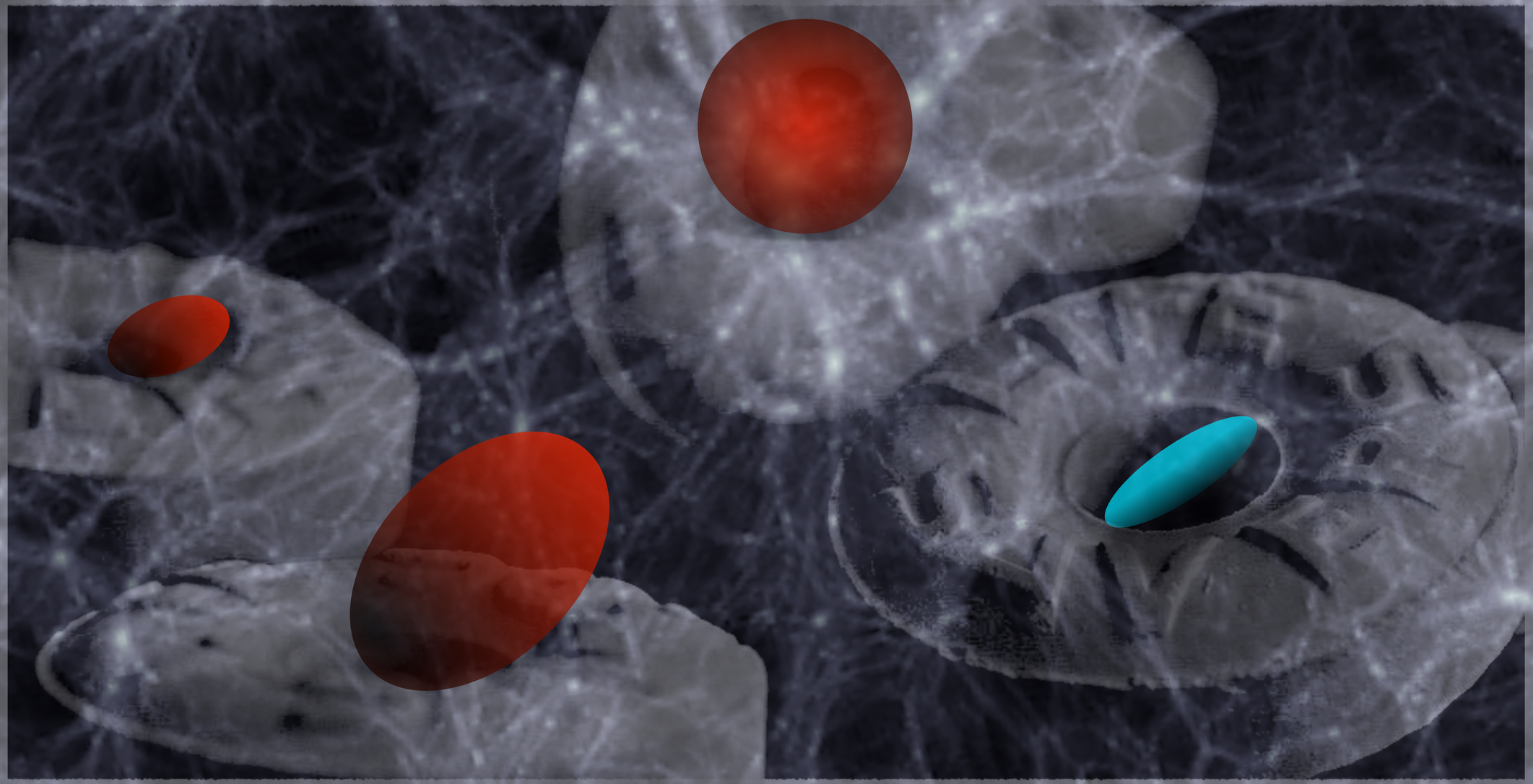


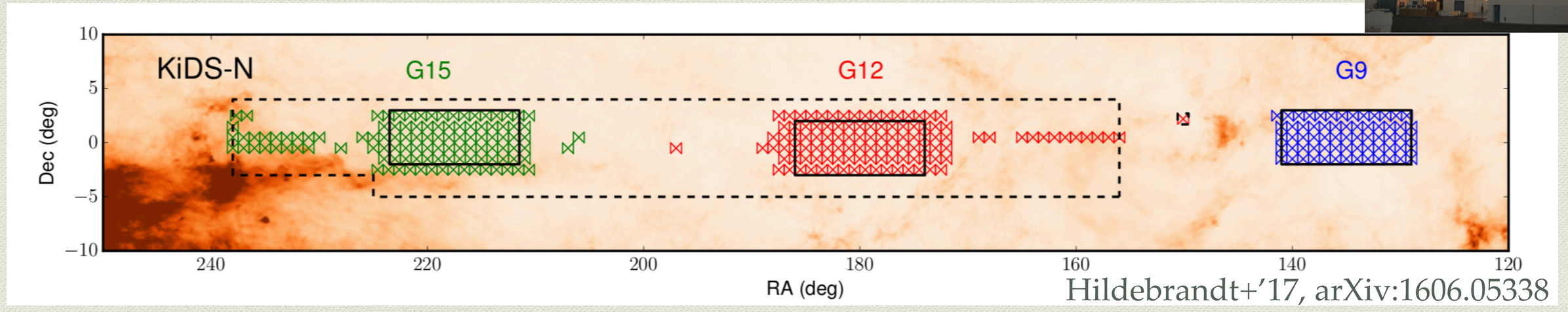
Intrinsic Alignments in KiDS+GAMA

Harry Johnston, UCL
with C. Georgiou, B. Joachimi, H. Hoekstra + KiDS +

KiDS

KiDS — Kilo Degree Survey

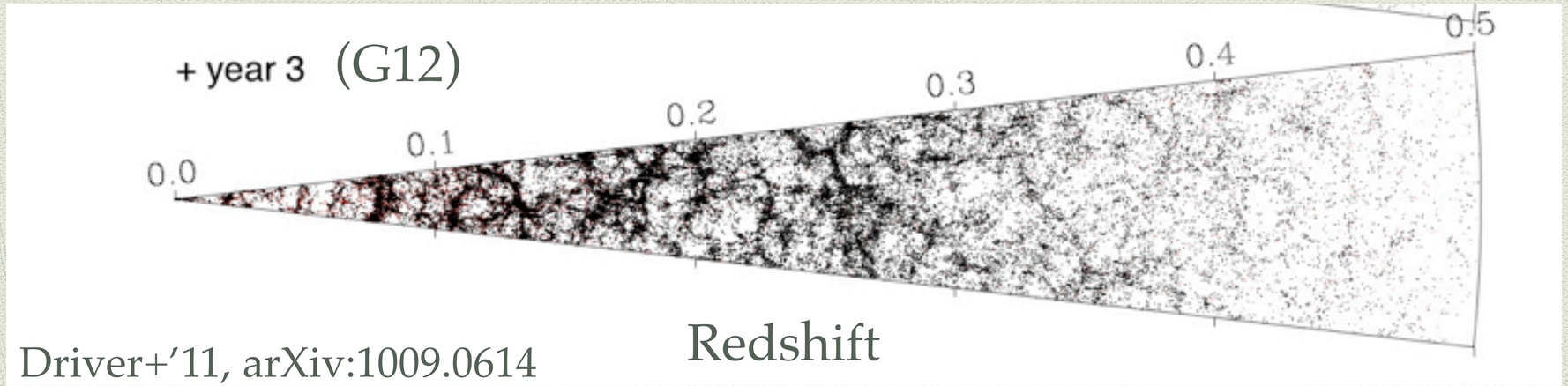
OmegaCAM @ VLT Survey Telescope (VST) — *ugri* imaging — approaching 1350deg^2



Hildebrandt+'17, arXiv:1606.05338

GAMA — Galaxy And Mass Assembly

AAOmega spectrograph @ Anglo-Australian Telescope (AAT) — 98% complete to r < 19.8



Driver+'11, arXiv:1009.0614

Astronomy & Astrophysics manuscript no. Paper2–Data
November 26, 2018

arXiv:1811.09598

KiDS+GAMA: Intrinsic alignment model constraints for current and future weak lensing cosmology

Harry Johnston[1⋆], Christos Georgiou[2], Benjamin Joachimi[1], Henk Hoekstra[2], Nora Elisa Chisari[3], Daniel Farrow[4], Maria Cristina Fortuna[2], Catherine Heymans[5], Shahab Joudaki[3], Konrad Kuijken[2] and Angus Wright[6]

[1] Department of Physics and Astronomy, University College London, Gower Street, London WC1E 6BT, UK
[2] Leiden Observatory, Leiden University, PO Box 9513, Leiden, NL-2300 RA, the Netherlands
[3] Department of Physics, University of Oxford, Keble Road, Oxford, OX1 3RH, UK
[4] Max-Planck-Institut für extraterrestrische Physik, Postfach 1312 Giessenbachstrasse, D-85741 Garching, Germany
[5] Scottish Universities Physics Alliance, Institute for Astronomy, University of Edinburgh, Blackford Hill, Edinburgh EH9 3HJ, UK
[6] Argelander-Institut für Astronomie, Universität Bonn, Auf dem Hügel 71, 53121 Bonn, Germany

Accepted XXX. Received YYY; in original form ZZZ

Nov 2018

Flux-limited r < 19.8

~170k GAMA redshifts

KiDS imaging

DEIMOS shapes

DEIMOS:
DEconvolution In
MOments Space

Astronomy & Astrophysics manuscript no. AandA_IA_wavelength
September 12, 2018

arXiv:1809.03602

The dependence of intrinsic alignment of galaxies on wavelength using KiDS and GAMA

Christos Georgiou[1⋆], Harry Johnston[2], Henk Hoekstra[1], Massimo Viola[1], Konrad Kuijken[1], Benjamin Joachimi[2], Nora Elisa Chisari[3], Hendrik Hildebrandt[4], and Arun Kannawadi[1]

