Bayesian inference of matter, velocity fields and power spectra from galaxy redshift surveys

Metin Ata[1] [1] mata@aip.de

Advisors: Francisco-Shu Kitaura (FSK), Volker Müller (VM)

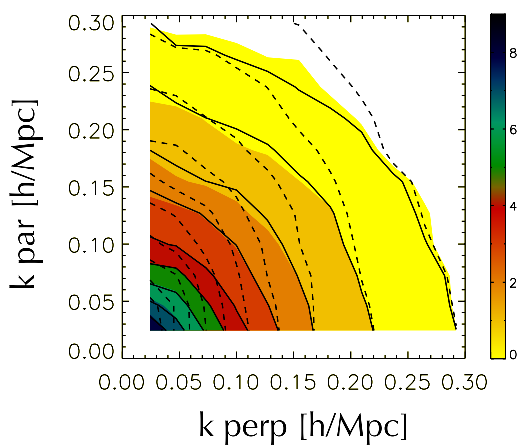
Leibniz-Institut für Astrophysik Potsdam (AIP)

ARGO-CODE combined Hamiltonian and Gibbs-sampling including stochastic nonlinear power-law bias (and second order nonlocal bias in prep)

$$\mathcal{P}\left(\delta, \{\mathbf{r}^{obs}\}, w, \mathbf{c} \mid \{\mathbf{s}^{obs}\}, m\left(\alpha, \delta\right), \{b_p\}, f_\Omega\right)$$

$$\begin{aligned}
\delta &\curvearrowleft \mathcal{P}\left(\delta \mid N\left(\{\mathbf{r}^{obs}\}\right), w, \mathbf{c}, \{b_p\}\right), \\
\{\mathbf{r}^{obs}\} &\curvearrowleft \mathcal{P}\left(\{\mathbf{r}^{obs}\} \mid \{\mathbf{s}^{obs}\}, \{\mathbf{v}\left(\delta, \mathbf{H}\left(\delta\right), f_\Omega\right)\}\right), \\
w &\curvearrowleft \mathcal{P}\left(w \mid \{\mathbf{r}^{obs}\}, m\left(\alpha, \delta\right)\right), \\
\mathbf{c} &\curvearrowleft \mathcal{P}\left(\mathbf{c} \mid \mathbf{\Phi}\left(\delta\right)\right).
\end{aligned}$$

galaxy bias model $\rho_G = \gamma \rho_M^\alpha \, \Theta\left(\rho_M - \rho_{th}\right)$

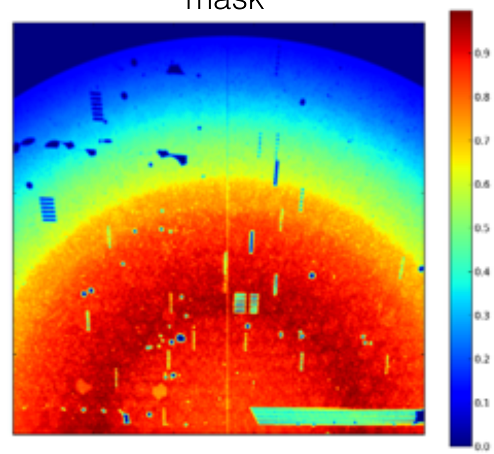


RSD corrections in collaboration with Raul Angulo, Carlos Hernandez Monteagudo, Sergio Rodriguez-Torres, Chia-Hsun Chuang, Francisco Prada

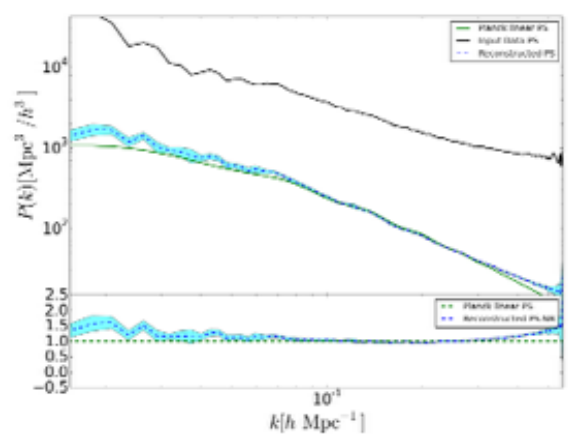
Tests on accurate BOSS BigMultiDark mock catalogs and application to BOSS DR12 in collaboration with Sergio Rodriguez-Torres, Chia-Hsun Chuang, Francisco Prada+BOSS collab.

Results of Power-spectrum sampling on light-cone BOSS DR12:

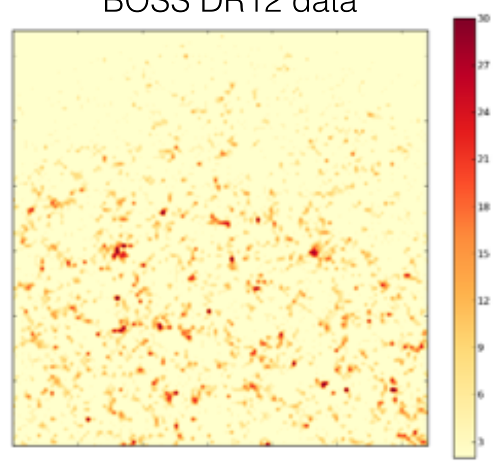
mask



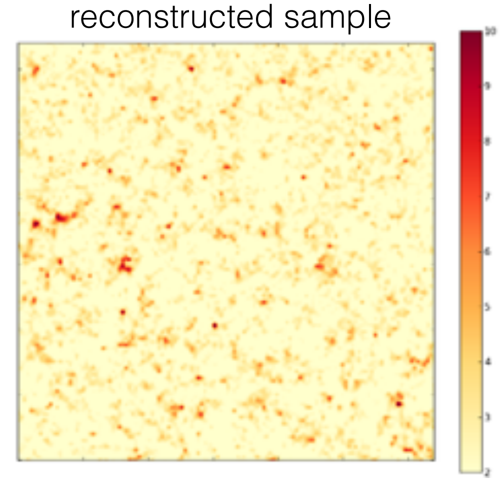
Power spectrum



BOSS DR12 data



reconstructed sample



A study of Eulerian and Lagrangian stochastic and nonlocal bias

Mathieu Autefage

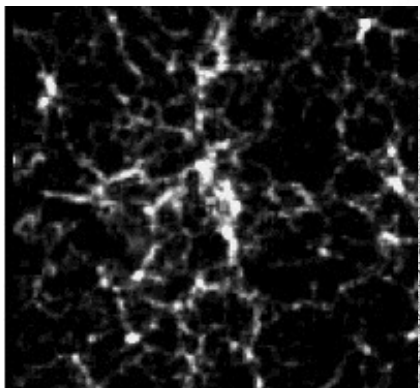
Advisor: Francisco-Shu Kitaura (FSK)

Leibniz-Institut für Astrophysik Potsdam (AIP)

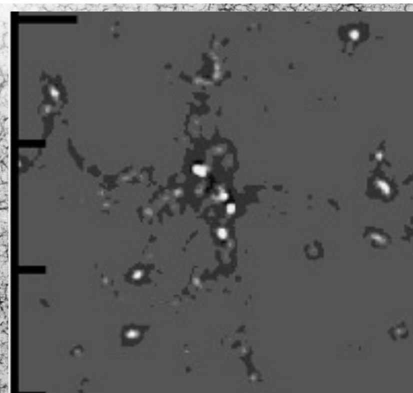
in collaboration with Christian Wagner & Raul Angulo

We use the PATCHY code and include second order nonlocal bias

Dark matter field from ALPT with PATCHY

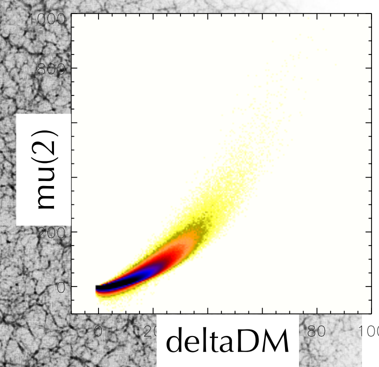


corresponding second order nonlocal bias

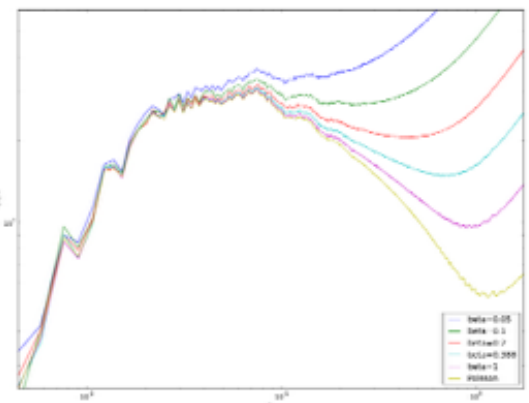


Bias model including the second order nonlocal tidal field term

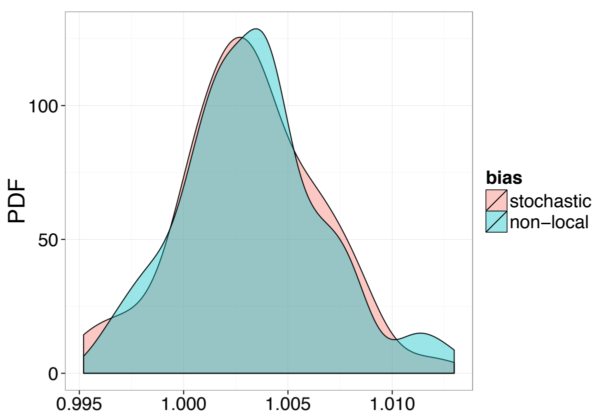
$$\rho_h = \gamma\Theta\left(\rho_M - \rho_{th}\right)\left[\rho_M^{\alpha} + c_{NL}\mu^{(2)}\right]\left(\rho_M - \rho_{th}\right)^{\epsilon}$$



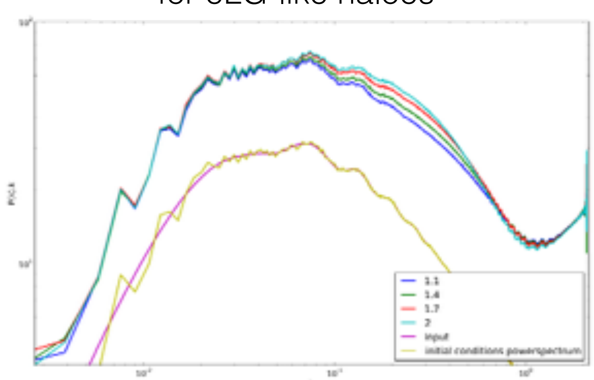
Stochastic bias for eLG-like haloes



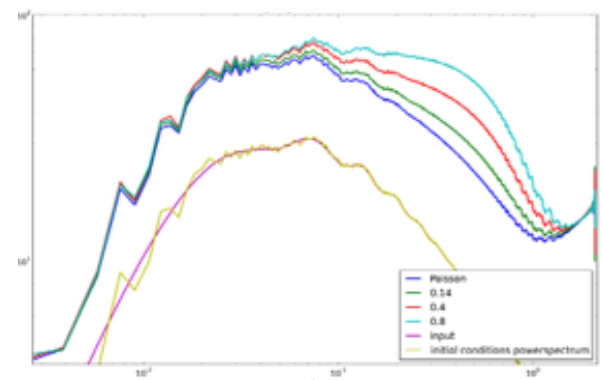
No relevant effect in the BAO shift seen for LRG-like haloes. We plan to investigate three point statistics.



