

THE LINK BETWEEN STELLAR MASS,
GALAXY SIZE AND DARK MATTER HALO
MASS FROM WEAK GRAVITATION LENSING

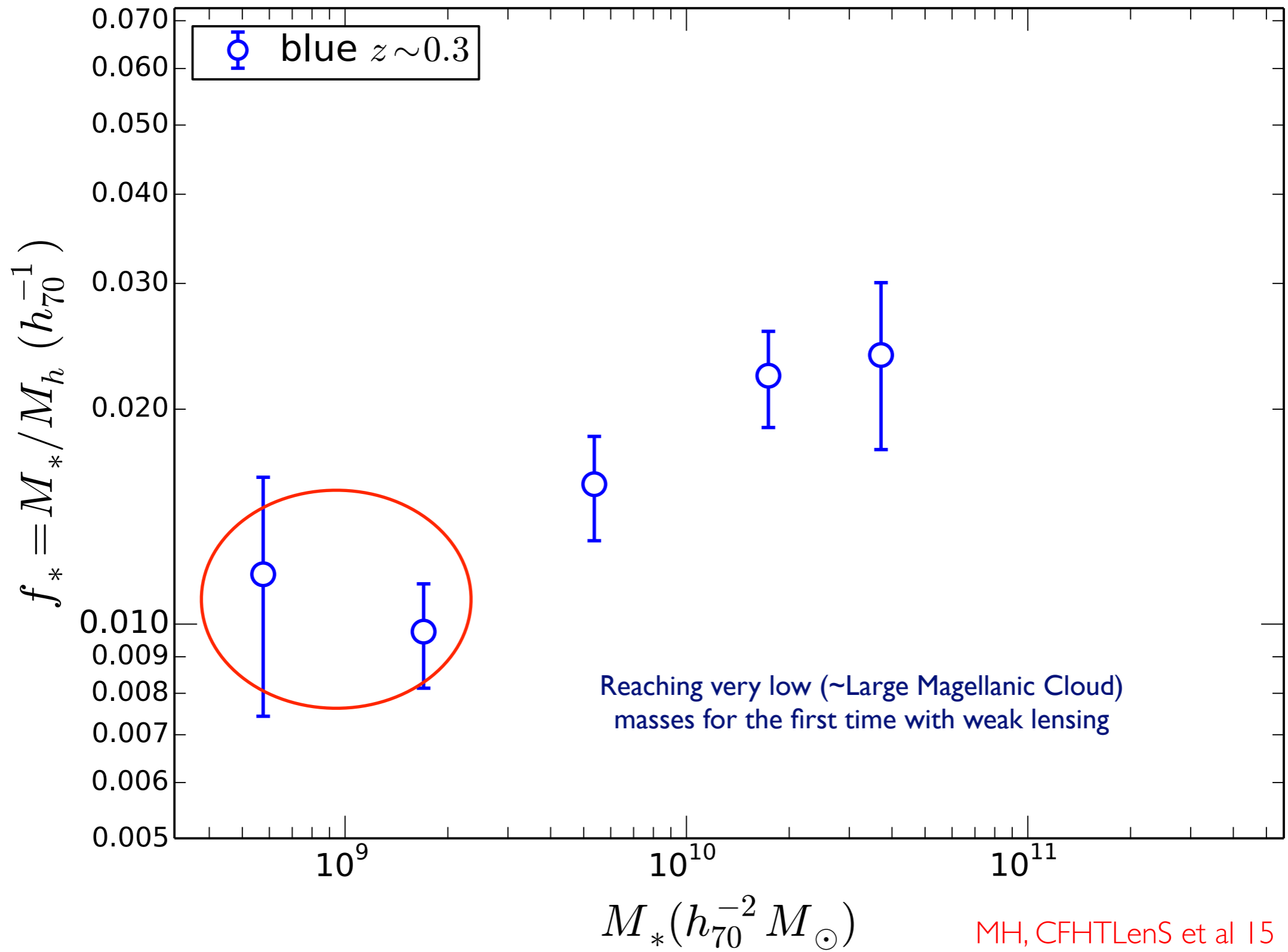
Mike Hudson (U. Waterloo) with P. Charlton & M. Balogh and
CFHTLenS team

