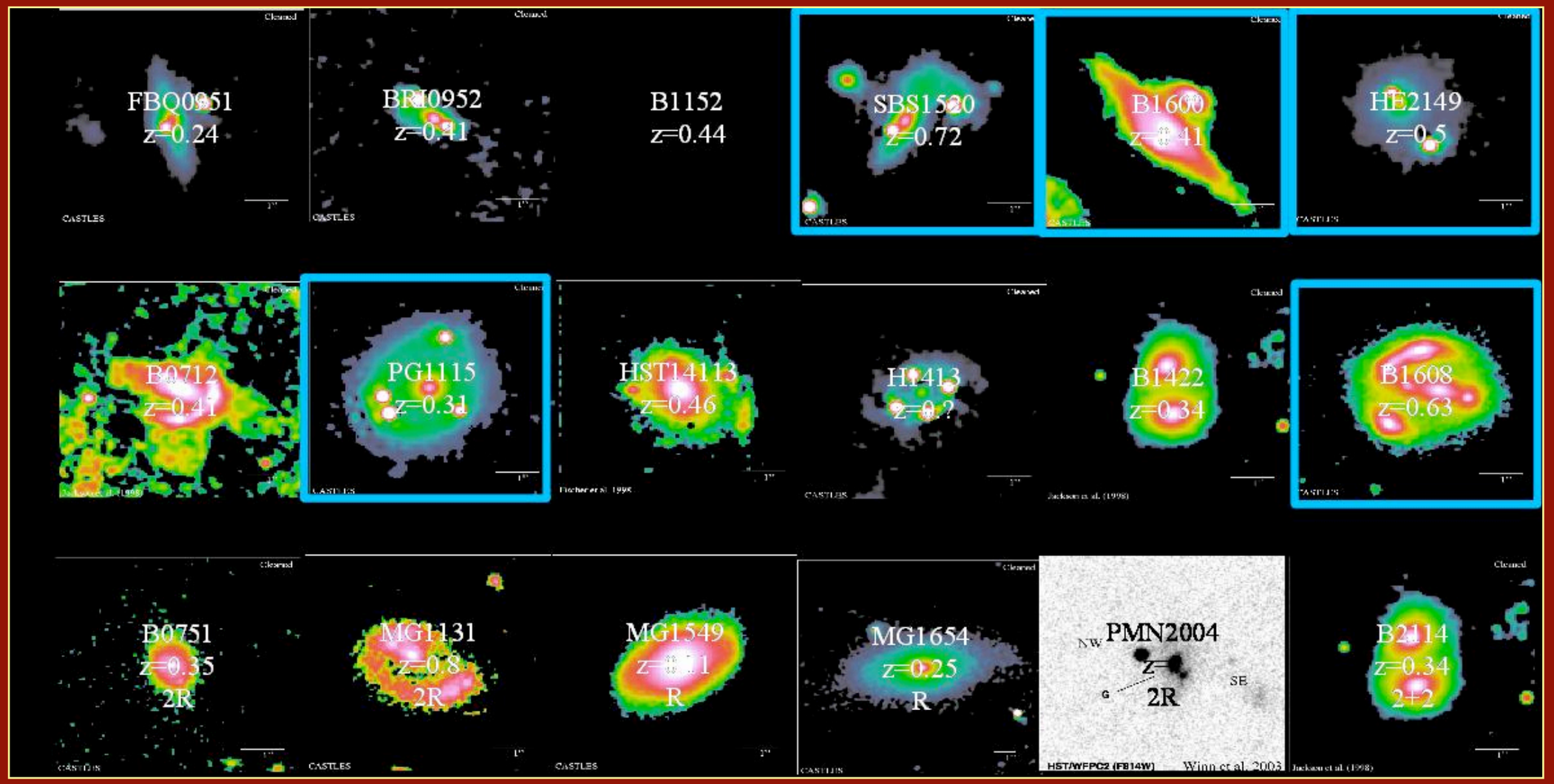
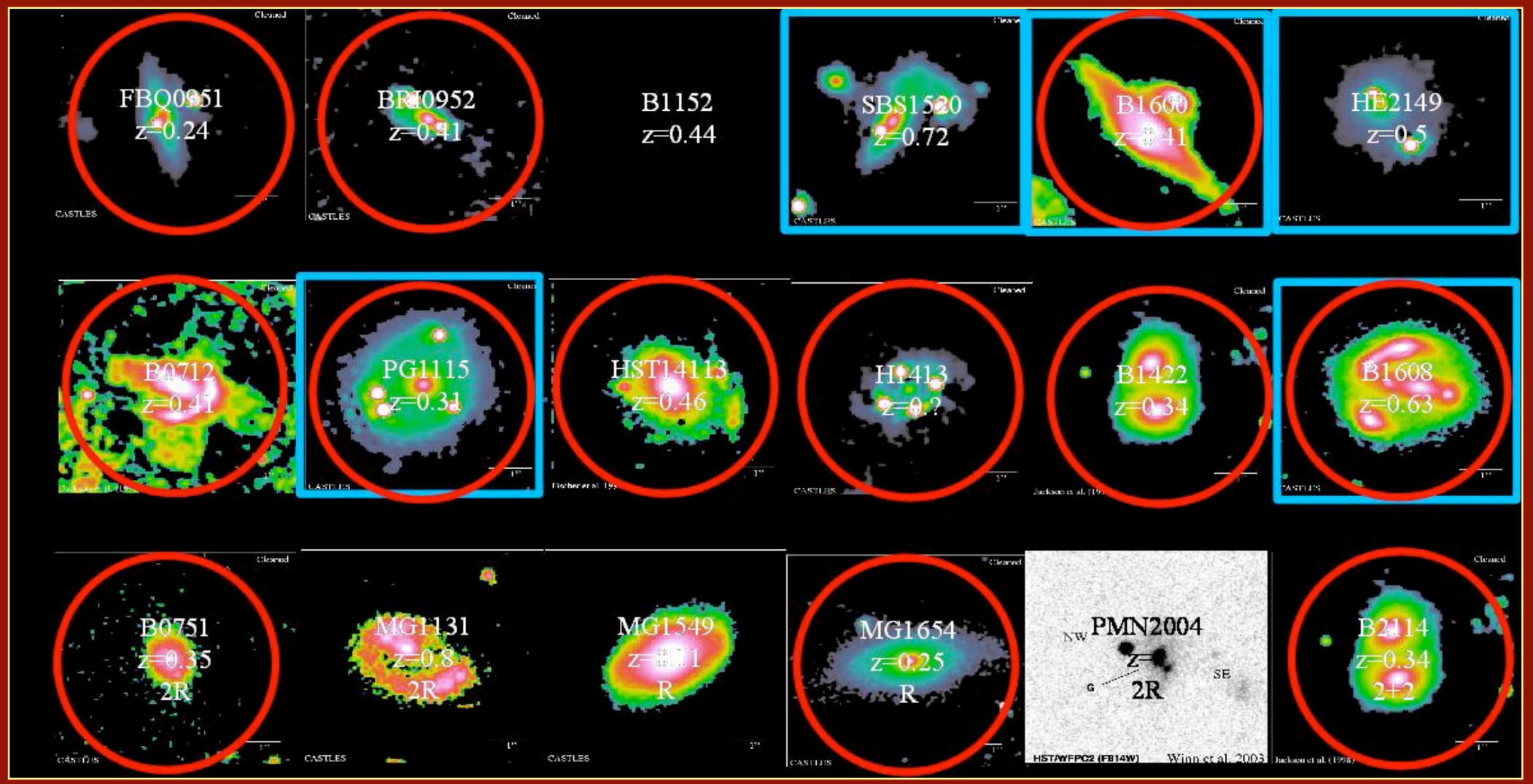
The Importance of Lens Environments