Lagrangian nonlocal bias for eLG-like haloes



Eulerian nonlocal bias for eLG-like haloes



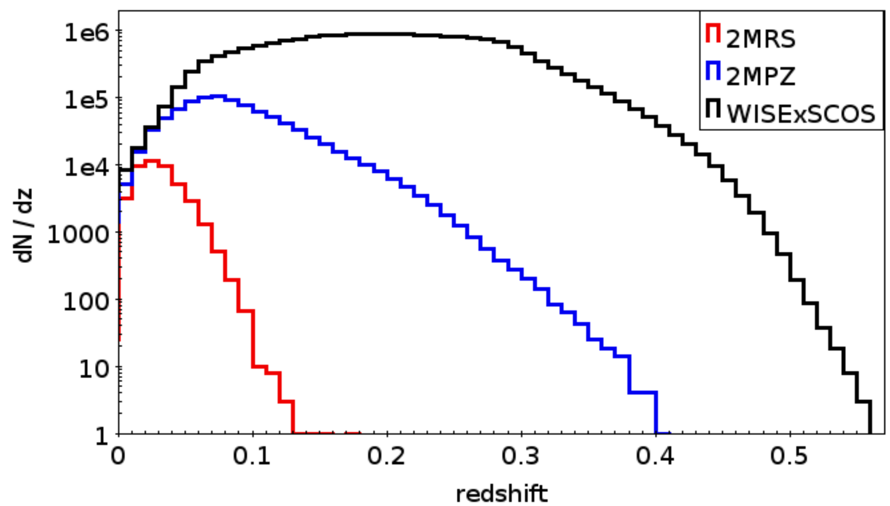
Observational progress on all-sky large-scale structure of the Universe

New photometric redshift catalogs from 2MASS, WISE and SuperCOSMOS

Maciej Bilicki[1,2,3,*], John Peacock[4], Thomas Jarrett[2], Michelle Cluver[5] et al.[6]

- We cross-matched the **largest all-sky galaxy samples** to construct **new photometric redshift catalogs**
- The **2MASS Photometric Redshift catalog (2MPZ)**: a million galaxies with a median z=0.08 over 95% of sky
- New **WISE×SuperCOSMOS photo-z sample of 2×10^7 galaxies** on 75% of sky has ⟨z⟩=0.2, reaching up to z~0.45
- Our photo-z's have **accuracy of σ_z=0.013** for 2MPZ and **0.033** for WISE×SCOS, and very low number of outliers
- These catalogs are being applied to **various cosmological tests** such as cross-correlations with other all-sky data

2MPZ color-coded by photometric redshift



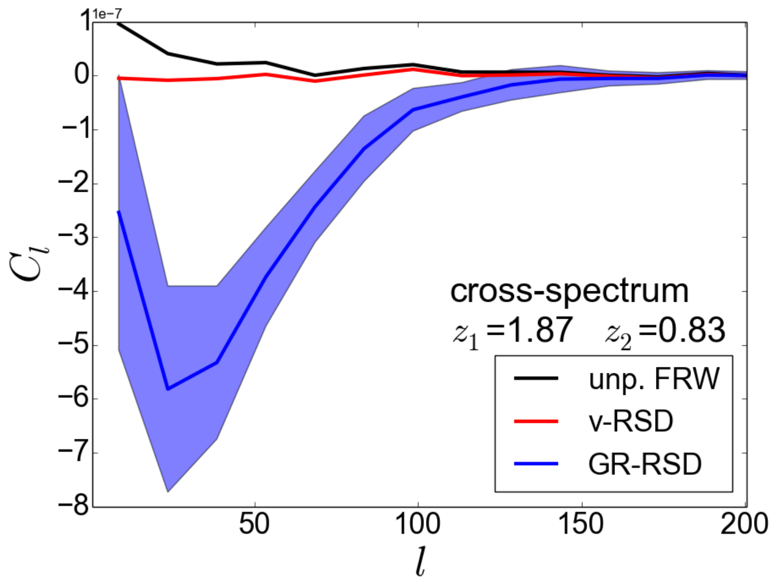
Redshift distributions for three all-sky samples

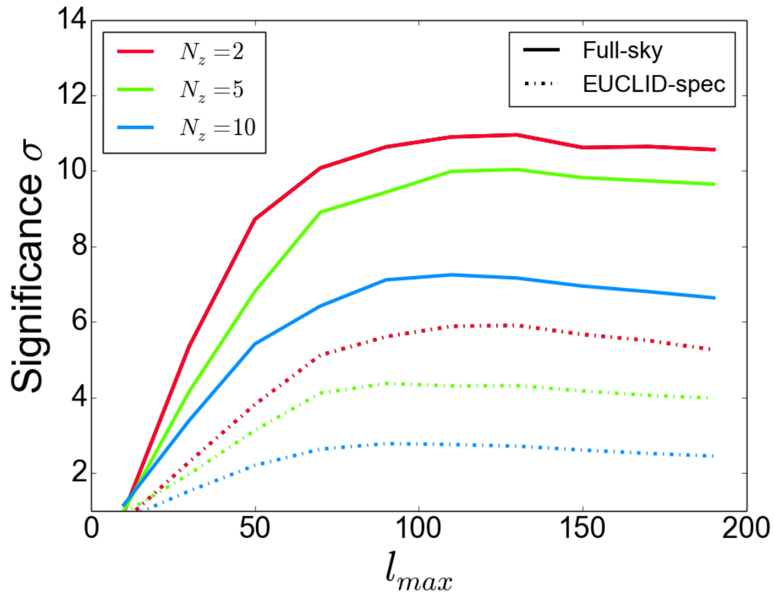
Bilicki et al. 2014a,b; 2015 in prep.

[1]Leiden University, the Netherlands · [2]University of Cape Town, South Africa · [3]University of Zielona Góra, Poland
[4]University of Edinburgh, UK · [5]University of the Western Cape, South Africa · [6]including the GAMA team · *maciek@ast.uct.ac.za*

Can we observe relativistic redshift-space distortions in forthcoming galaxy surveys?

M. Borzyszkowski, D. Bertacca and C. Porciani (AIfA, Bonn University)





Galaxy correlations on large scales.

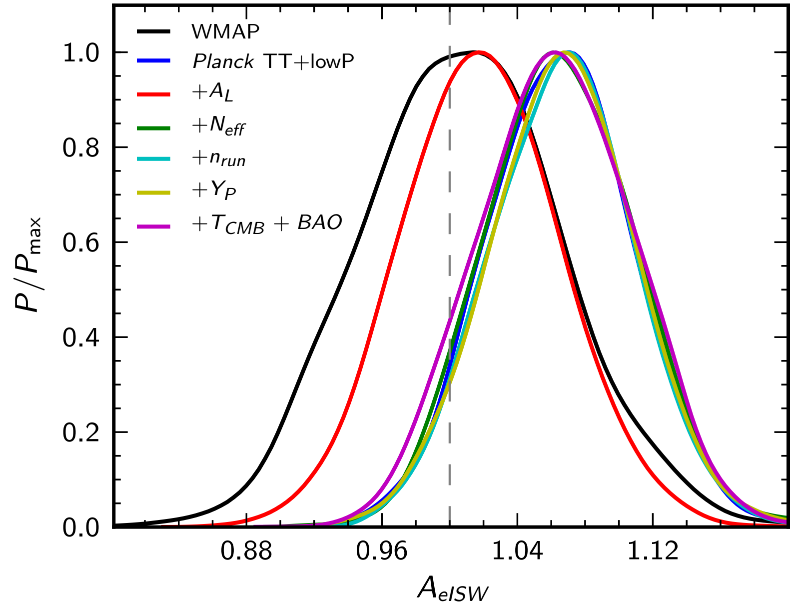
- Implement relativistic redshift-space distortions through particle shifting in numerical simulations.
- Can we measure them? Yes, with statistical significance of 10σ (full-sky) and 5σ (EUCLID-like survey)

Constraints on the Early and Late Integrated Sachs-Wolfe effects after Planck 2015

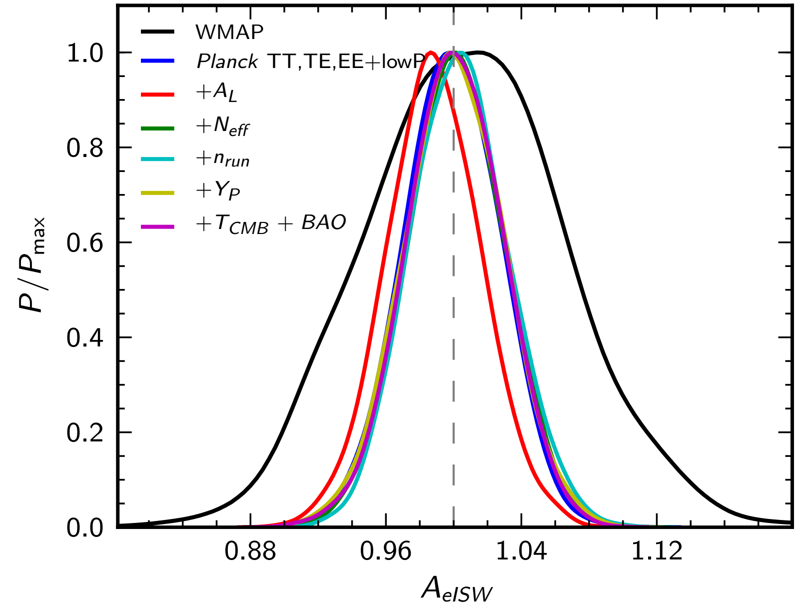
Giovanni Cabass, Martina Gerbino, Elena Giusarma,
Alessandro Melchiorri, Luca Pagano, and Laura Salvati