[1] Leiden Observatory, Leiden University, Niels Bohrweg 2, 2333 CA Leiden, The Netherlands
[2] Department of Physics and Astronomy, University College London, Gower Street, WC1E 6BT London, UK
[3] Department of Physics, University of Oxford, Keble Road, Oxford OX1 3RH, UK
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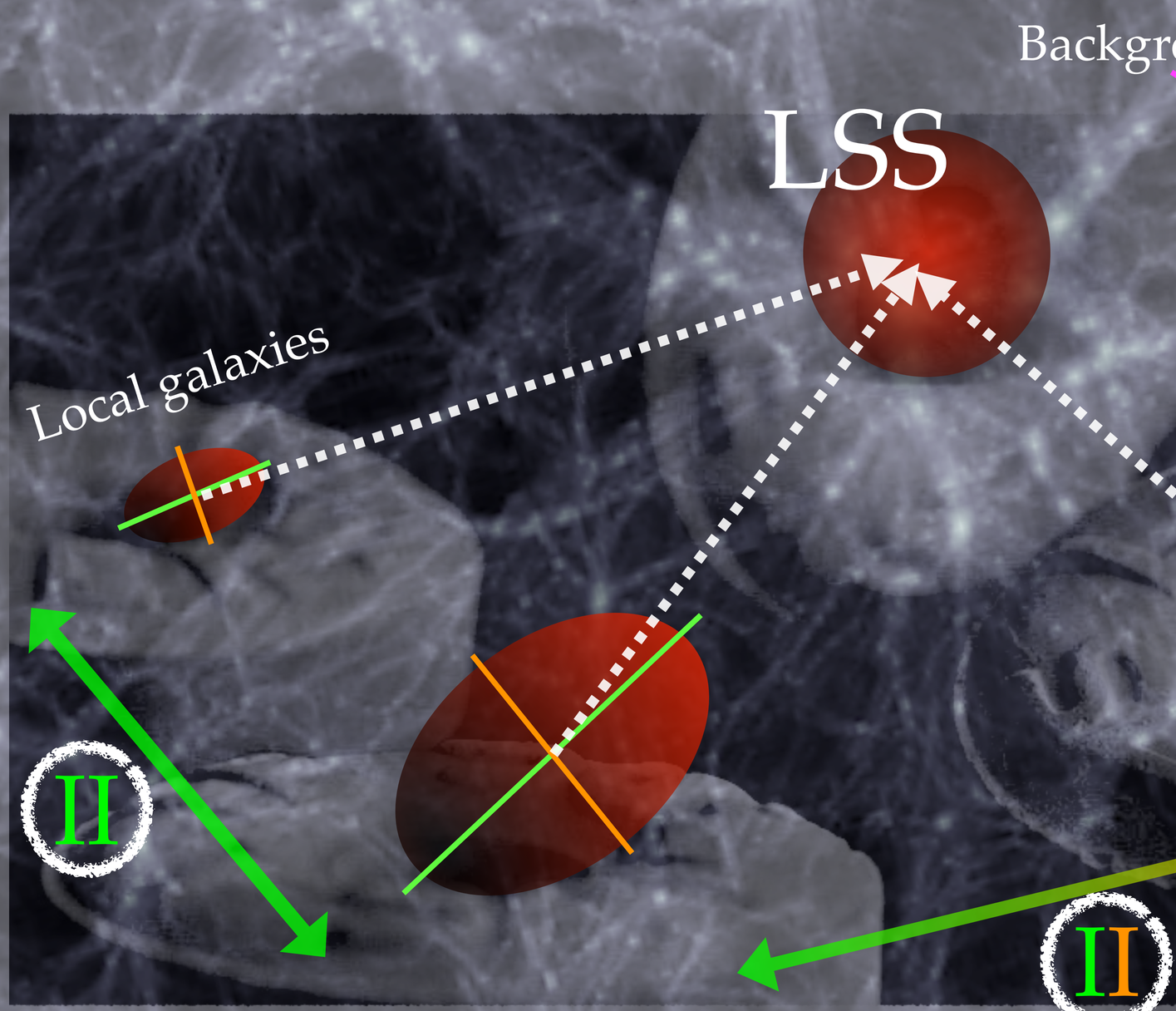
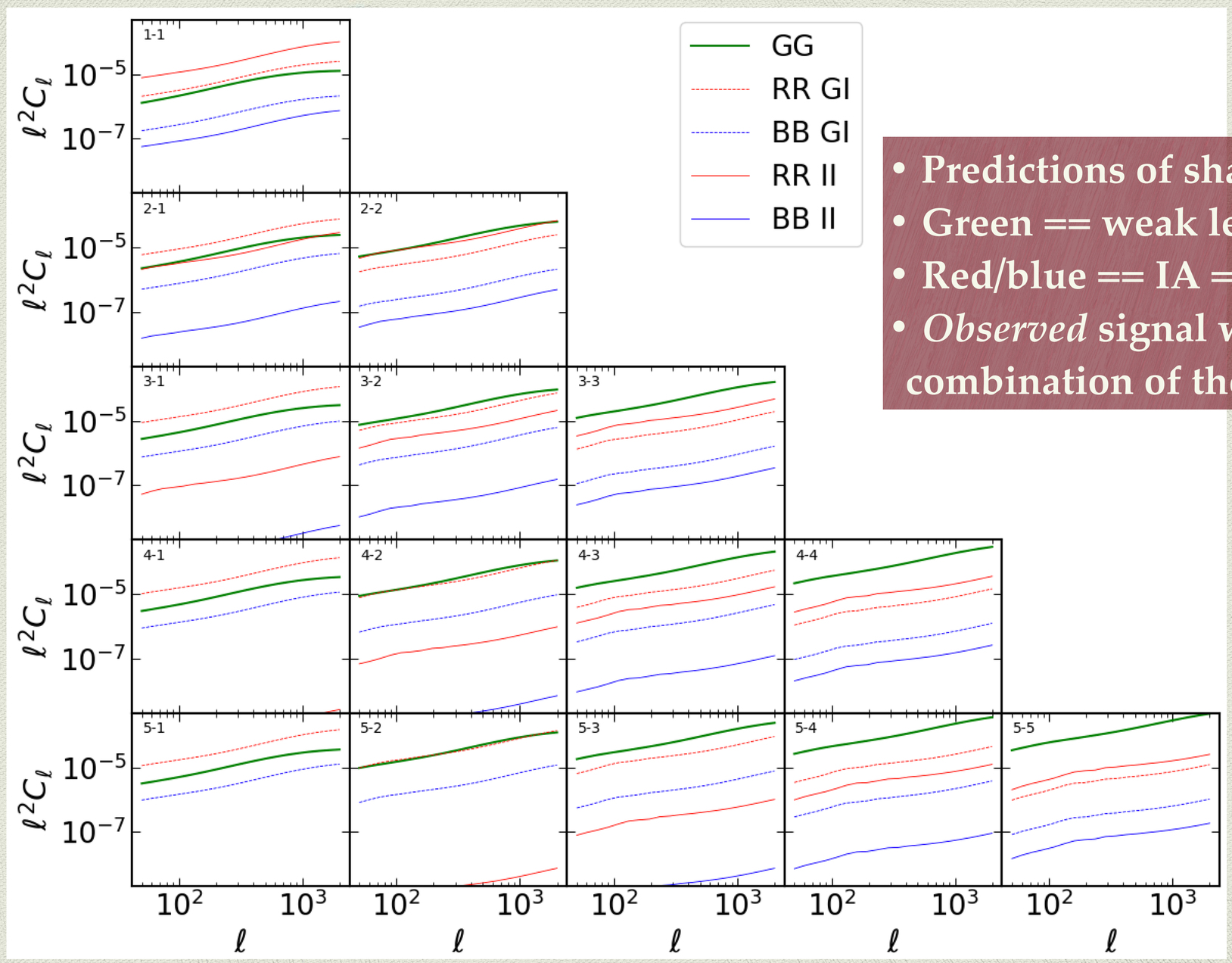
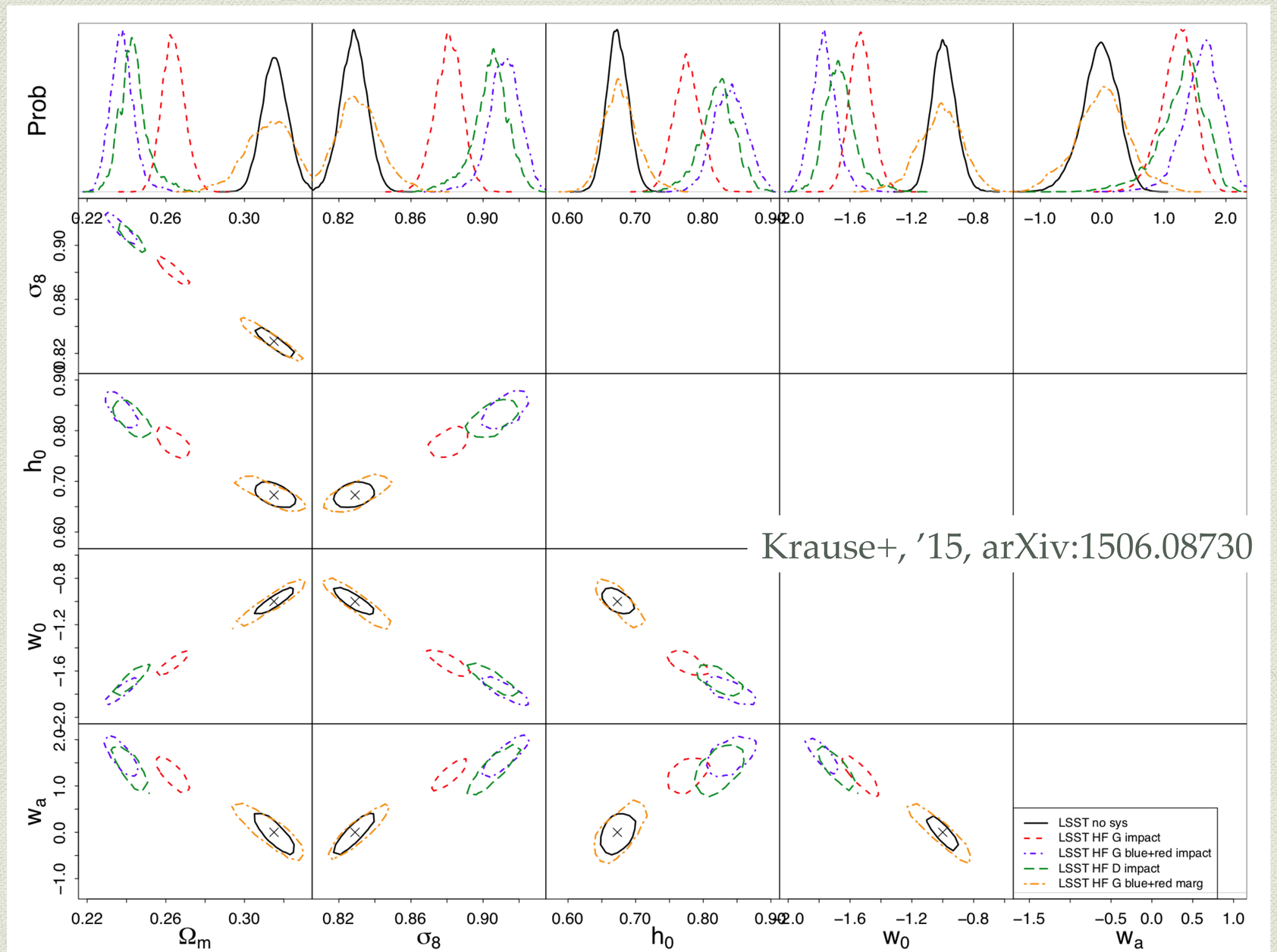
Received <date> / Accepted <date>

18


Background source
LSS
Local galaxies
GI
w_{g+}
II
II



- Predictions of shape-shape angular power spectra
- Green == weak lensing (shear)
- Red/blue == IA == contamination!
- *Observed* signal will be some weighted linear combination of these (and more)

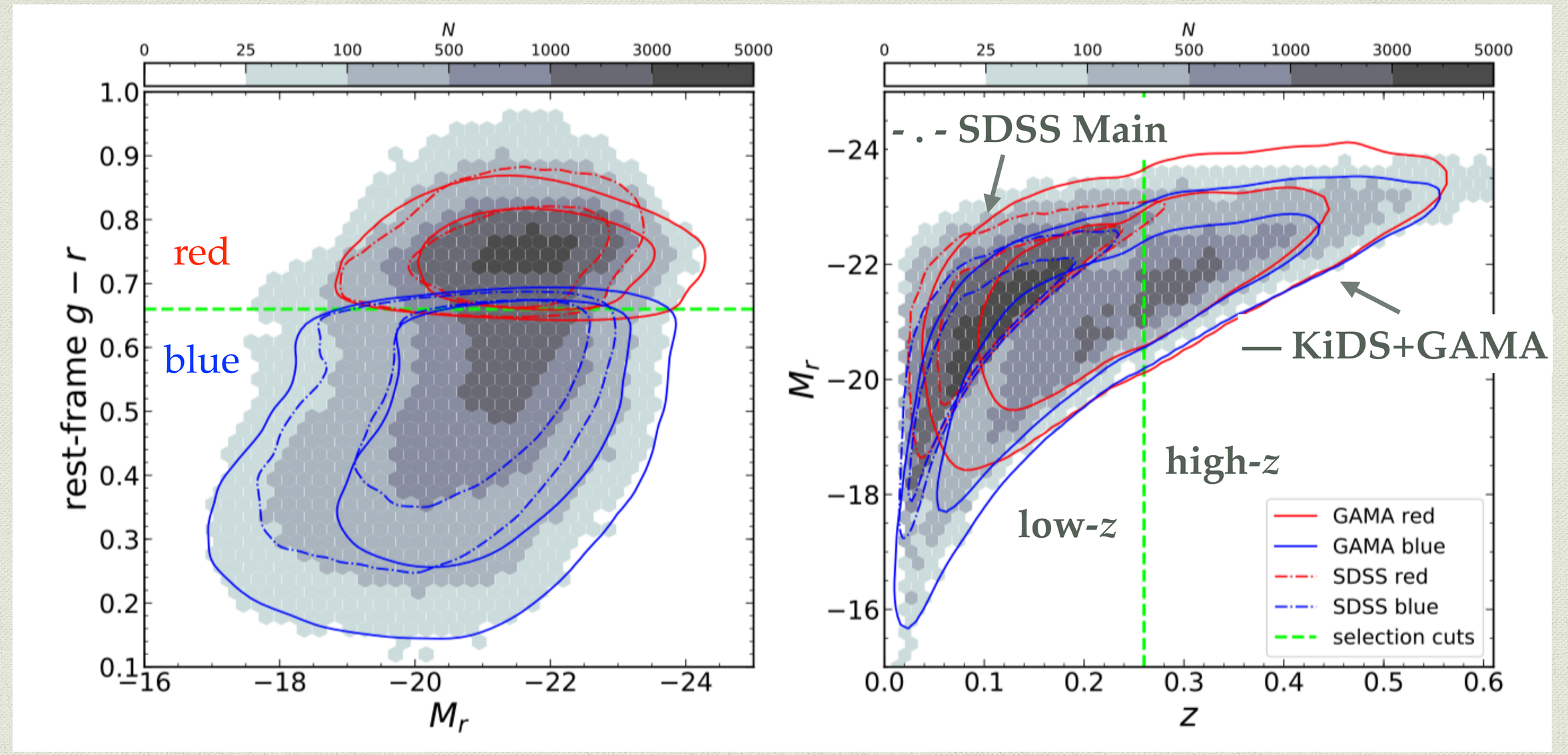


Krause+, '15, arXiv:1506.08730

Ignoring IA will result in large cosmological parameter biases!

So how do we model it?

Systematics?
Model correct?
Degradation?



