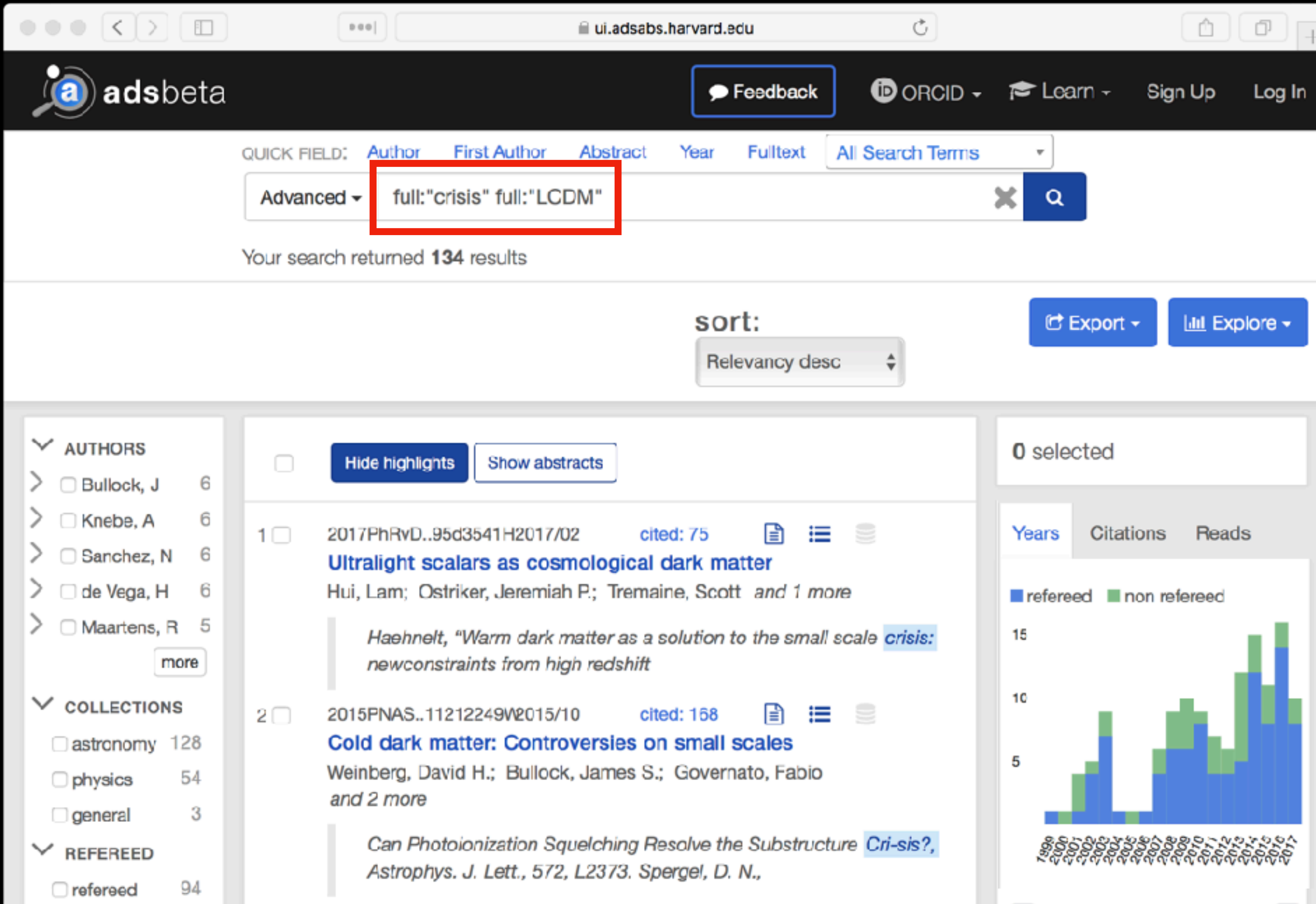
THE ROYAL SOCIETY

UCL

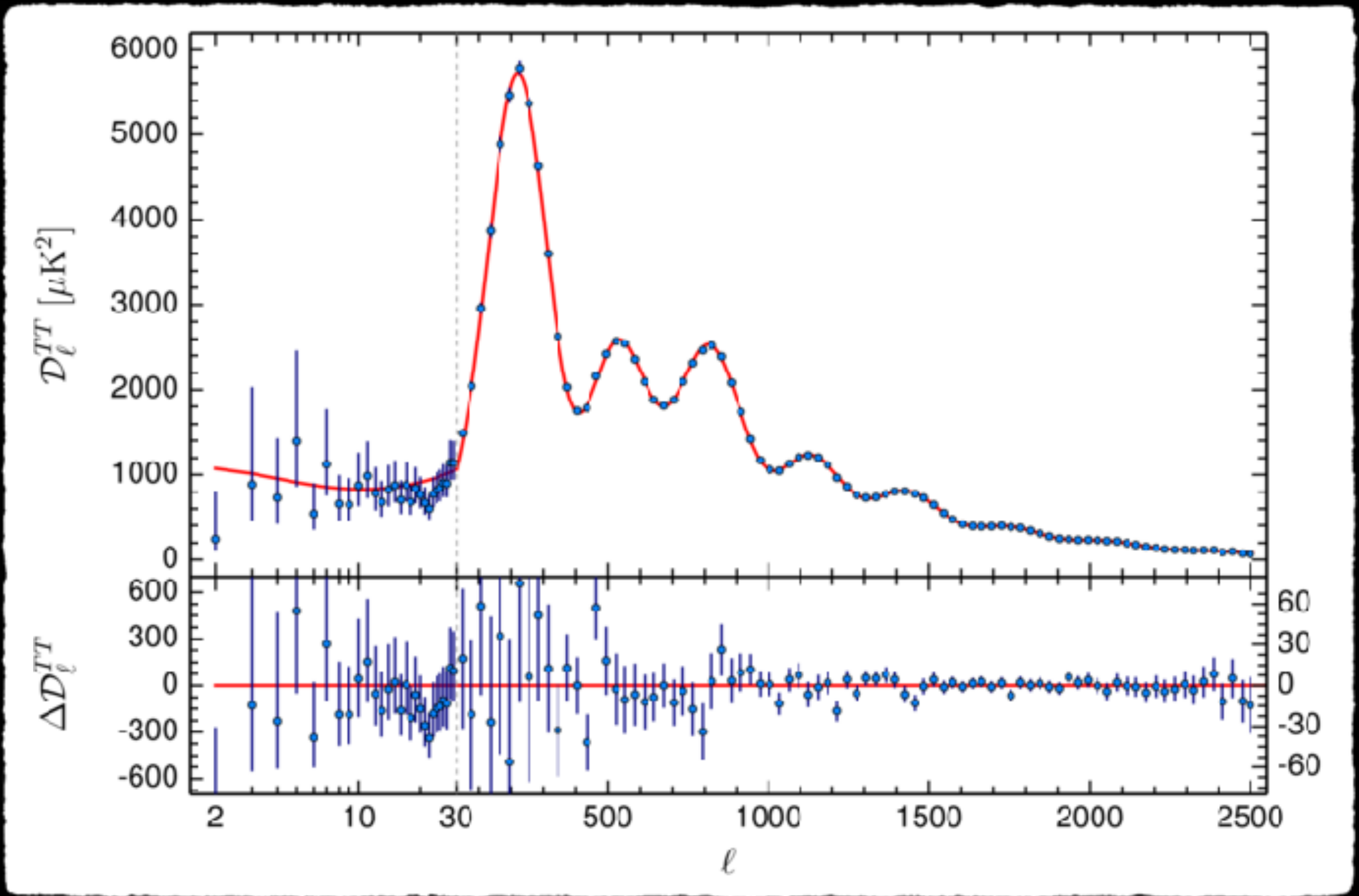
ΛCDM health check

Andrew Pontzen

Jason McEwen, Stephen Feeney, Fabio Governato, Hiranya Peiris, Jorge Peñarrubia, Nina Roth, Daniela Saadeh, Amélie Saintonge, Michael Tremmel, Marta Volonteri


ui.adsabs.harvard.edu
adsbeta
Feedback
ORCID
Learn
Sign Up
Log In
QUICK FIELD: Author First Author Abstract Year Fulltext All Search Terms
Advanced
full:"crisis" full:"LCDM"
Your search returned 134 results
sort:
Relevancy desc
Export
Explore
AUTHORS
Bullock, J 6
Knebe, A 6
Sanchez, N 6
de Vega, H 6
Maartens, R 5
more
COLLECTIONS
astronomy 128
physics 54
general 3
REFEREED
refereed 94
Hide highlights
Show abstracts
1 2017PhRvD..95d3541H 2017/02 cited: 75
Ultralight scalars as cosmological dark matter
Hui, Lam; Ostriker, Jeremiah P.; Tremaine, Scott and 1 more
Haehnelt, "Warm dark matter as a solution to the small scale crisis: newconstraints from high redshift
2 2015PNAS..11212249W 2015/10 cited: 158
Cold dark matter: Controversies on small scales
Weinberg, David H.; Bullock, James S.; Governato, Fabio
and 2 more
Can Photoionization Squelching Resolve the Substructure Cri-sis?, Astrophys. J. Lett., 572, L2373. Spergel, D. N.,
0 selected
Years
Citations
Reads
refereed
non refereed
15
10
5

