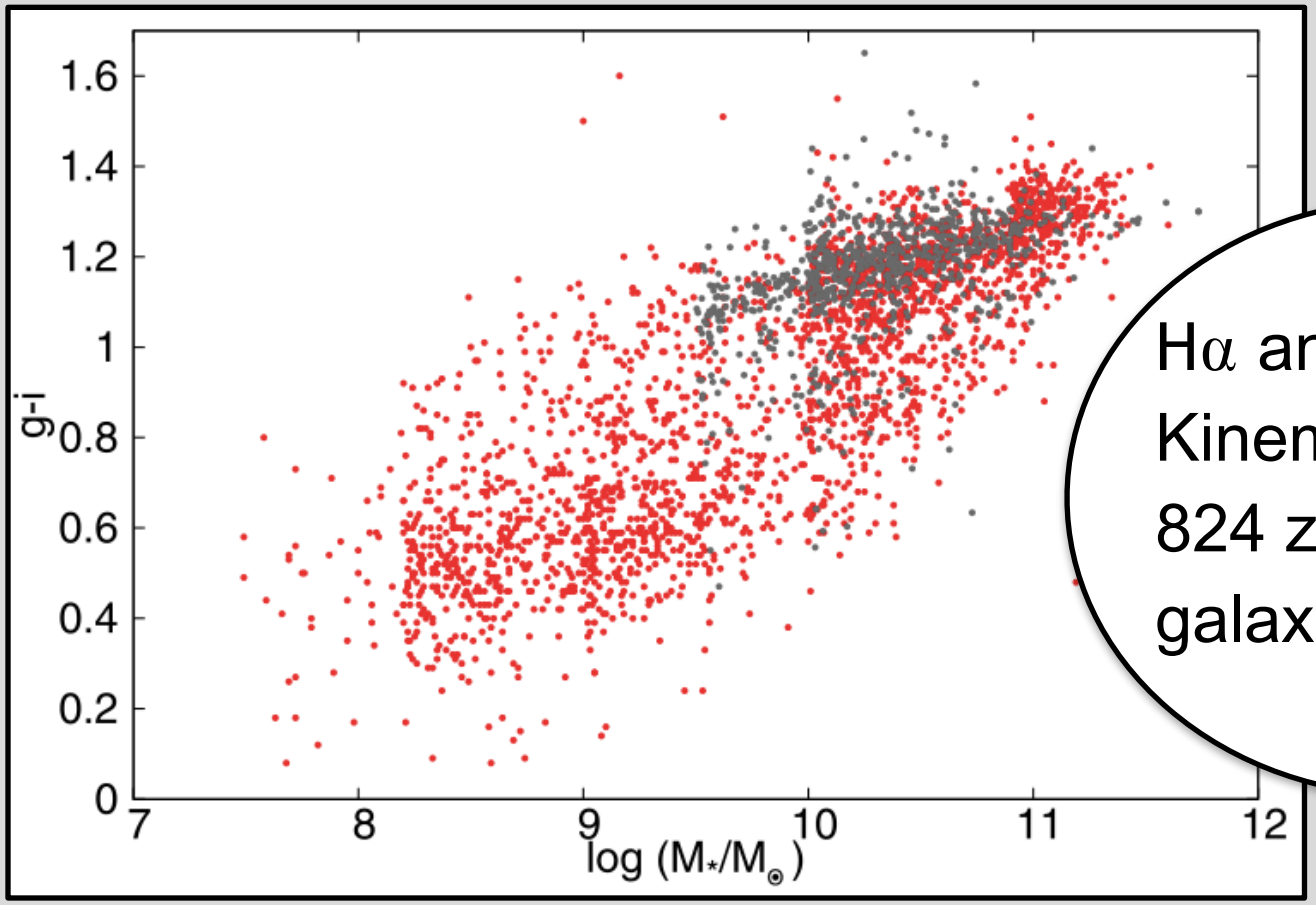

Hα and [N II] Kinematics from 824 z~0 SAMI galaxies in GAMA

Bryant+16

“DIRECT” COMPARISON?

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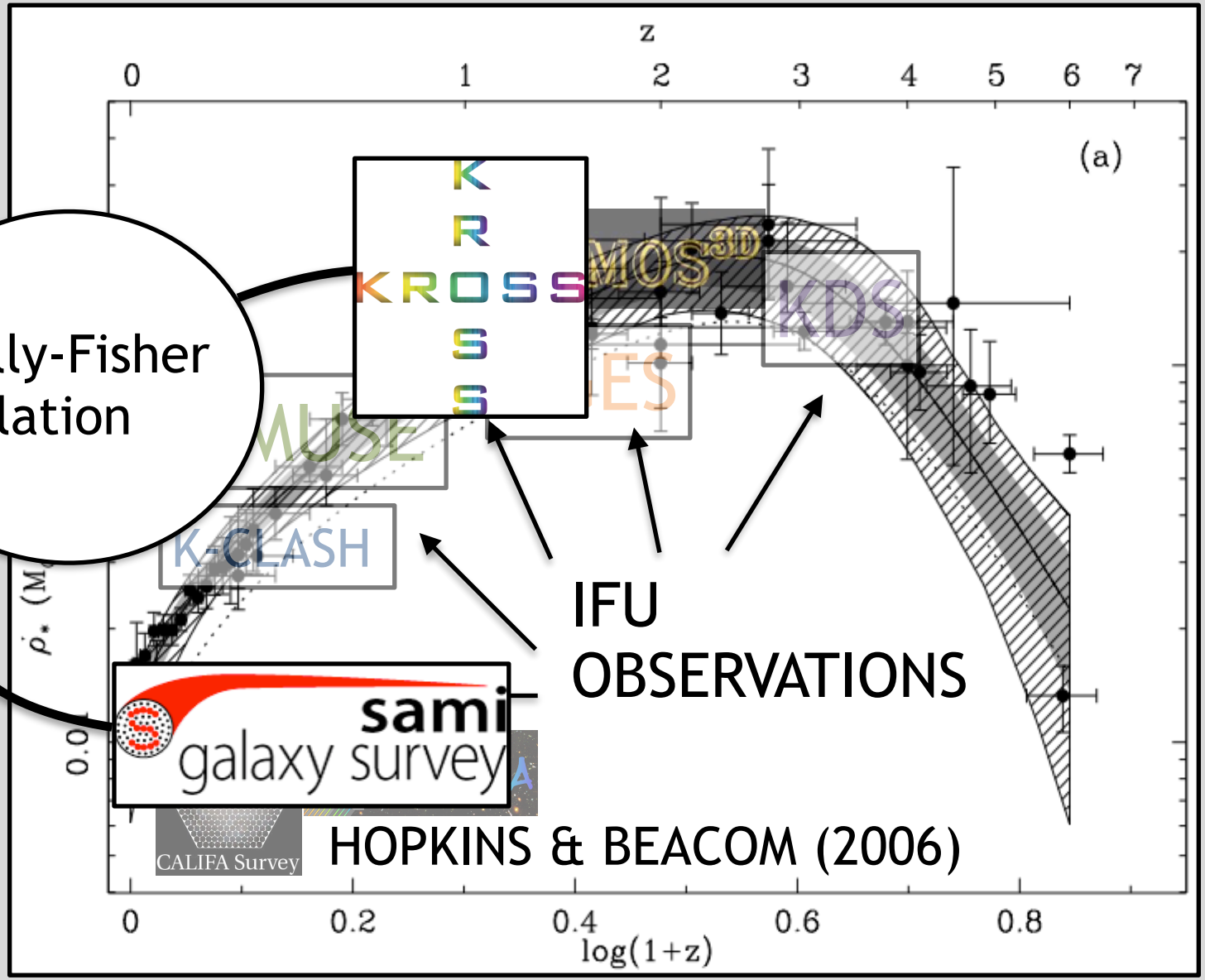