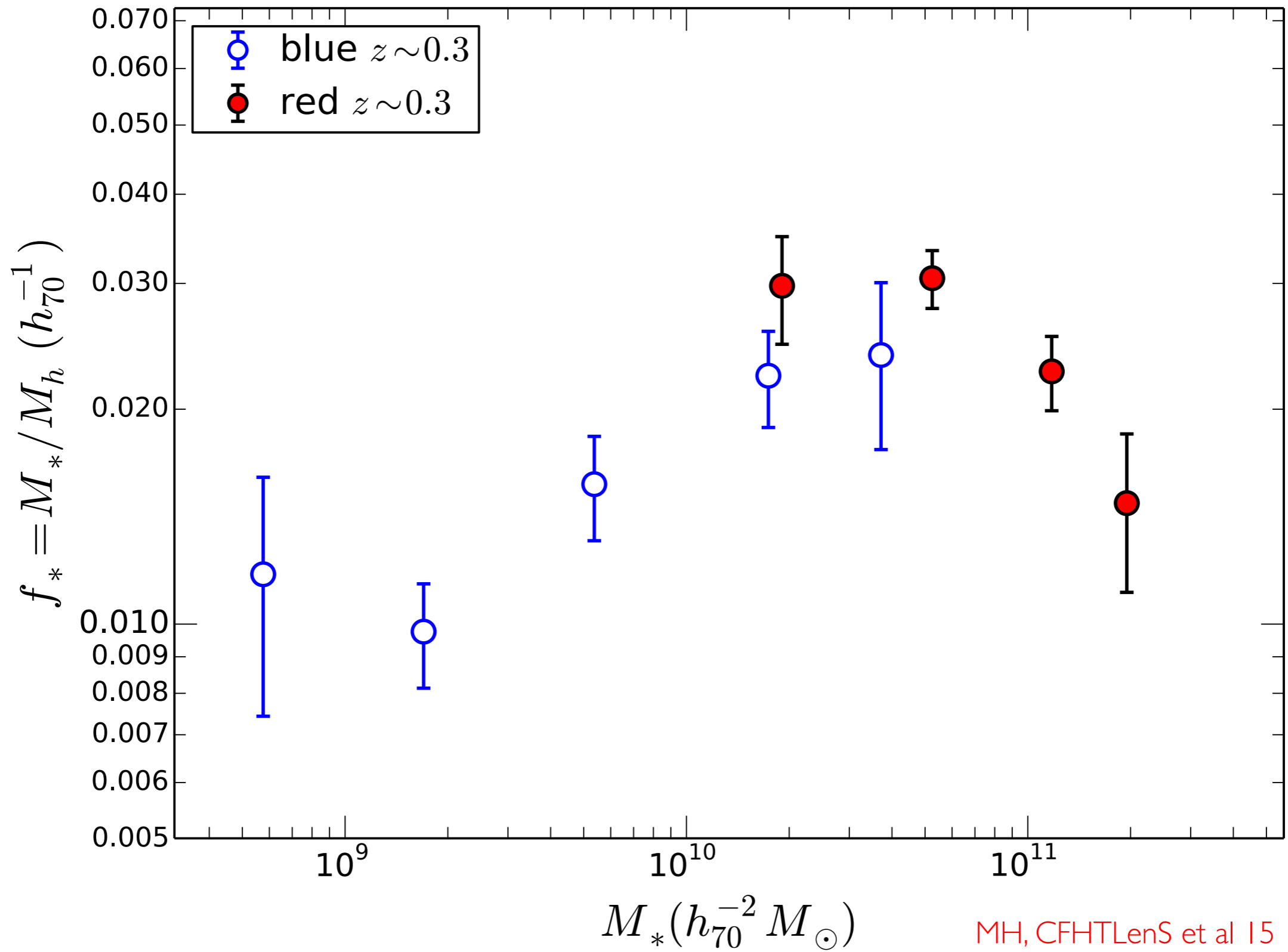


CFHTLENS PROJECT

Thanks for the weak lensing intro, Mathilde

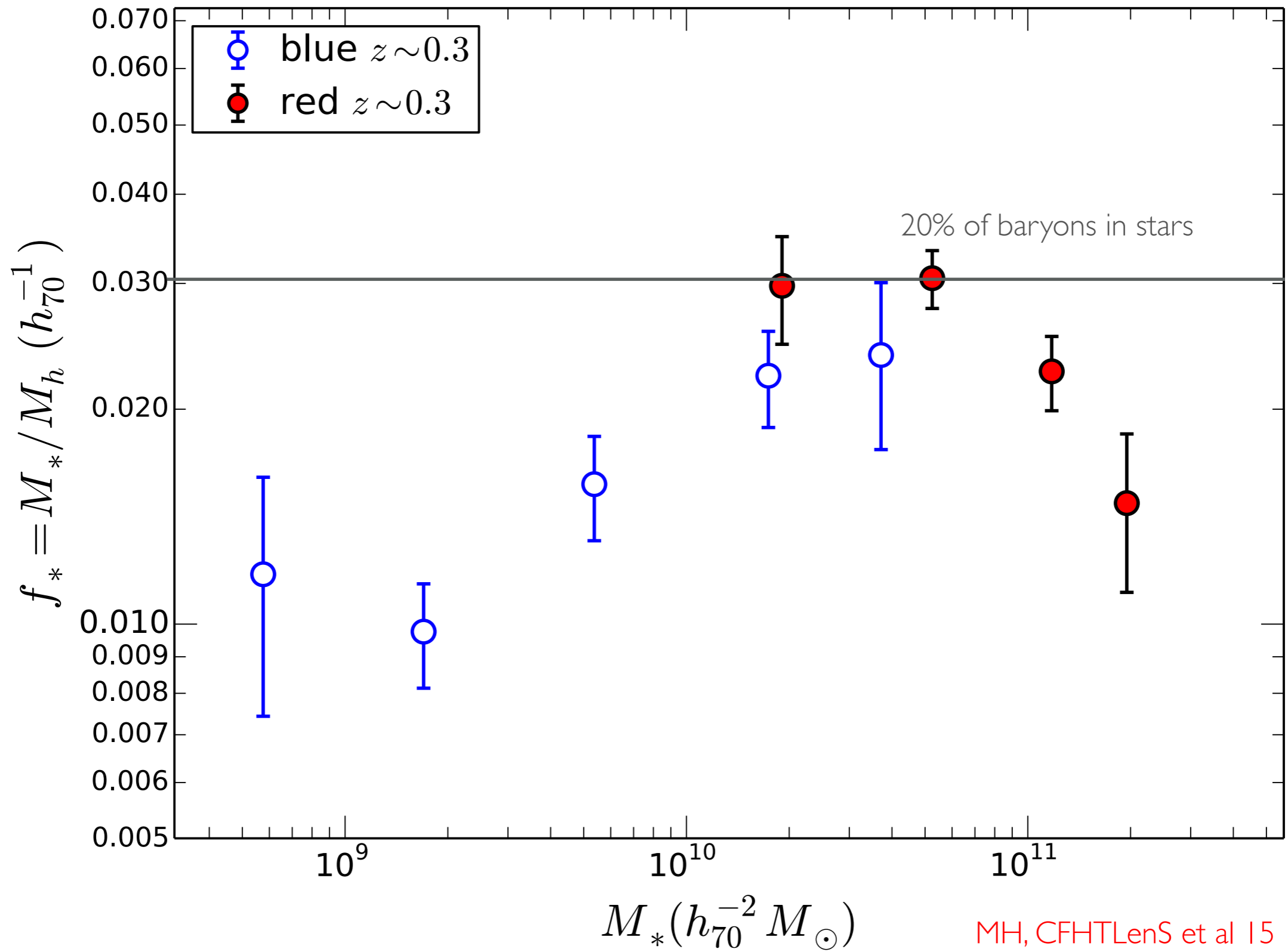
- 154 sq. deg. of deep multi-band imaging on CFHT, $\sim 0.7''$ PSF, $i < 24.7$
- Stack thousands to hundreds of thousands of lens galaxies, split into bins of:
 - stellar mass ($10^9 - 10^{11.5}$ solar)
 - colour (red / blue)
 - (photo-) redshift (0.3 - 0.5 - 0.7)
- Fit tangential shear with model: stellar mass + **mass** (M_{200}) of NFW halo model + nearby clustered haloes