I. Momcheva, K. Williams, A. Zabludoff (Arizona)
and
C. Keeton (Rutgers)



The Importance of Lens Environments

I. Momcheva, K. Williams, A. Zabludoff (Arizona)
and
C. Keeton (Rutgers)



The Importance of Lenses

galaxy halo properties, cosmological parameters

complementary to CMB, distance ladder

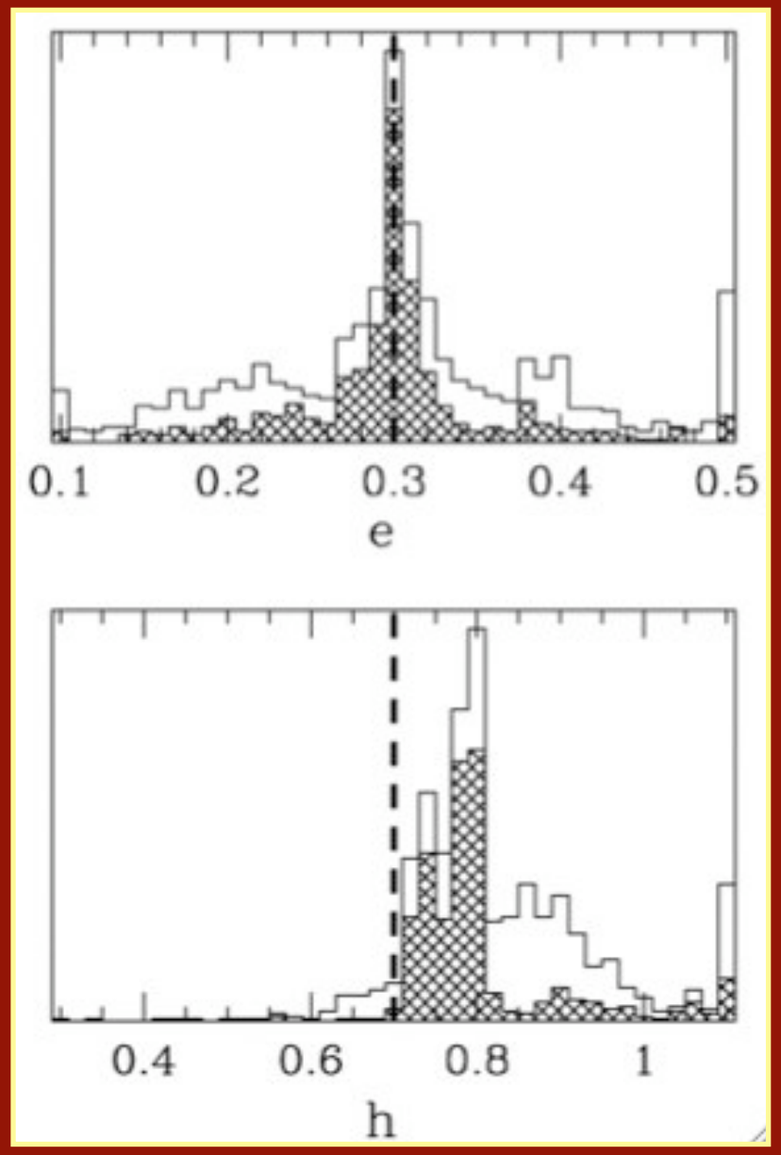
other methods have 5-10% errors

Most lens environments, line-of-sight structures unknown.

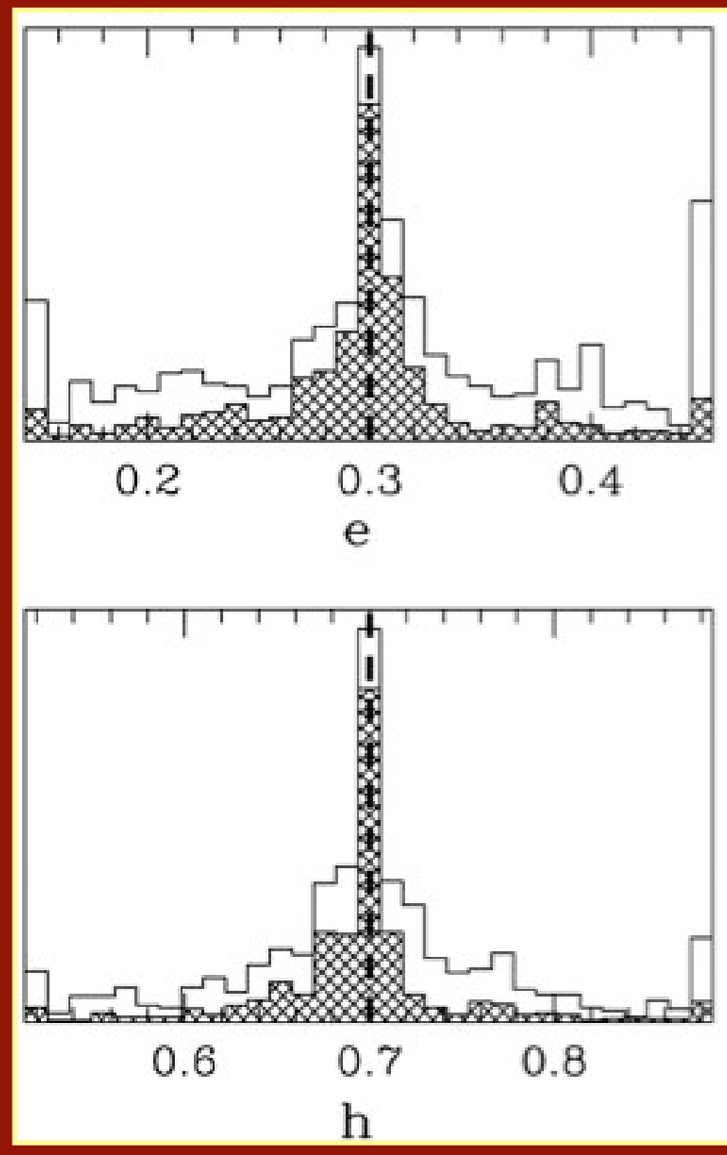
And >25% of lenses in groups or clusters (Keeton, Christlein, & Zabludoff 2000). Additional mass adds shear, convergence ==> large biases and uncertainties.

Lens Environments: So What?