Tully-Fisher Relation

IFU OBSERVATIONS

HOPKINS & BEACOM (2006)

$v^2 = GM/r$

$\Sigma \propto M/\pi r^2$

$M = L(M/L)$

$M \propto L(M/L) \propto v^2 r \propto (L/\Sigma)^{1/2} v^2$

$L \propto v^4/[\Sigma(M/L)]$

The Tully-Fisher Relation

Tully+Fisher 1977

$v^2 = GM/r$

$\Sigma \propto M/r^2$

$M \propto (M/L)$

$M \propto L(M/L) \propto v^2 r \propto (\Sigma(M/L))^{1/2} v^2$

$L \propto v^4/[\Sigma(M/L)]$

PHOTOMETRY

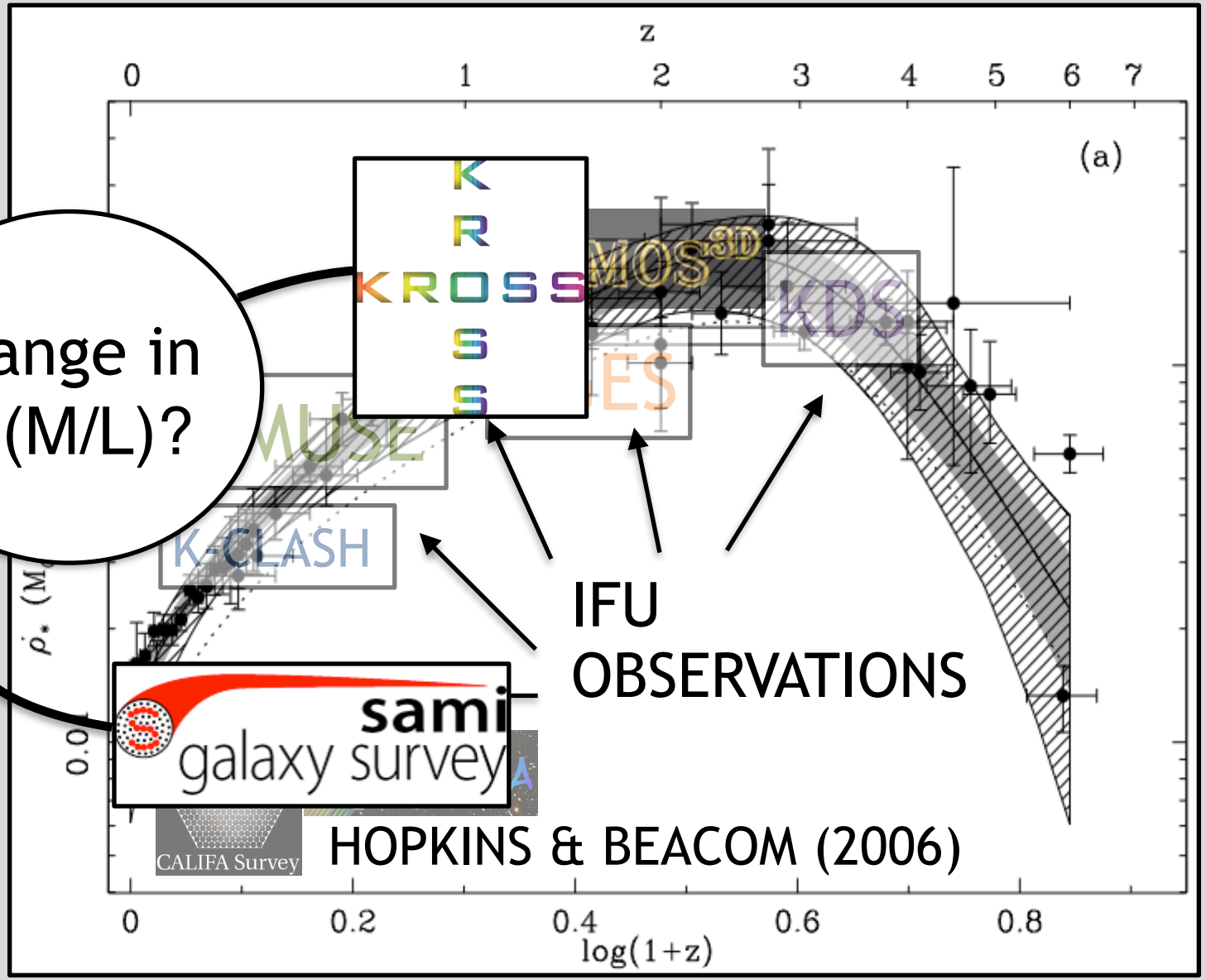
IFS

PROBE THIS

The Tully-Fisher Relation

Tully+Fisher 1977

“DIRECT” COMPARISON?



Change in Σ(M/L)?

IFU OBSERVATIONS

KROSS-SAMI

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No

Miller+11,12
Conselice+05
Flores+06
Kassin+07a,b
Tiley+16

Evolution in TFR zero-point?