Physics Department and INFN, Università di Roma "La Sapienza", P.le Aldo Moro 2, 00185, Rome, Italy

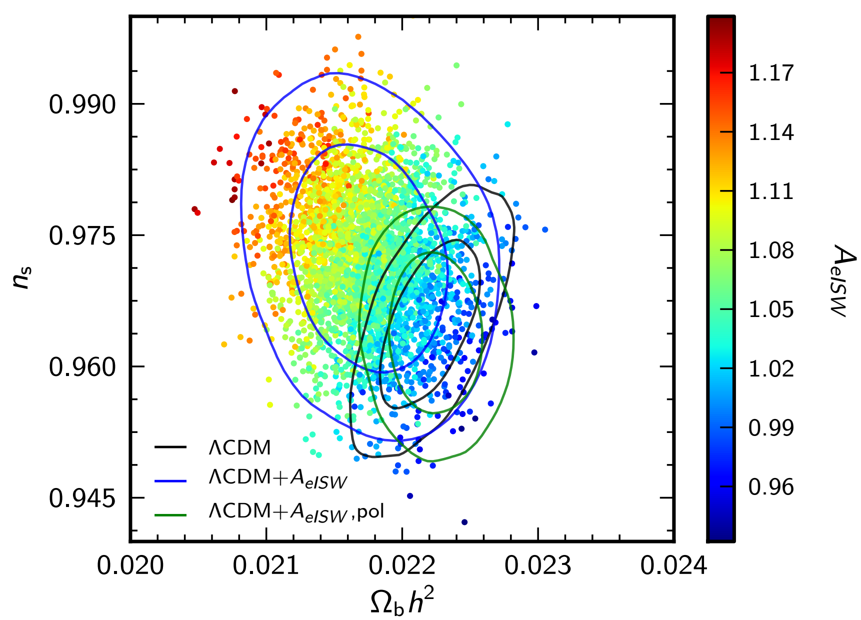
in preparation



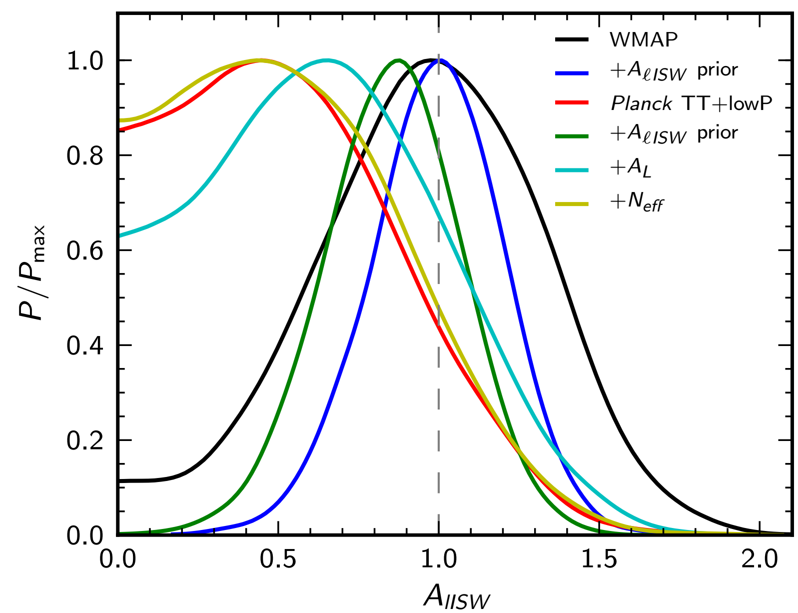
Planck $TT+$lowP data are consistent with a non-zero early ISW, with a 1σ evidence of $A_{\rm eISW} \neq 1$ that is stable under the most common extensions of the ΛCDM model.



Recent Planck polarization data at high ℓ erase the evidences for a non-standard value of $A_{\rm eISW}$.



$A_{\rm eISW} \to 1$ through its degeneracy with $\Omega_{\rm b}h^2$ and $n_{\rm s}$, which return in agreement with the ΛCDM best fit when polarization is included.



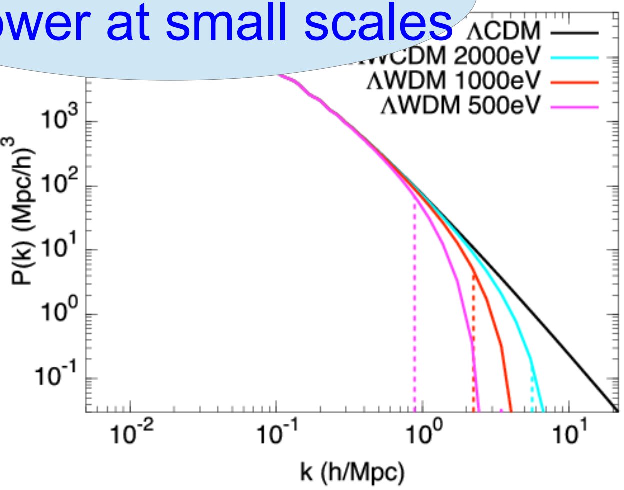
Planck data place a constraint $A_{l\rm ISW} \lesssim 1.1$ at 95% *c.l.* When supplemented with a prior on $A_{l\rm ISW}$ (coming from CMB temperature anisotropies-weak lensing correlations) $\Rightarrow$ $A_{l\rm ISW} = 0.85 \pm 0.21$ ($\sim 4\sigma$ detection).

Isabella Paola Carucci (Sissa-Trieste)

The imprint of warm dark matter on the 21cm power spectrum: forecasts for SKA

In collaboration with Matteo Viel and Francisco Villaescusa-Navarro (Trieste Observatory)

WDM: suppression of power at small scales

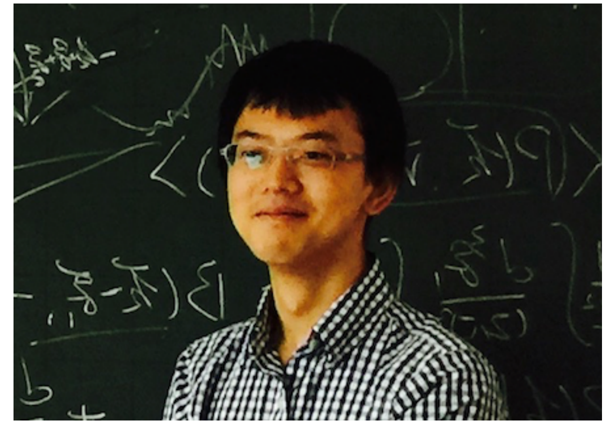


What happens to the 21cm signal in WDM cosmologies?

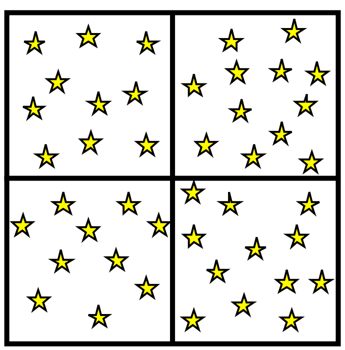
The 21cm power spectrum gets boosted at all scales!

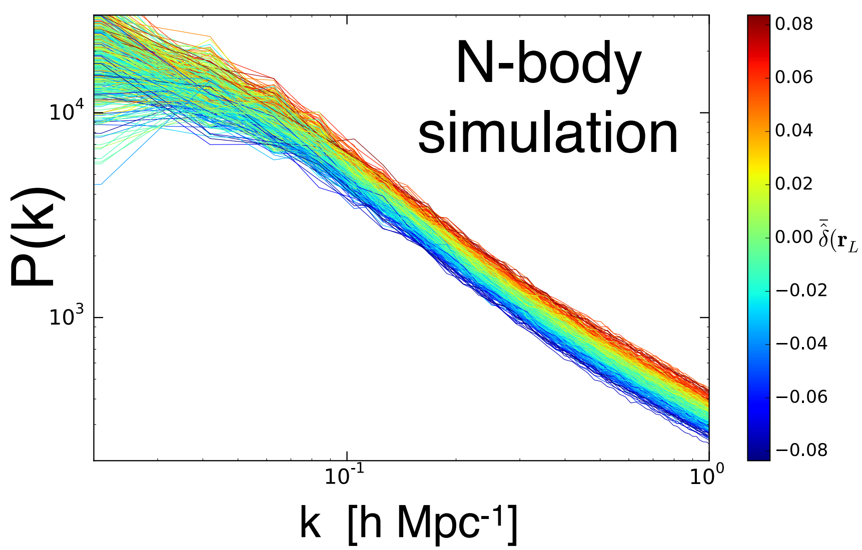
SKA1-LOW with 5k hour observation time can constrain competitively the warmness of DM by measuring the 21cm power spectrum (intensity mapping)

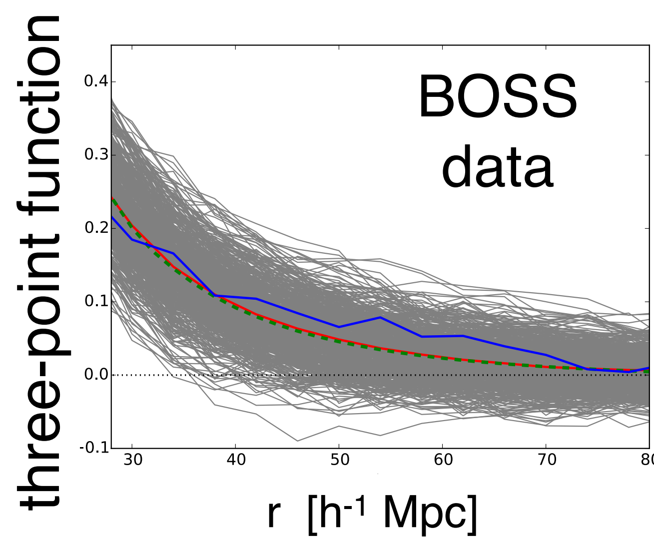
Chi-Ting Chiang
(MPA→Stony Brook)