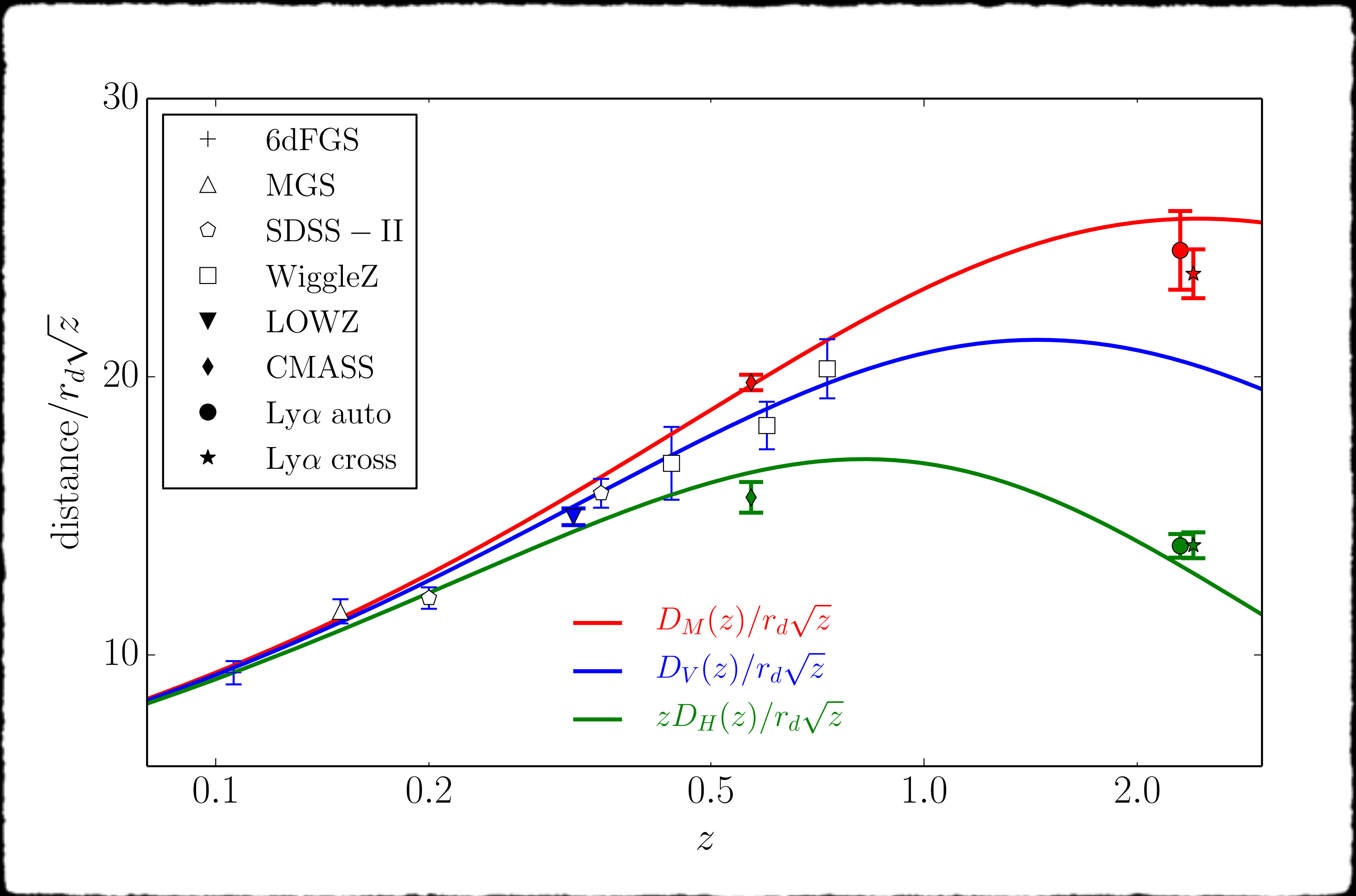
Some *a priori* successes of ΛCDM



Planck Collaboration 2015

- Prediction of cosmic microwave background temperature & E-mode polarisation anisotropies (up to a few parameters)

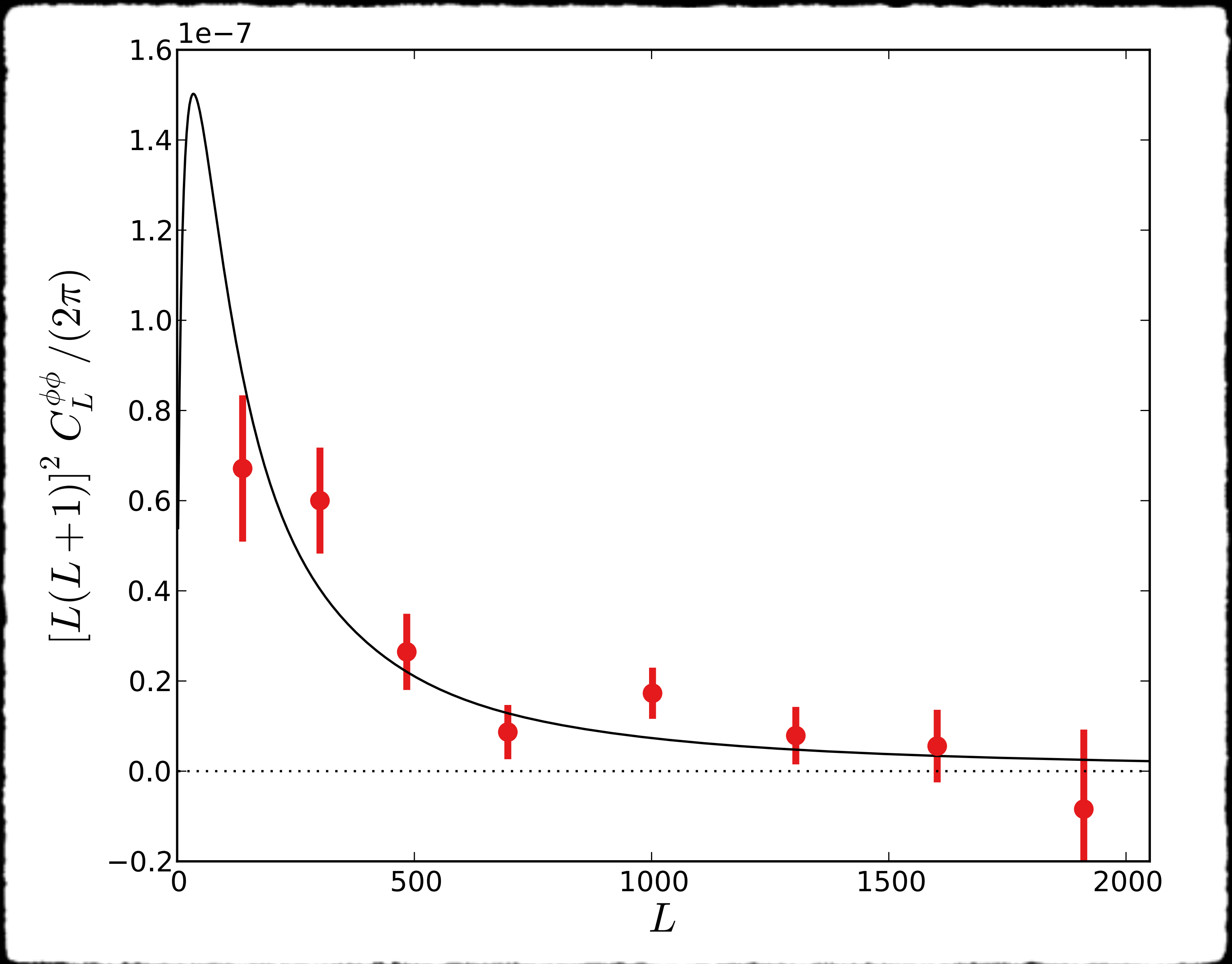
Some *a priori* successes of ΛCDM



Auborg+ 2015 (BOSS collaboration)

- Prediction of baryon acoustic oscillation scale (and amplitude) in galaxy survey data

Some *a priori* successes of ΛCDM



Sherwin+ 2017
(ACTPol collaboration)

- Prediction of CMB lensing amplitude and approximate scale dependence

Some *a priori* successes of ΛCDM

Clowe+ 2006
"bullet cluster"

- Prediction of present day mass distribution on ~Mpc scales (and larger)