HJ+ ’18, arXiv:1811.09598

$$w_{g+} \propto b_g \int P_{\delta I}(A_{IA}, \beta)$$

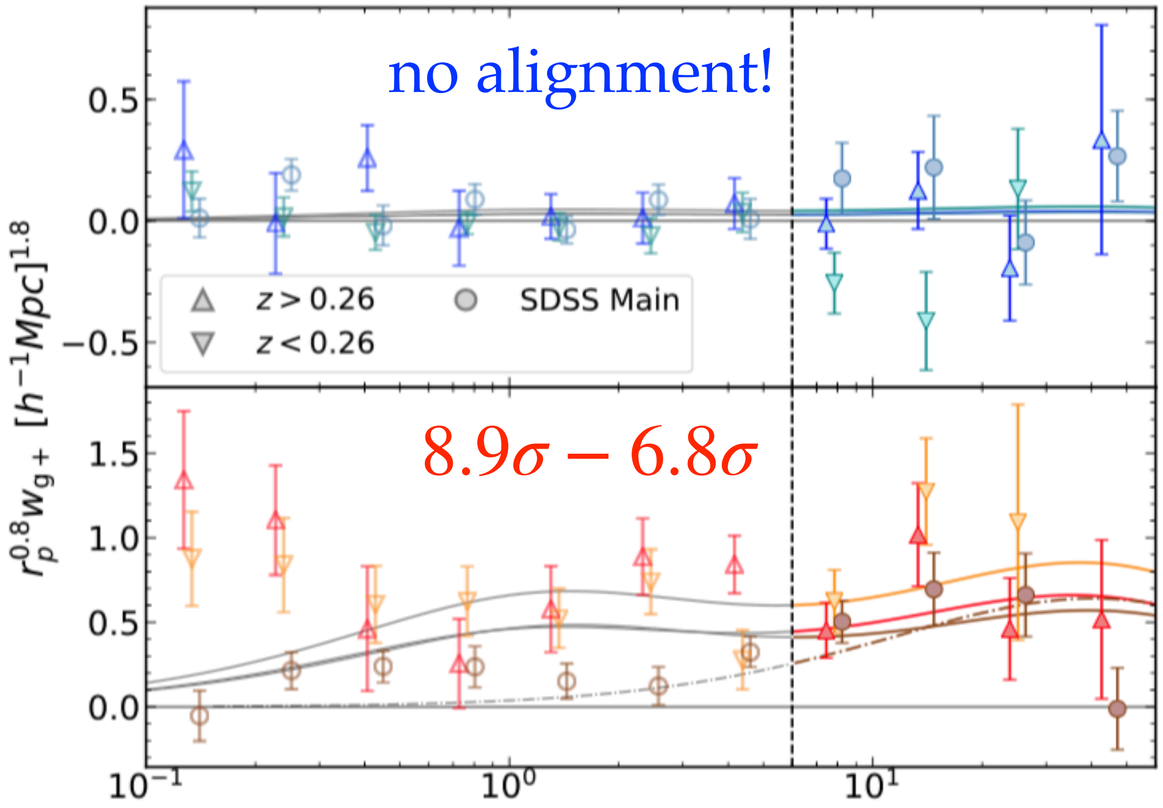
$$w_{gg} \propto b_g^2 \int P_\delta$$

Fixed ΛCDM cosmology

N/LA model(s)

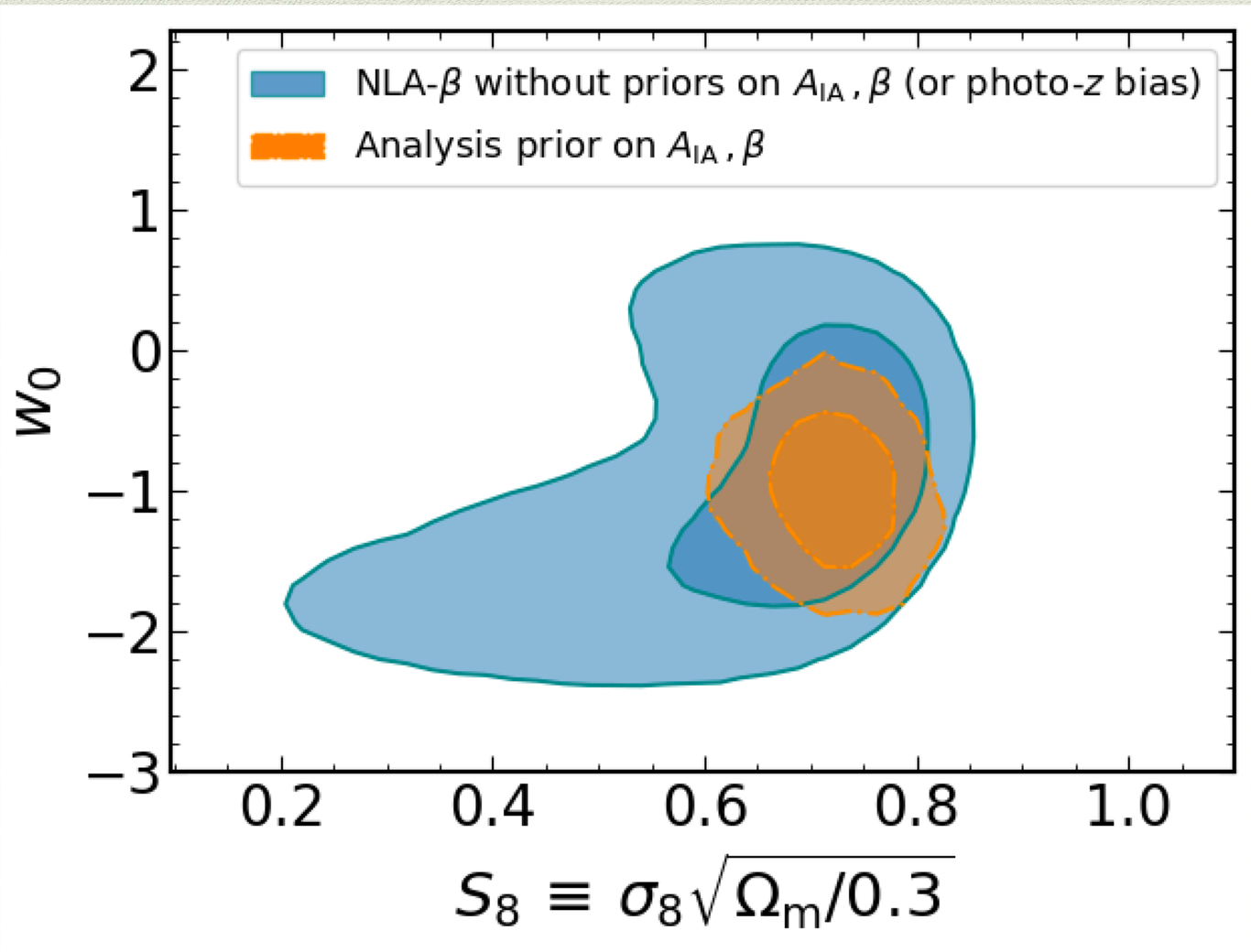
$$P_{\delta I}(k,z) = -A_{IA} \cdot \left\langle \frac{L}{L_{piv}} \right\rangle^{\beta} \cdot C_1 \frac{a^2 \bar{\rho}(z)}{D(z)} P_\delta(k,z)$$

- Blue galaxies (*top*) == zero-signal
- Red galaxies (*bottom*) == highly significant signals
- We constrain A_{IA} (and β) above 6Mpc/h
- Red signals vary greatly below ~6Mpc/h — why?



HJ+ '18, arXiv:1811.09598

Completed-KiDS Forecast — demonstrating potential impact of IA priors



- colour-split cosmic shear-only
- 1350deg^2 , 9 galaxies arcmin^{-2}
- 5-bin tomography , z[0.1, 1.2]
- photo-z scatter = 0.05(1+z)

Fisher forecast cosmo parameters:

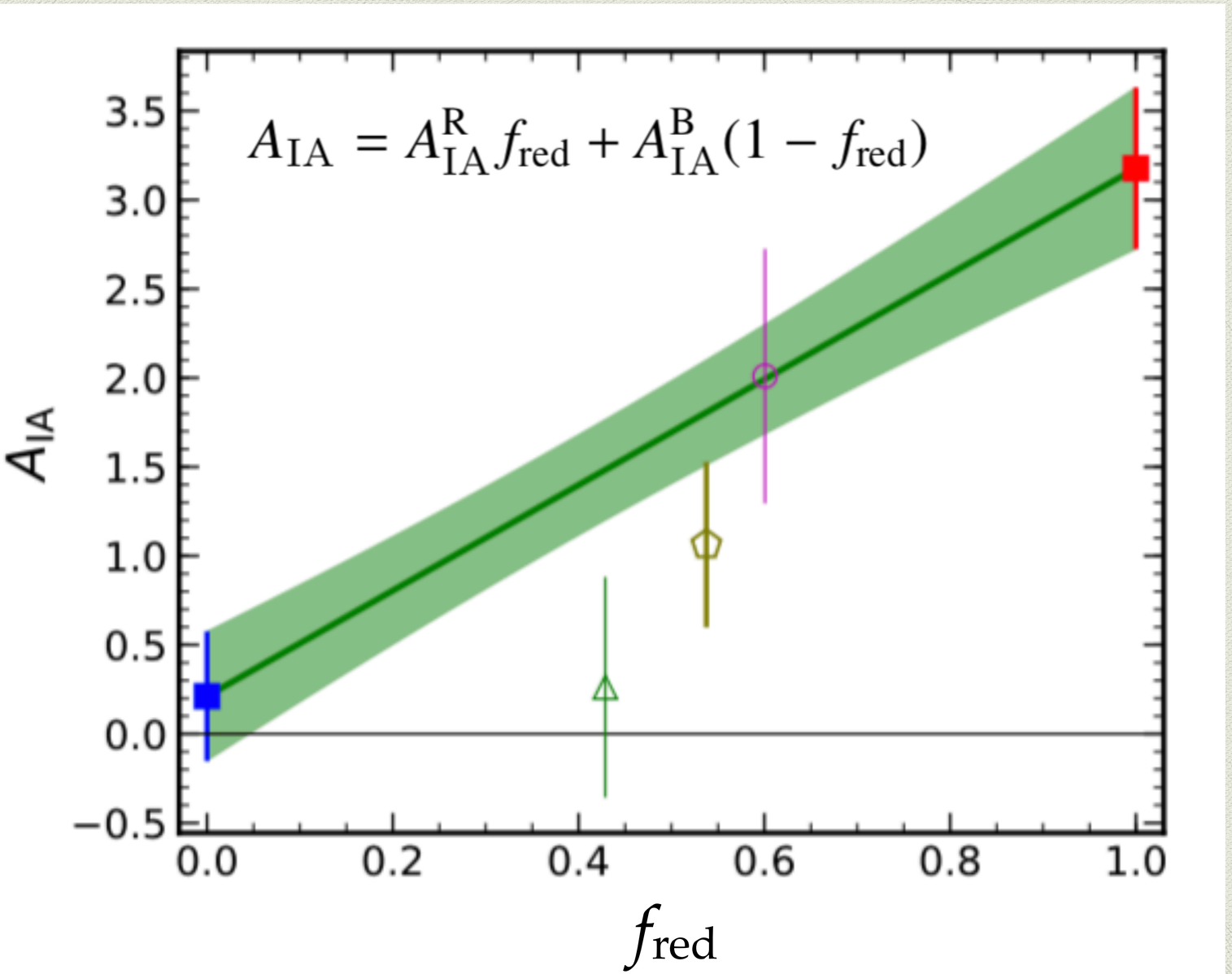
$$\Omega_{\rm m}\,,\sigma_8\,,w_0\,,\Omega_{\rm b}\,,h\,,n_{\rm s}$$

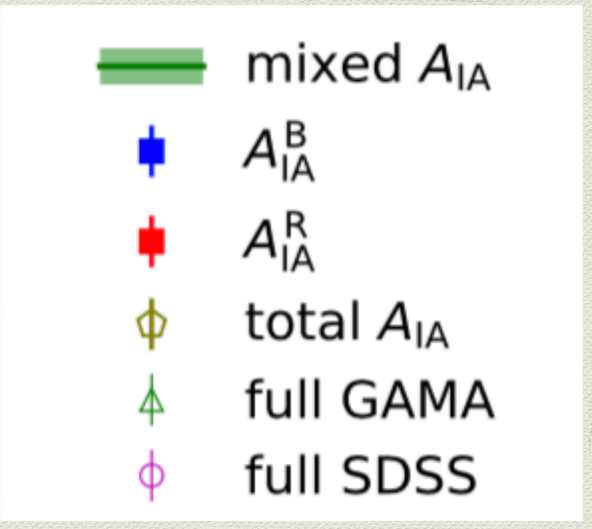
and nuisance parameters:

$$A_{\rm IA}\,,\beta\,,a_{z1}\,,\ldots a_{z5}$$

with 2 each for red/blue!

HJ+ ’18, arXiv:1811.09598 for details of forecast setup





If red vs. blue dominates alignment profiles, why do the full-sample GAMA fits disagree?