Position-dependent power spectrum:
obtaining the squeezed-limit bispectrum ***without measuring it***



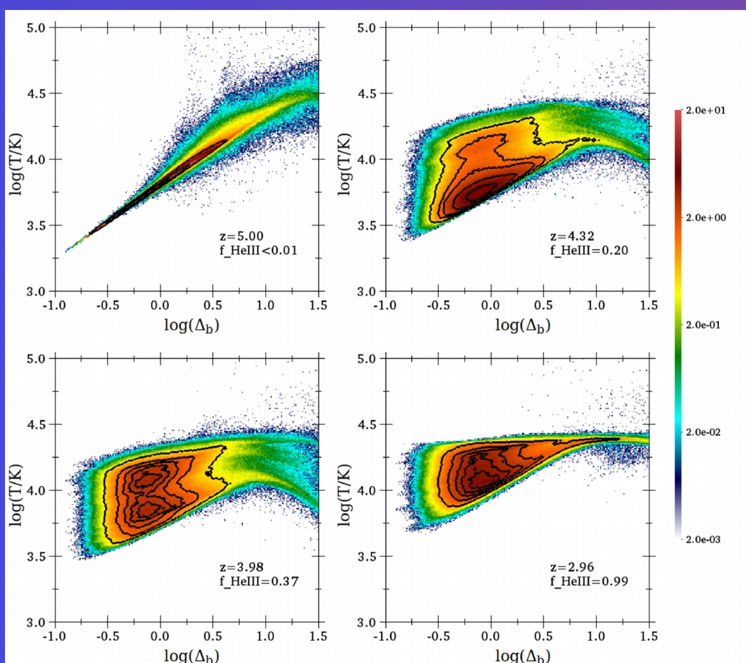




A Numerical Perspective on Helium Reionization

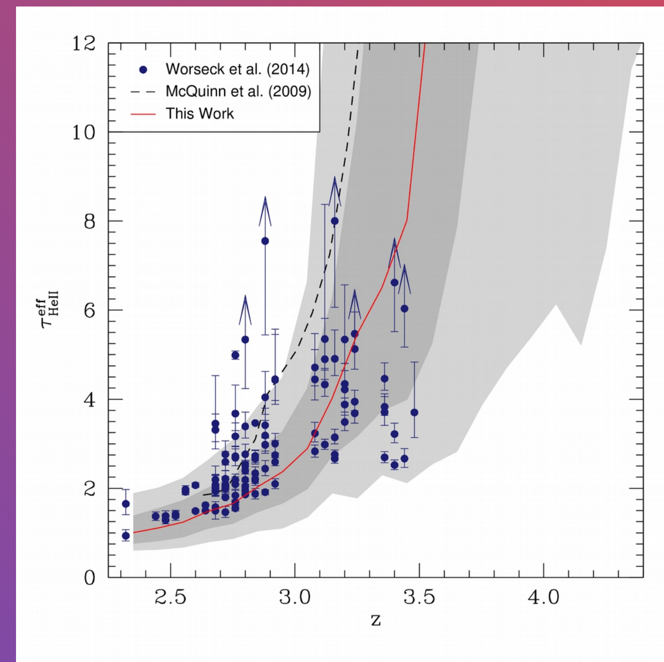
Where we started:

- Suite of cosmological AMR hydrodynamic simulations
- Source model calibrated against observations



Bimodal distribution of T during HeII reionization

Radiative Transfer from AGNs



Redshift evolution of the HeII effective optical depth.

What we have found:

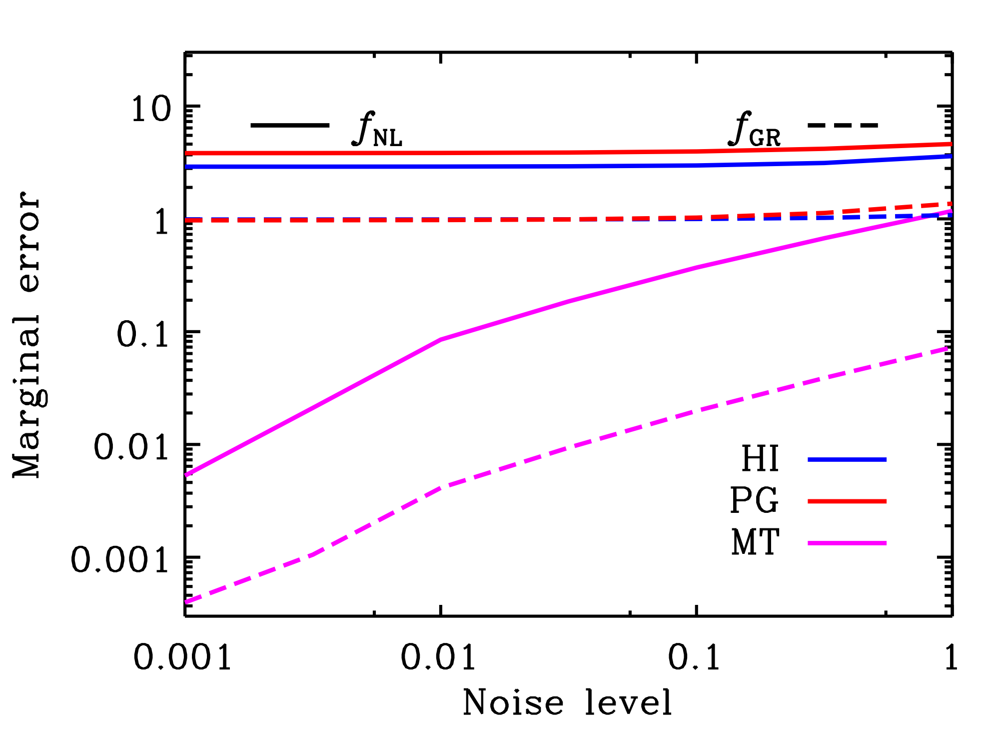
- Temperature bimodality
- Observed population of AGNs can ionize most of the He in the IGM by z~3
- Imprint on HI Lyα forest

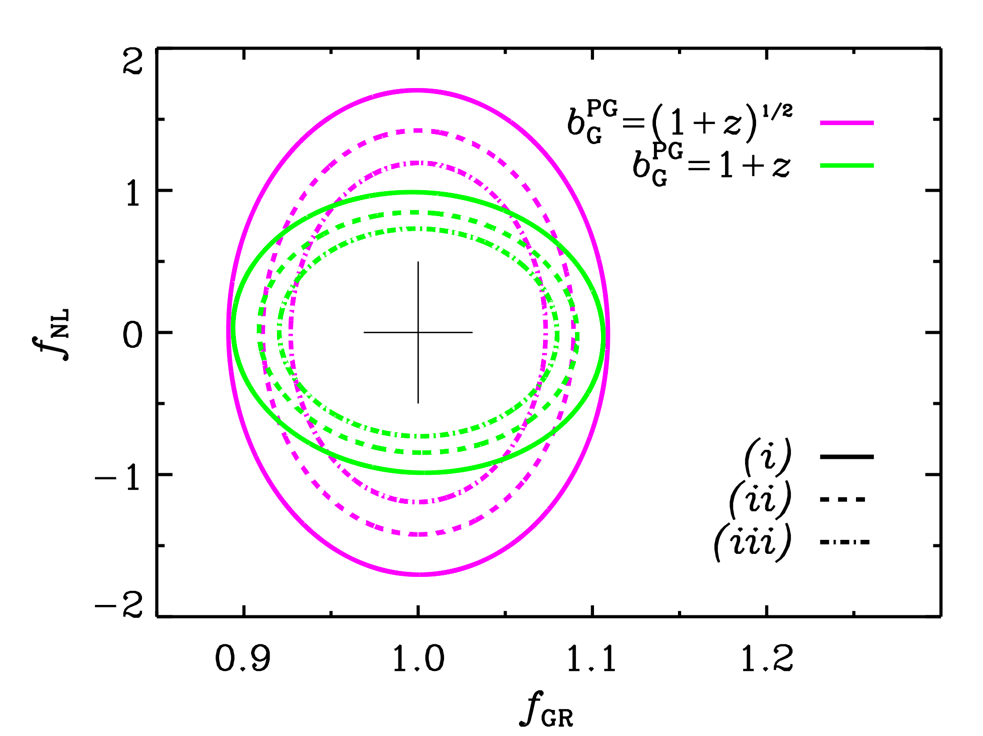
Michele Compostella (MPA Garching)

in collaboration with Cristiano Porciani (AIfA Bonn) and Sebastiano Cantalupo (ETH Zürich)

JOSÉ FONSECA - UNIVERSITY OF THE WESTERN CAPE
IN COLLABORATION WITH STEFANO CAMERA, MÁRIO SANTOS AND ROY MAARTENS

UNIVERSITY of the WESTERN CAPE





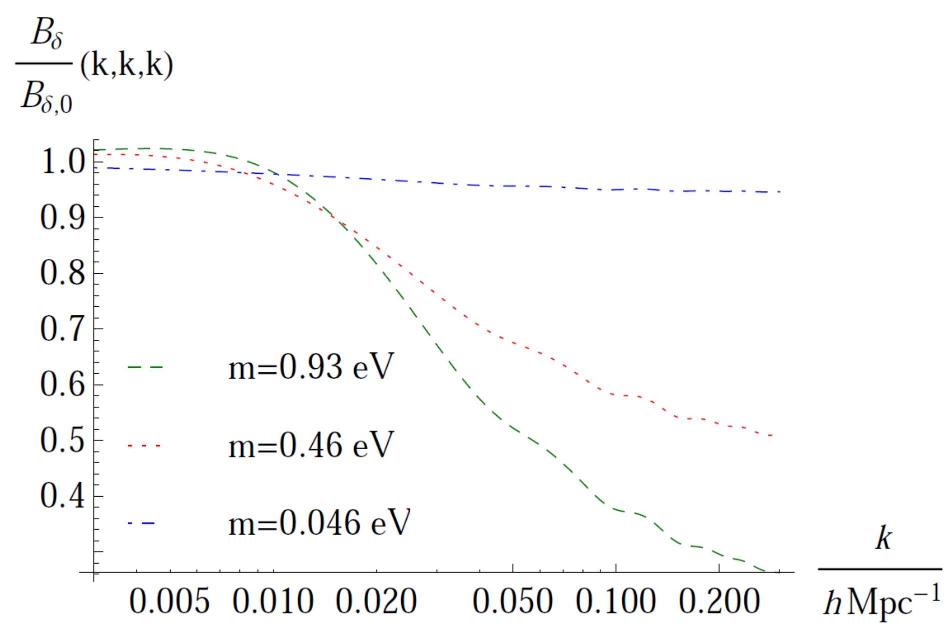
HUNTING DOWN HORIZON-SCALE EFFECTS WITH MULTI-WAVELENGTH SURVEYS

Higher-order massive neutrino perturbations in large-scale structure

Florian Führer (ITP Heidelberg)