Some challenges to ΛCDM

1. Anomalies in the cosmic microwave background

2. The under-abundance of dwarf galaxies (aka “missing satellites”)

3. The unexpected dark matter distribution around dwarf galaxies (aka “cusp/core”)

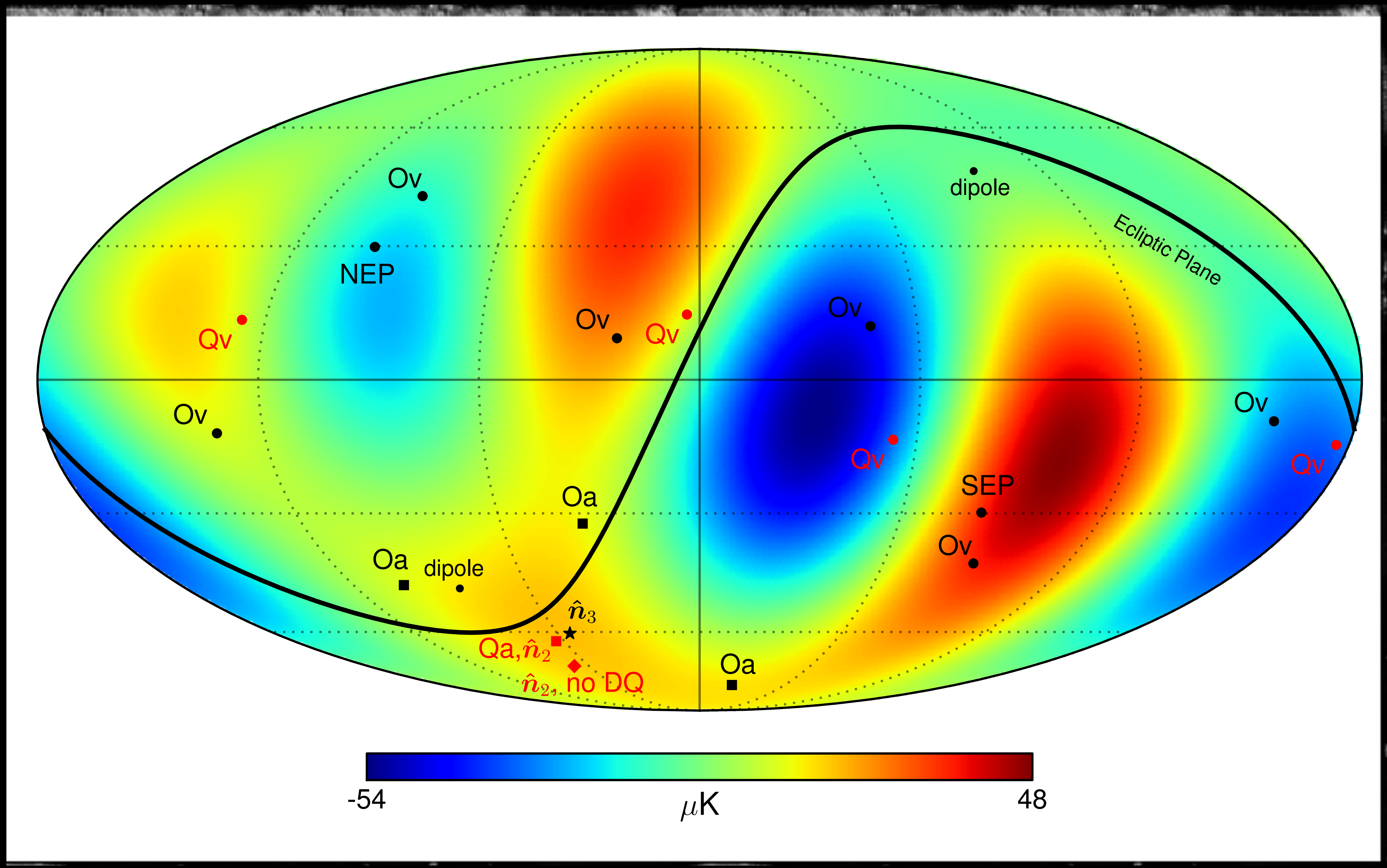
4. The low masses of dwarf galaxies (aka “too big to fail”)

5. Unexpected alignments in the distribution of dwarf galaxies

6. The existence of a common acceleration scale

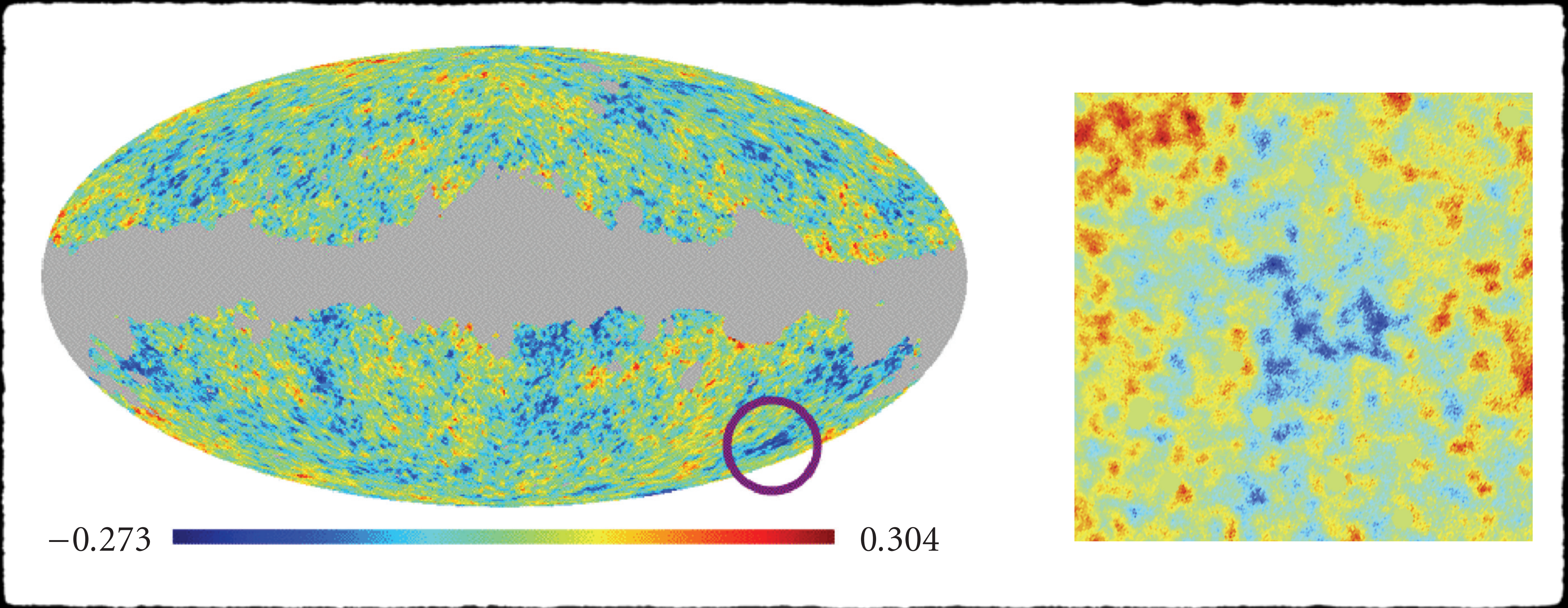
CMB anomalies: low-l alignments

(= “missing power” on large scales – see Pontzen & Peiris 2010)



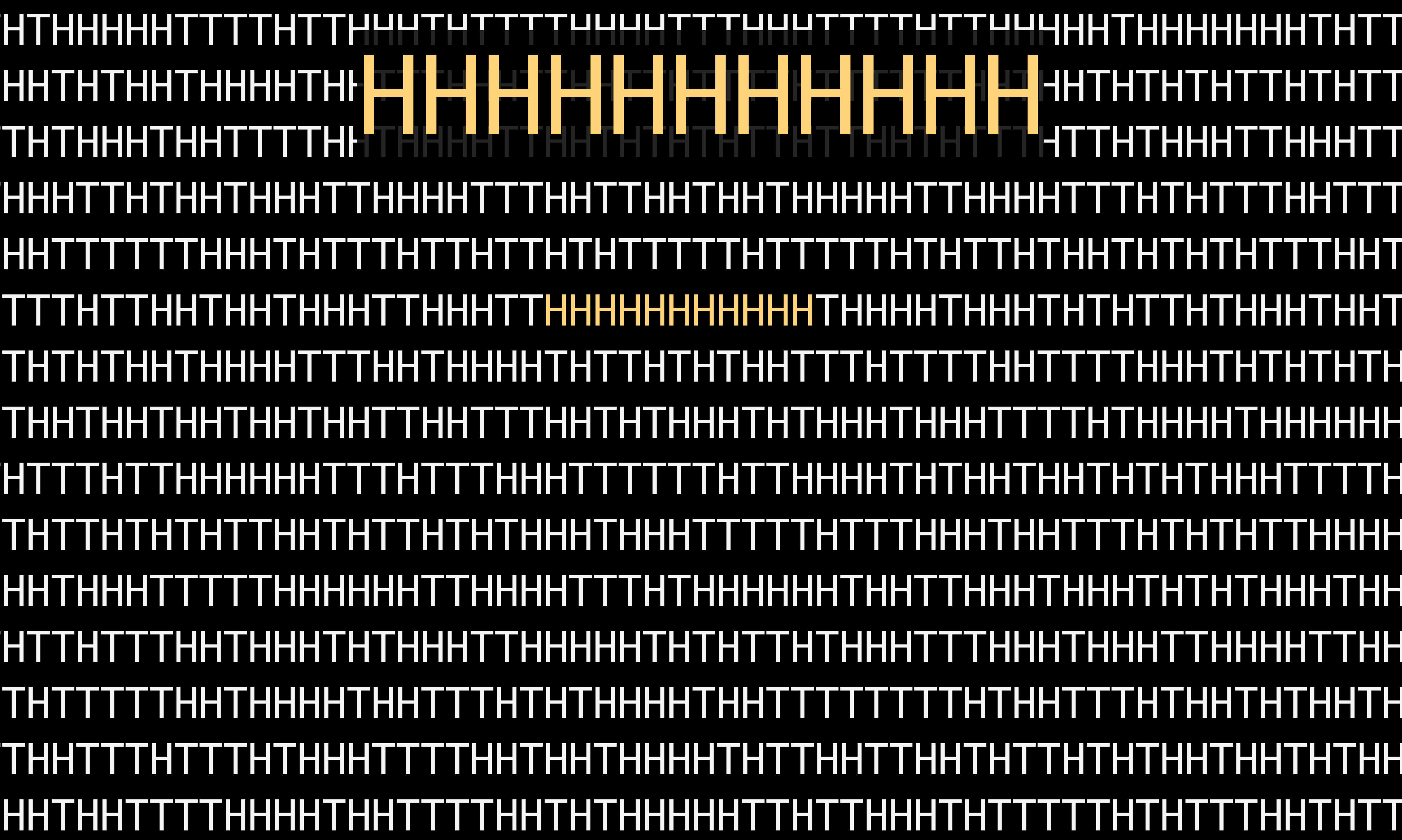
Schwarz+ 2015

CMB anomalies: cold spot



Vielva 2010

CMB anomalies: look elsewhere



CMB anomalies: look elsewhere

$$p(T|D) = p(D\ |\ T)\ p(T)\ /\ p(D)$$

Use **all** the relevant data
(or get as close as possible)