MH, CFHTLenS et al 15



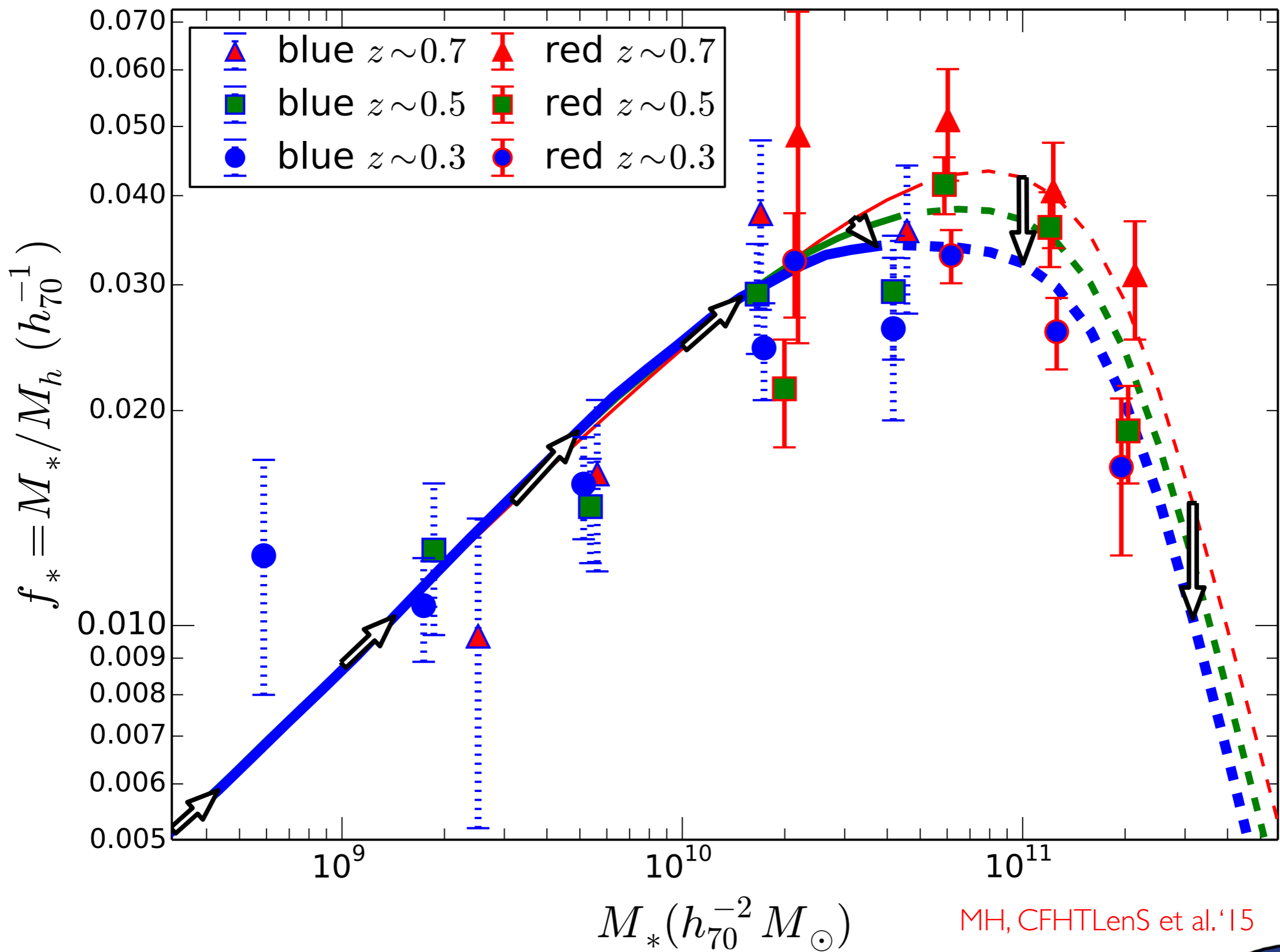


MH, CFHTLenS et al 15



Total (M_{200}) halo mass from weak lensing

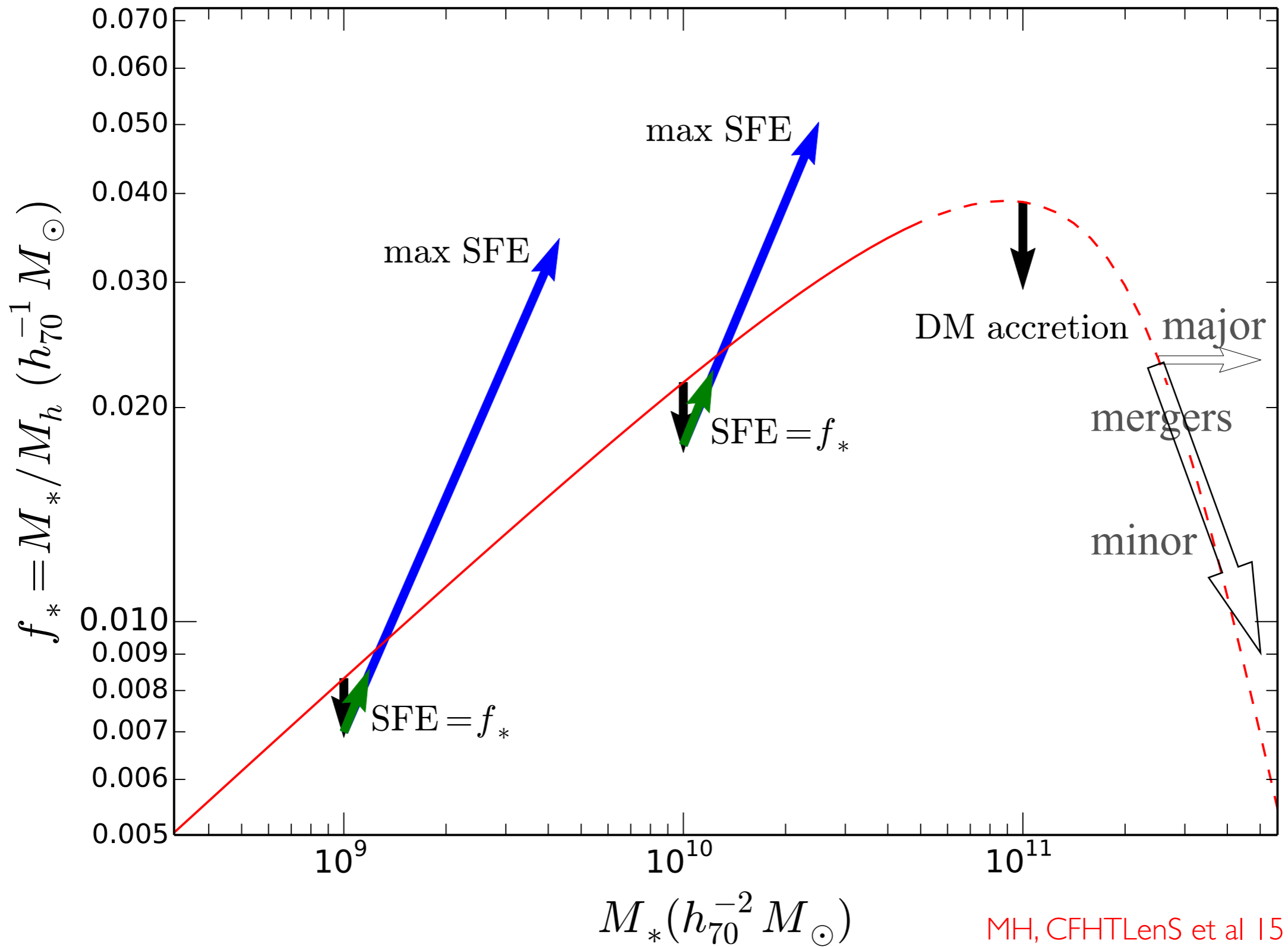
fraction of baryons in stars



MH, CFHTLenS et al.'15