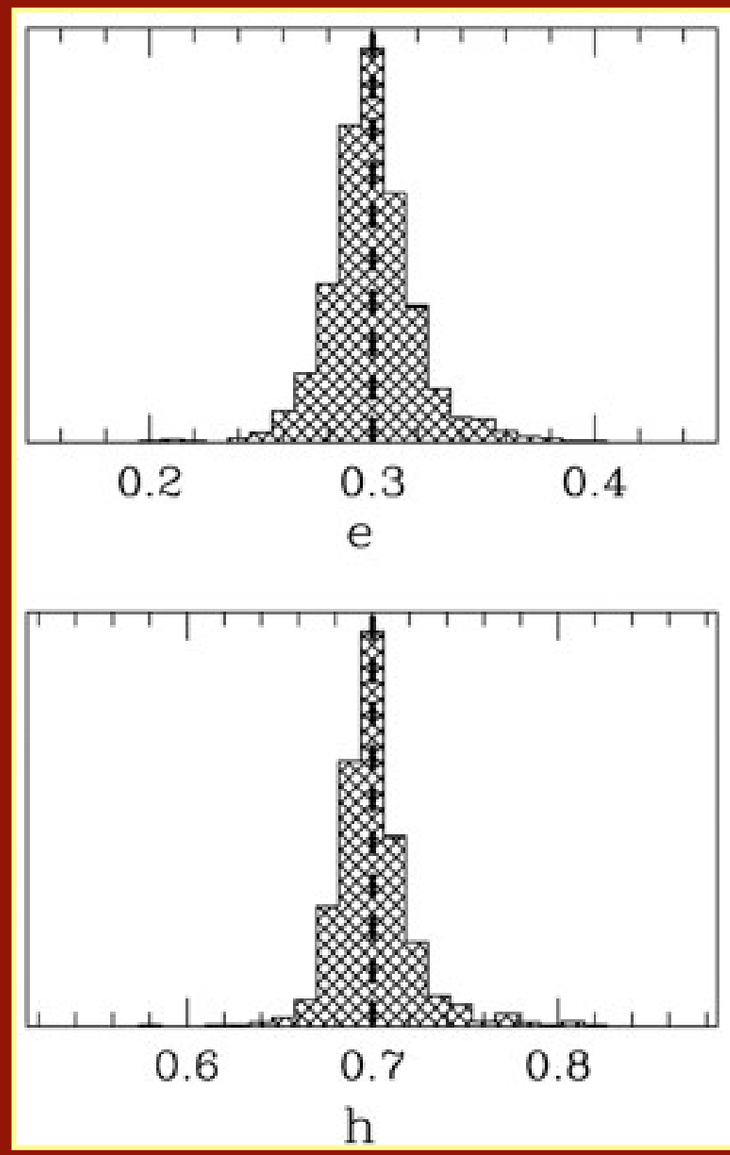
Keeton & Zabludoff 2004



group not included



κ_{env} included

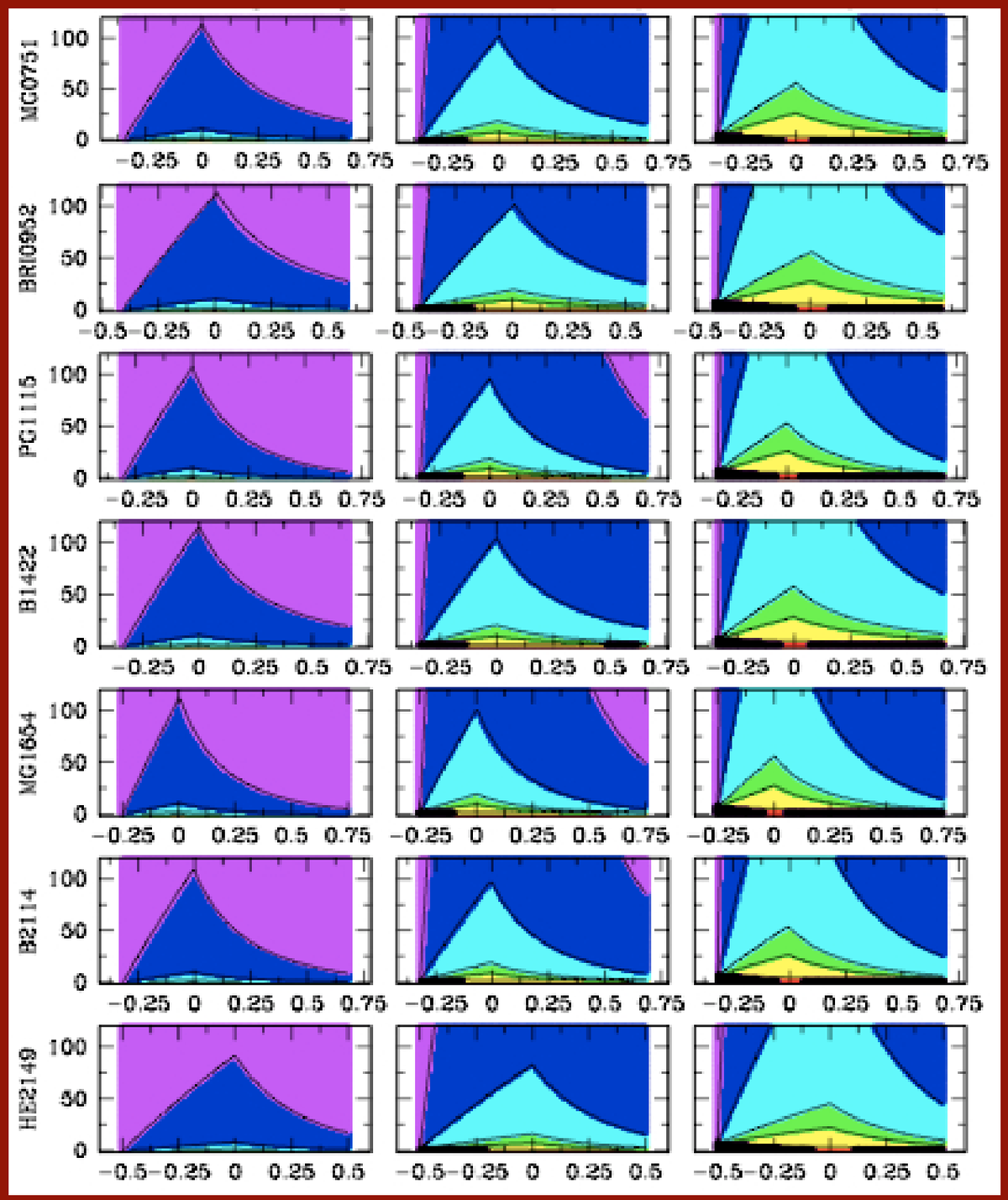


group included

identify, model all mass components; $\kappa_{env}, \gamma_{env},$ and higher-order terms included self-consistently

Line-of-Sight Structures: So What?

$\sigma = 100\ km\ s^{-1}$ $300\ km\ s^{-1}$ $500\ km\ s^{-1}$



green, yellow: $\gamma_{eff}, \kappa_{eff} \geq 0.05$

effects add simply (convergence) or in quadrature (shear)

convergence rises faster, causes biases ==> los significant?