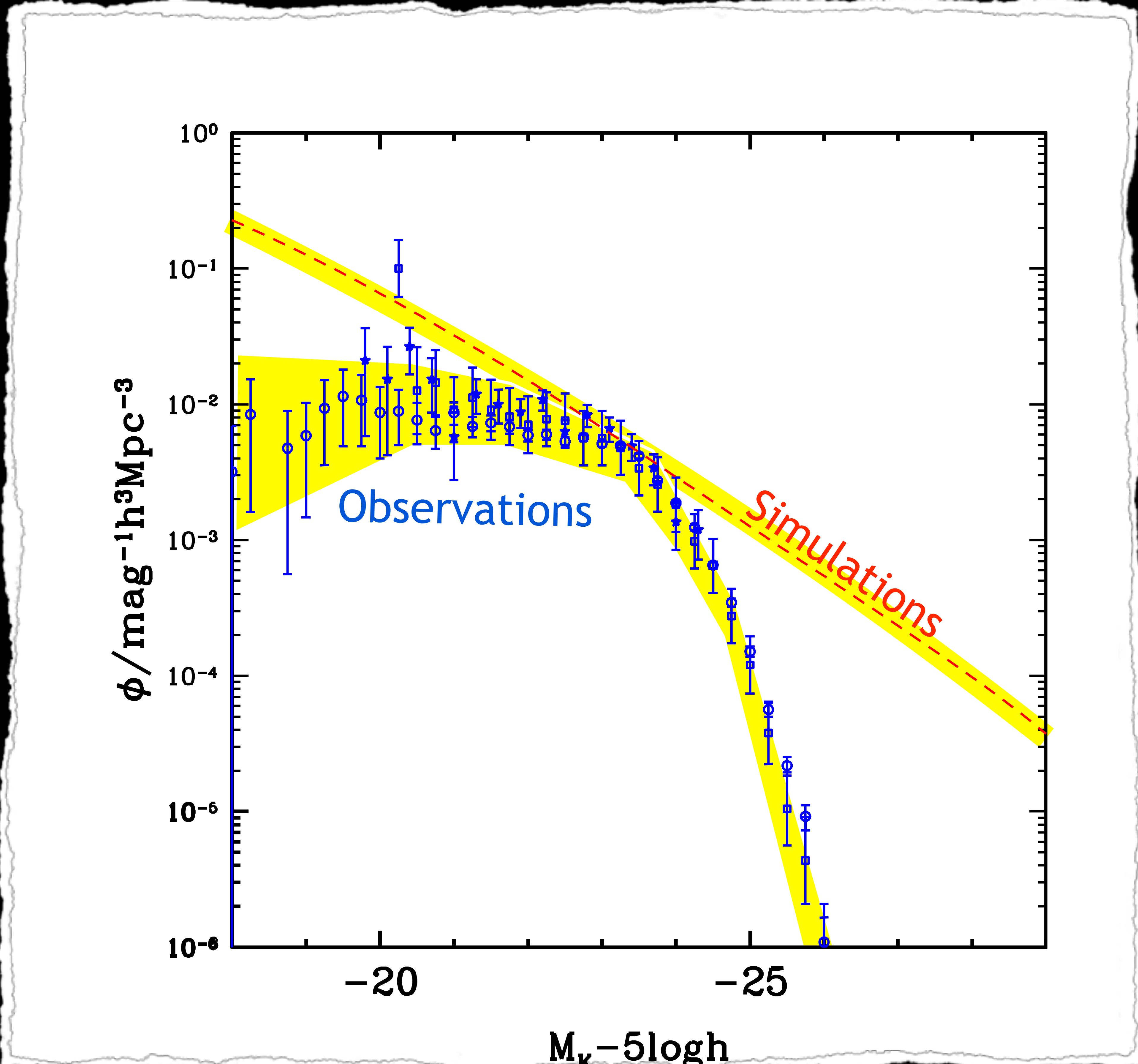
Be **realistic** about
what other theories
are plausible

Even **very** contrived anisotropic theories
only improve p(D|T) by factors of a few tens;
easily overwhelmed by p(T).

Pontzen & Peiris 2010

Chances of anisotropic expansion 121,000:1 against

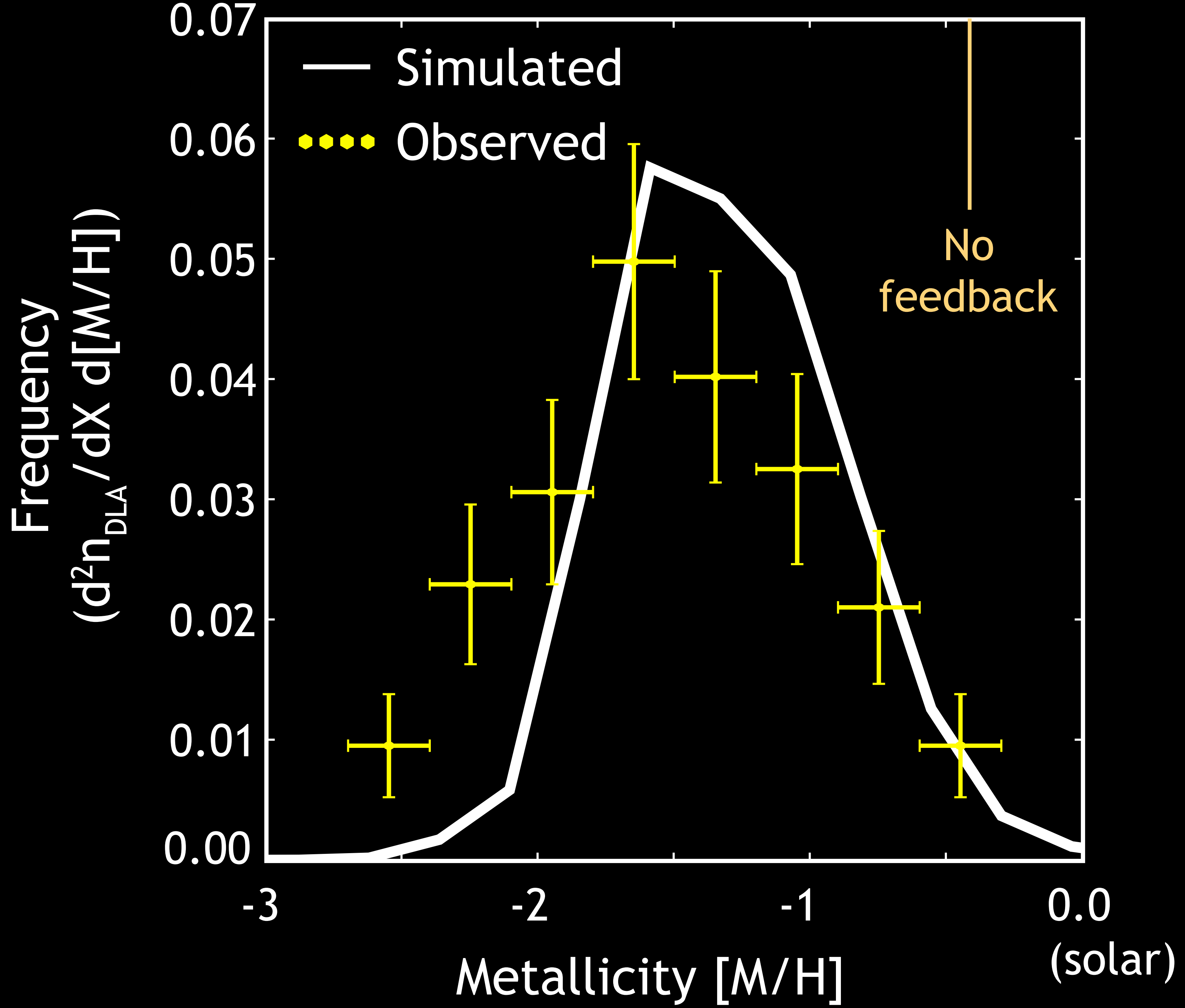
Saadeh+ 2016



Missing satellites (and missing bright galaxies)