TOWARDS A PHYSICAL MODEL



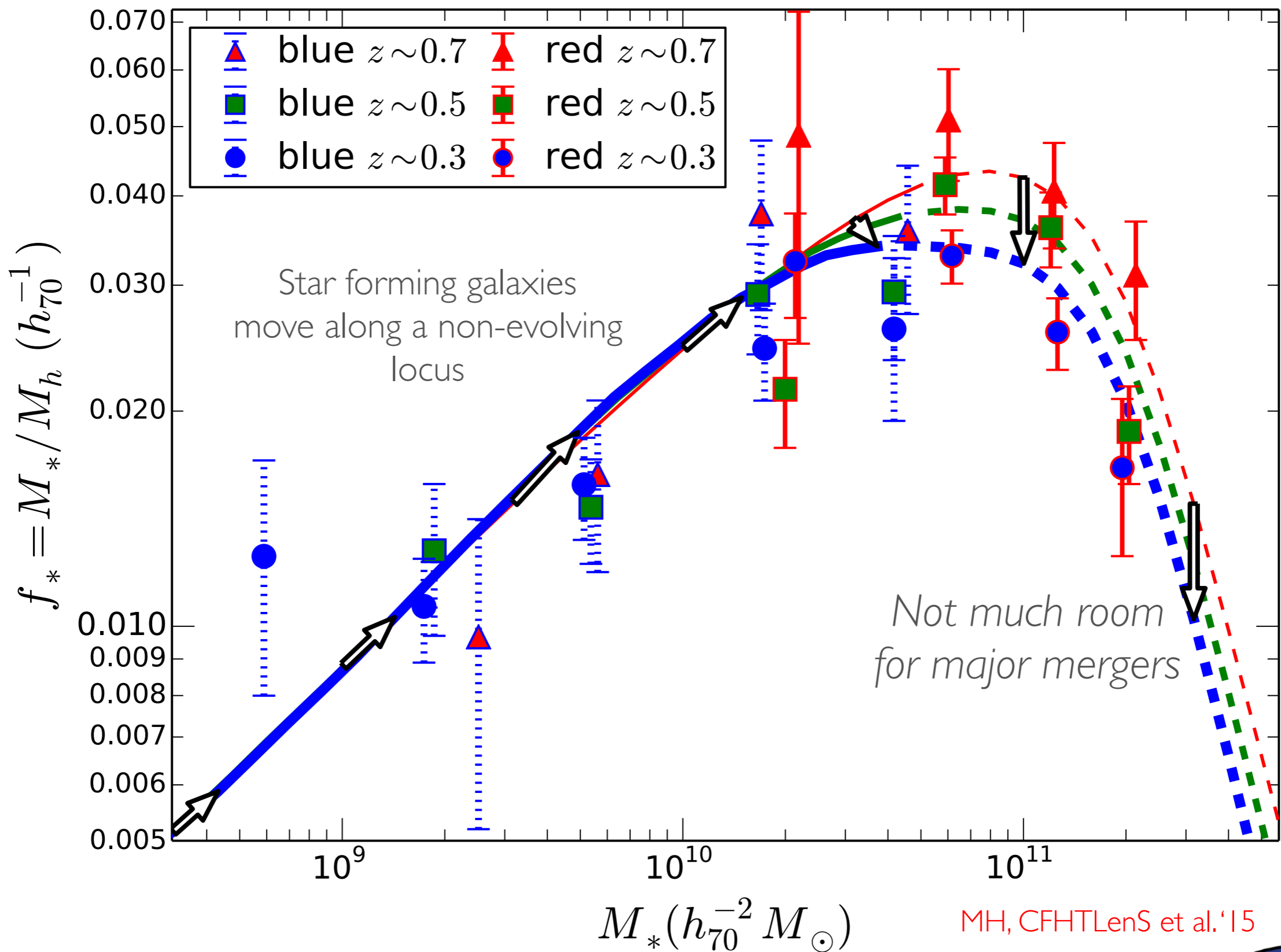
TOWARDS A MORE PHYSICAL MODEL:

- Empirical star formation rates from the literature
- “Quenching” at a given halo mass
- N-body DM accretion rates
- (No mergers)