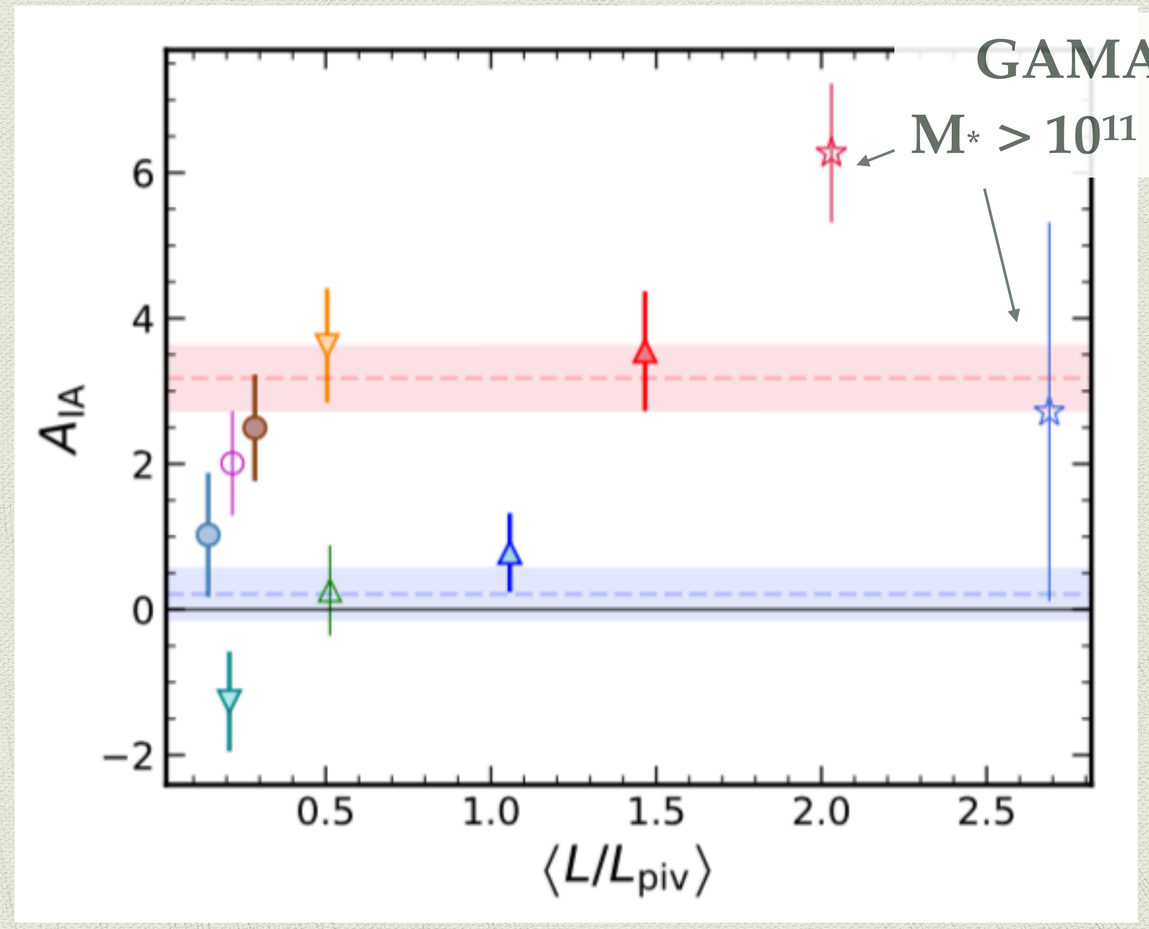
HJ+ ’18, arXiv:1811.09598

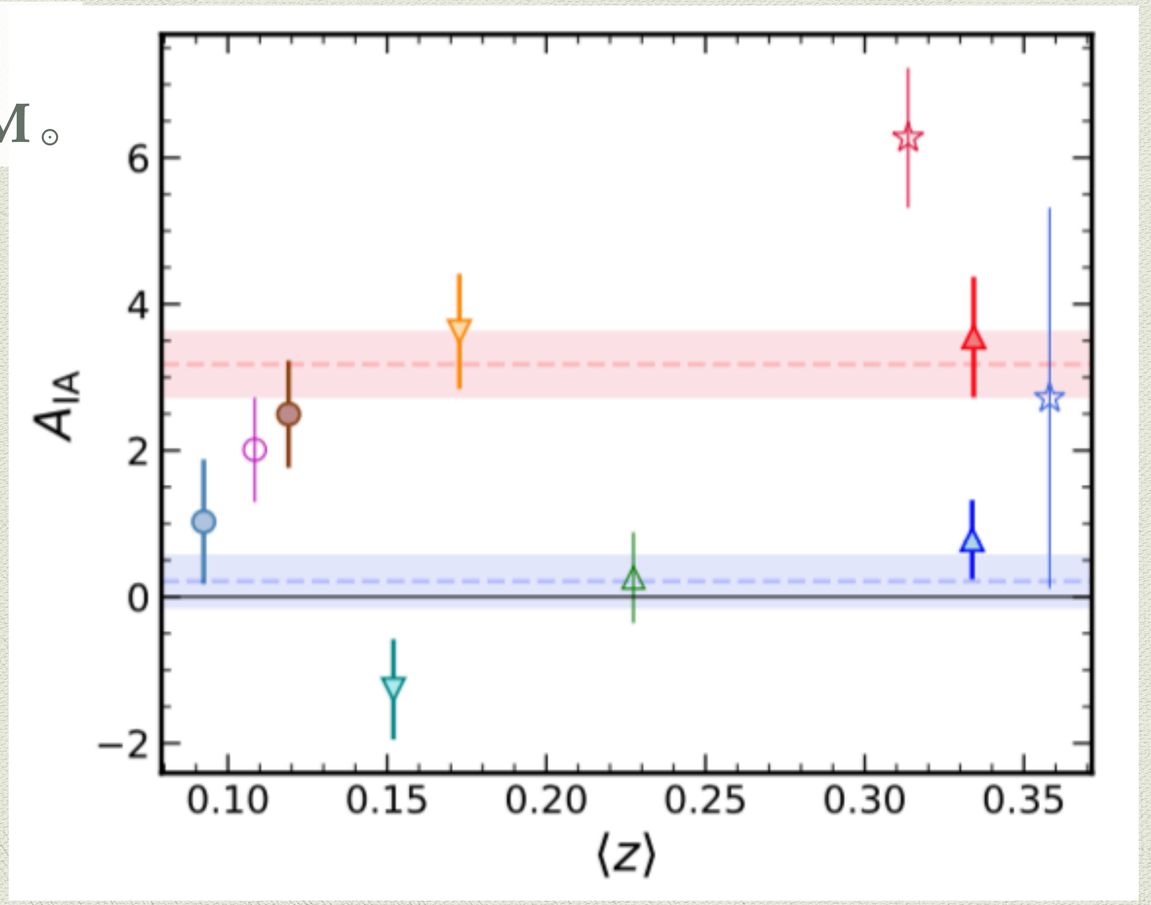
full GAMA
full SDSS

high-z GAMA:
blue
red

low-z GAMA:
blue
red

SDSS Main:
blue
red

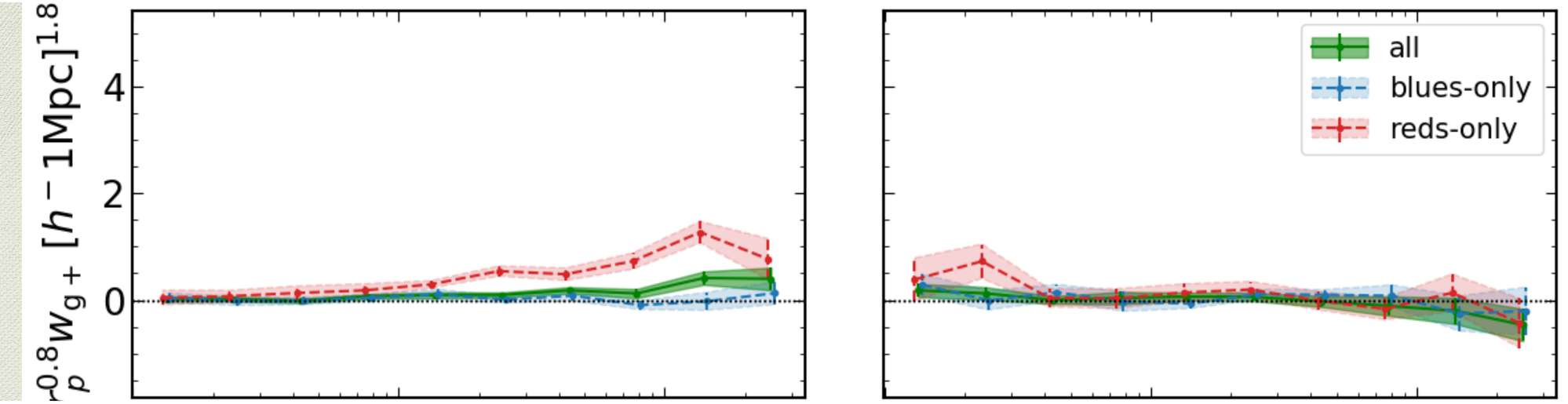




HJ+ ’18, arXiv:1811.09598

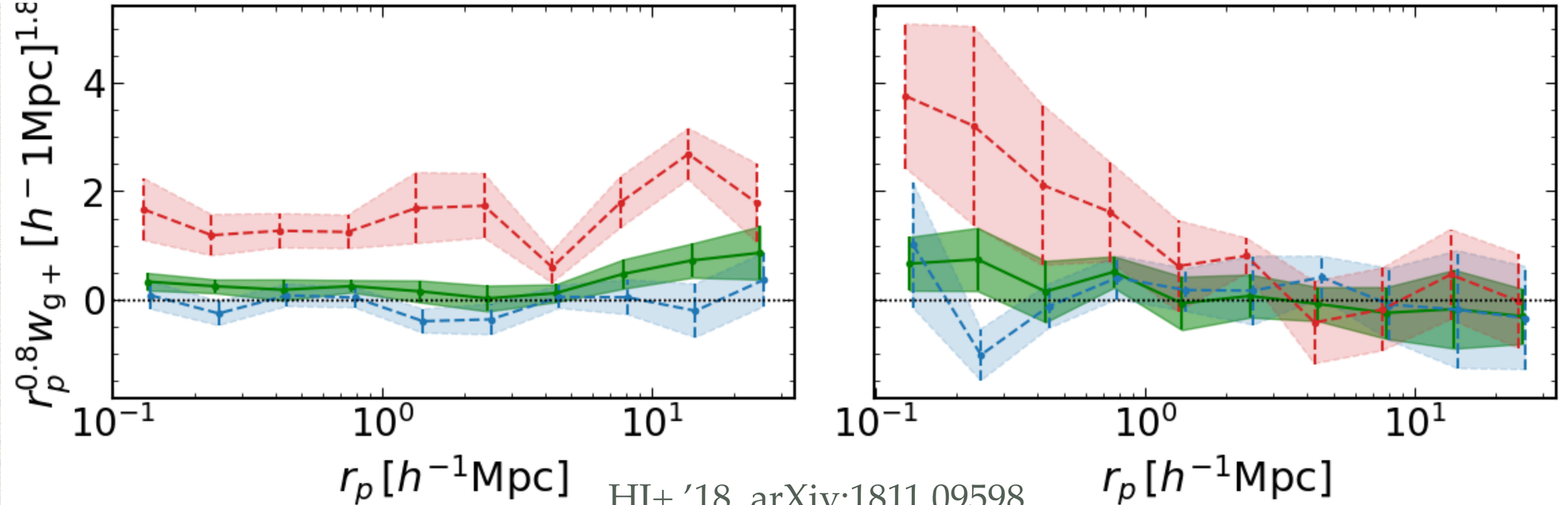
CENTRALS pointing towards CENTRALS

SATELLITES pointing towards CENTRALS



CENTRALS pointing towards SATELLITES

SATELLITES pointing towards SATELLITES



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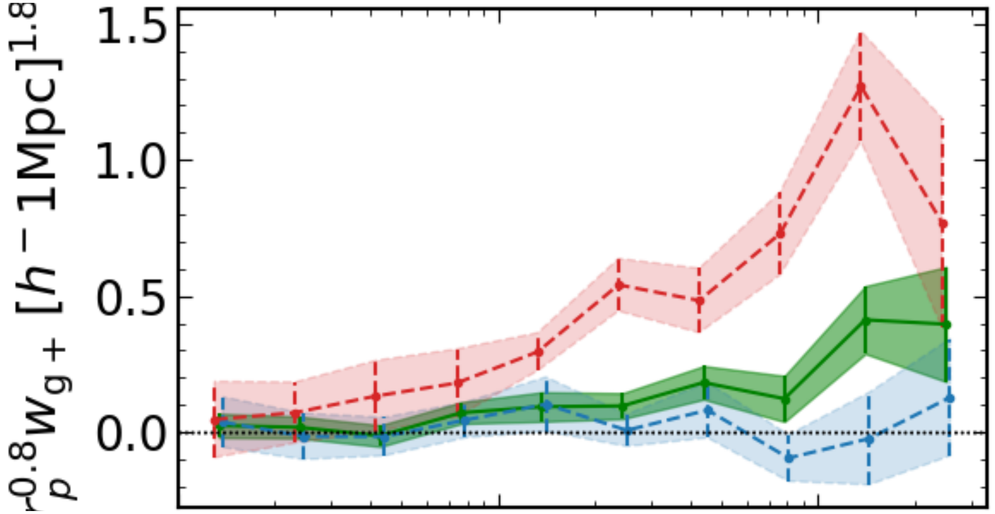
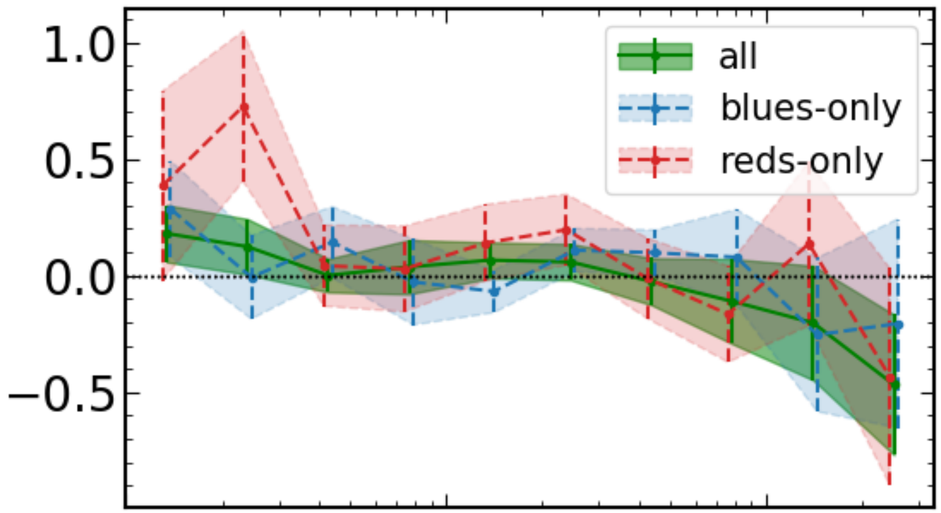
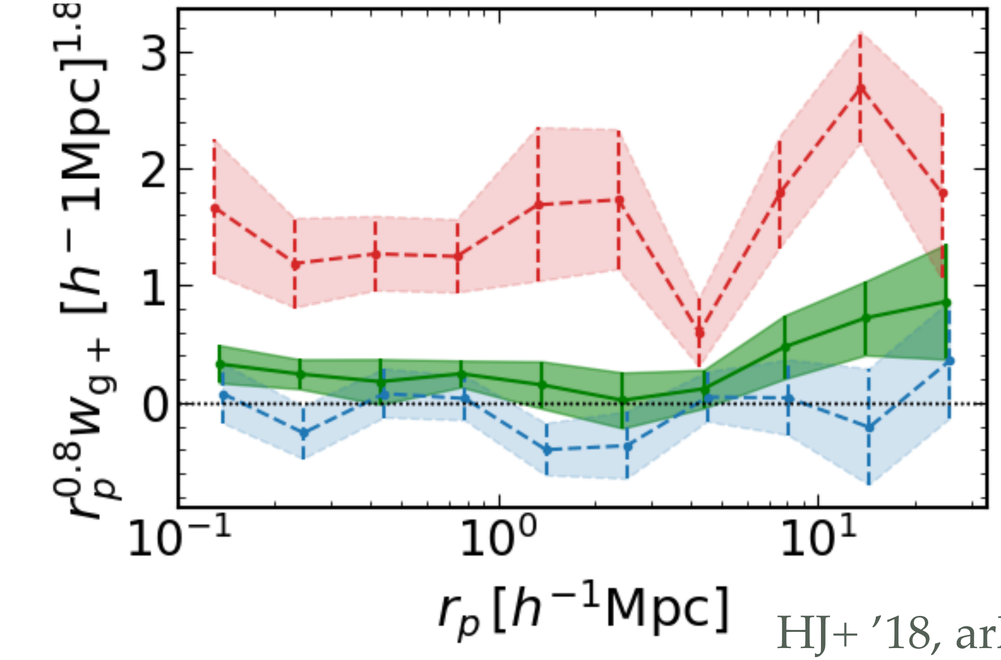