Benson et al 2003

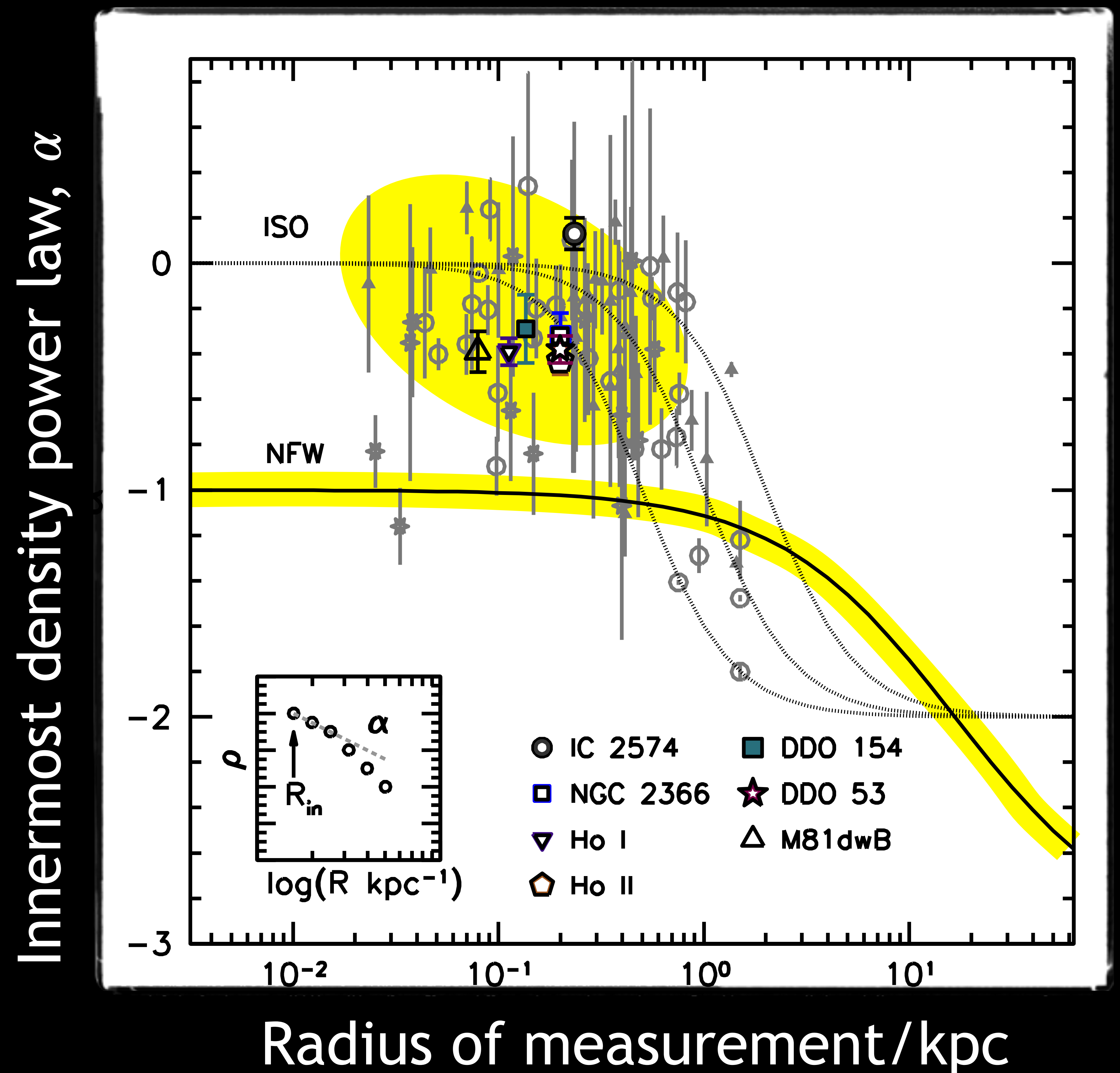
With a posteriori solutions, try to find independent cross-checks



Observational data = HIRES/UVES compilation (Prochaska 2008)

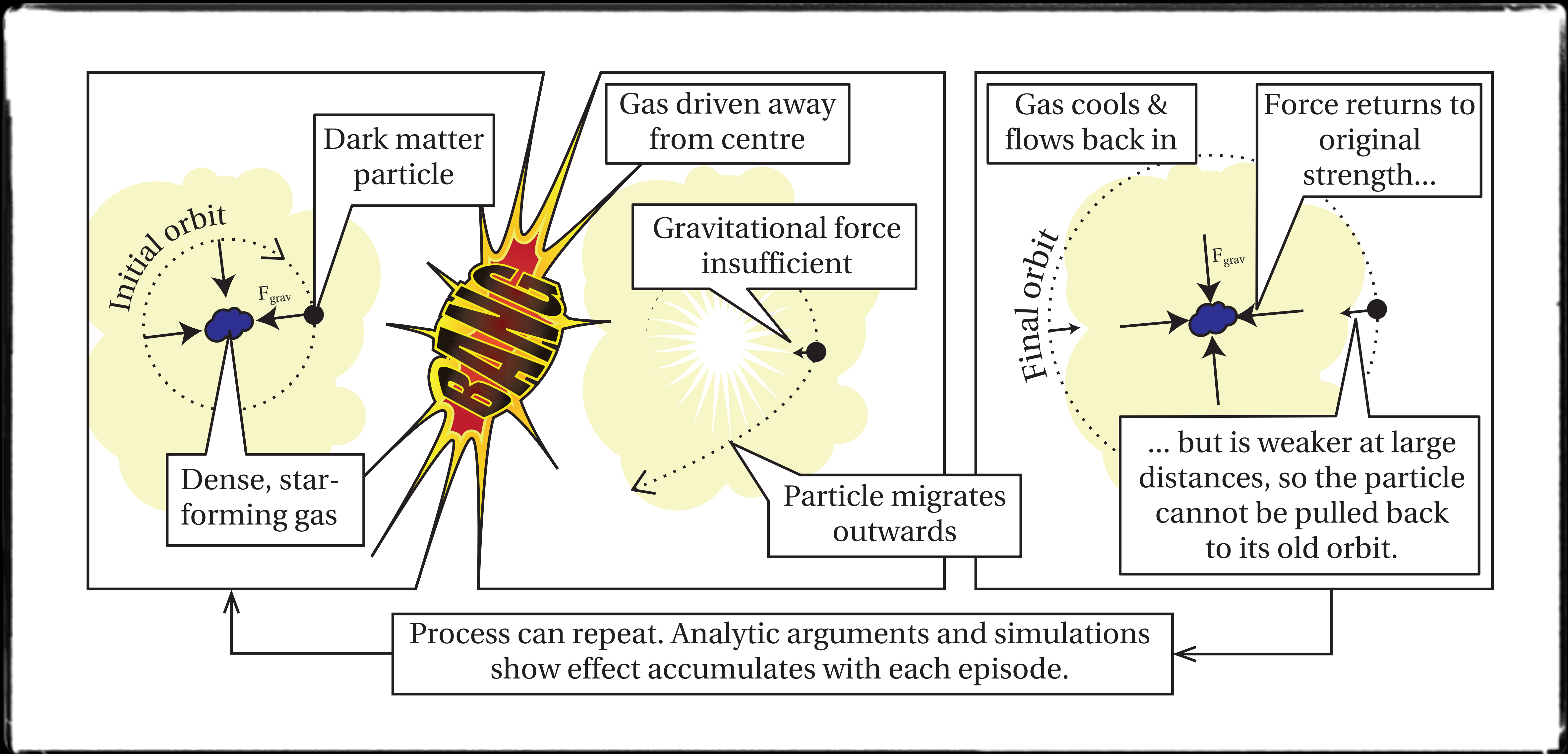
Pontzen+08
Pontzen+10

Cusp/ core



Oh+2011 (THINGS collaboration)

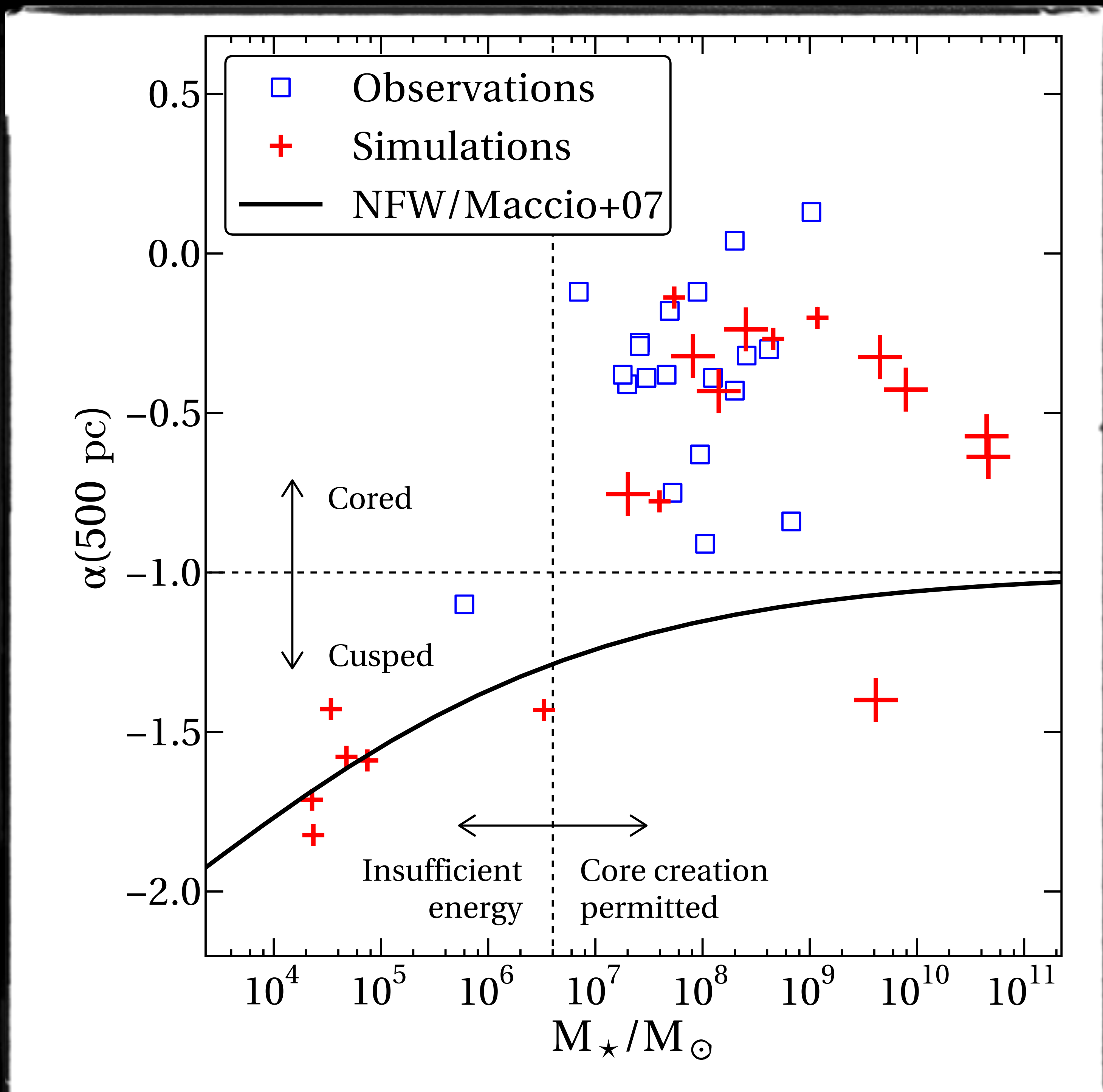
Cusp/core



Pontzen & Governato 2014/2012

Also at cluster scale with AGN (e.g. Martizzi, Teyssier & Moore 2013)