Yes

Chiu+07
Puech+08
Cresci+09
Gnerucci+11
Swinbank+12
Vergani+12
Sobral+13
Tiley+16
Übler+17
Straatman+17

KROSS-SAMI

TILEY 2017

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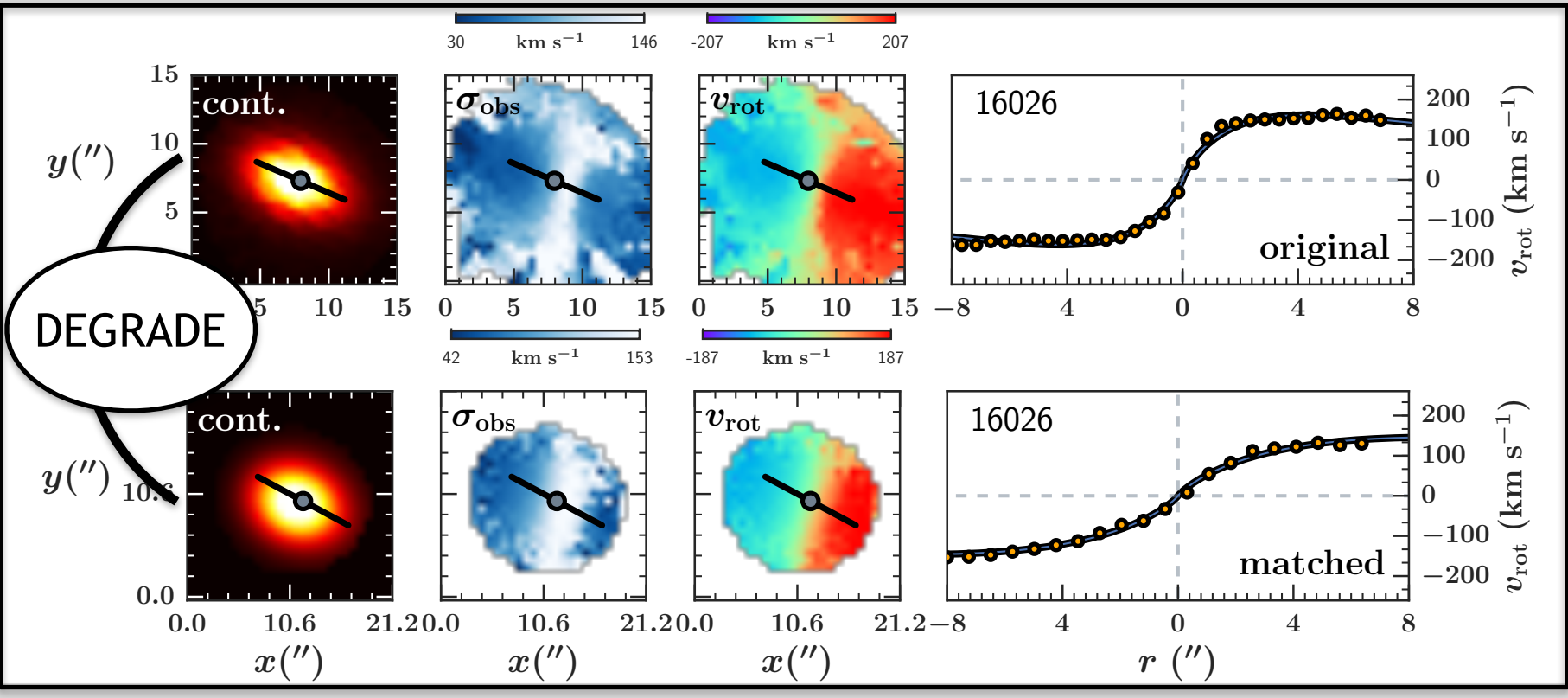

Degrade SAMI data to match KROSS quality:

- spatial (kpc) res. & spectral resolving power and sampling
- median Hα S/N

KROSS-SAMI

sami galaxy survey

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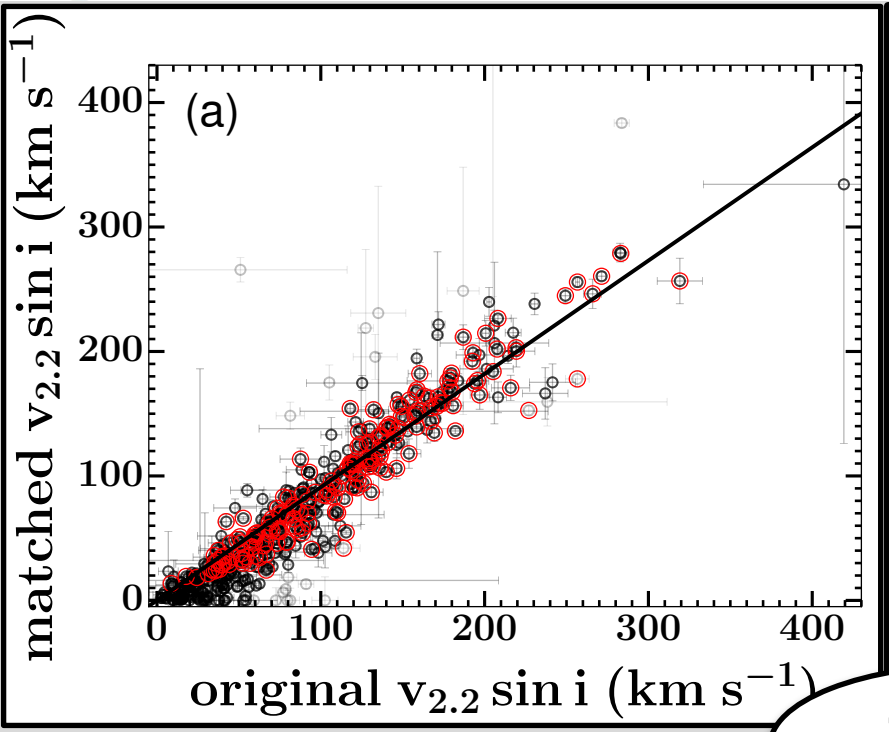