SATELLITES pointing towards CENTRALS



CENTRALS pointing towards SATELLITES



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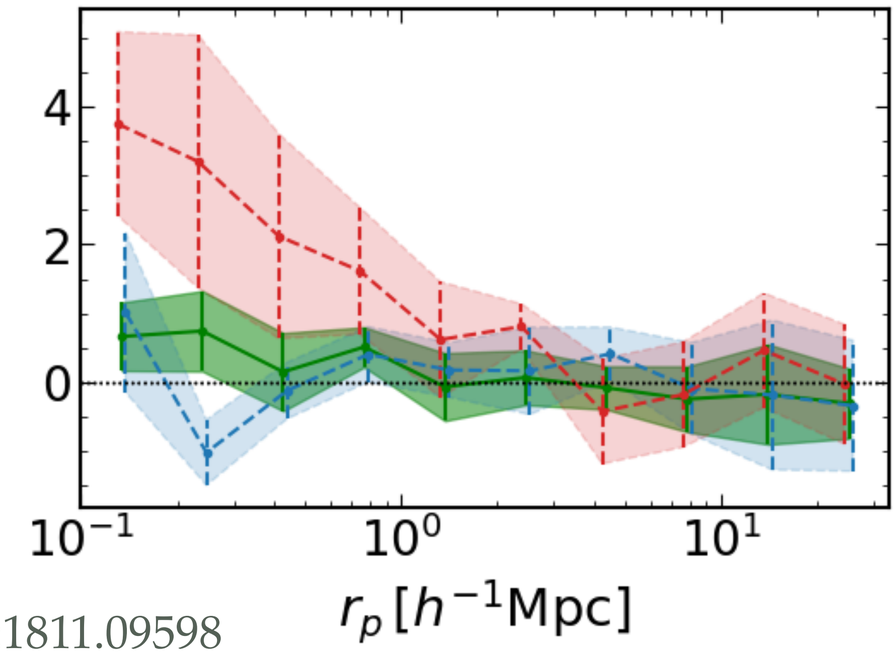
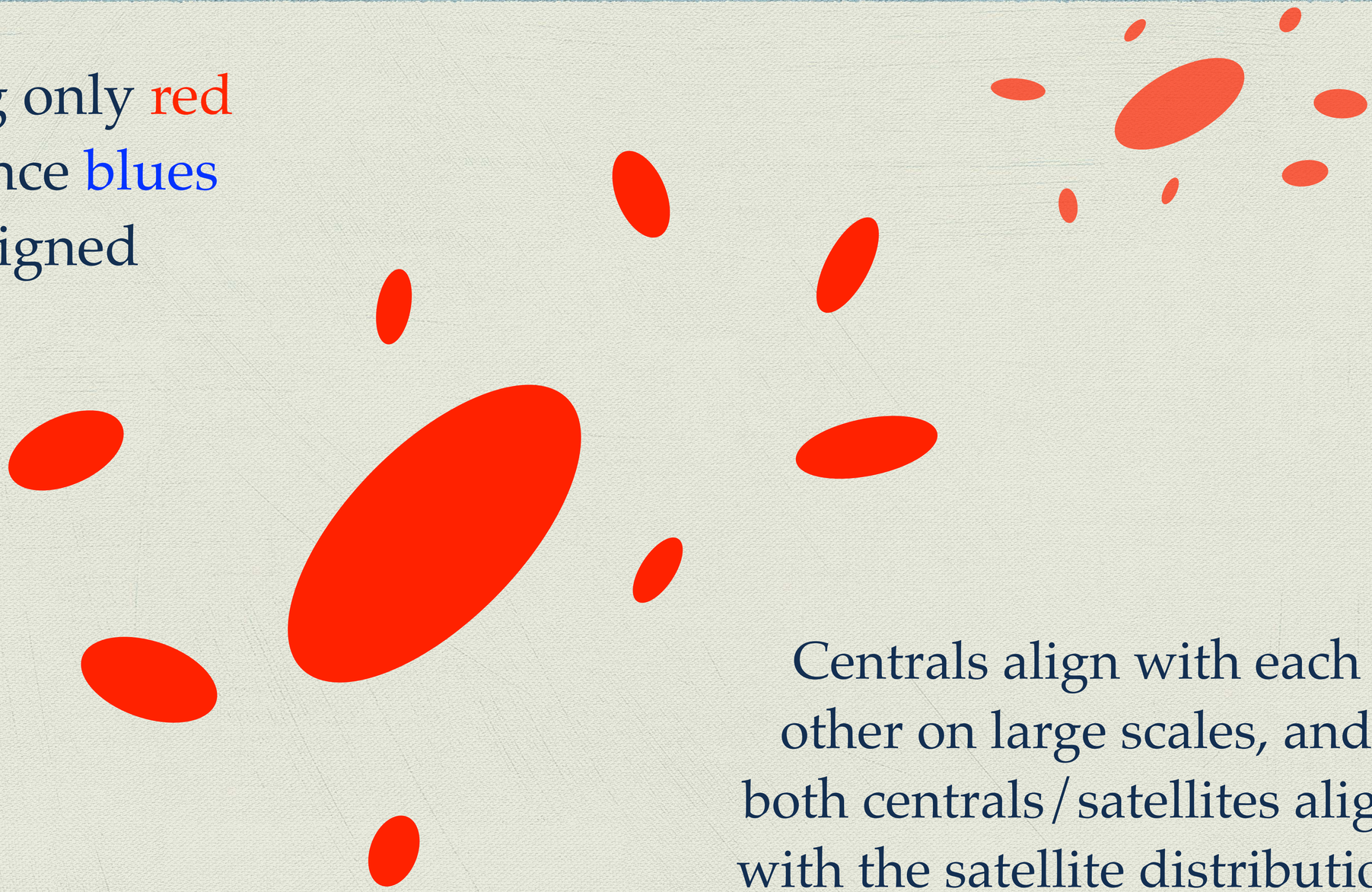


HJ+ ’18, arXiv:1811.09598

Considering only red galaxies, since blues are unaligned



Centrals align with each other on large scales, and both centrals / satellites align with the satellite distribution on small scales

Considering only red galaxies, since blues are unaligned

Centrals align with each other on large scales, and both centrals / satellites align with the satellite distribution on small scales

Astronomy & Astrophysics manuscript no. Paper2–Data
November 26, 2018

arXiv:1811.09598

KiDS+GAMA: Intrinsic alignment model constraints for current and future weak lensing cosmology

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Accepted XXX. Received YYY; in original form ZZZ

Nov 2018

Flux-limited r < 19.8

~170k GAMA redshifts

KiDS imaging

DEIMOS shapes

DEIMOS:
DEconvolution In
MOments Space

Astronomy & Astrophysics manuscript no. AandA_IA_wavelength
September 12, 2018

arXiv:1809.03602

The dependence of intrinsic alignment of galaxies on wavelength using KiDS and GAMA

Christos Georgiou[1⋆], Harry Johnston[2], Henk Hoekstra[1], Massimo Viola[1], Konrad Kuijken[1], Benjamin Joachimi[2], Nora Elisa Chisari[3], Hendrik Hildebrandt[4], and Arun Kannawadi[1]

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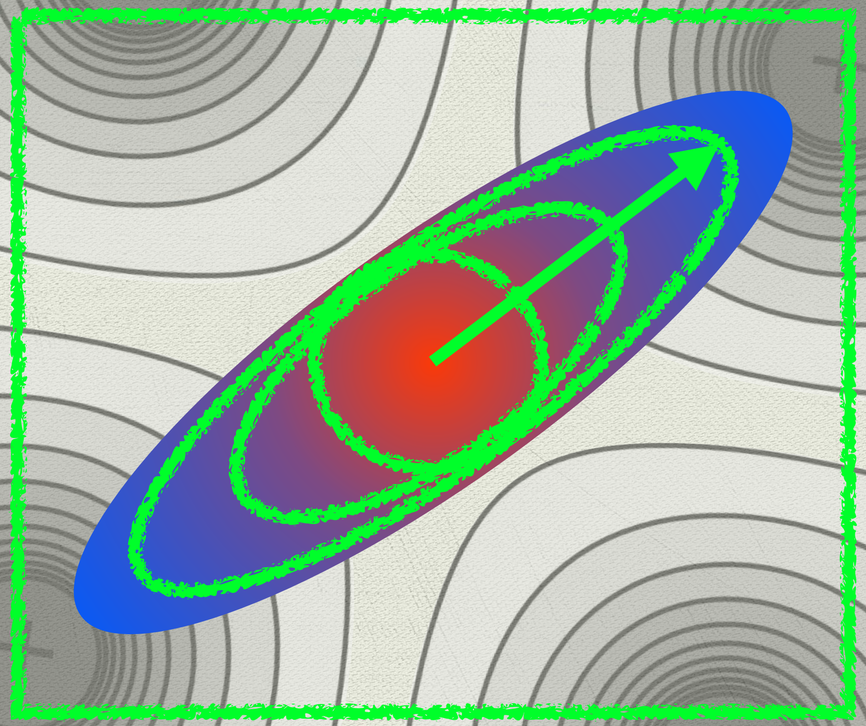
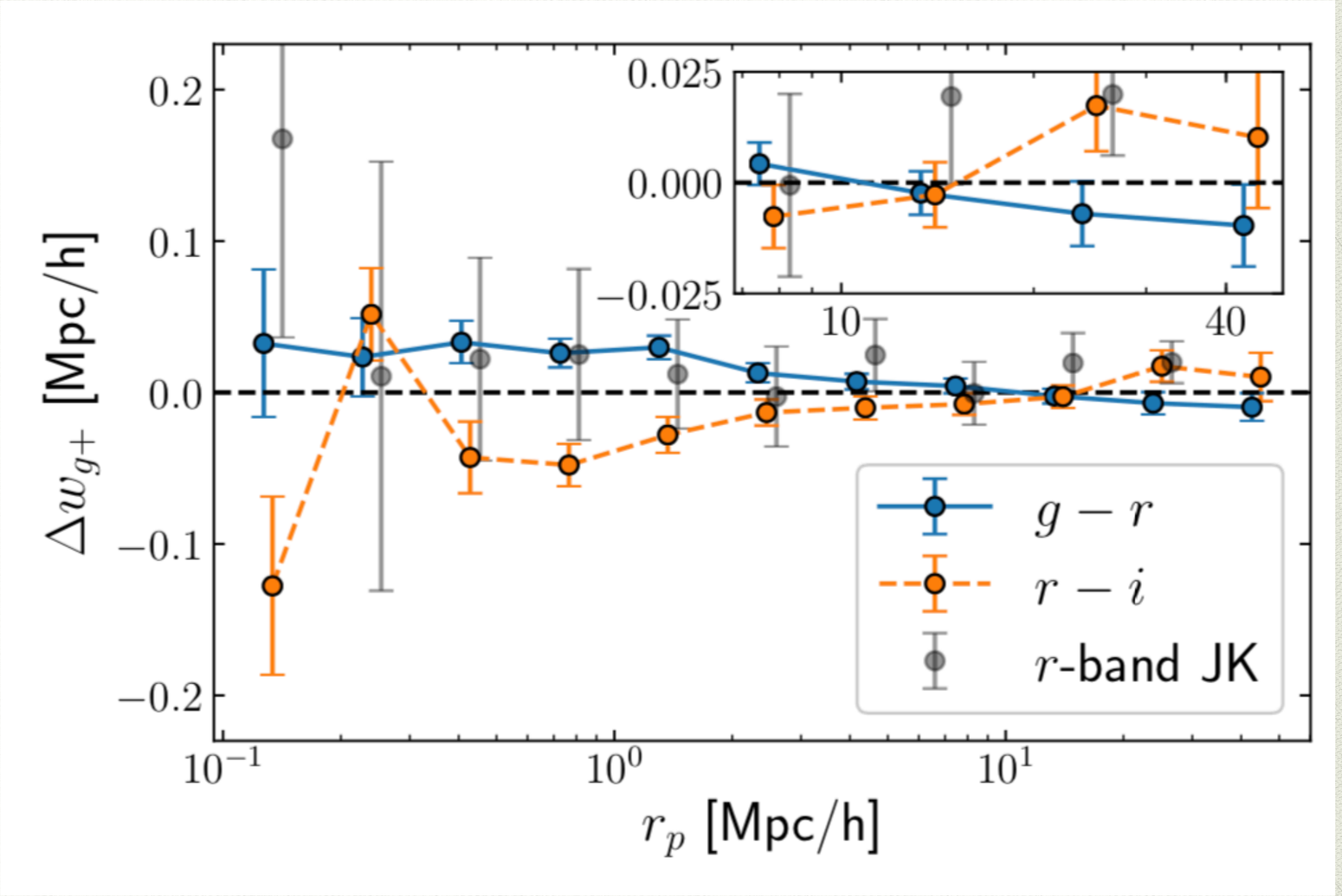
Received <date> / Accepted <date>

18



Galaxies tend to have colour gradients along the radial direction — any gravitational shielding should dissipate along the same direction