Cusp/core



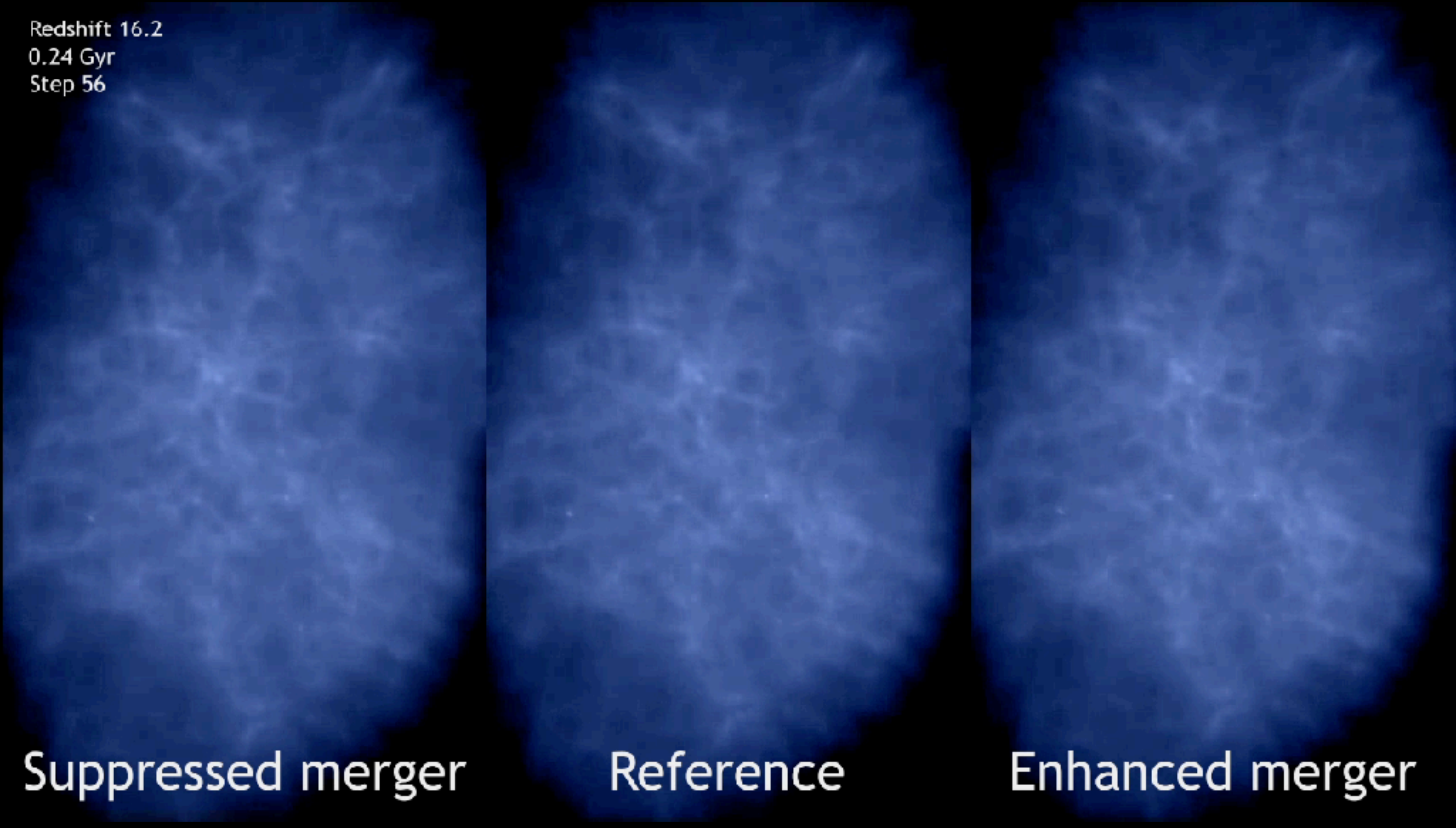
Key prediction from energetic arguments: baryonic-sourced core size scales steeply with stellar mass.

Peñarrubia, Pontzen, Walker, Koposov 2012

Pontzen & Governato 2014

Cusp/core next steps (advert)

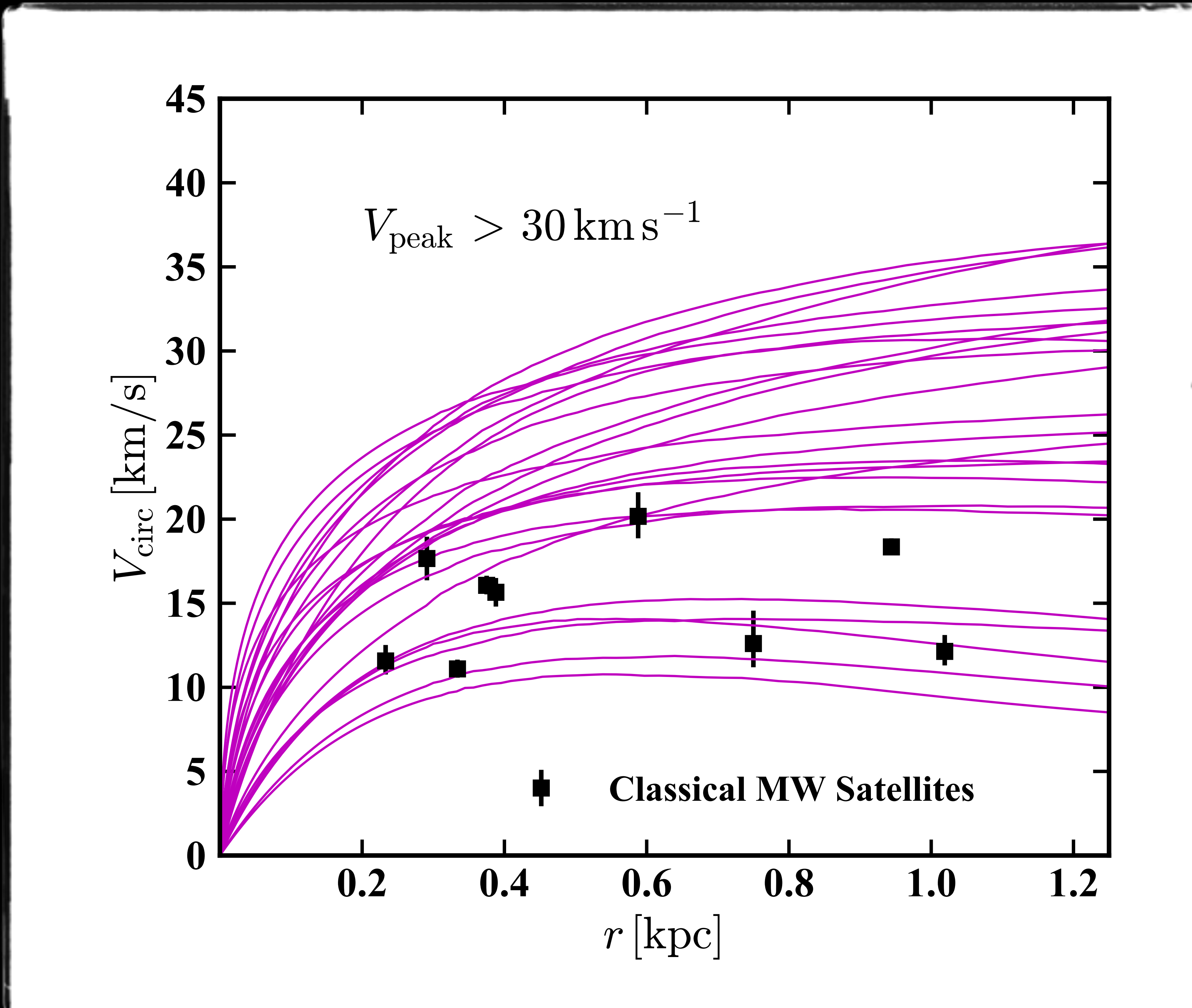
Sensitivity to history with “genetic modification” approach; high resolution (1pc) RAMSES-RT sims



Dwarf masses

aka "too big to fail"