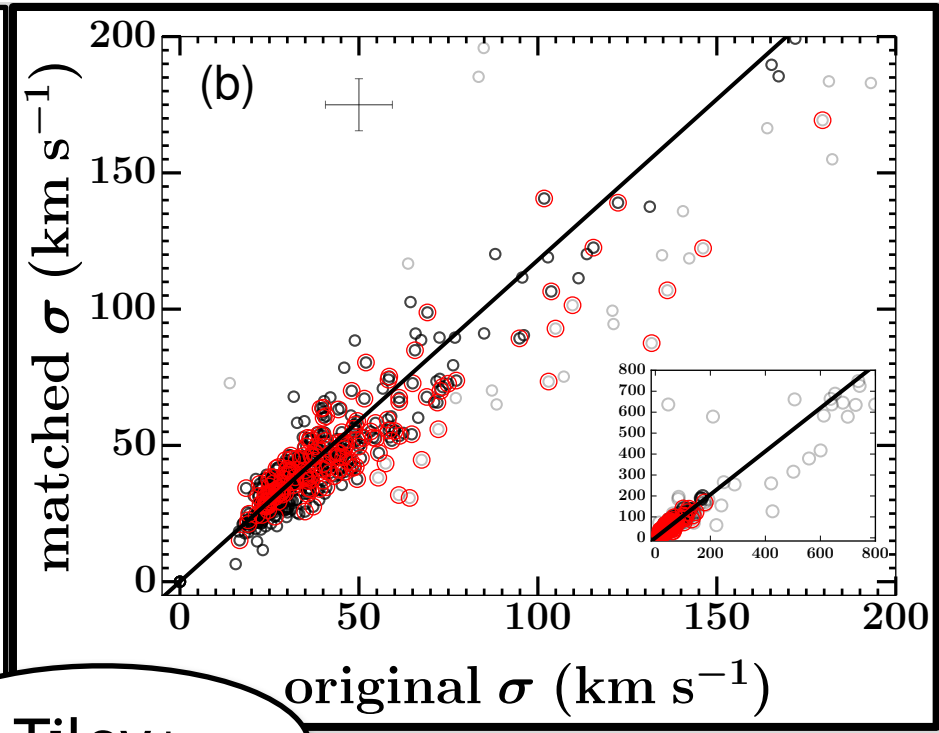

Tiley+

Strongly correlated but measurements from matched data biased ~10-15% toward lower v and higher σ - despite beam smearing correction

KROSS-SAMI

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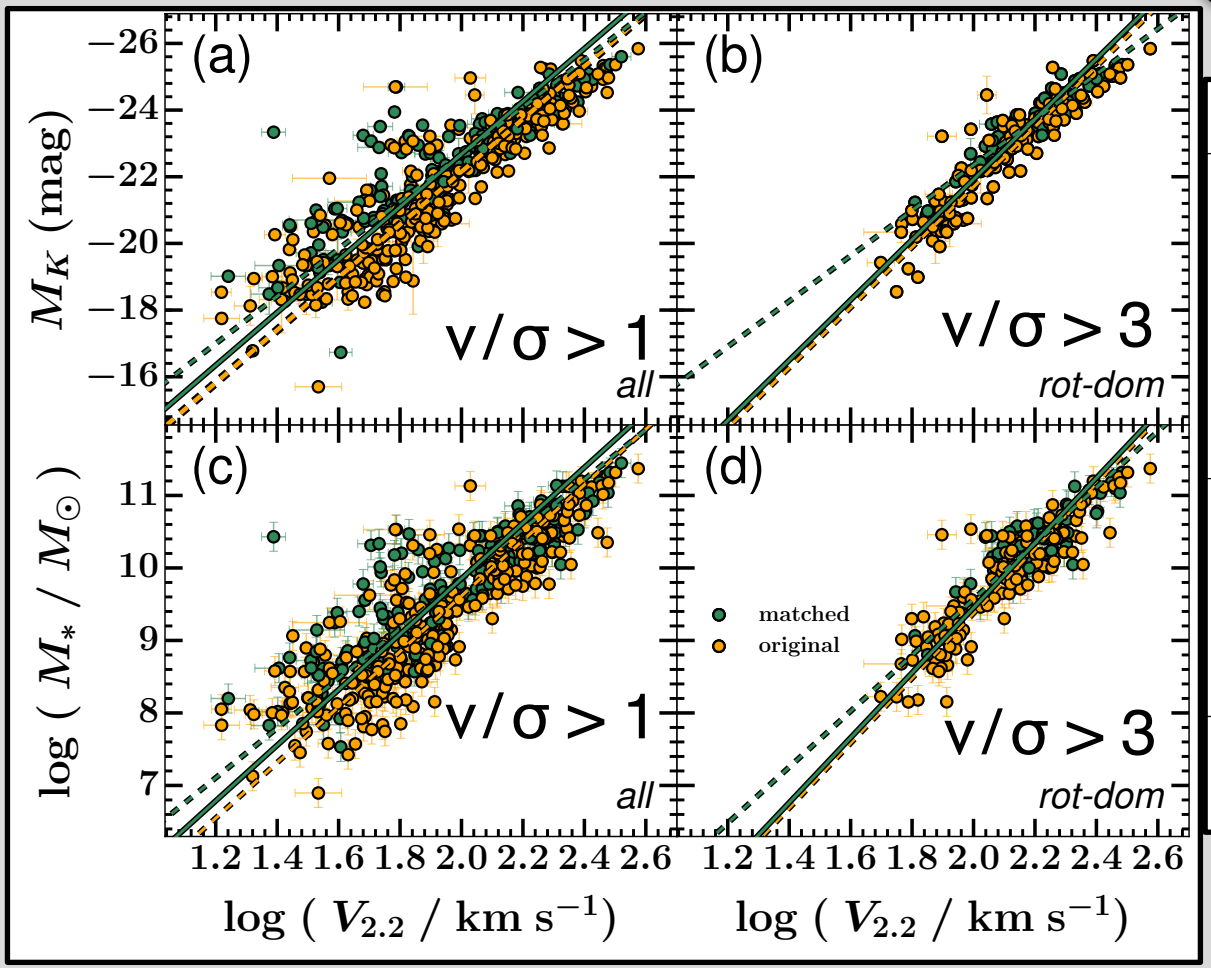
SAMI MATCHED
SAMI ORIGINAL

Tiley+



Sub-sample	Criterion	SAMI original	SAMI matched	KROSS
parent	Detected in Hα	824	824	719
	Resolved in Hα	752	575	552
	M_K and M_* from SED fitting	751	574	535
	$v_{2.2}$	668	479	528
all	$\frac{\Delta_{v_{2.2}}}{v_{2.2}} \leq 0.3$	614	404	464
	$\frac{r_{\mathrm{H}\alpha,\mathrm{max}}}{r_e} \geq 1.31$	516	361	454
	$45° < i < 85°$	355	248	355
	$\frac{v_{2.2}}{\sigma} + \Delta\frac{v_{2.2}}{\sigma} > 1$	306	186	297
rot-dom	$\frac{v_{2.2}}{\sigma} + \Delta\frac{v_{2.2}}{\sigma} > 3$	164	78	156
	$R^2 > 80\%$	142	71	138