Based on: FF, Yvonne Y. Y. Wong JCAP 1503 (2015) 046 arXiv: 1412.2764

- Massive neutrinos contribute to non-relativistic matter $f_\nu = O(5\%)$
- No satisfactory satisfactory non-liner approach exists
- A new first principle approach
  - Closed formal equation for density
  - No expansion in $\frac{f_\nu}{f_{\text{CDM}}}$
  - Also applicable to Warm Dark Matter cosmologies
- Tested common approximations
  - Qualitatively good agreement for the total matter bispectrum
  - Fail for the neutrino bispectrum



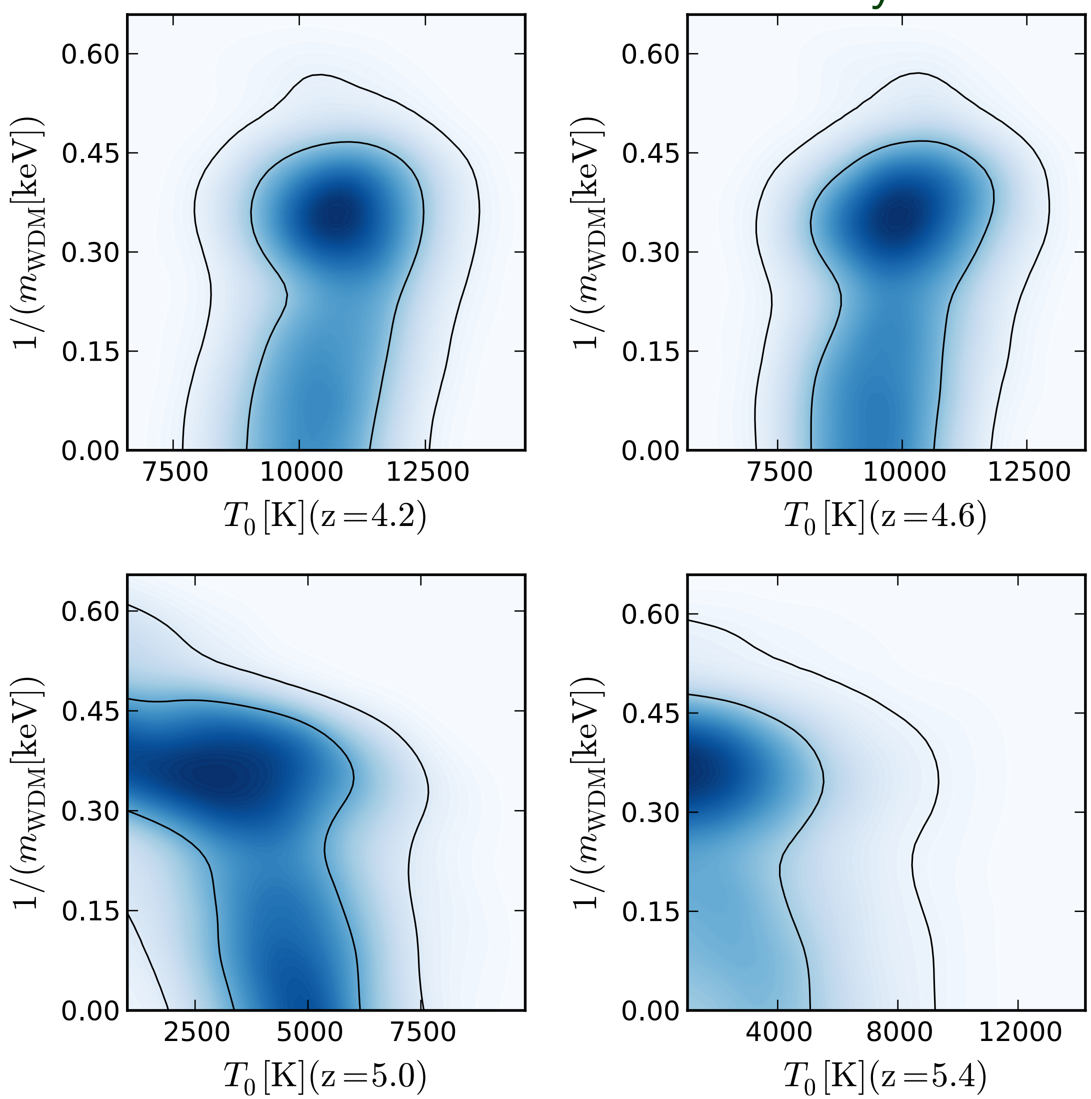
Warm Dark matter: constraints from Lyman α forest

Universiteit Leiden

A. Garzilli, A. Boyarsky, O. Ruchayskiy and M. Viel

INSTITUUT LORENTZ

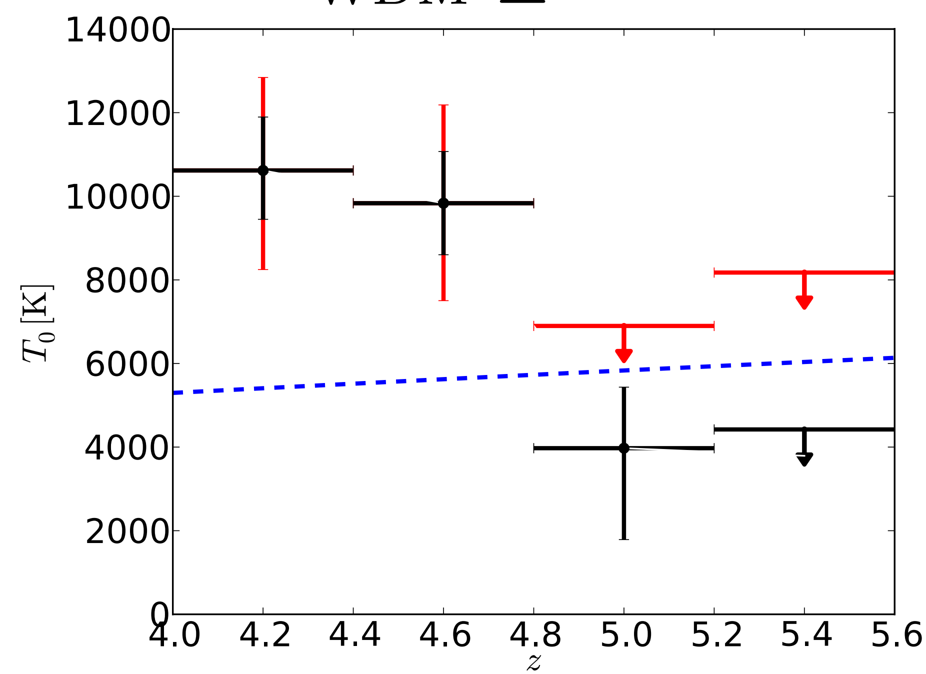
Redshift-binned parametrization on IGM thermal history



The high resolution data in (Viel et al 2013) CANNOT CONSTRAIN WDM better than previous constraints from SDSS

updated constraints:

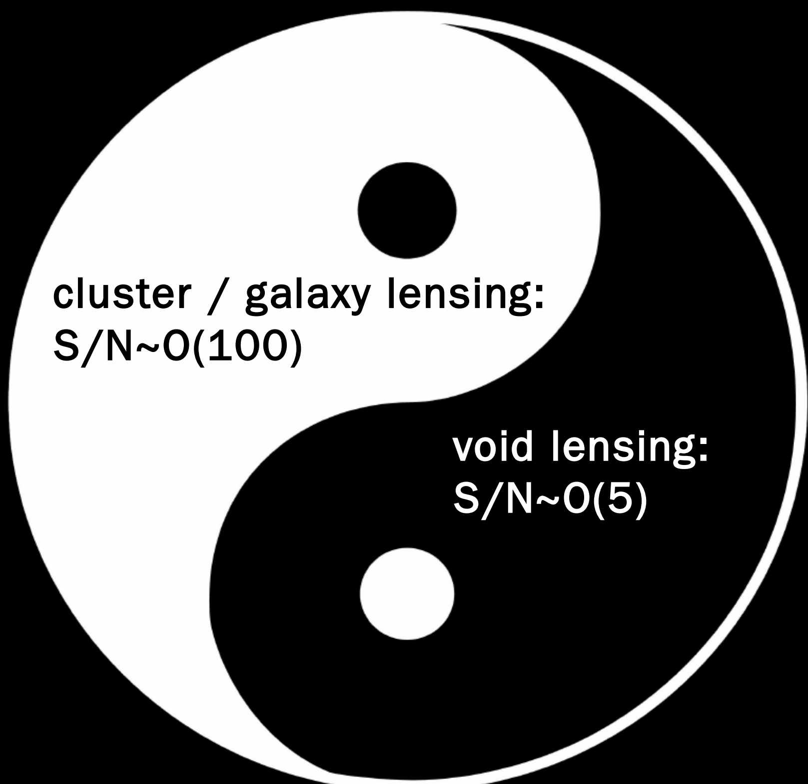
$$m_{\rm WDM} \geq 2\,\rm keV$$

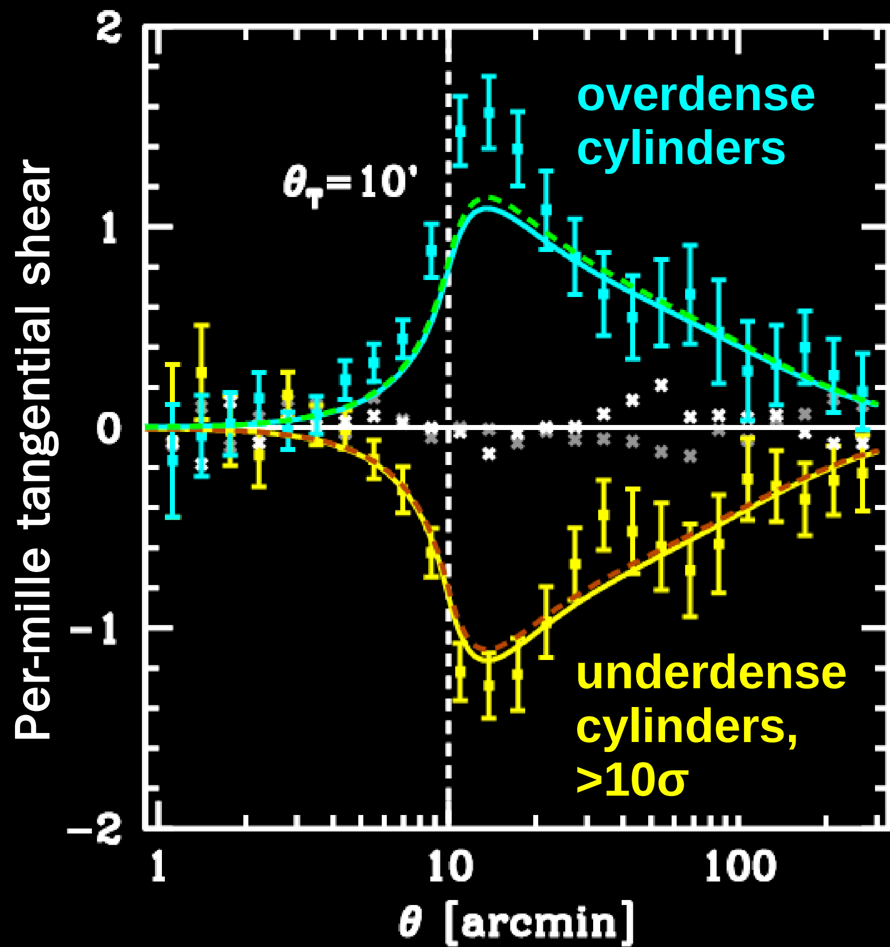


Weak Lensing by Galaxy Troughs in DES Science Verification Data

Daniel Gruen, LMU Munich

underdense regions in the projected galaxy field

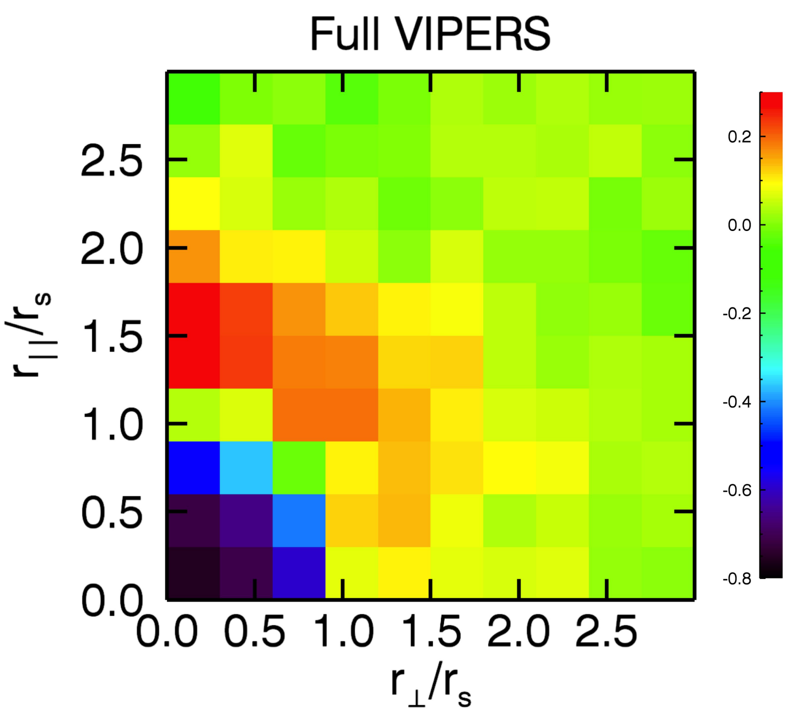


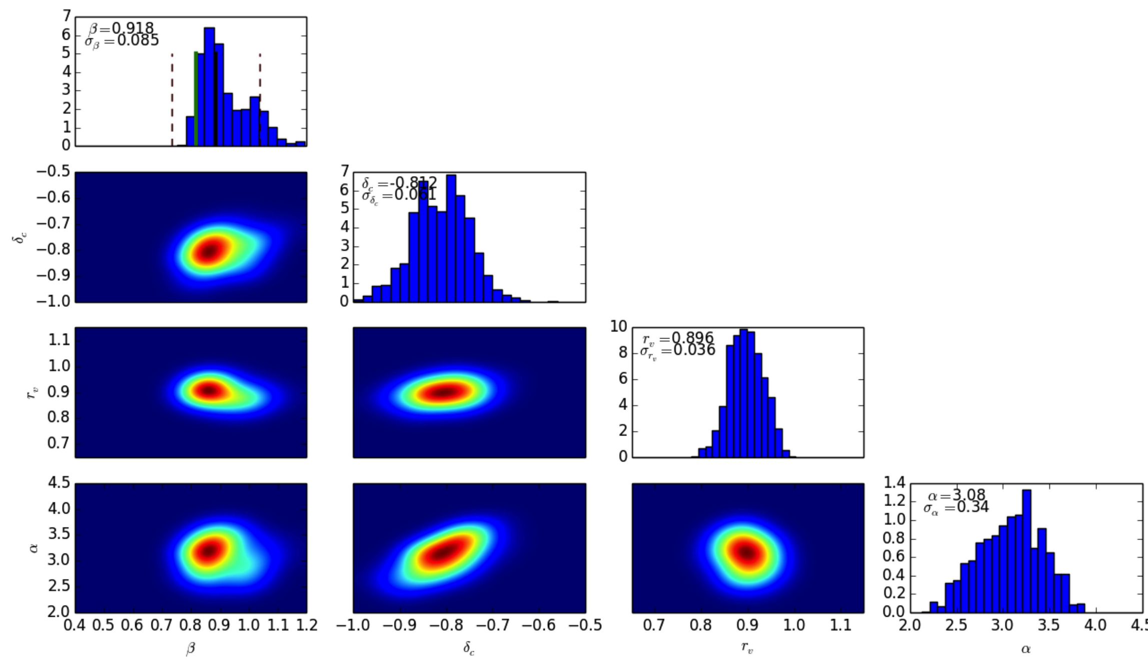


Measuring the growth rate of structure around cosmic voids in VIPERS

Adam J. Hawken

Osservatorio Astronomico di Brera, INAF, Merate/Milano





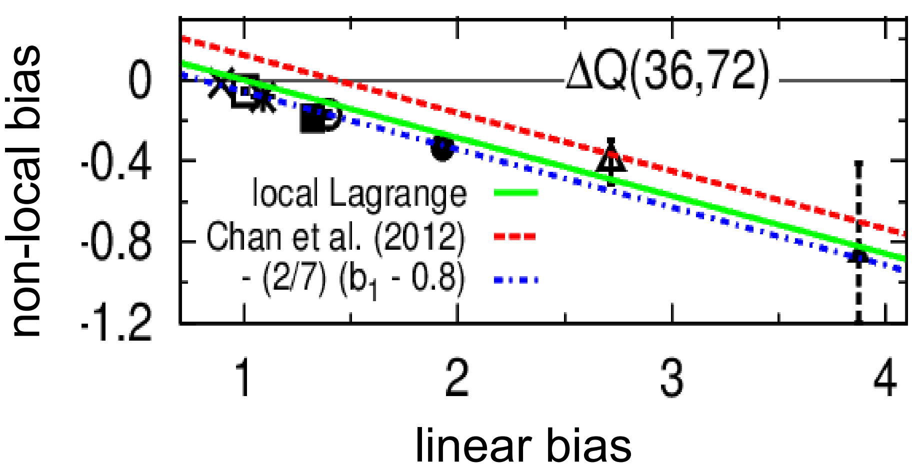
This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 291521

Non-local bias contribution to galaxy 3-point correlations

Kai Hoffmann, Julien Bel, Enrique Gaztañaga

(MNRAS, 2015, 447, 1724; MNRAS, 2015, 450, 1674; arXiv:1504.02074)

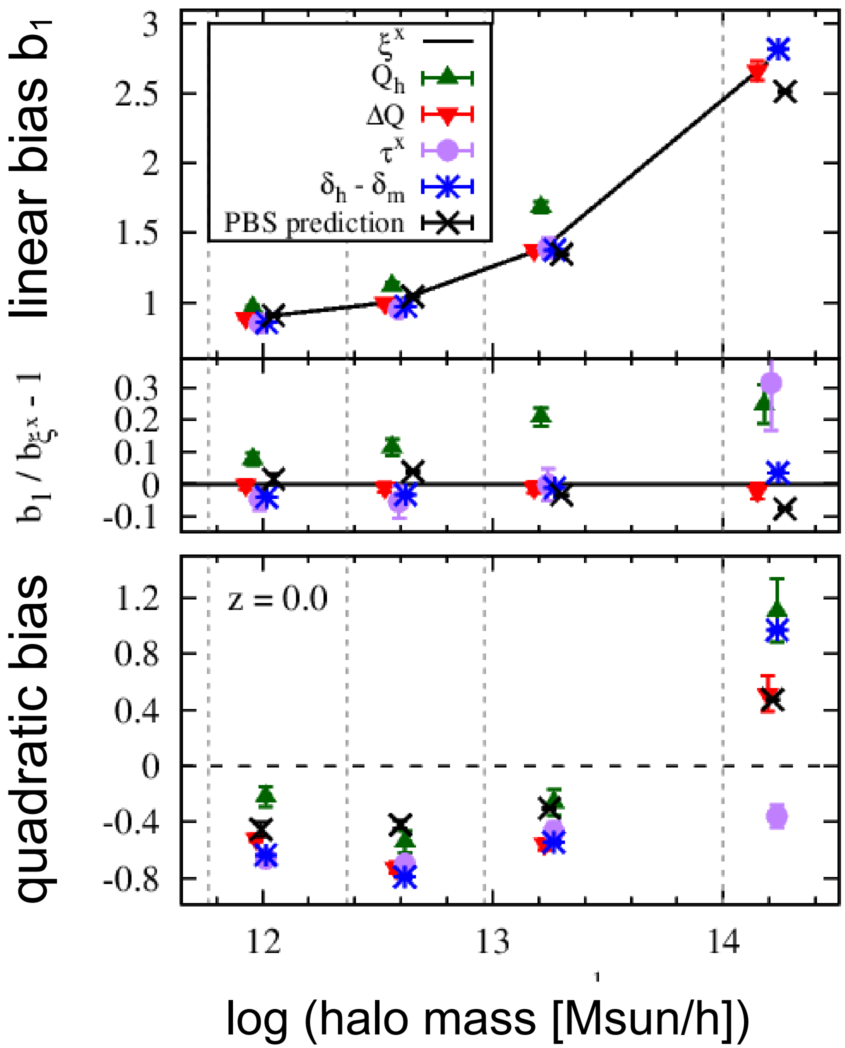
- first non-local bias measurement in real space