Boylan-Kolchin+ 2012



Baryonic effects + uncertainty in MW mass scale

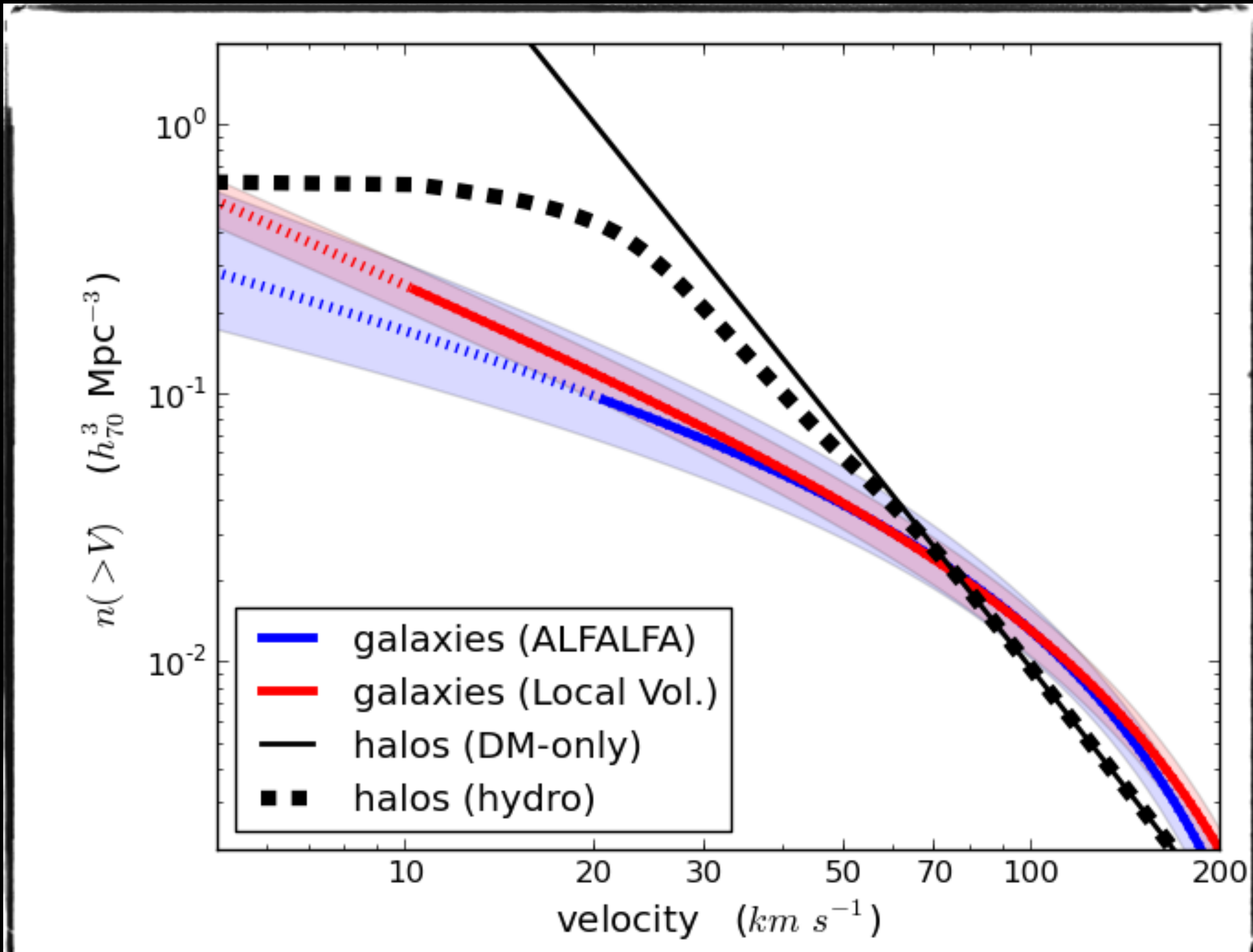
Zolotov+ 2012

Dwarf masses

aka “too big to fail”