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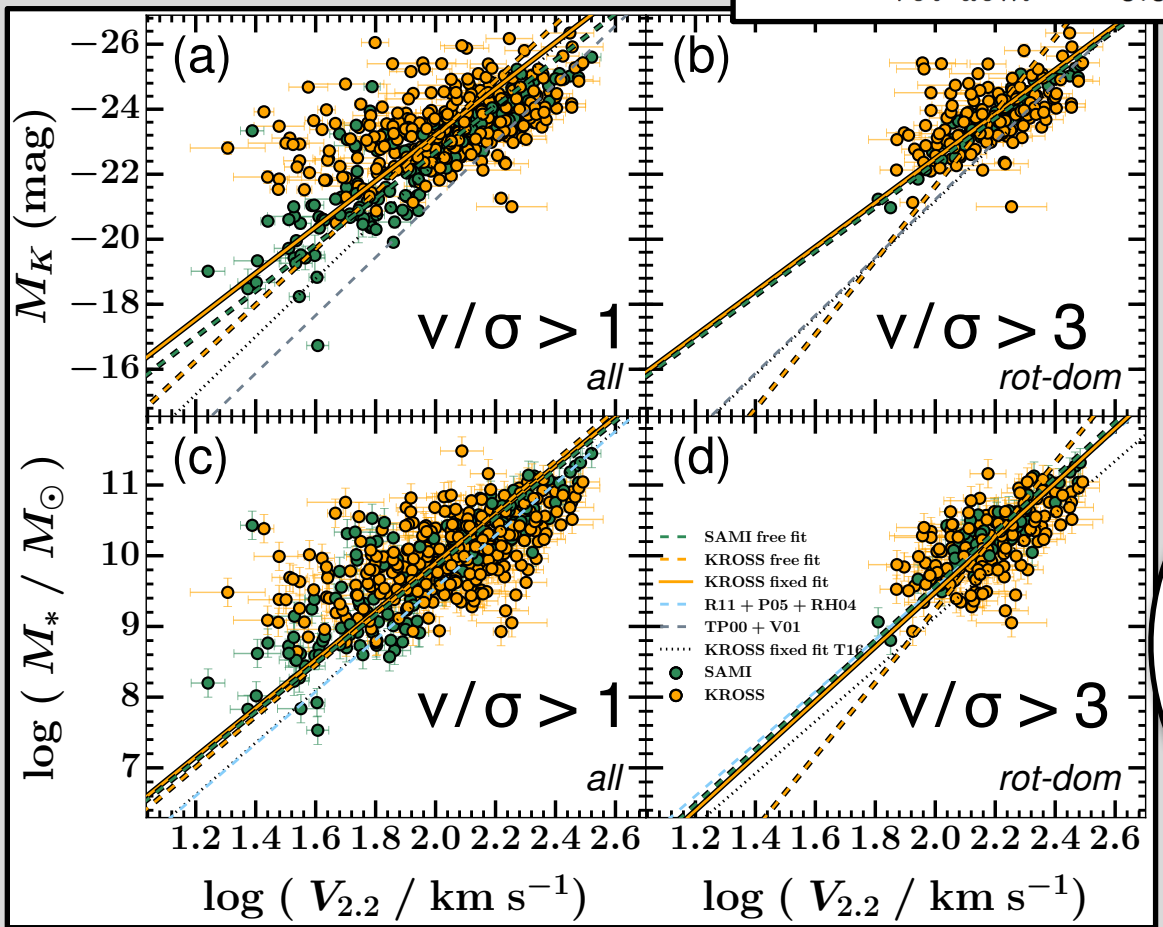
SAMI MATCHED
KROSS

TFR	Sample	matched-original	KROSS-matched
M_K	*all*	-0.53 ± 0.09 mag	-0.5 ± 0.1 mag
	rot-dom	-0.23 ± 0.08 mag	-0.13 ± 0.09 mag
M_*	*all*	0.24 ± 0.05 dex	0.05 ± 0.05 dex
	rot-dom	0.07 ± 0.05 dex	-0.08 ± 0.05 dex



Tiley+

TFR zero-point matched-original SAMI >= KROSS-matched in every case!

KROSS-SAMI

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TFR	Sample	matched-original	KROSS-matched
M_K	*all*	-0.53 ± 0.09 mag	-0.5 ± 0.1 mag
	rot-dom	-0.23 ± 0.08 mag	-0.13 ± 0.09 mag
M_*	*all*	0.24 ± 0.05 dex	0.05 ± 0.05 dex
	rot-dom	0.07 ± 0.05 dex	-0.08 ± 0.05 dex

Tiley+

Assuming constant surface mass density, for SF galaxies with $v/\sigma > 3$:

- M^*/M_{TOTAL} ↑ x 1.2 +/- 0.1 over last ~8 Gyr
- M^*/L_K ↑ x 1.3 +0.4/-0.2 over last ~8 Gyr