Total (M_{200}) halo mass from weak lensing

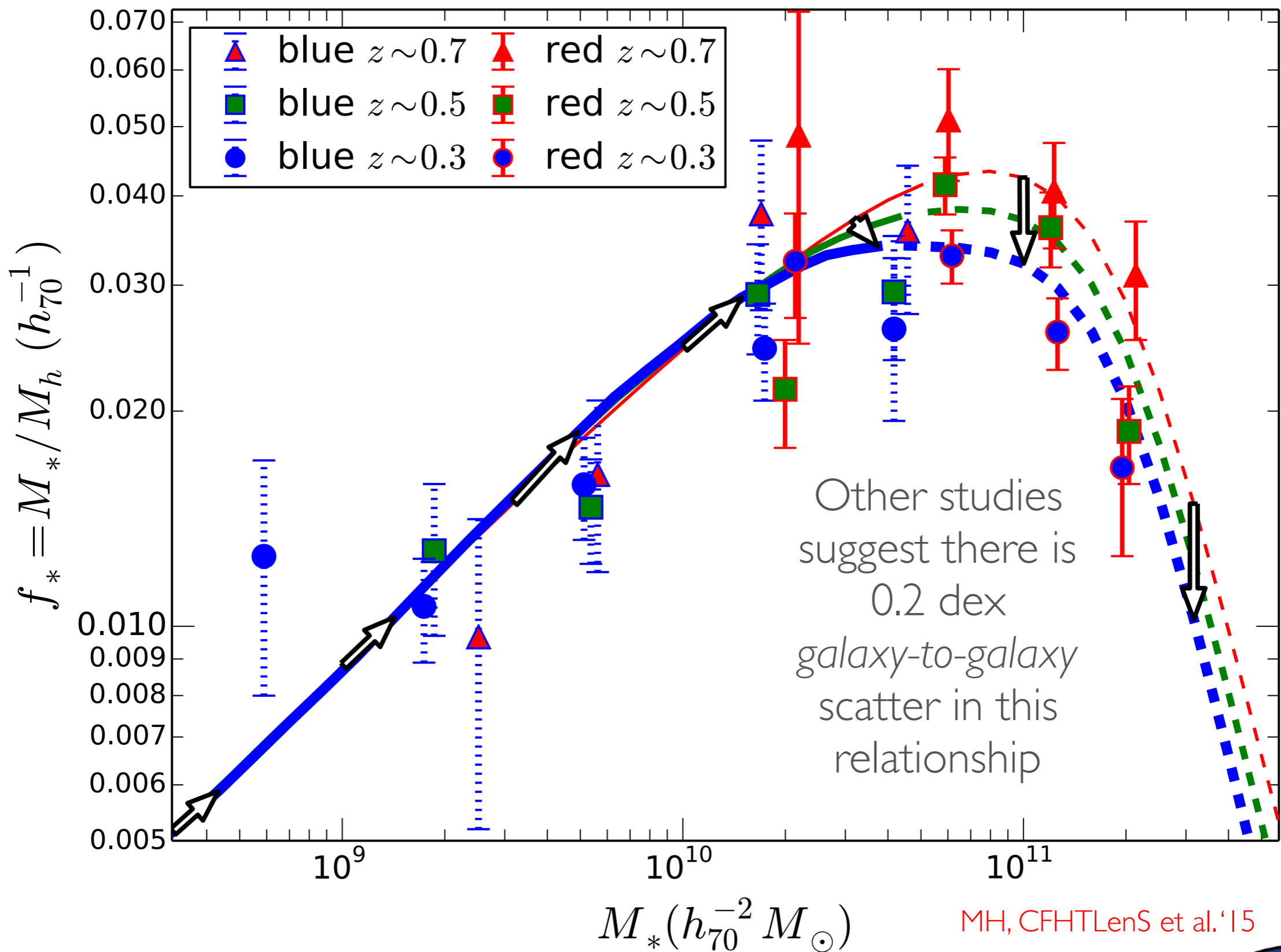
fraction of baryons in stars

0.45
0.39
0.33
0.26
0.20
0.13
0.07



Total (M_{200}) halo mass from weak lensing

fraction of baryons in stars



0.45

0.39

0.33

0.26

0.20

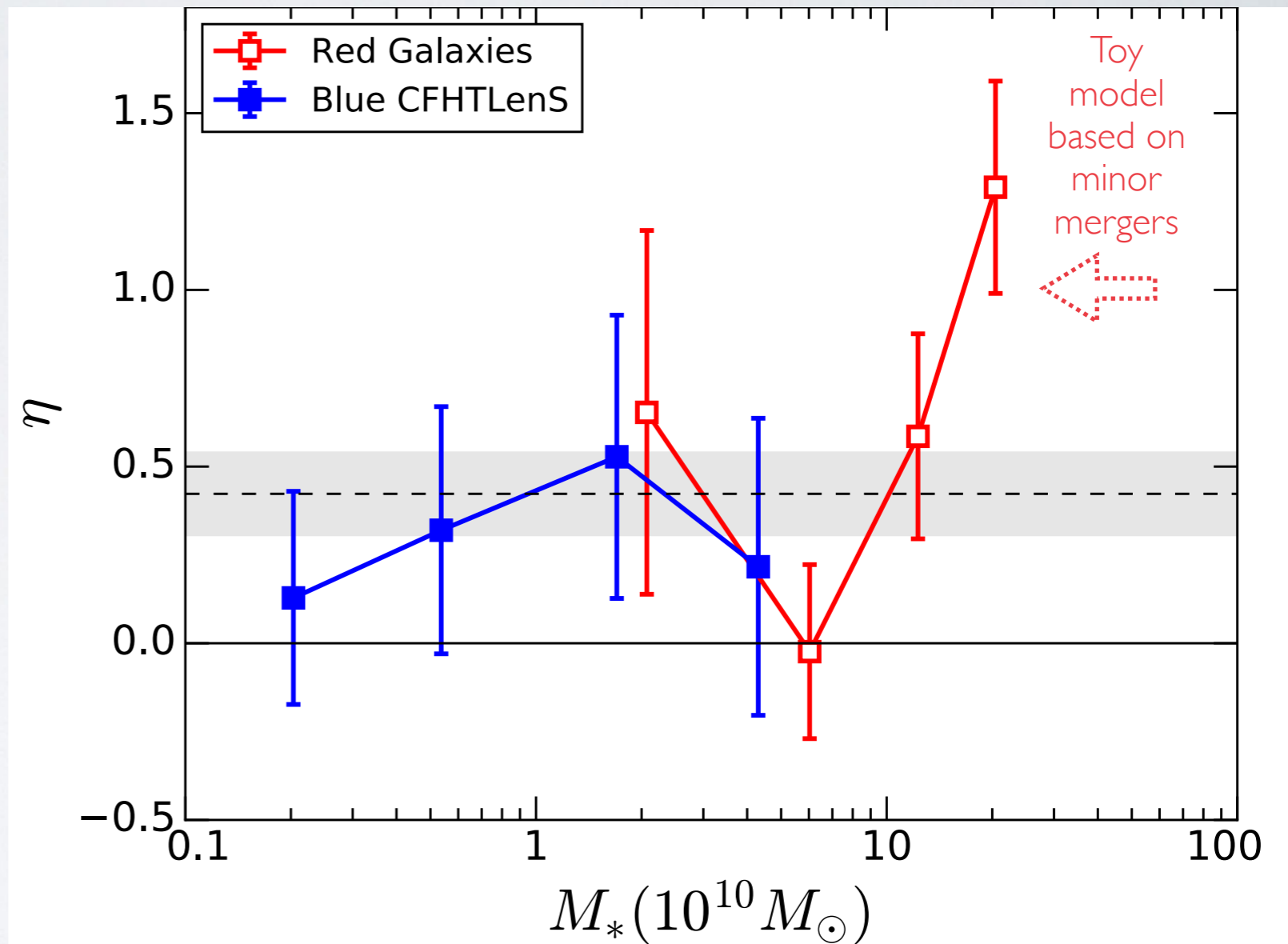
0.13

0.07



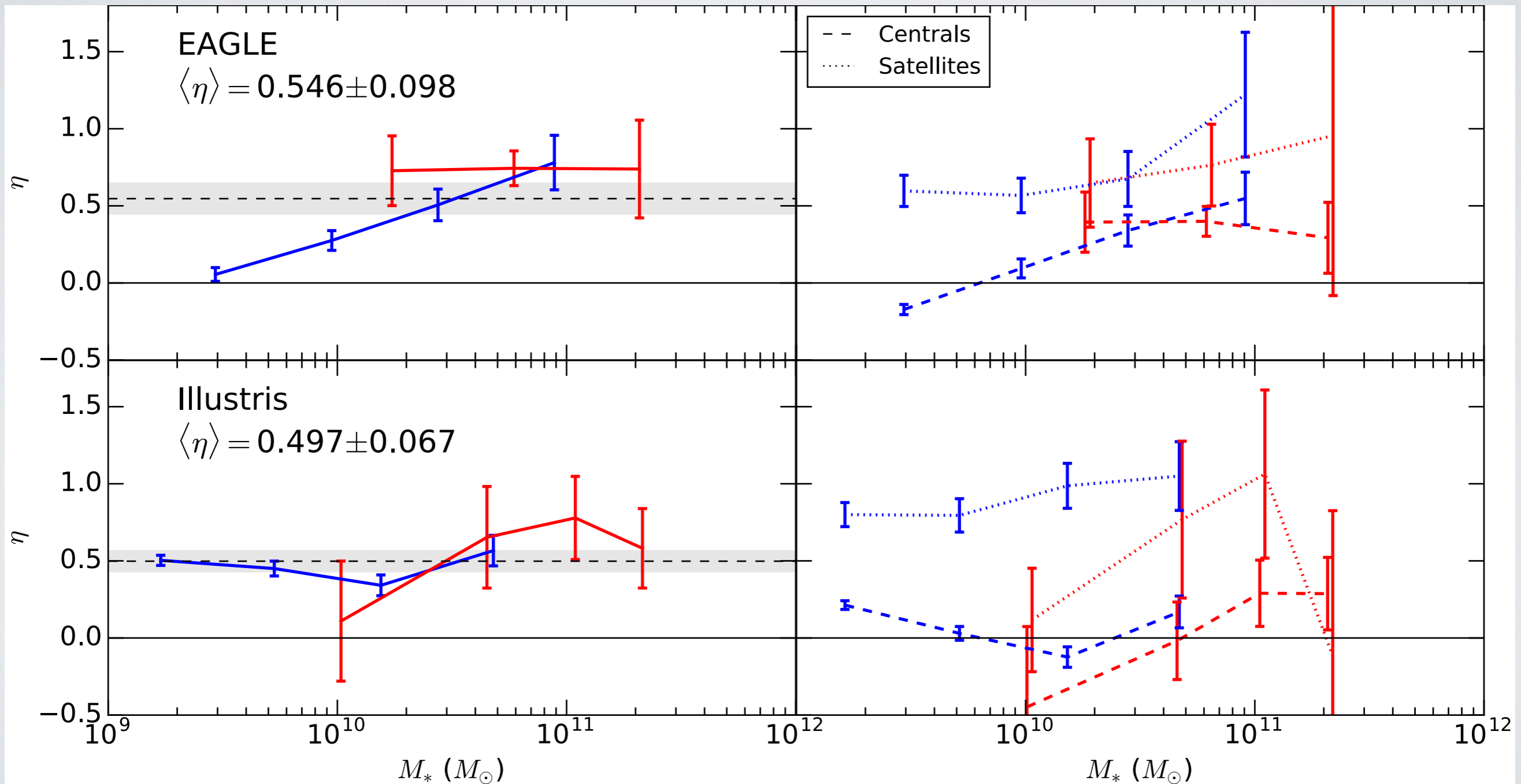
DOES SIZE MATTER?

- Split stellar mass bins by size, measure halo mass from WL at *fixed* M_*
- $M_{\text{halo}}(M_*) \propto [R_e(M_*)]^\eta$
- From weak lensing on average, $\eta > 0$
- Especially high for red galaxies with $M_* \sim 2 \times 10^{11}$ (i.e. LRGs: dominant galaxies in rich groups)
- Minor merger model gives $\eta \sim 1$



Charlton, MH, Balogh & Khatri 2017 arXiv 1707.04924.

SIZE MATTERS: EVEN IN SIMULATIONS



Much of the effect from (stripped) satellites?