Ferrero+ 2012

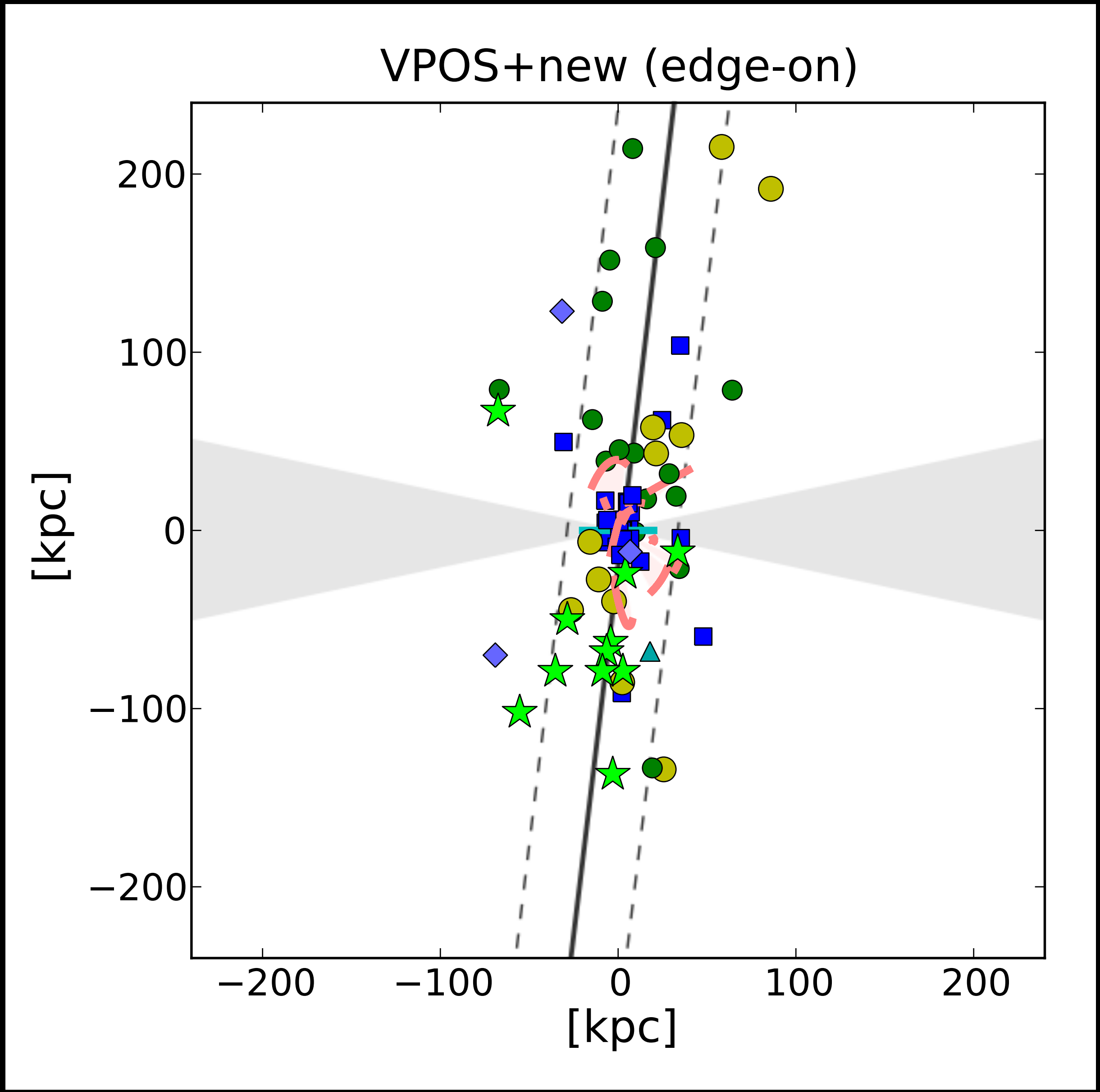
Papastergis & Shankar 2016

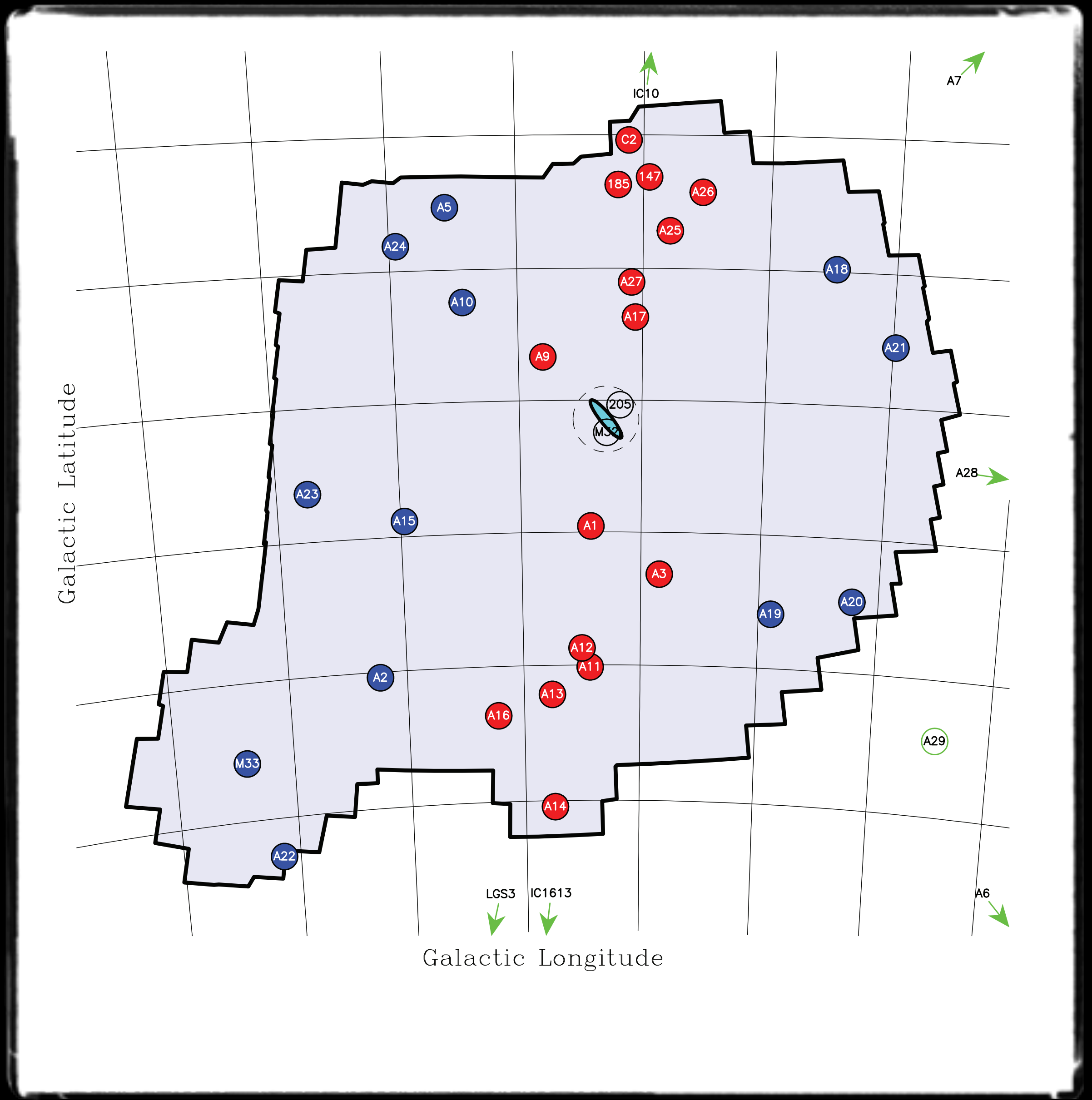


HI does not trace potential; survey biases

Brooks+ 2017

Alignments





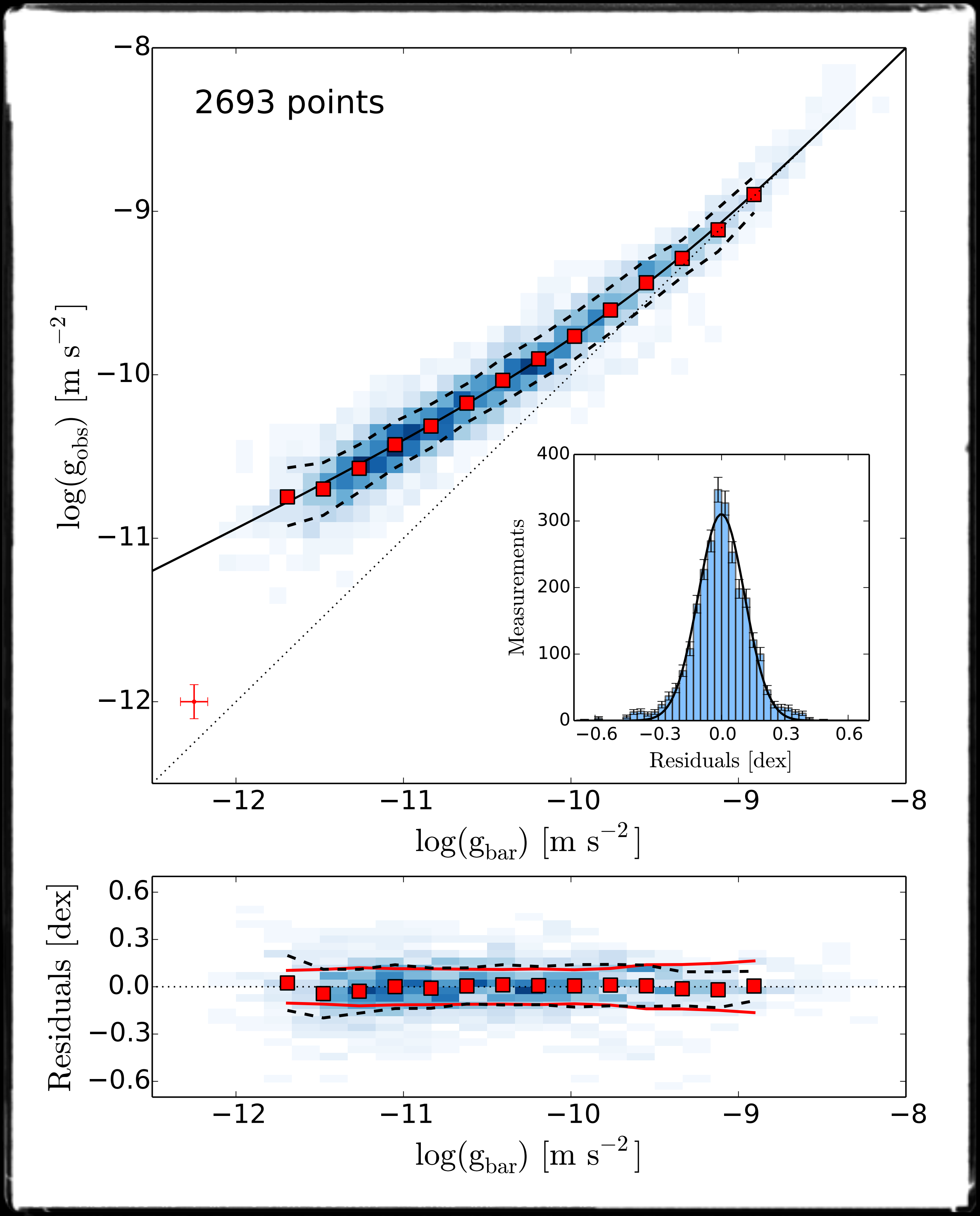
MW e.g. Pawlowski, McGaugh & Jerjen 15

M31 e.g. Ibata+ 2013

These are expected(ish) — check with proper motions

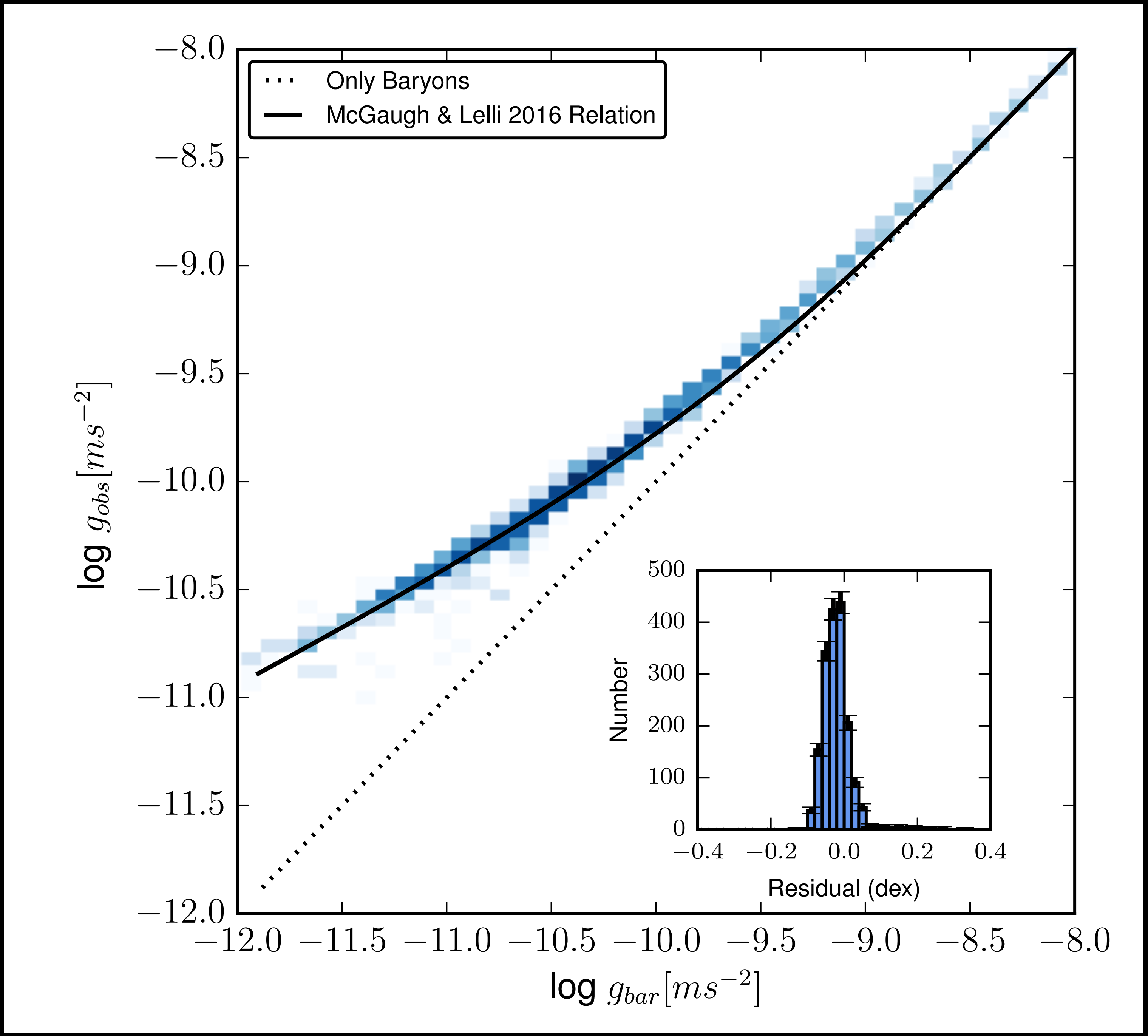
e.g. Libeskind+09; Buck, Dutton & Macciò 16

Acceleration scale



McGaugh, Lelli & Schombert 2016

Acceleration scale



This happens naturally in simulations.

Scale set by cH_0.

Keller & Wadsley 2016

see also e.g. van den Bosch & Dalcanton 2000; Kaplinghat & Turner 2002

THE ROYAL SOCIETY

UCL

ΛCDM health check

1. There are, as yet, no killer blows to ΛCDM:
It is resilient. That does not mean it is "correct".

2. Focus on physics, not *p*-values:
p(D|T) will always be small; let's see concrete alternative T (and avoid cherry-picking D).

3. There is plenty of fun physics worth focussing on:
SIDM, baryon physics, interplay with large scale environment and (especially) combining two or more of these aspects.

Andrew Pontzen