- new method for accurate linear bias measurement from 3pc

- comparison of lin.&quad. bias
  - measurements: $\delta_m - \delta_g$, 2pc, 3pc, 3rd-order correlators
  - predictions: peak-background split

bias comparison



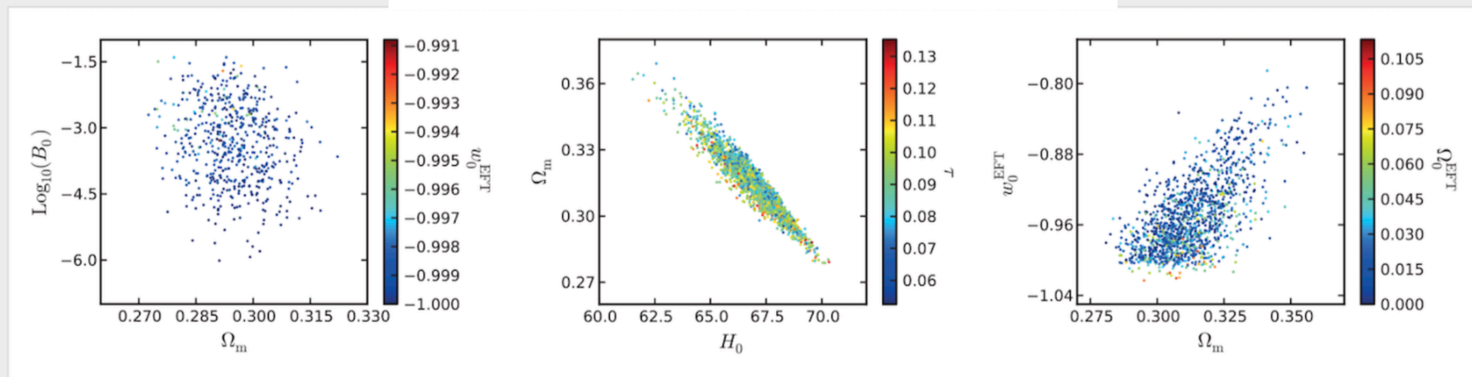
Effective Field Theory with CAMB

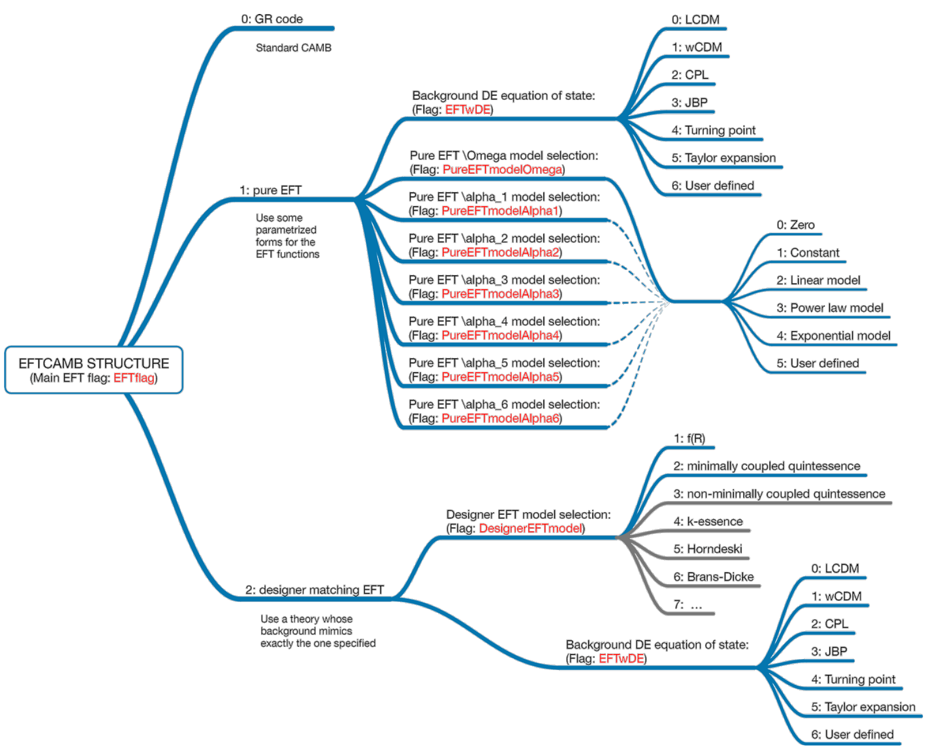
B. Hu, M. Raveri

Google Nederland

N. Frusciante, A. Silvestri

EFTCAMB



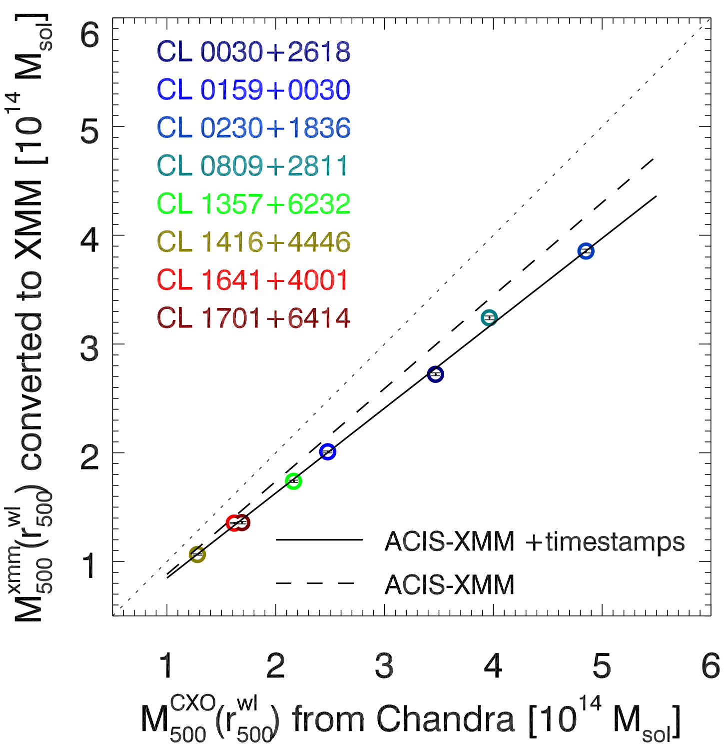


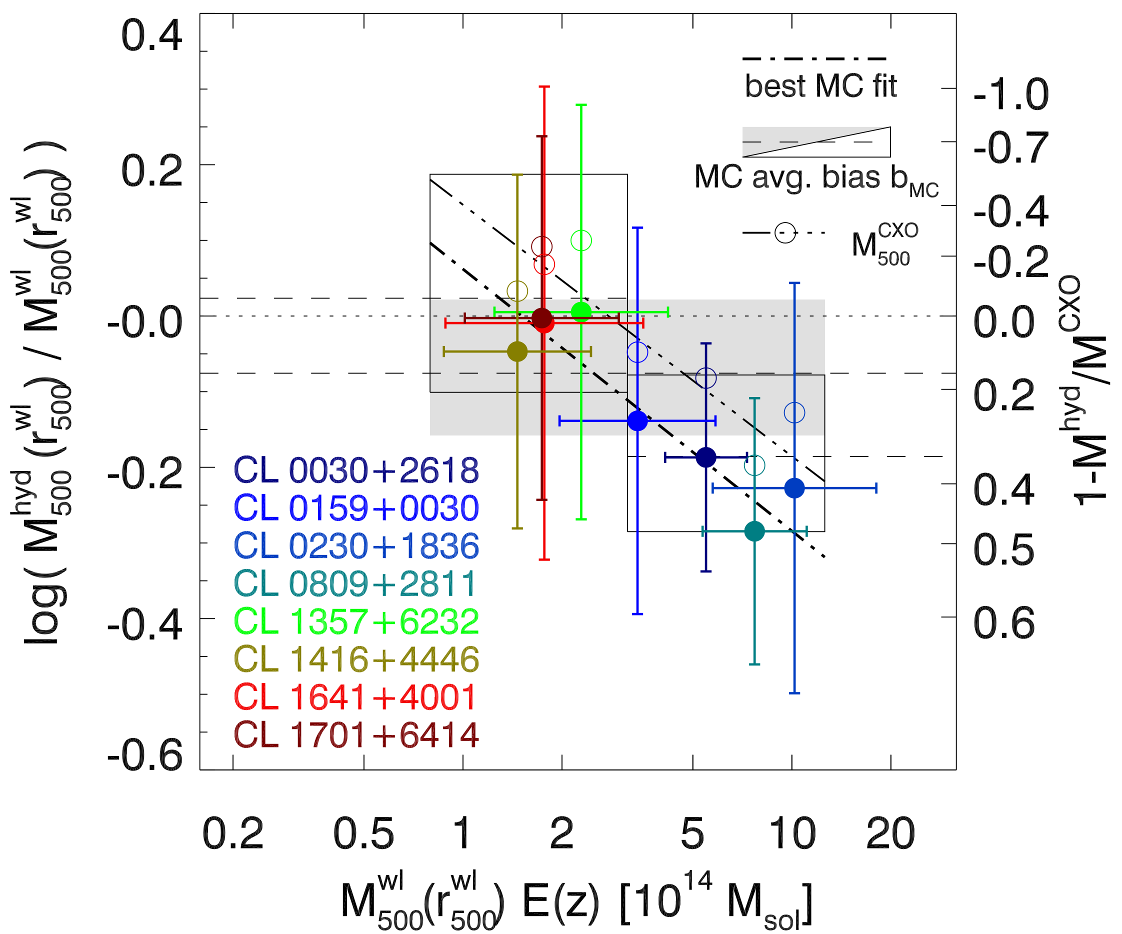
- unify description single scalar field DE/MG by using EFT language
- selected by Planck and Euclid
- New release updated with Planck-2015 likelihood is coming soon

Reconciling *Planck* cluster counts and cosmology?