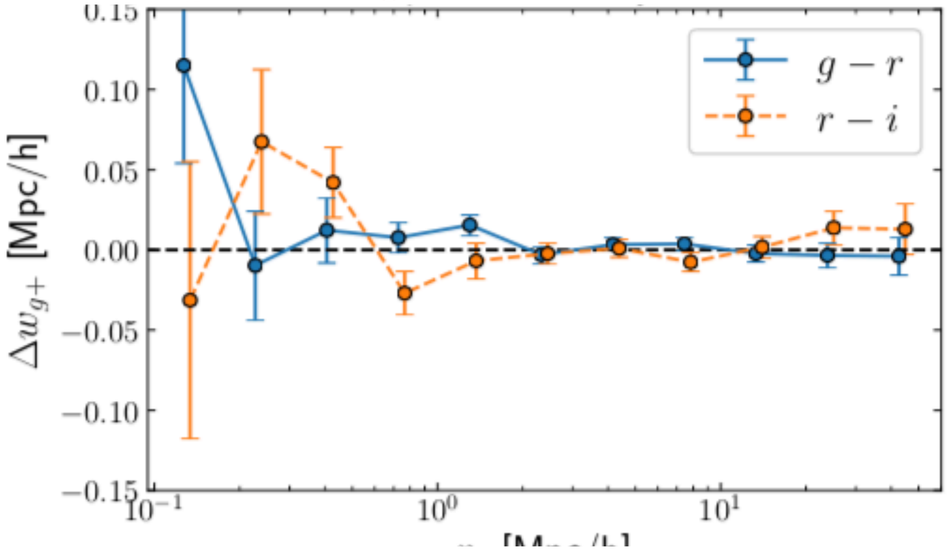
DEIMOS requires an elliptical Gaussian weight function to suppress image noise; we can fix the physical scale being measured



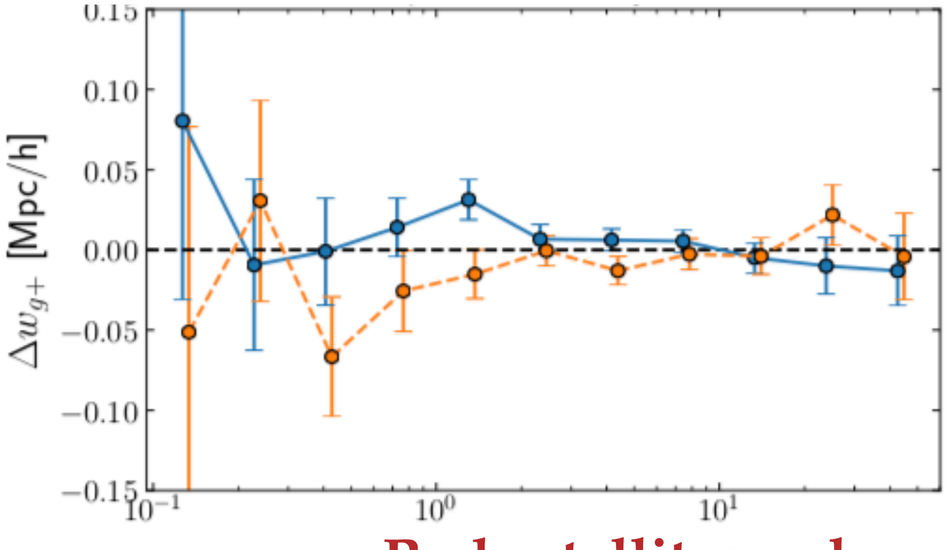
- Bluer *g*-band shapes *more* aligned than *r*-band
- Difference comparable to total *r*-band signal
- Redder *i*-band shapes also more aligned than *r*-band??

C. Georgiou, HJ+ ’18, arXiv:1809.03602

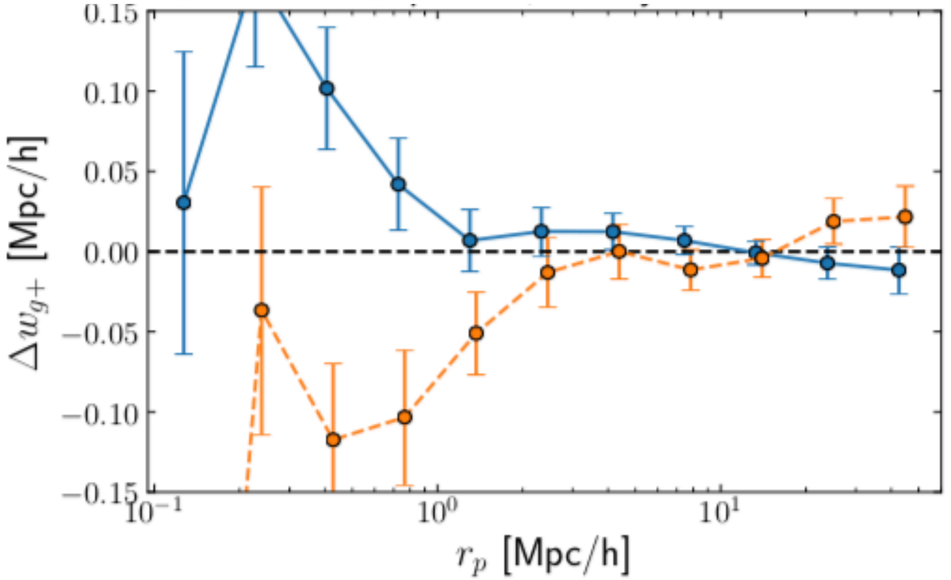
CENTRALS pointing towards CENTRALS



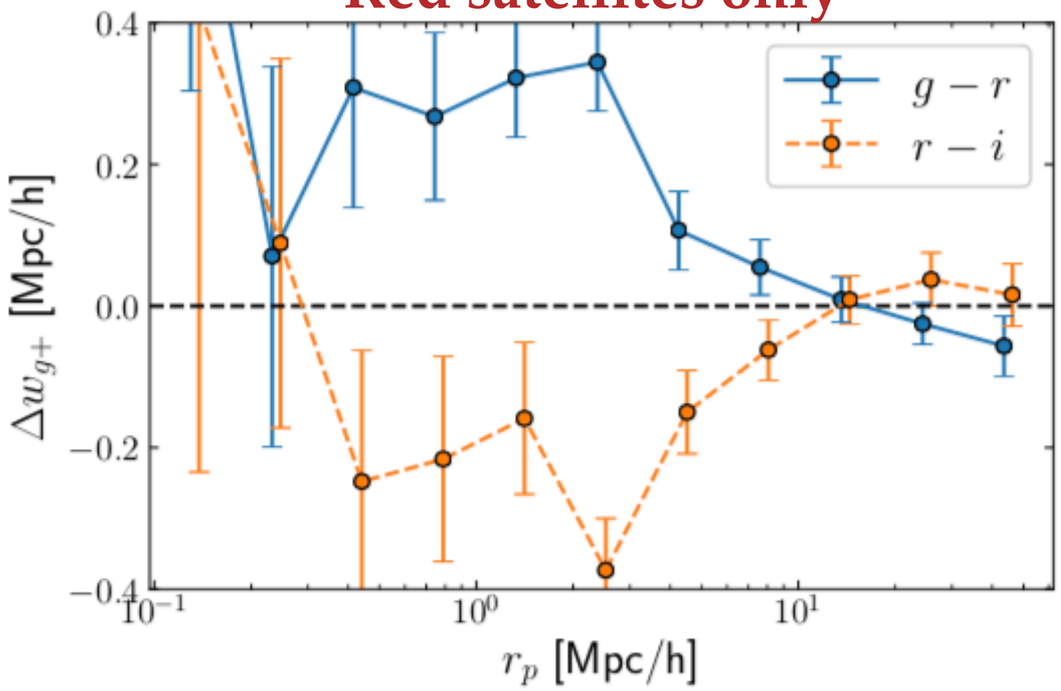
SATELLITES pointing towards CENTRALS



CENTRALS pointing towards SATELLITES



Red satellites only



C. Georgiou, HJ+ '18, arXiv:1809.03602

elliptical galaxies only!

r-band

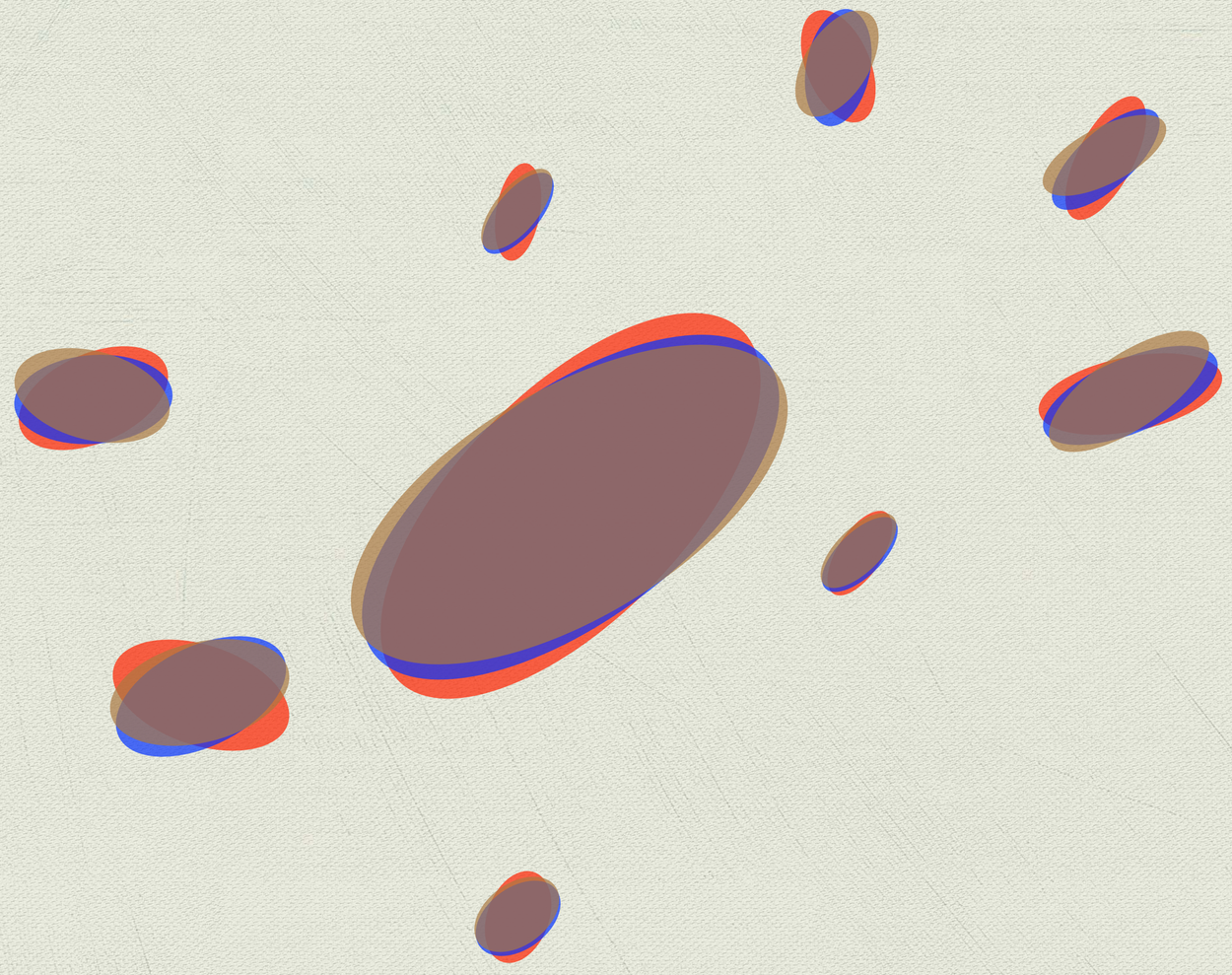
old stars

g-band

r-band

i-band?

elliptical galaxies only!