KROSS-SAMI

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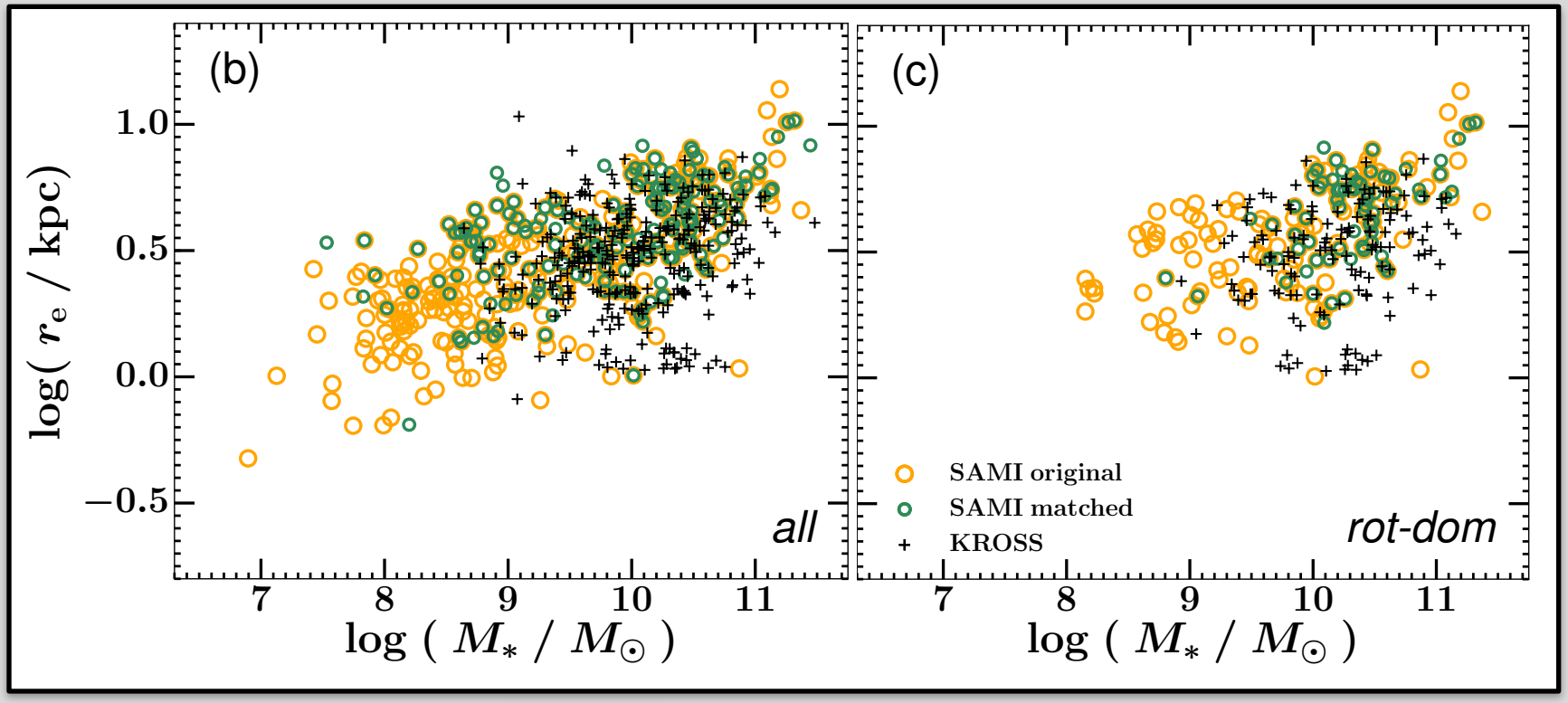

Assume constant surface mass density?

Tiley+

But...

-35% gas to baryonic mass fraction for KROSS (Stott+16)
-potential 0.24 dex offset
-short depletion timescales
-further accretion since z~1 (e.g. Elbaz+07,Salim+07,Dutton+10)
-*must* be significant M* growth since z~1

But…

must be significant M* growth since z~1

Baryonic + dark accretion & growth intimately linked over last ~8Gyr

KROSS-SAMI

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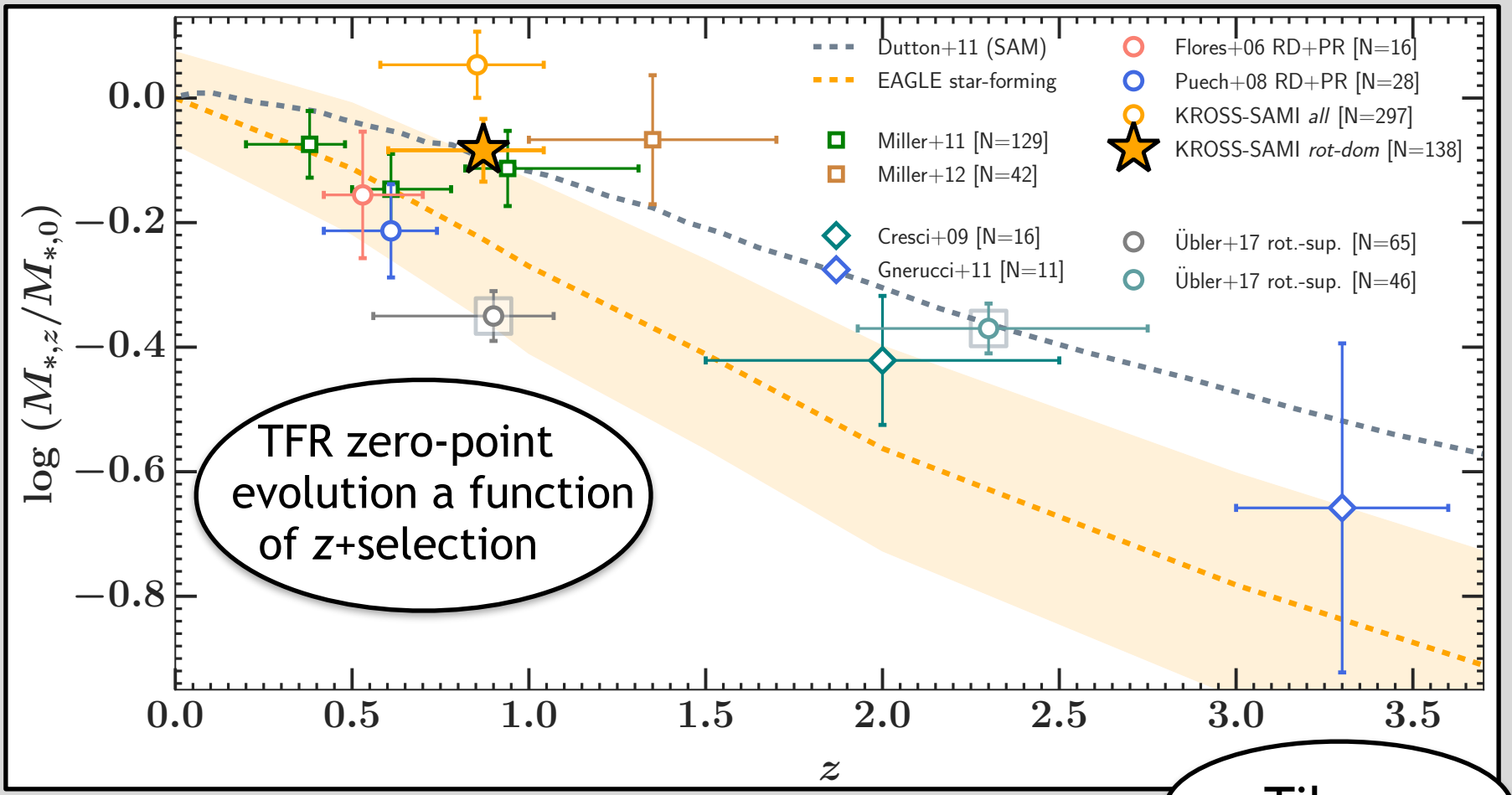