need to survey within $\Delta z \approx \pm 0.3$ *and at least several arcmin*

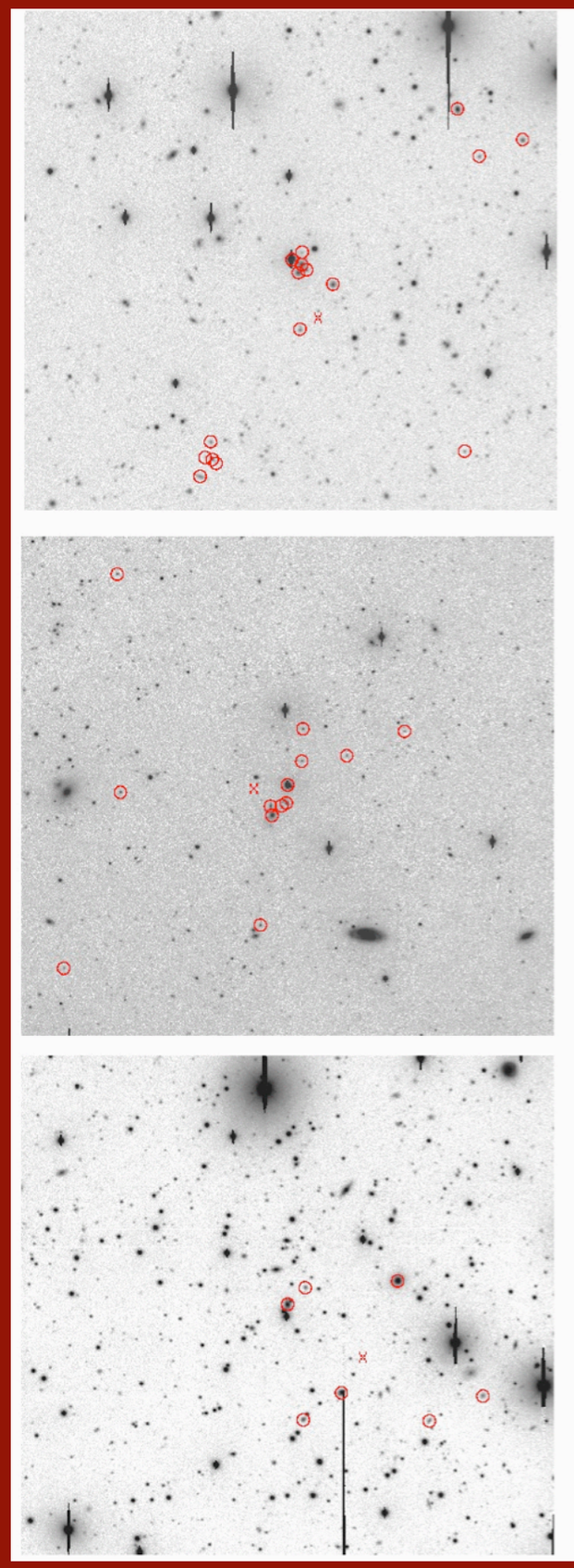
The Survey

wide-field images of 69 CASTLES lens fields

$0.04 < z < 0.90$ (most at 0.3-0.7)

30 (2-image), 21 (4), 10 (R), 8 (other)

14 time-delays



The Survey

wide-field images of 69 CASTLES lens fields

0.04 < *z* < 0.90 (most at 0.3-0.7)

30 (2-image), 21 (4), 10 (R), 8 (other)

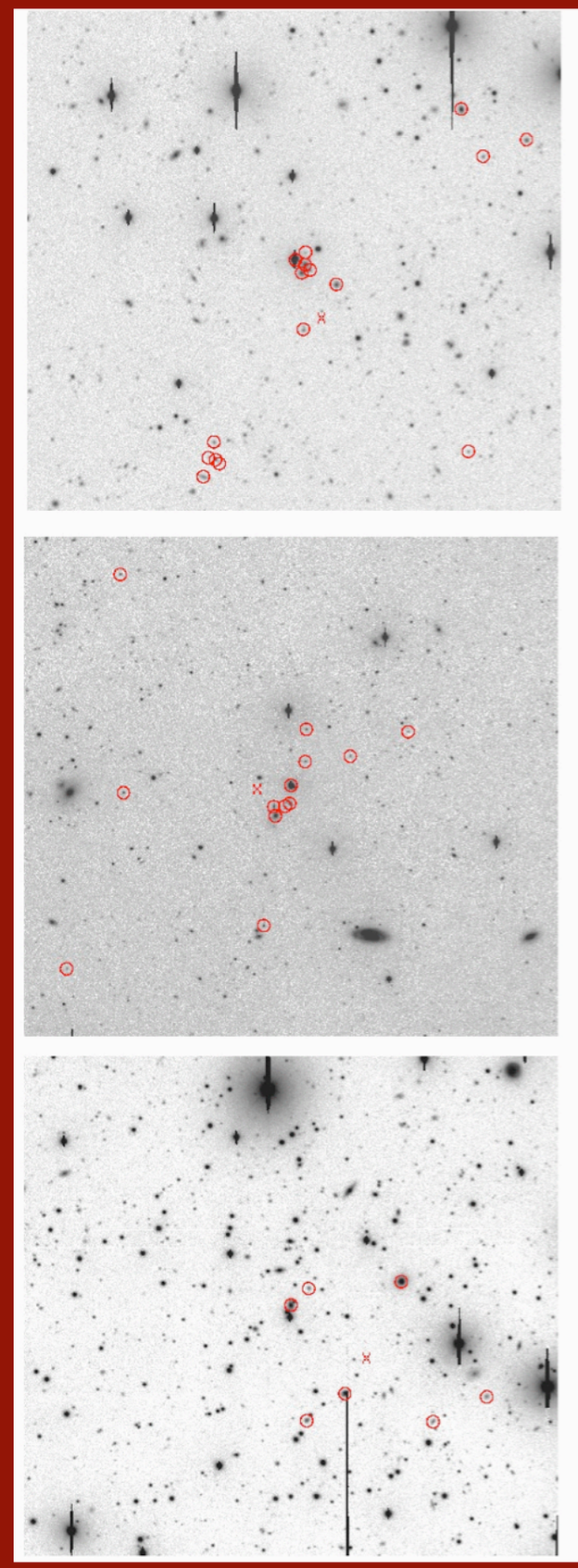
14 time-delays

multi-object spectra of 28 lens fields

0.11 < *z* < 0.84 (most at < 0.6)

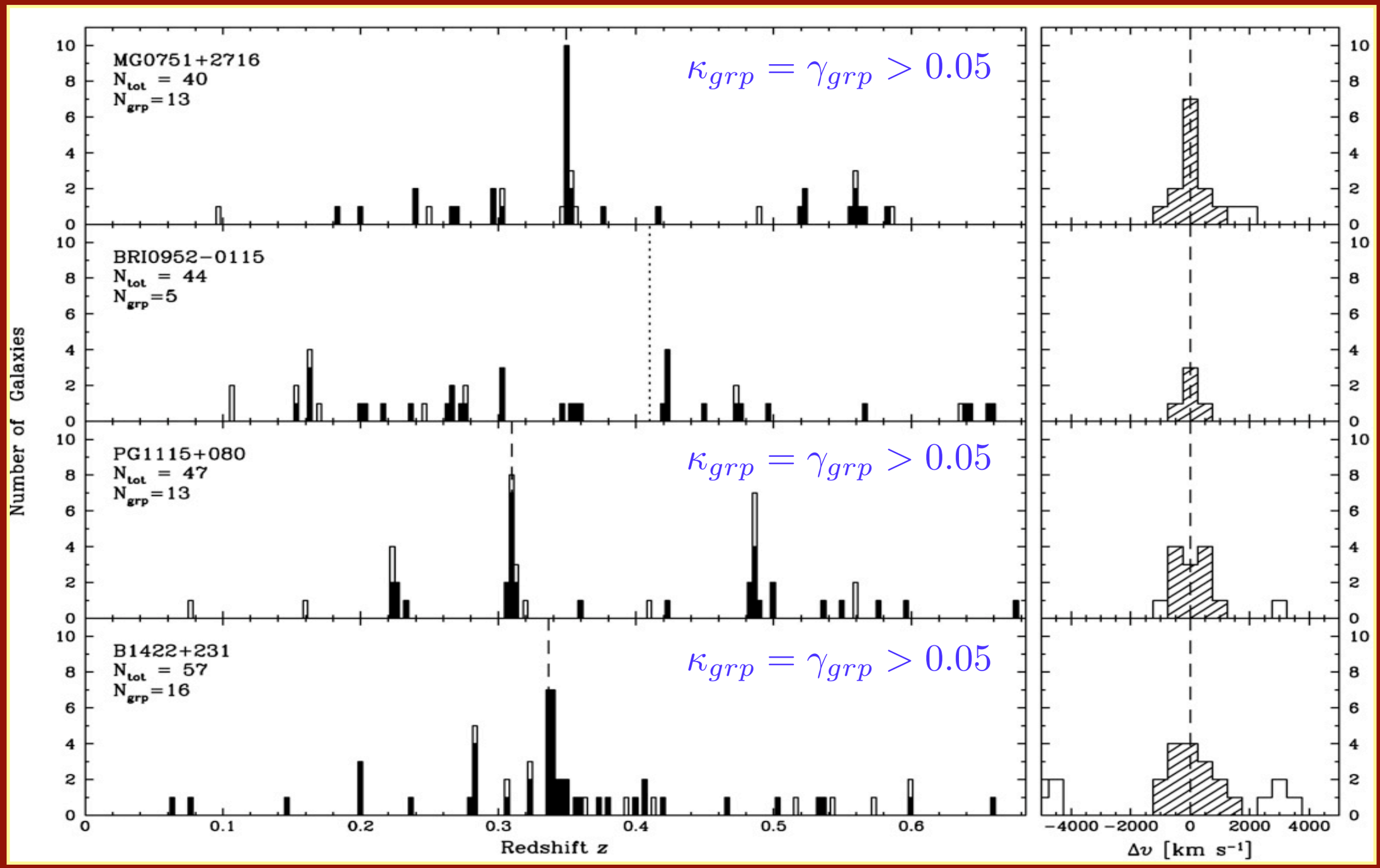
12 (2), 8 (4), 3 (R), 5 (other)