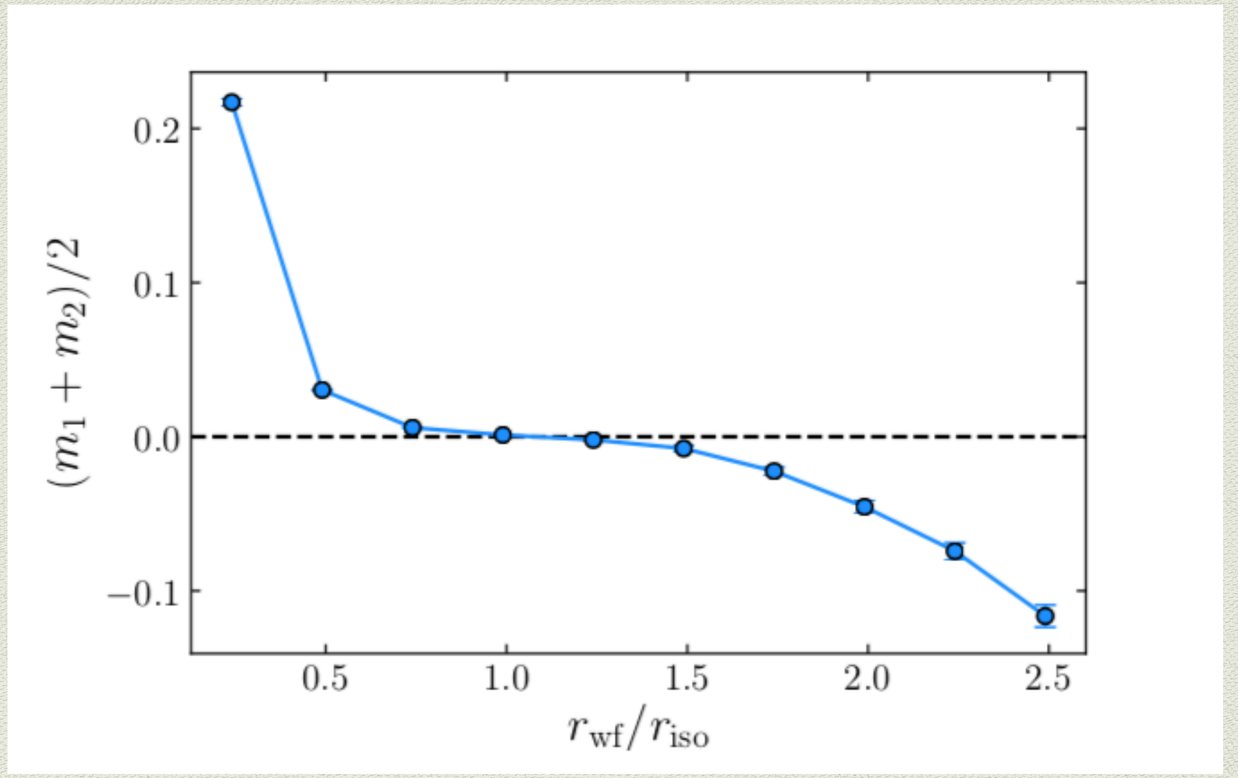
star-forming

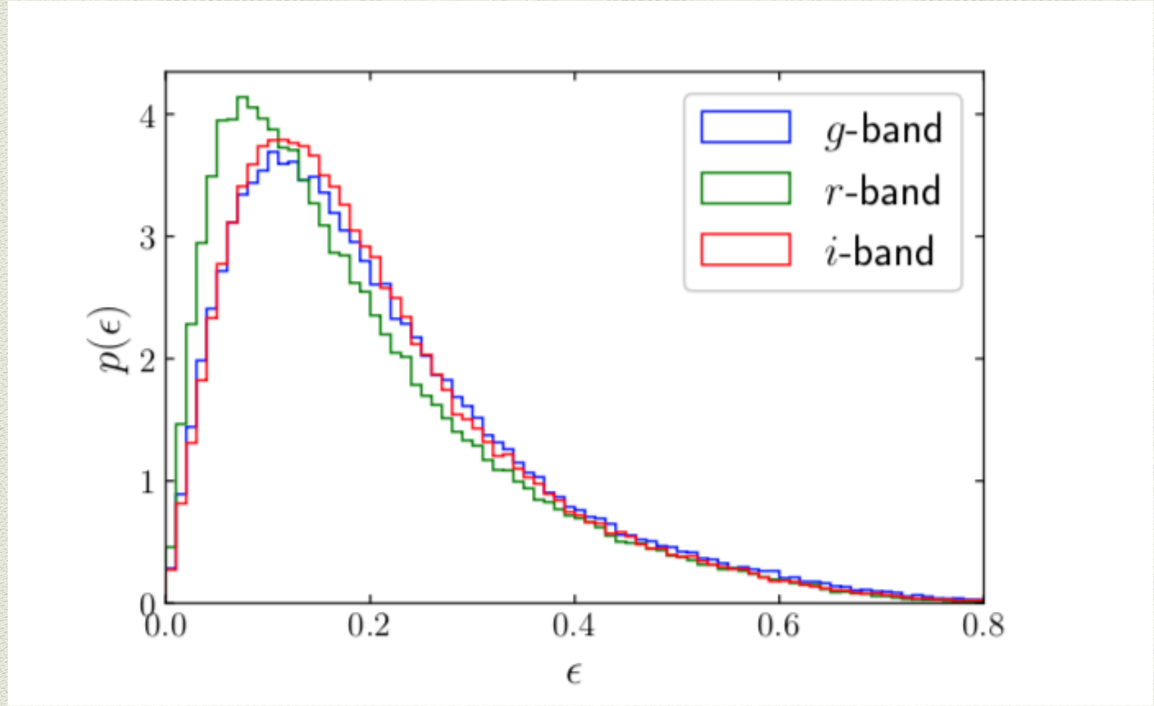
old stars

dust?

Summary

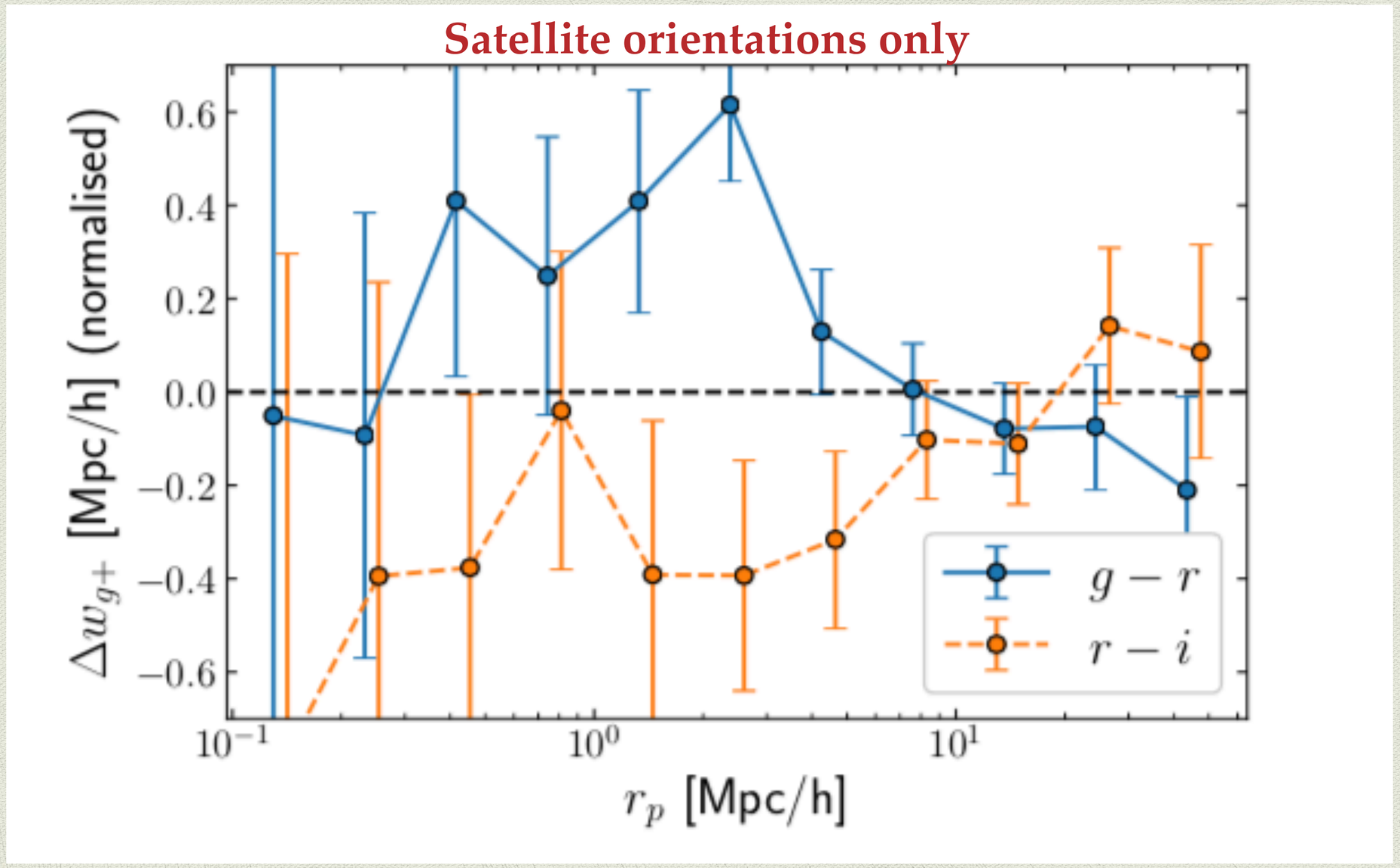
- We *directly* measure intrinsic alignments in today's most shear-representative samples; KiDS+GAMA & SDSS Main
- Alignments *will* differ as a function of observational passband
  - *g*- and *i*-band shapes more strongly aligned with galaxy field than *r*-band — 'bluer' outskirts less shielded, but how to explain *i*-band result?
- Red elliptical galaxies radially aligned at up to 9σ
- Blue spiral galaxy alignments == zero
- No evidence for *L*- or *z*-dependence on linear scales
- Group status — satellites vs. centrals — seen to be a strong driver of variation on all scales
- We constrain the NLA model, providing informative priors for future weak lensing
- Also working on IA prediction with MillenniumS, halo models, PAUS





C. Georgiou, HJ+ ’18, arXiv:1809.03602

Satellite orientations only

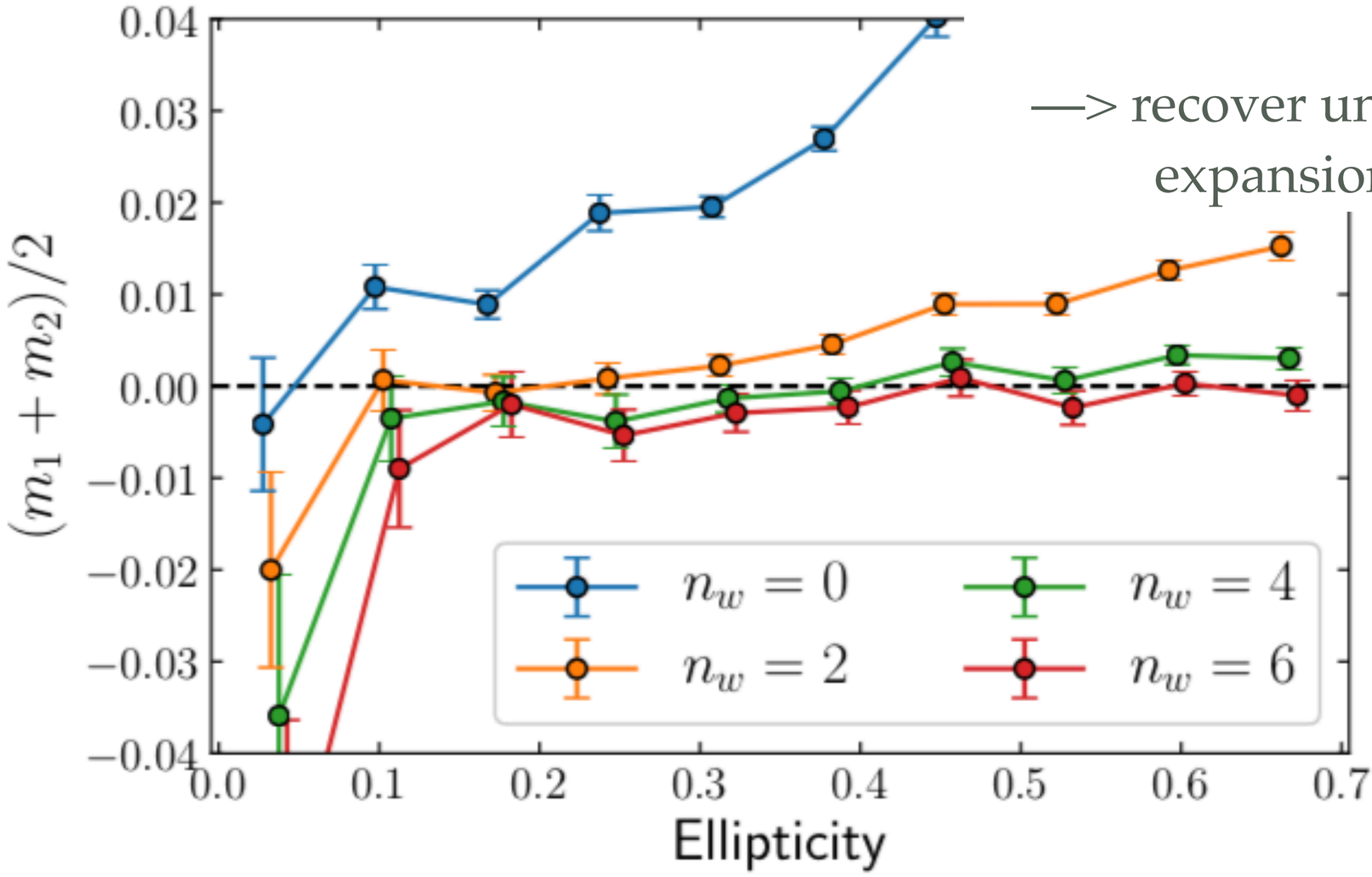


C. Georgiou, HJ+ ’18, arXiv:1809.03602

Weighted image flux $I_w(\boldsymbol{x})$:

$$I_w(\boldsymbol{x}) = I(\boldsymbol{x})\, W(\boldsymbol{x})$$

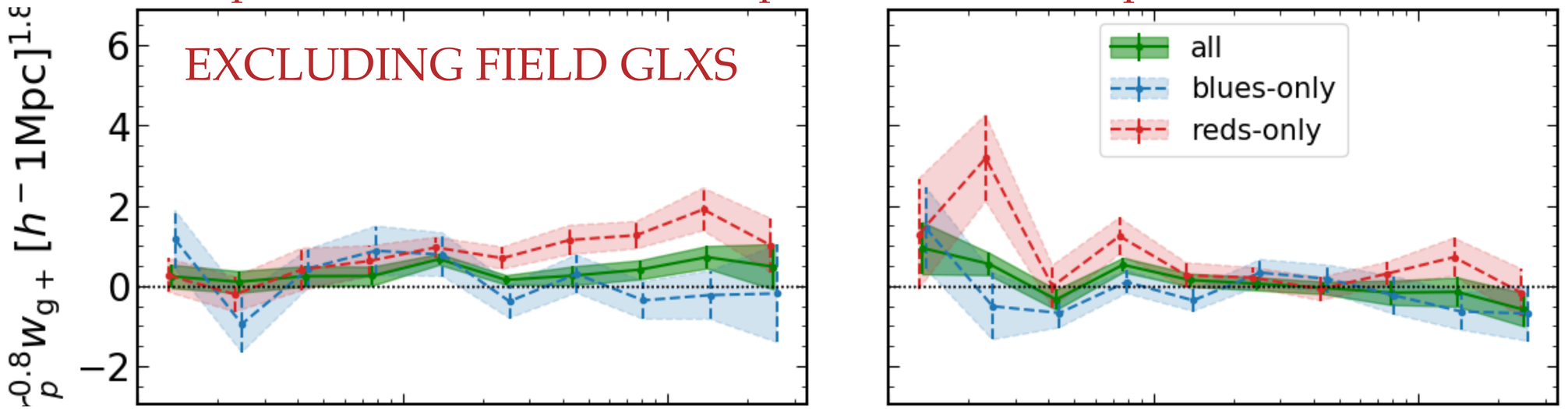
—> recover unweighted $I(\boldsymbol{x})$ with Taylor expansion of $1/W$, to order n_w