KROSS-SAMI

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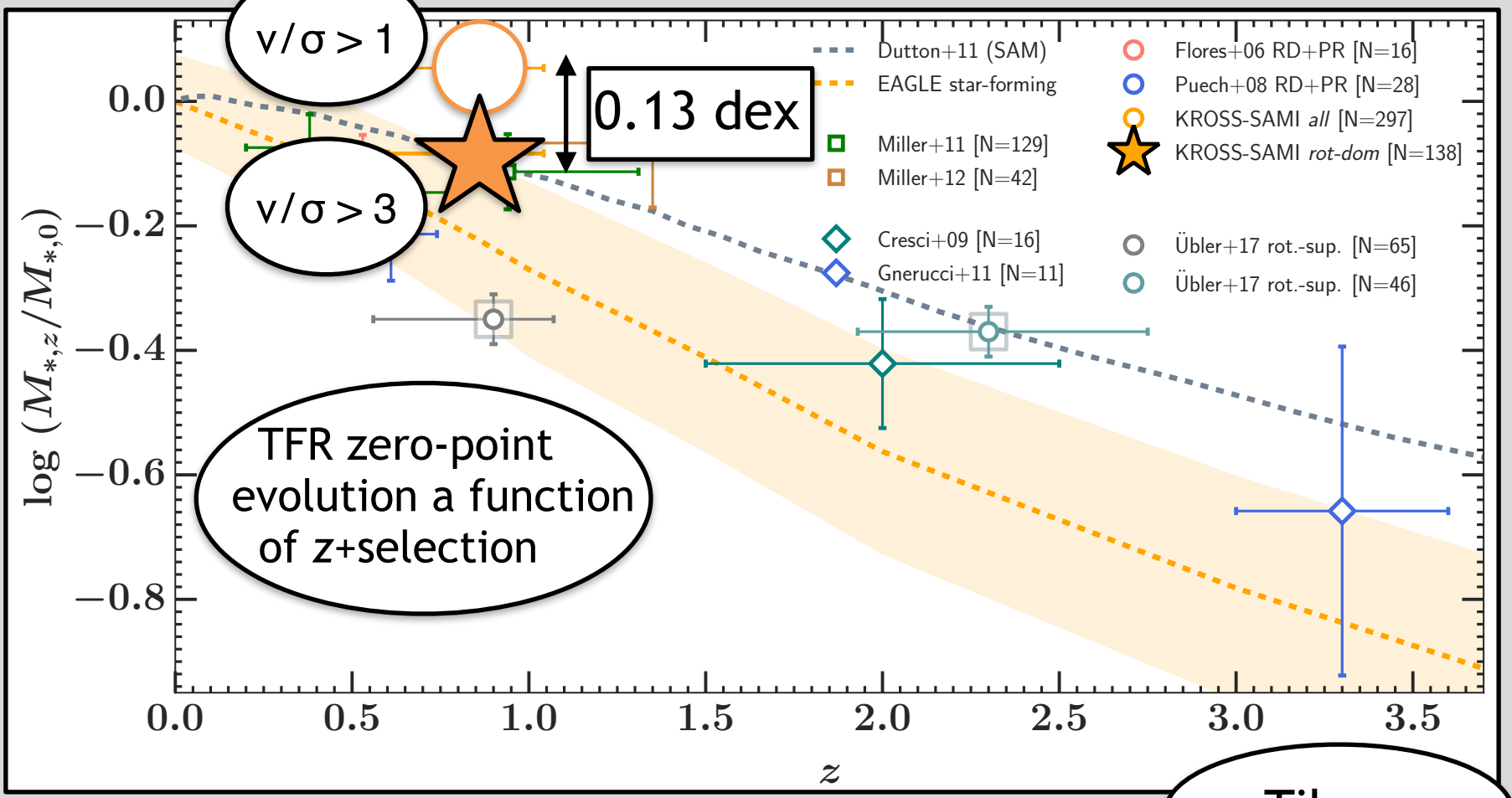

Tiley+

CONCLUSIONS

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- different sub-samples + TFRs for different data quality: same applies to all IFS comparisons between high and low-z
- Effect larger than zero-point evolution with *z*
- Literature zero-point evolution with z but this depends on data quality and sample selection
- Matched comparison gives small offset between zero-point for $v/\sigma > 3$ star forming galaxies at z~0.9 and z~0
- Despite ongoing mass assembly, M^*/M_{TOTAL} and M^*/L_K ~constant
- dark + baryonic mass growth and accretion intimately linked

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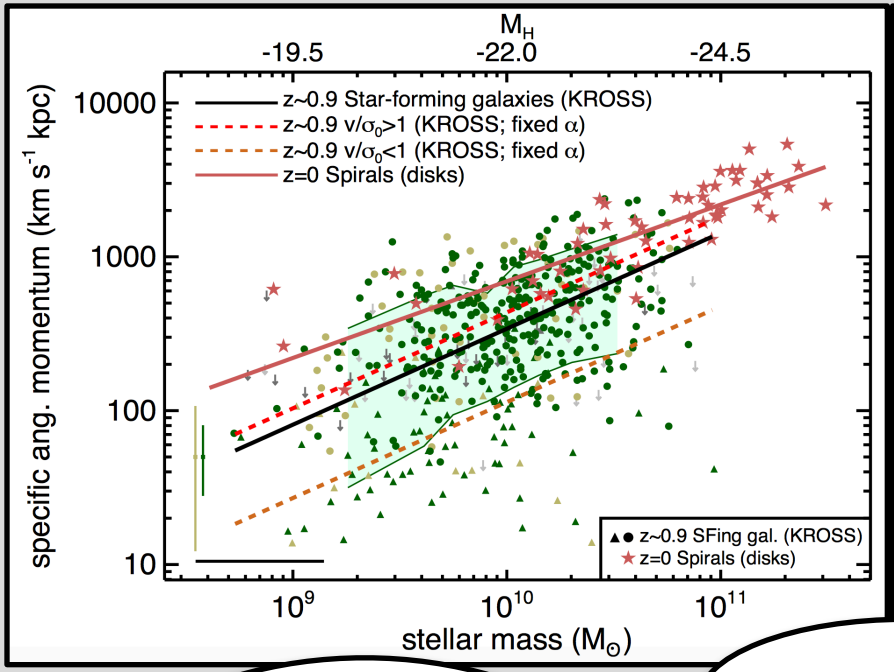