8 time-delays



Lens Environments: Results from Spectroscopy

Momcheva et al. 2006

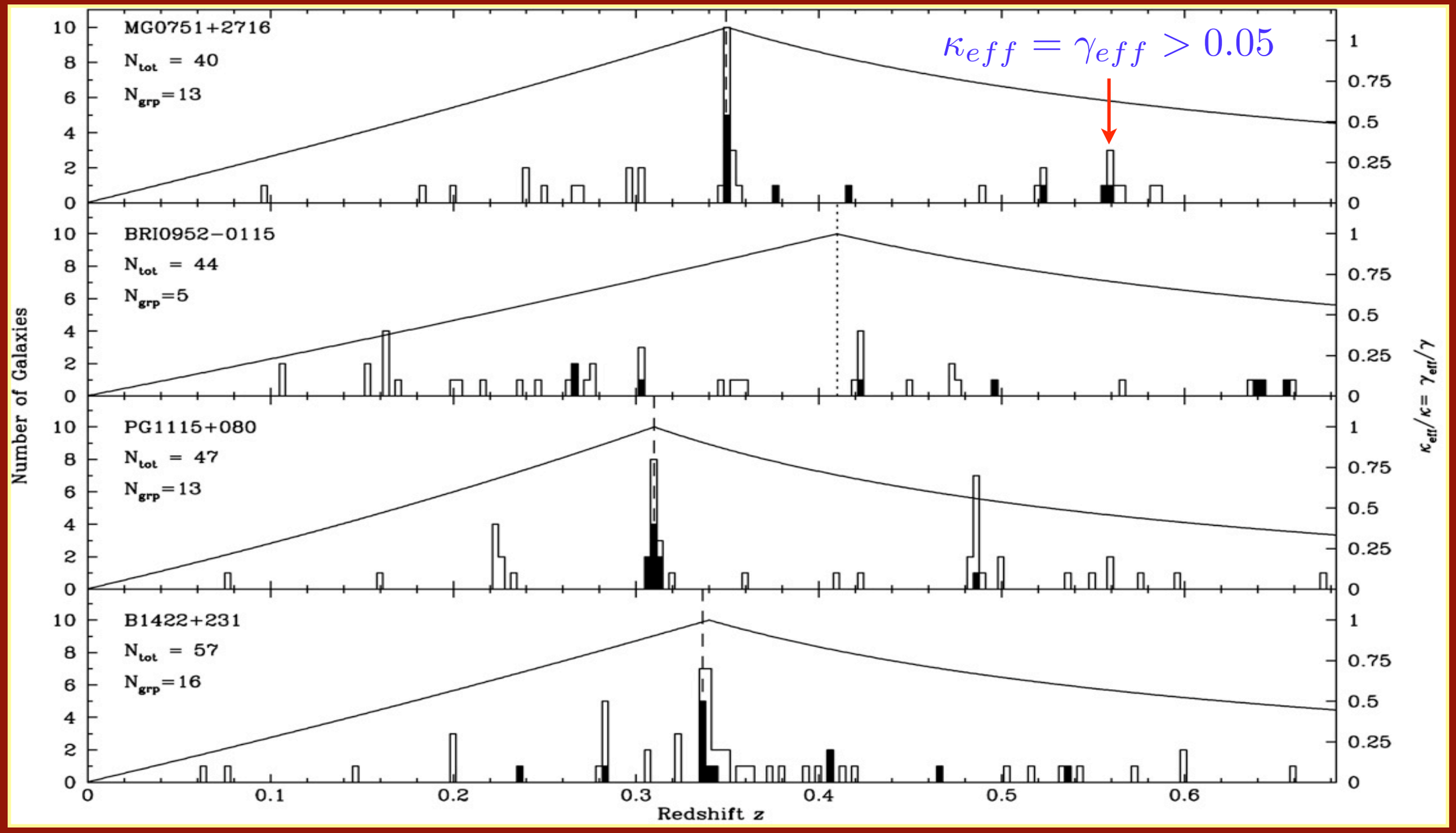


number of galaxies

redshift

Interloping Structures: Results from Spectroscopy

Momcheva et al. 2006



number of galaxies

normalized shear,conv

redshift

peaks, galaxies within 1'; *new data improving completeness…*

Going for Gold

characterized lens environments, interlopers

most lenses in dense environments: *at least 6 of 8 (spectroscopy), 8 of 12 (photometry)*