C. Georgiou, HJ+ ’18
arXiv:1809.03602

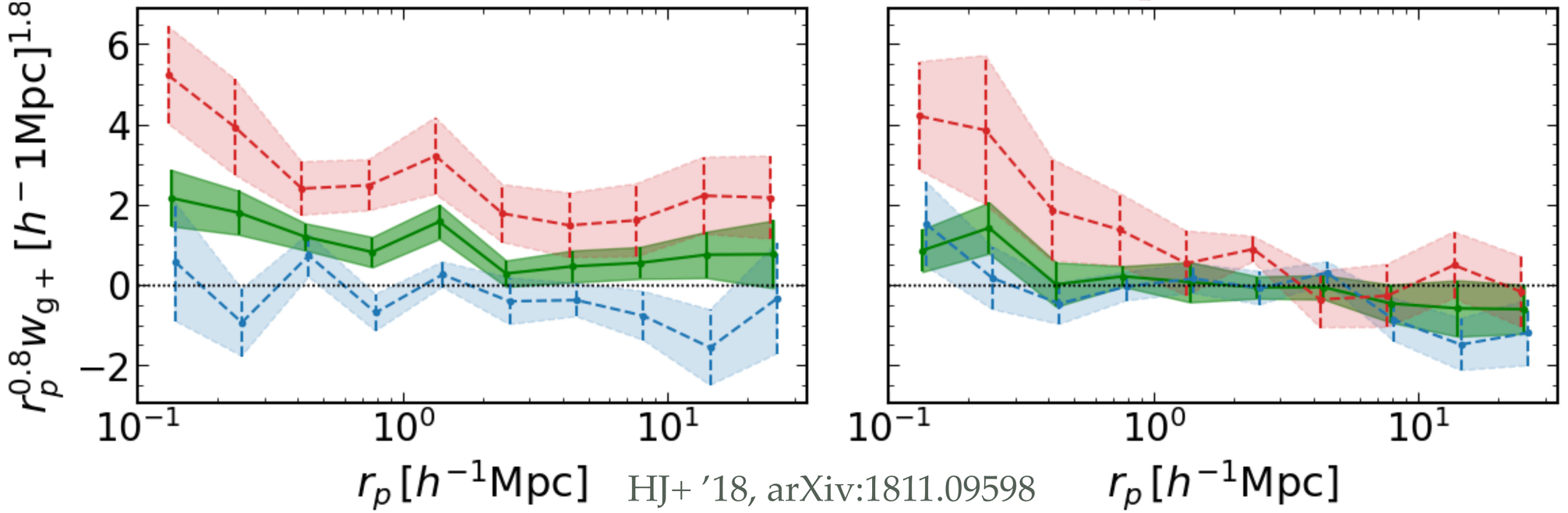
CENTRAL positions vs. CENTRAL shapes

CENTRAL positions vs. SATELLITE shapes

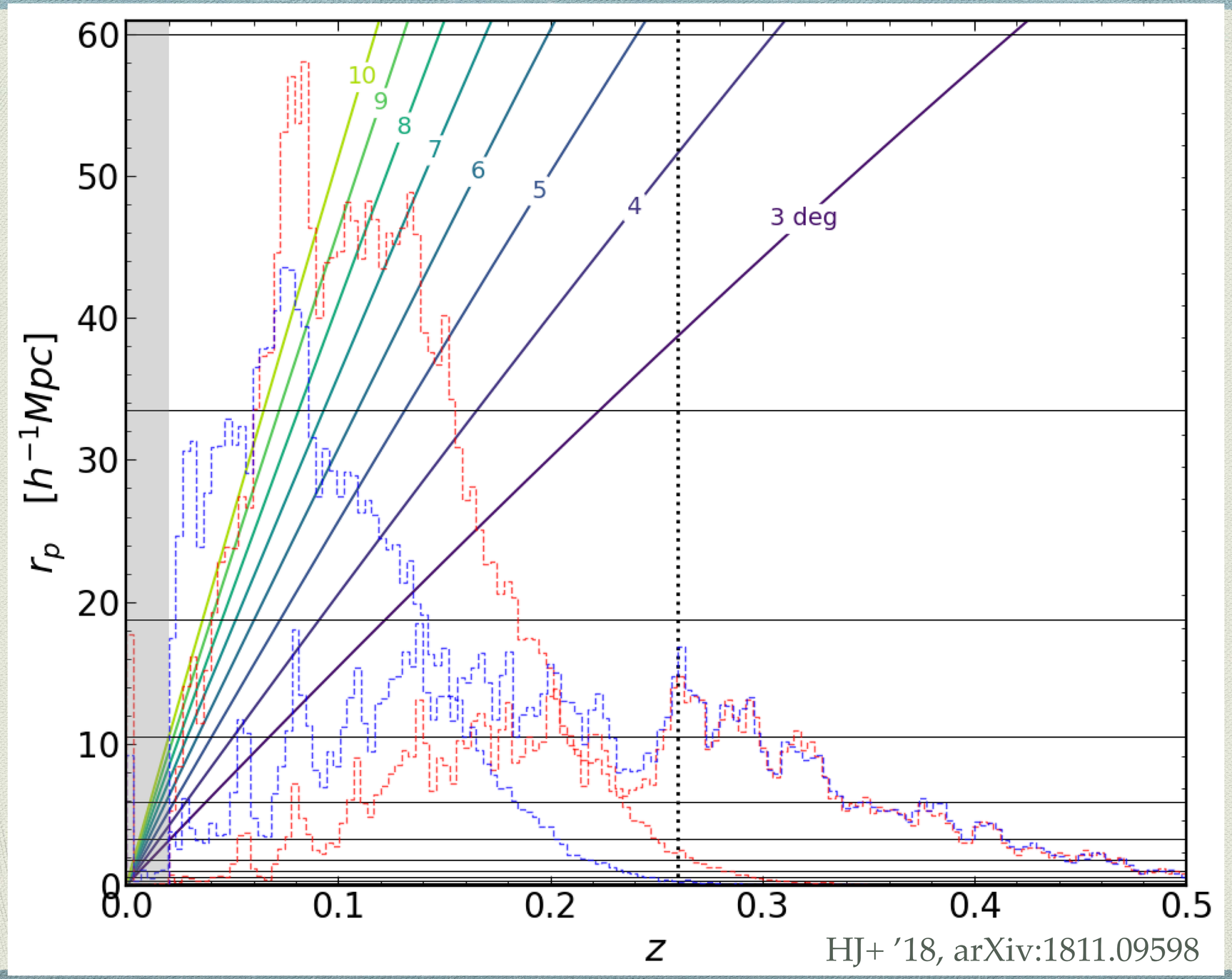


SATELLITE positions vs. CENTRAL shapes

SATELLITE positions vs. SATELLITE shapes



HJ+ '18, arXiv:1811.09598



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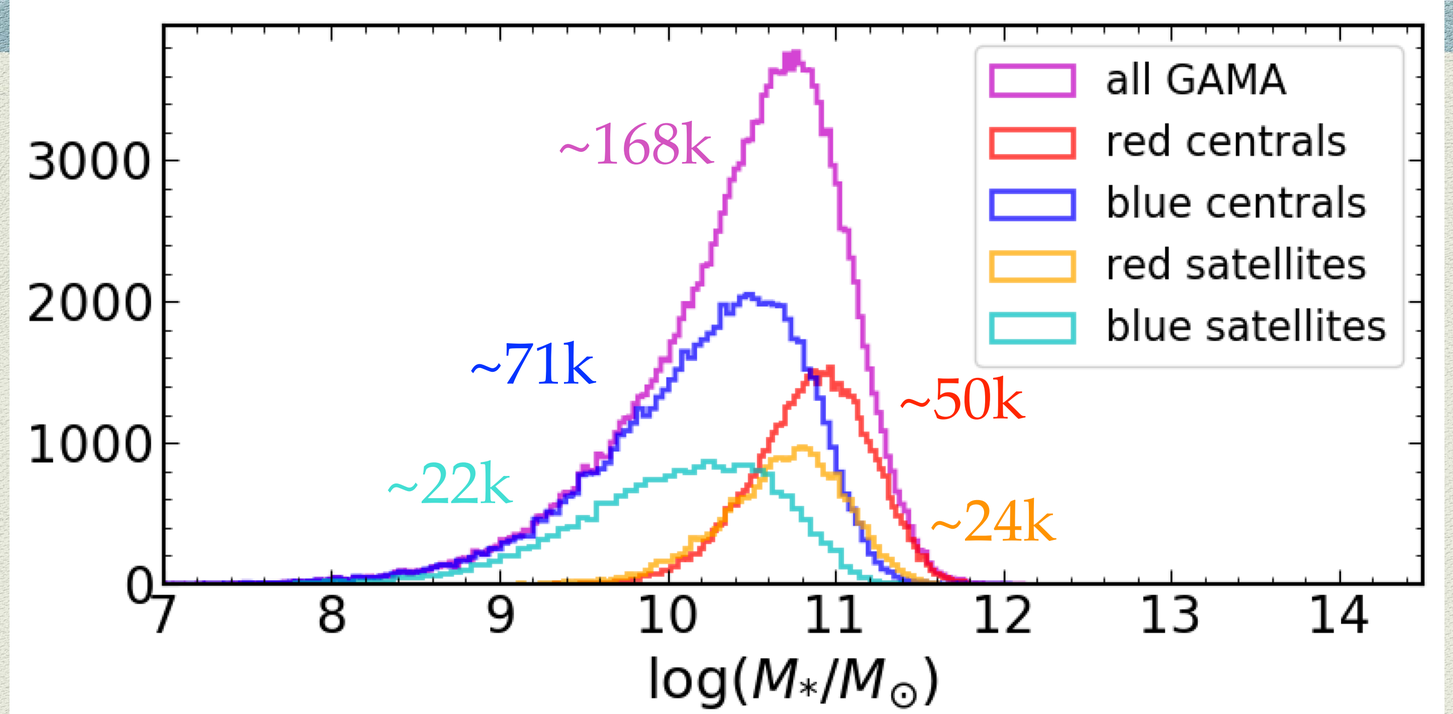
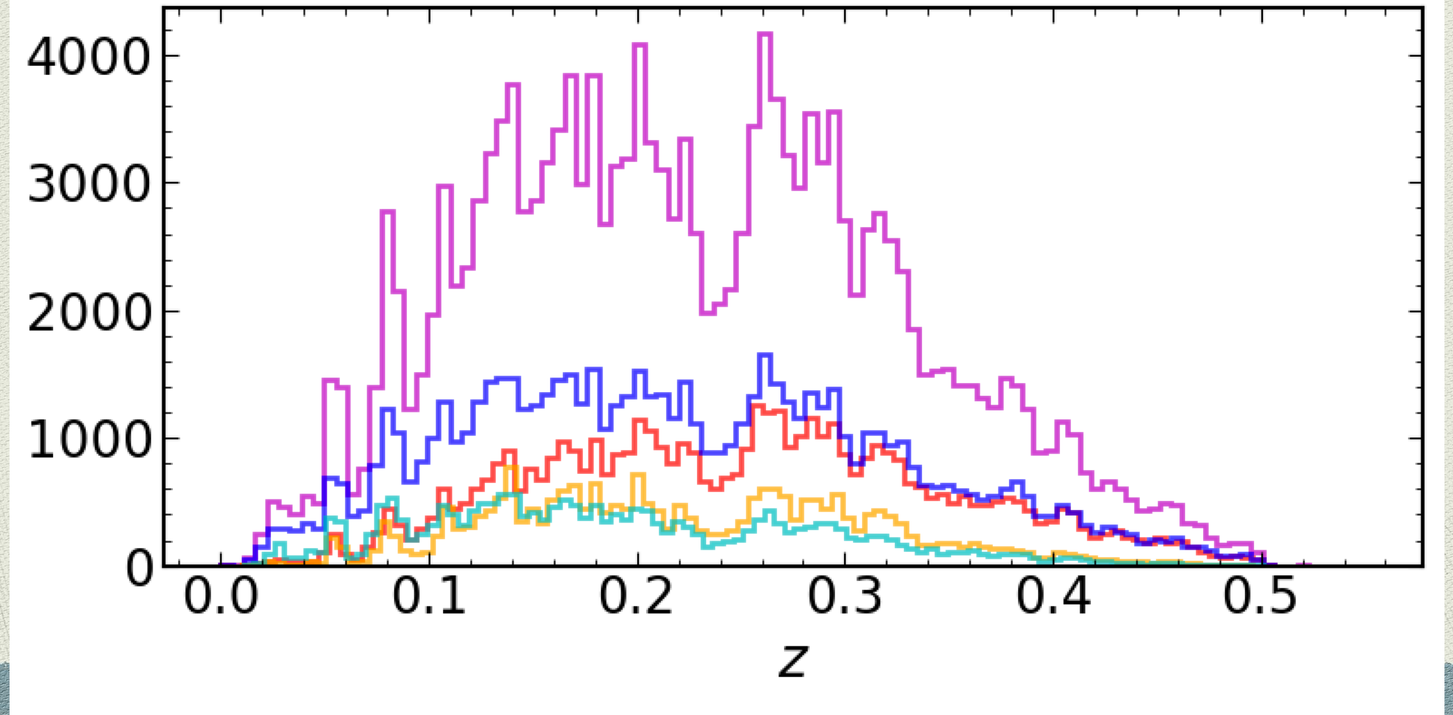

all GAMA
red centrals
blue centrals
red satellites
blue satellites
~168k
~71k
~50k
~24k
~22k
3000
2000
1000
0
7
8
9
10
11
12
13
14
log(M*/M⊙)


4000
3000
2000
1000
0
0.0
0.1
0.2
0.3
0.4
0.5
z