Charlton, MH, Balogh & Khatri 2017

DARK MATTER FILAMENTS

Rotate, scale and stack 23,000
BOSS LRG pairs

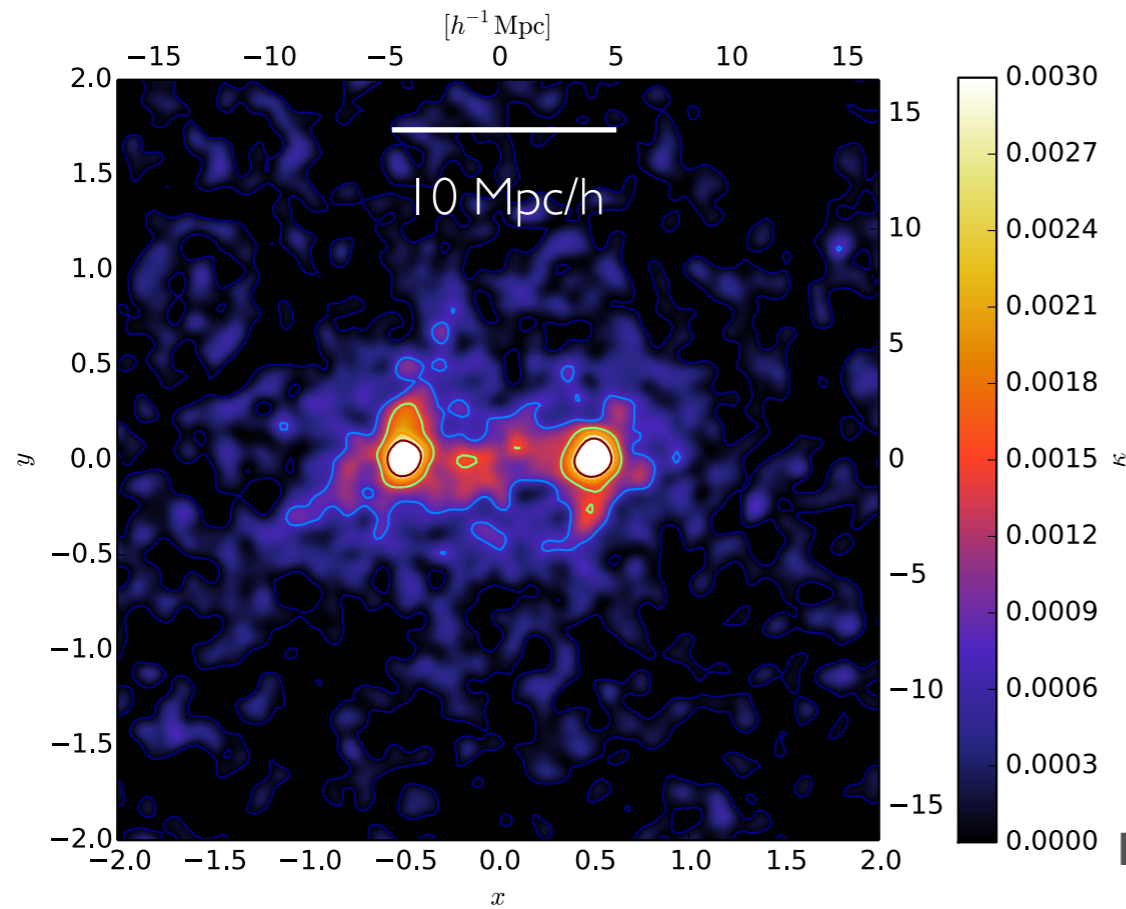
$$\langle z \rangle \sim 0.42$$

$$M_* \sim 10^{11.3}$$

$$M_h \sim 10^{13}$$

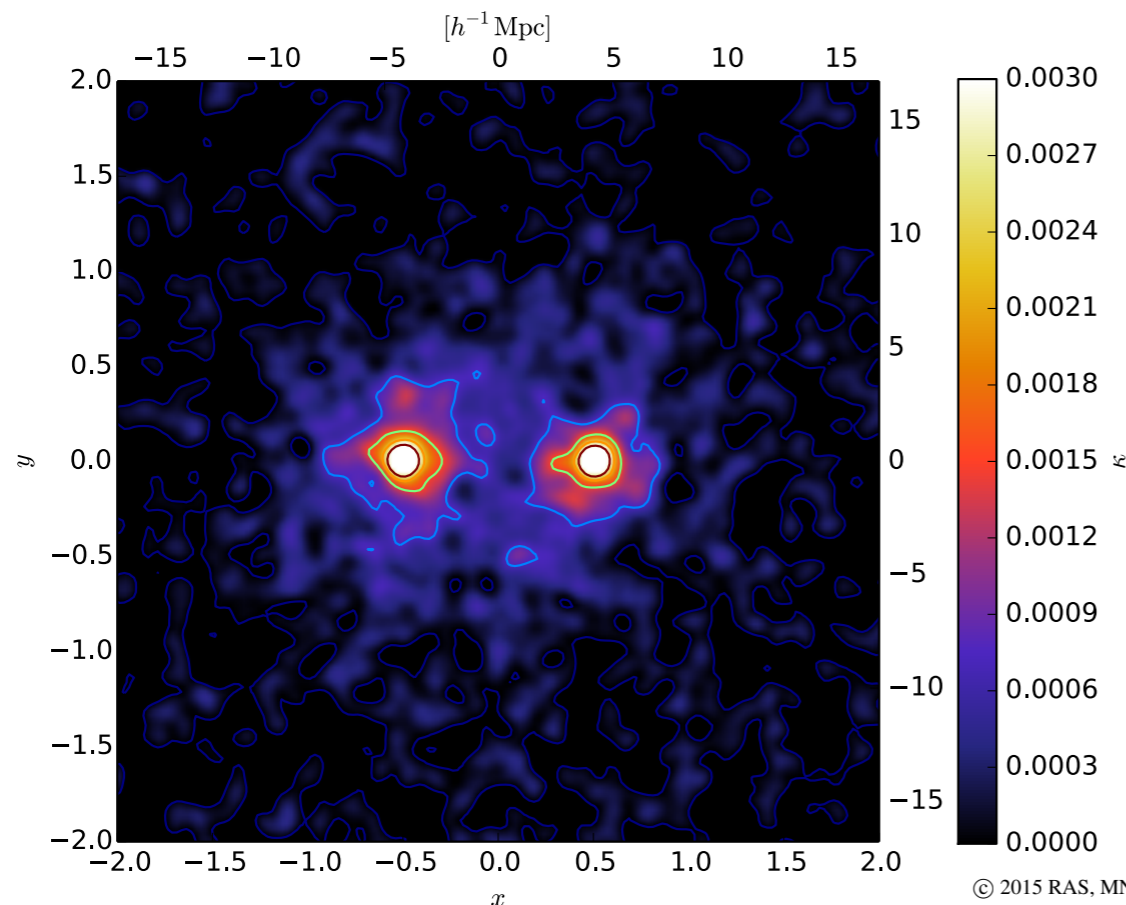
Stack shears and solve for
projected mass density using Kaiser
and Squires