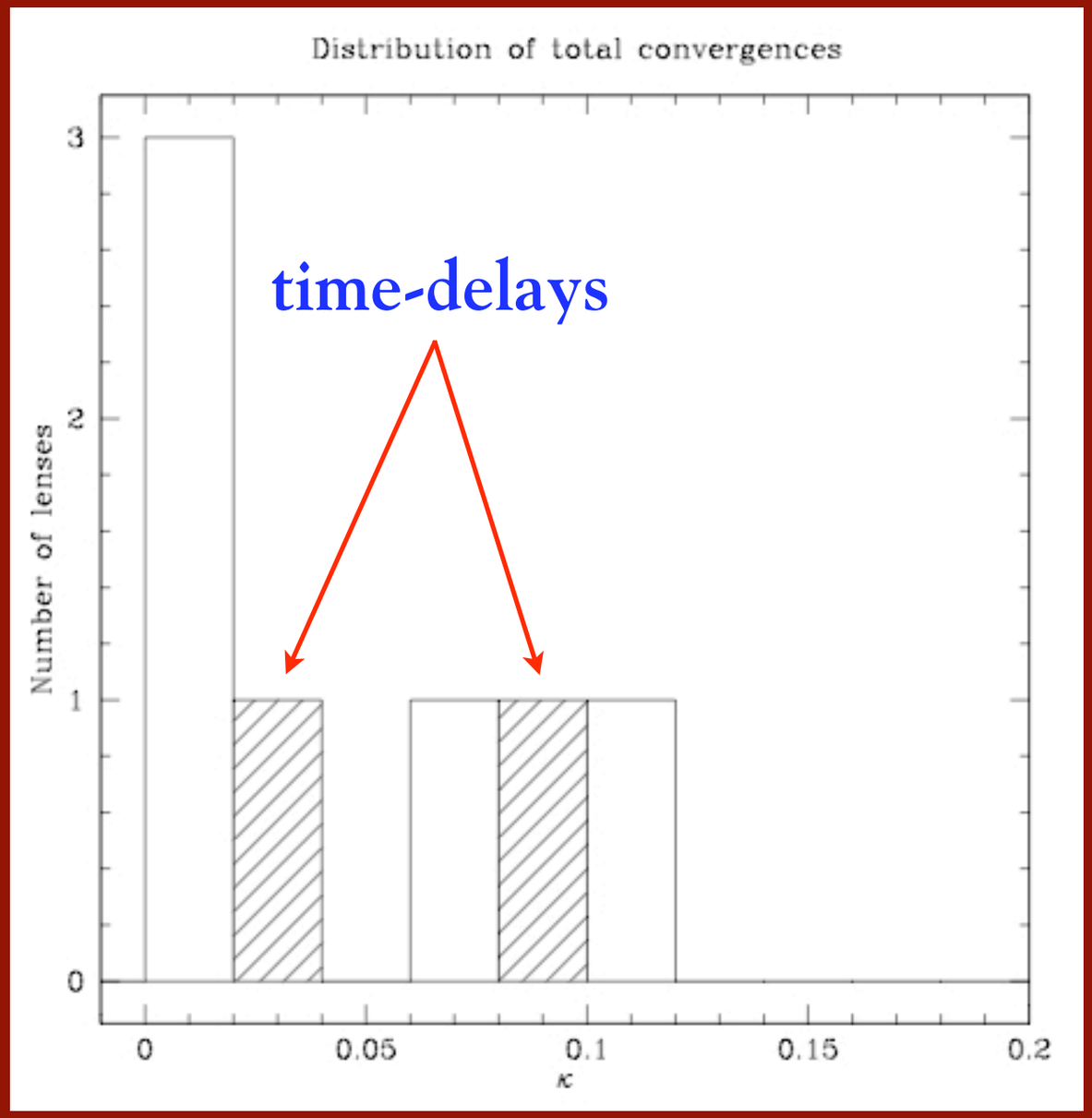
>50% of environments affect lens potential

>50% have at least one superposed structure

>10% of los structures affect lens potential

exclude or account for lenses with complex environments and/or that lie in atypical beams

Going for Gold (cont.)

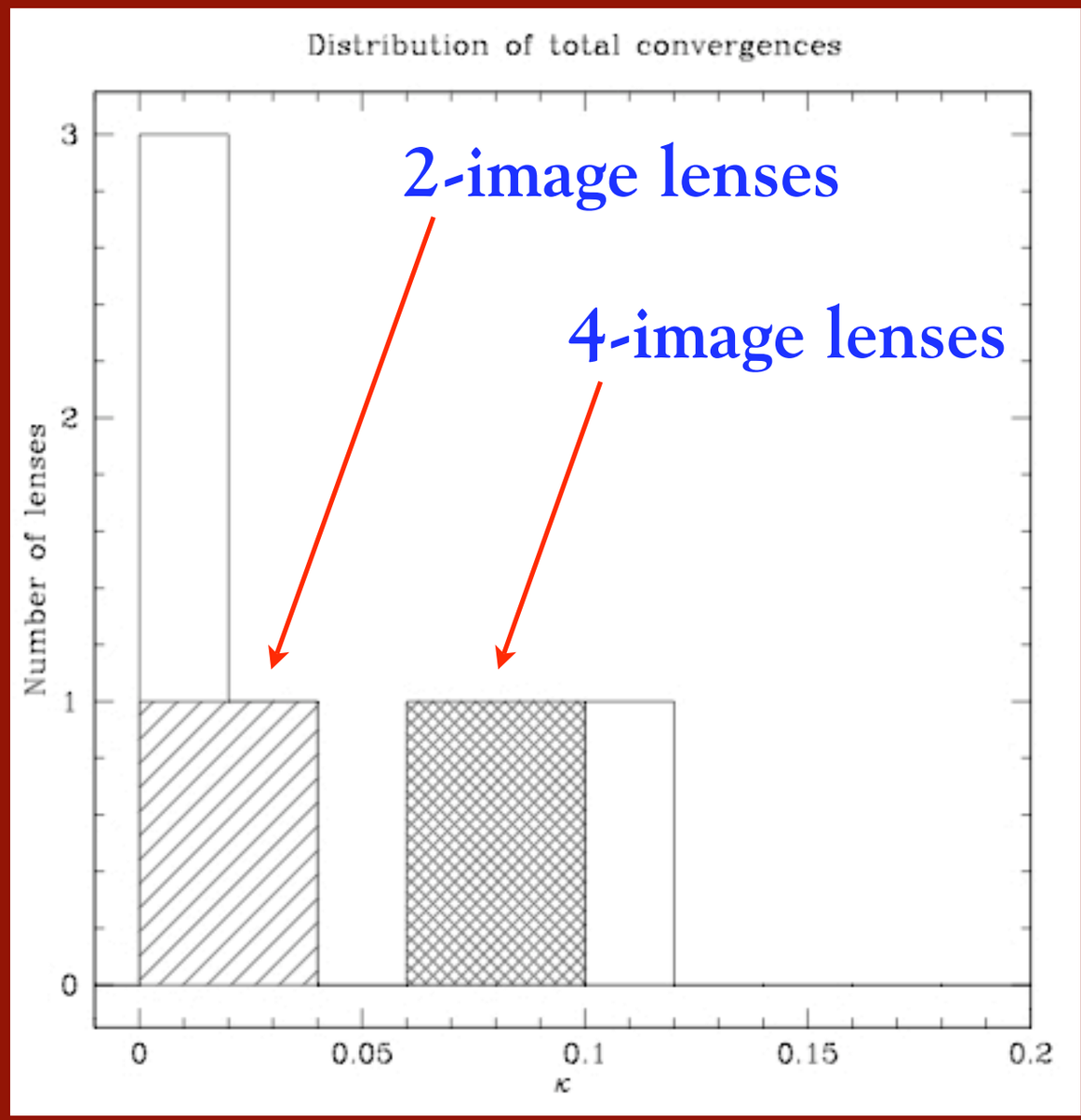


number of lenses

total convergence

golden versus tarnished

environment dependence?