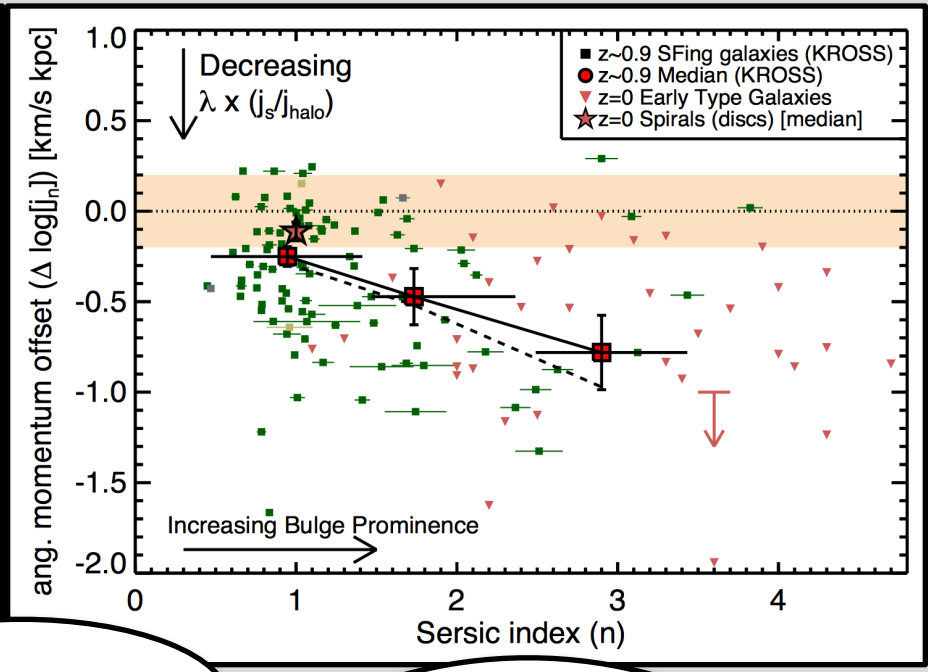

Harrison+17

~0.2–0.3 dex more specific ang. mom. In z~0 spirals than z~0.9 SF galaxies at fixed M*

On average, galaxies with higher *n* have lower specific ang. mom. at both z~0 and z~0.9

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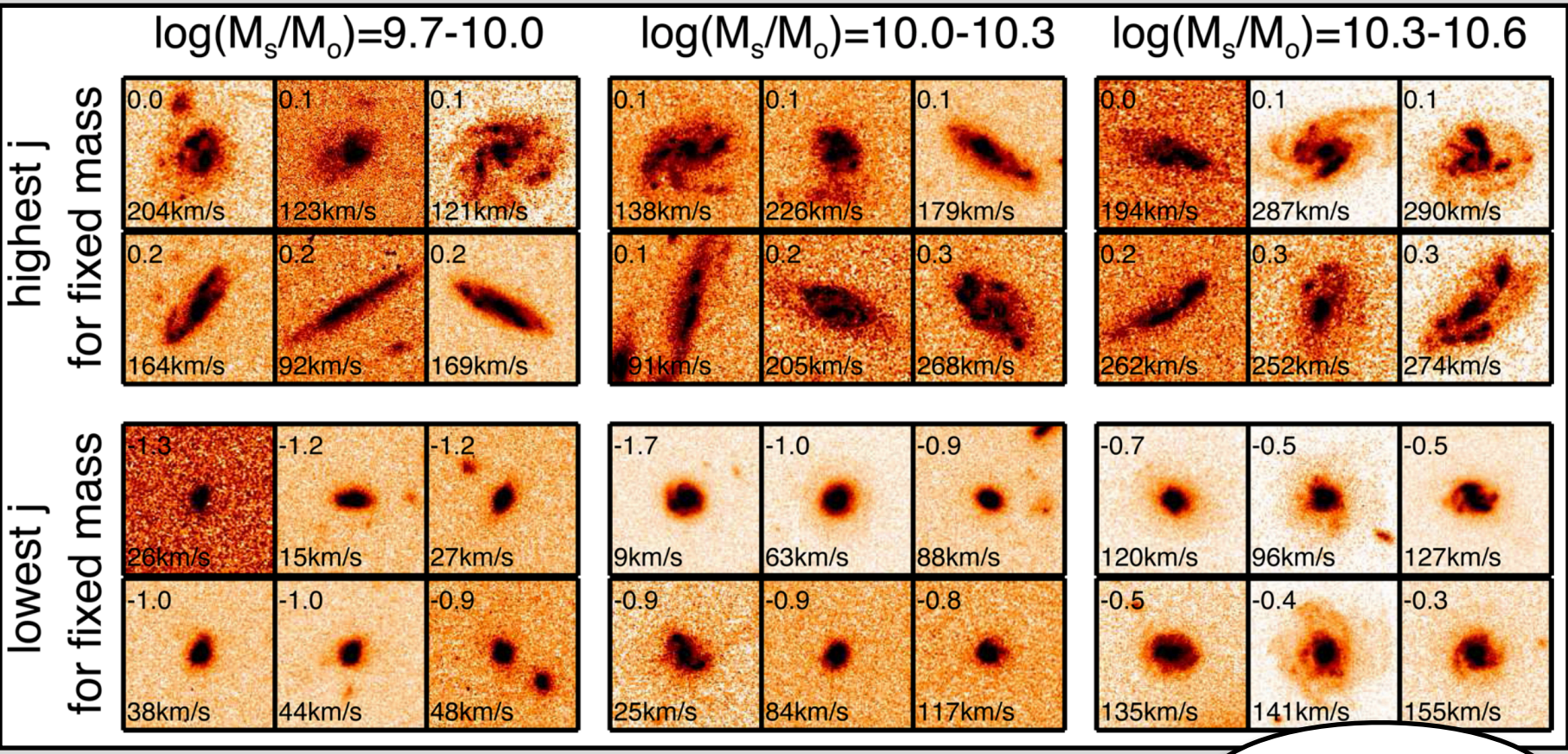

Harrison+17

Highest specific ang. mom: disc-like
Lowest specific ang. mom: more bulge-dominated