Filament Size: 7 Mpc/h \times 2.5 Mpc/h
Filament Mass: 1.5×10^{13} solar



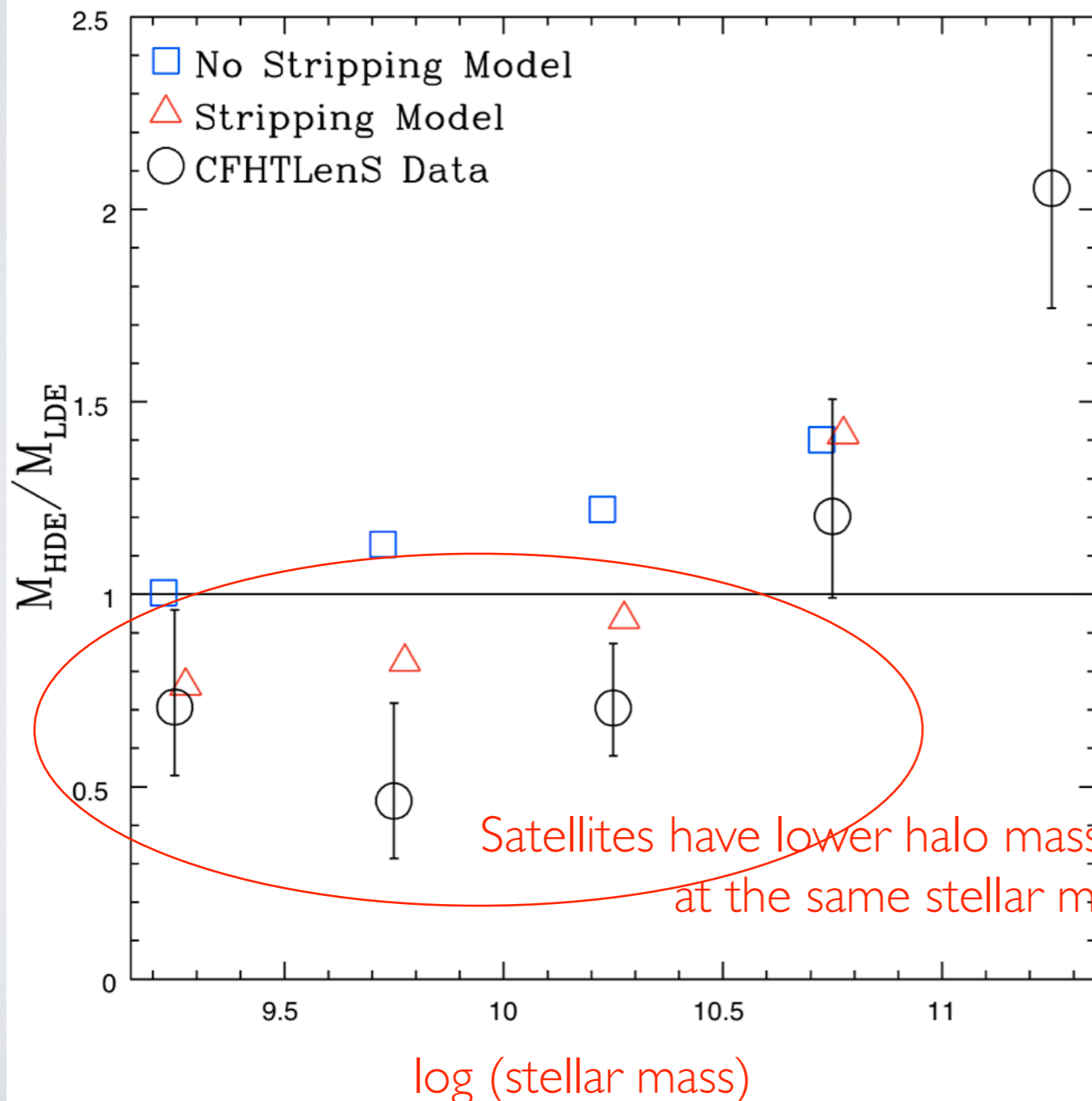
Physical pairs

Projected
Surface
Mass
Density



Projected pairs

TIDAL STRIPPING

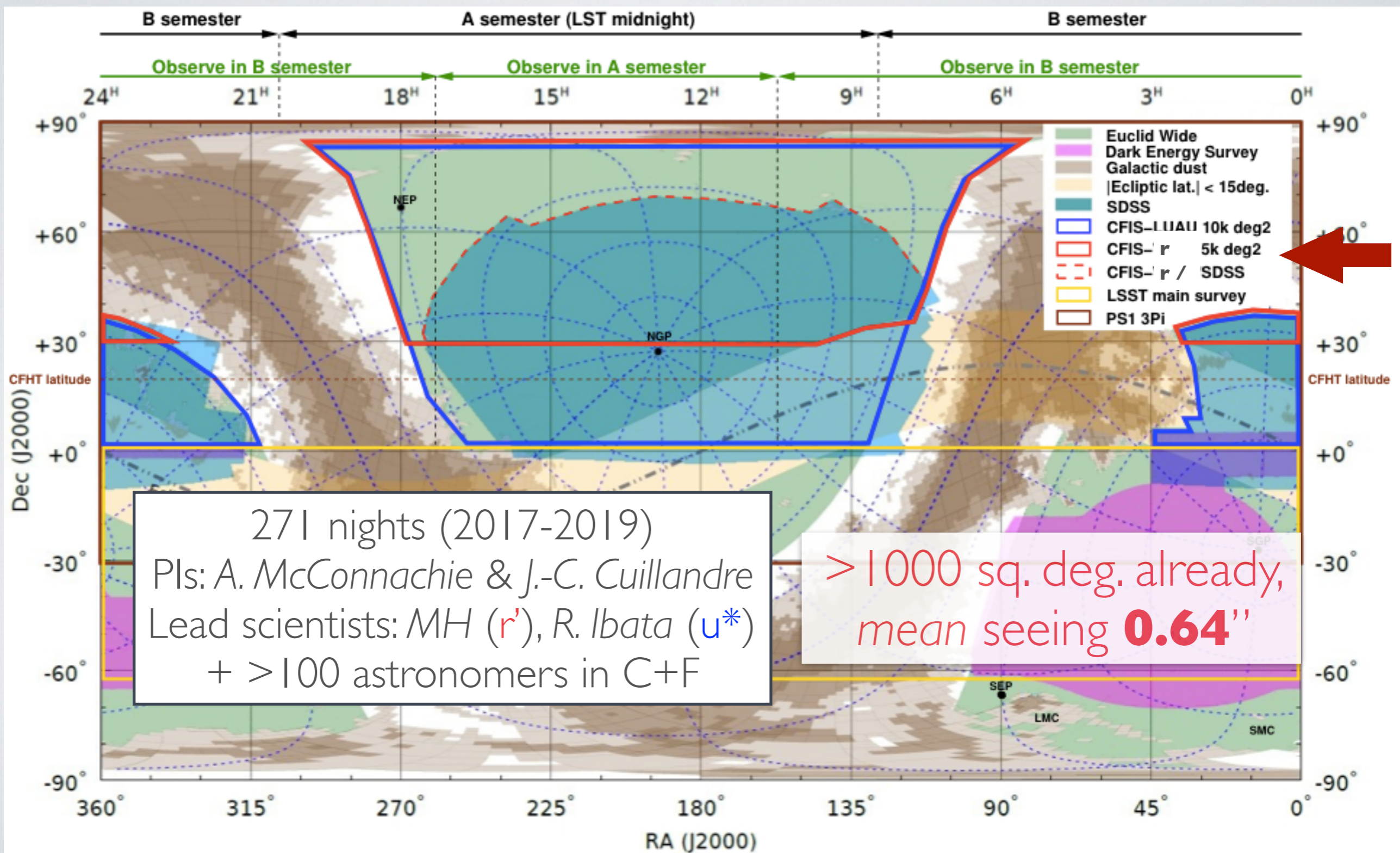


Tidal stripping of satellite dark matter halos can be measured by weak lensing,

Gillis, MH and CFHTLenS, 2013



CANADA-FRANCE IMAGING SURVEY (CFIS)



SUMMARY

- There is a non-linear relation between stellar mass and DM-halo mass, that evolves with redshift
 - Limited role for major mergers in growth of largest galaxies
- There is a (secondary) dependence of halo mass on galaxy size:
 - Mostly (but not only) due to tidal stripping of satellites, according to simulations
 - Minor mergers explain the evolution of LRGs