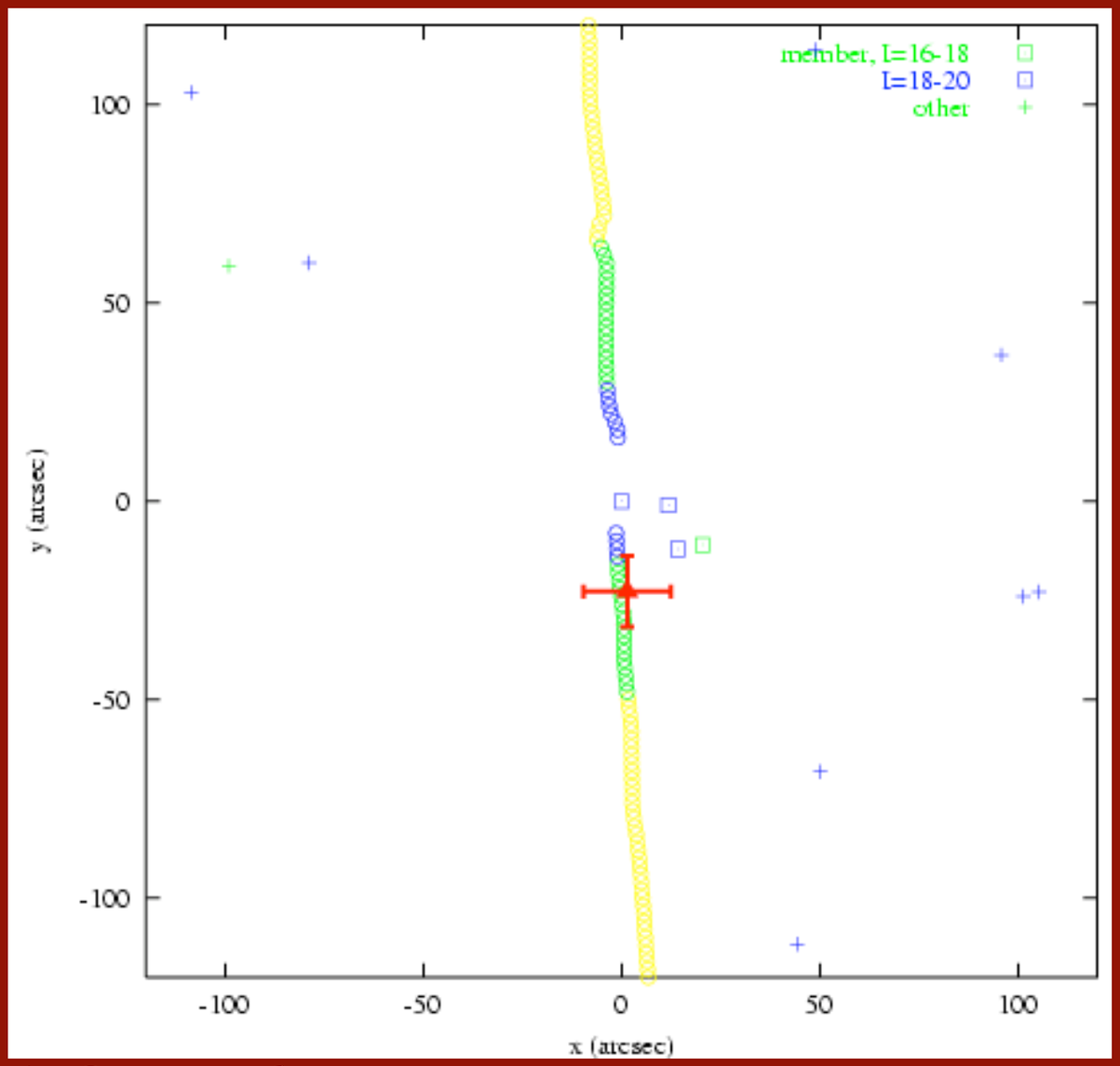


number of lenses

total convergence

The Kitchen-Sink Model

include group galaxies (positions, luminosities) and group halo (velocity dispersion, centroid)



A. Cangi et al.

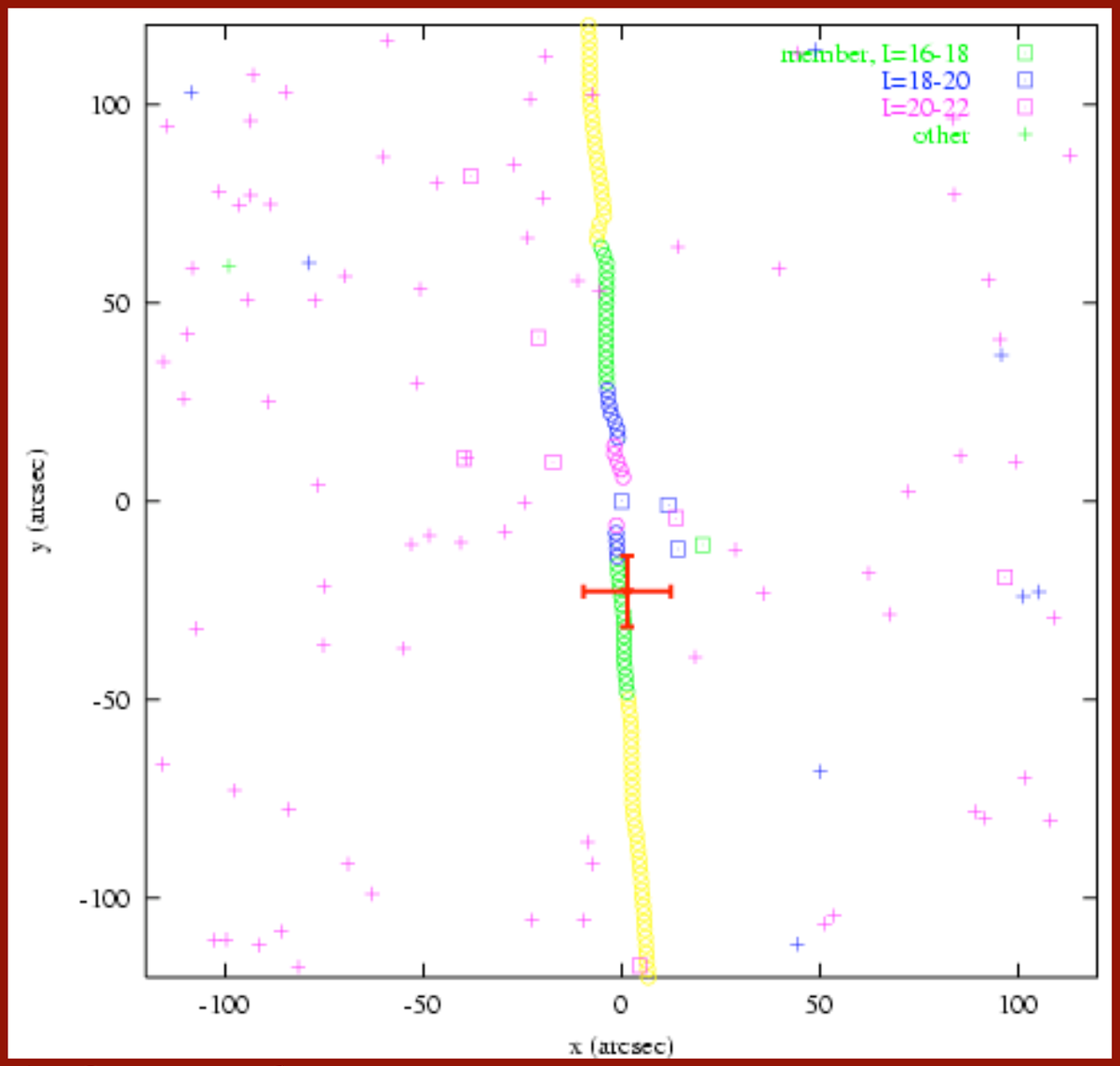
models need additional mass component

allowed centroid goes through observed group centroid

no single galaxy has right position and mass

The Kitchen-Sink Model

include group galaxies (positions, luminosities) and group halo (velocity dispersion, centroid)



A. Cangi et al.

models need additional mass component

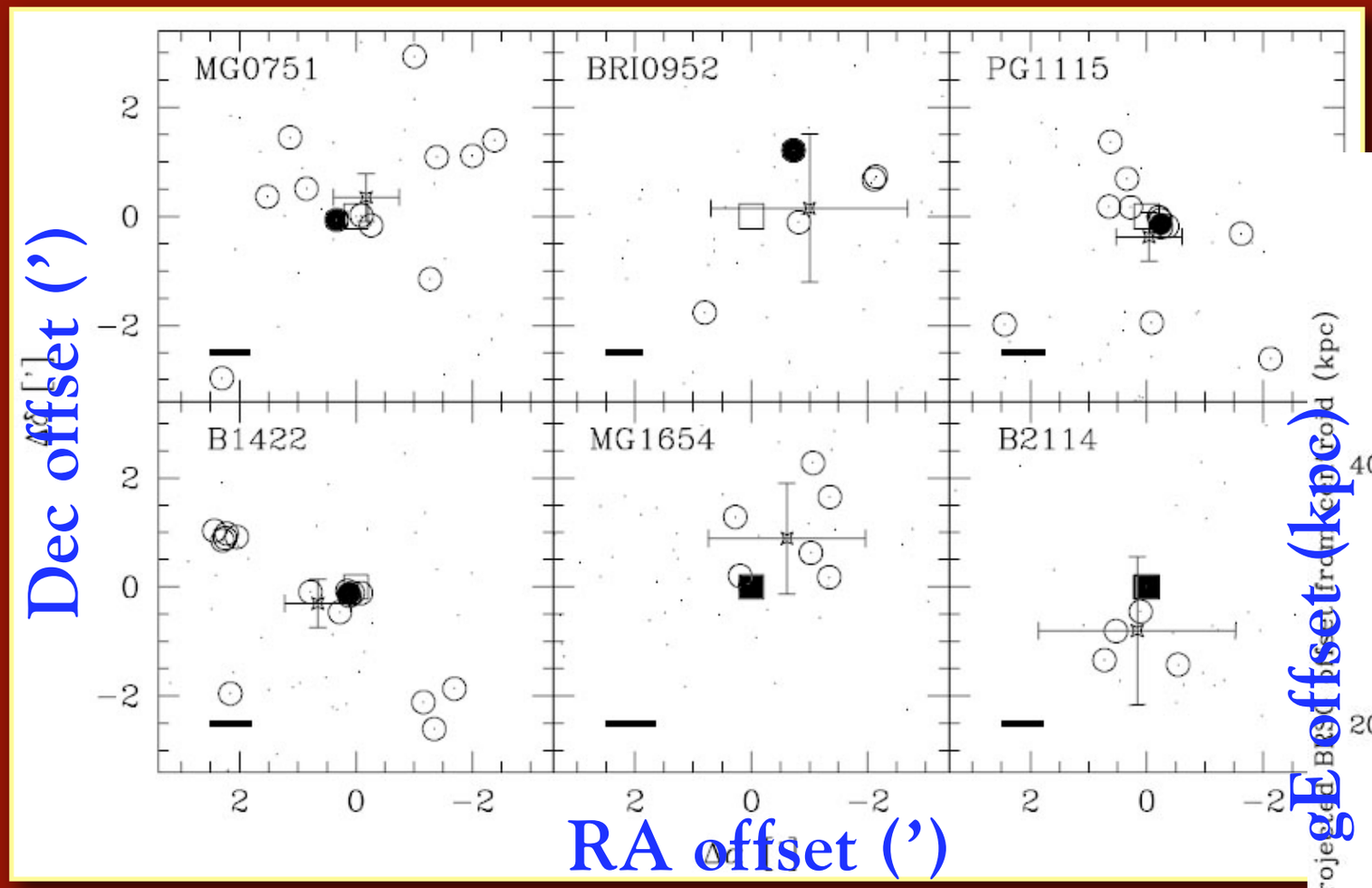
allowed centroid goes through observed group centroid

no single galaxy has right position and mass

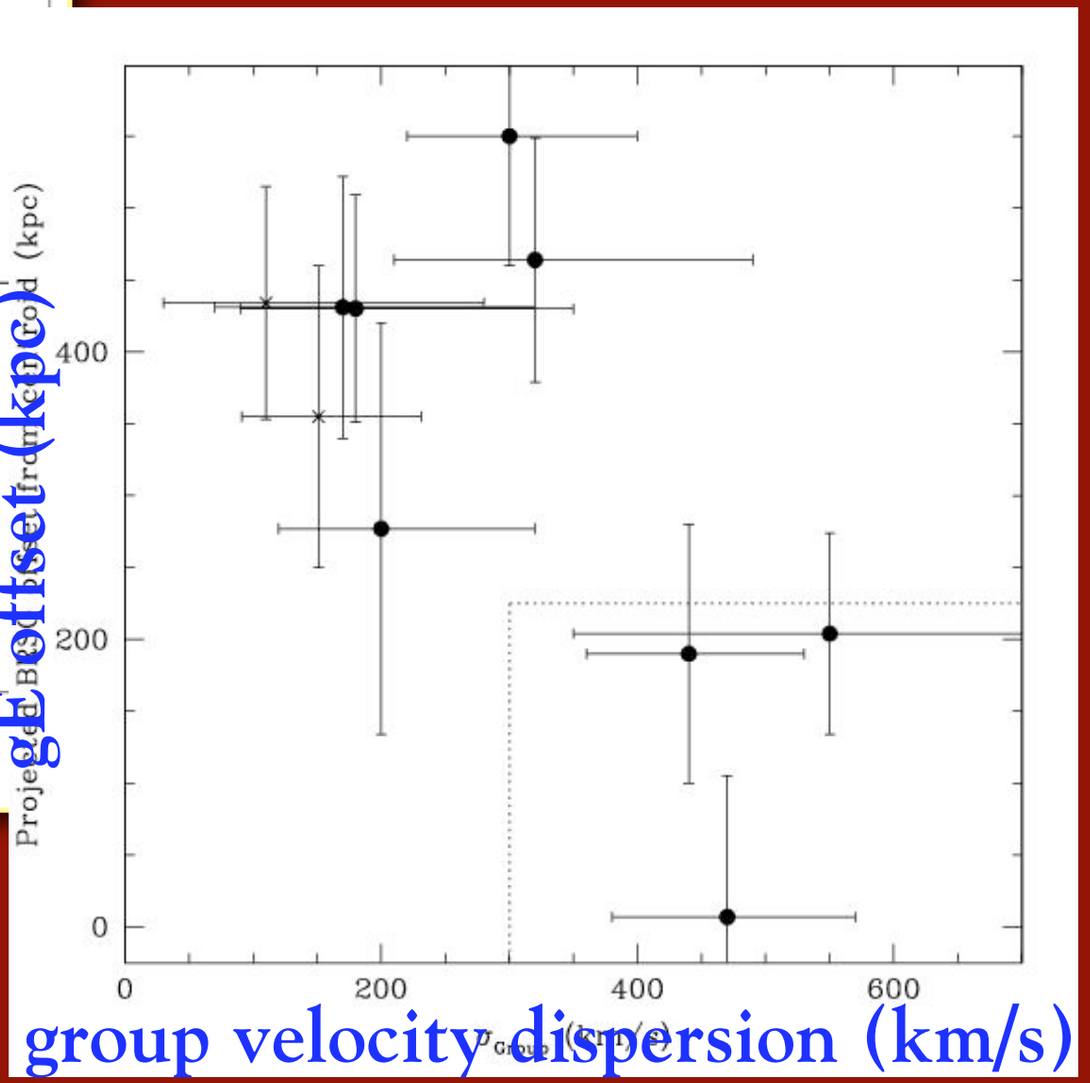
Observing Group Evolution *Directly*

few $z > 0.1$ poor groups known, yet common,
simpler environments, also affect cluster evolution

highest-σ groups have central gE, others still forming?



Momcheva et al. 2006



Williams et al. 2006

more data soon…

Conclusions

environments affect models (double lenses, with fewer constraints, even worse) at 5-10% level

line-of-sight structures can also be problem

possible to improve models

can find golden lenses or gild them

new window on group evolution: unbiased sample over wide redshift range

brightest group elliptical, gas vs. galaxy kinematics, consequences for galaxy evolution elsewhere