Chandra/XMM instrumental calibration and hydrostatic mass bias

Holger Israel (Durham University)





Conclusion: Given the *Planck* cluster masses, if an (unlikely) un-corrected ~20 per cent calibration bias existed, this tension would be eased, but not resolved.

Please talk to me or write to:
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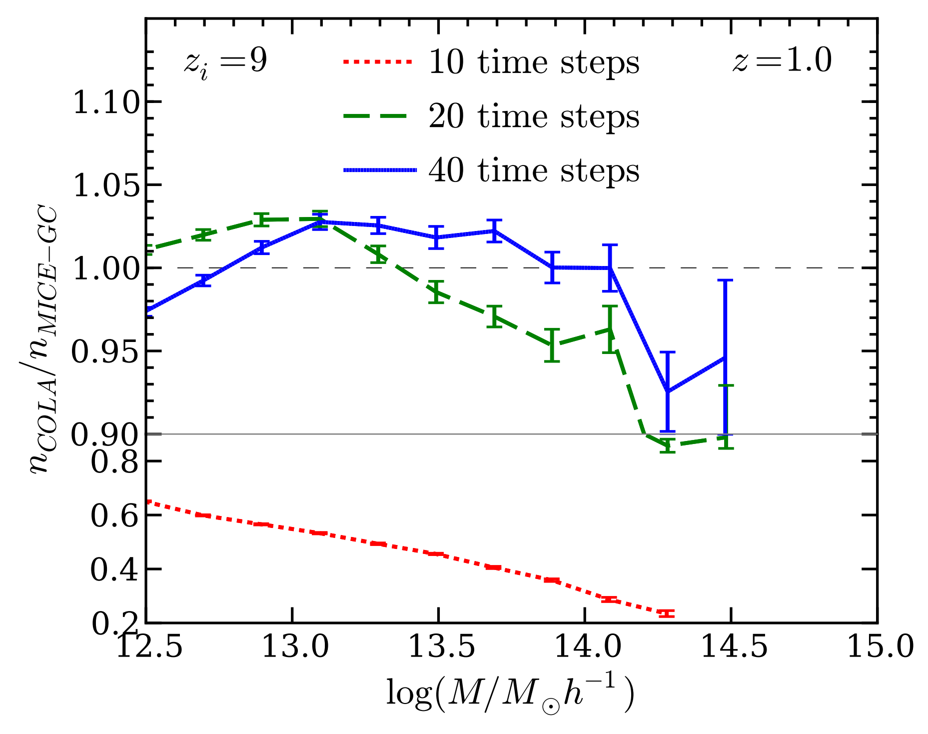
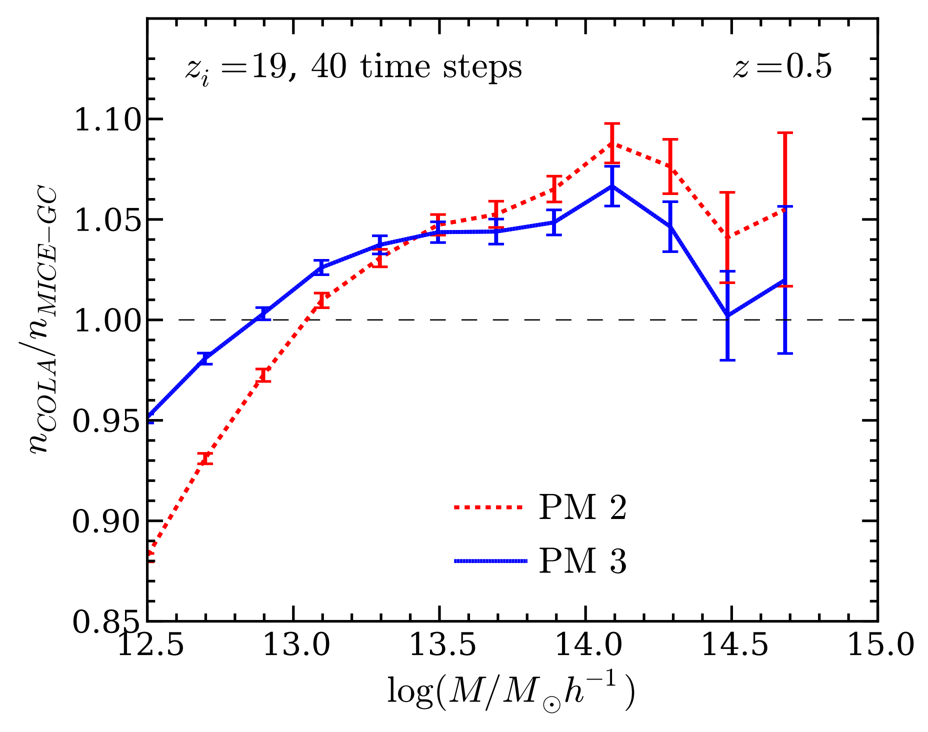
Durham University

Towards fast and accurate massive galaxy mocks using Lagrangian methods

Albert Izard · Martin Crocce · Pablo Fosalba
Institut de Ciències de l'Espai, IEEC-CSIC

The COLA method: $\partial_t^2 \boldsymbol{x}_{\rm res}(t) = -\nabla\Phi(t) - \partial_t^2 \boldsymbol{x}_{\rm LPT}(t)$





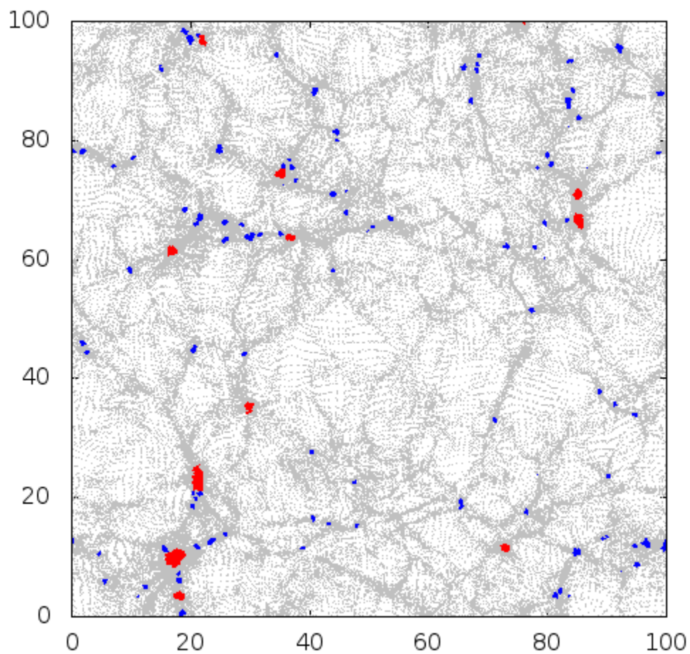
See halo clustering in real and redshift space in the poster

Generating fast and accurate mock galaxy catalogues of low mass galaxies

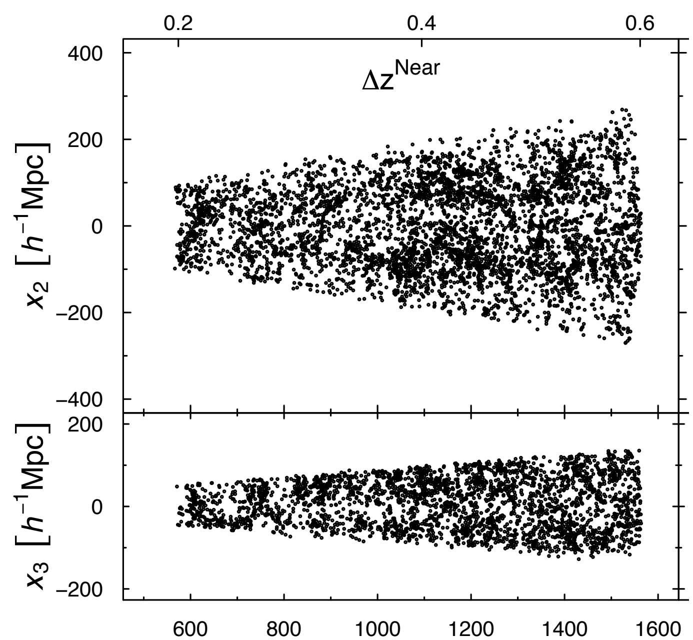
Jun Koda

INAF – Osservatorio Astronomico di Brera / DARKLIGHT

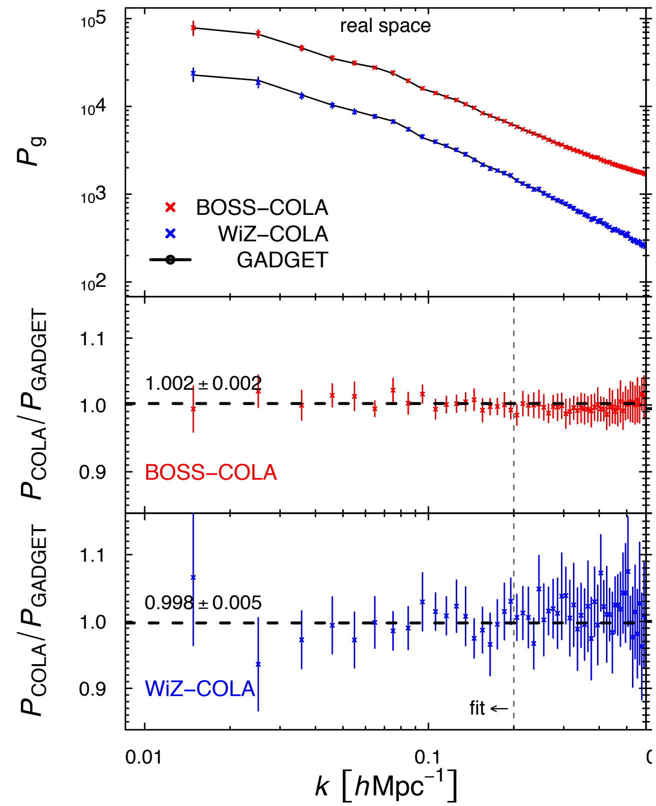
COLA 10 time-step simulation



600 Mock galaxy catalogues for WiggleZ survey



About 1% accuracy in power spectra

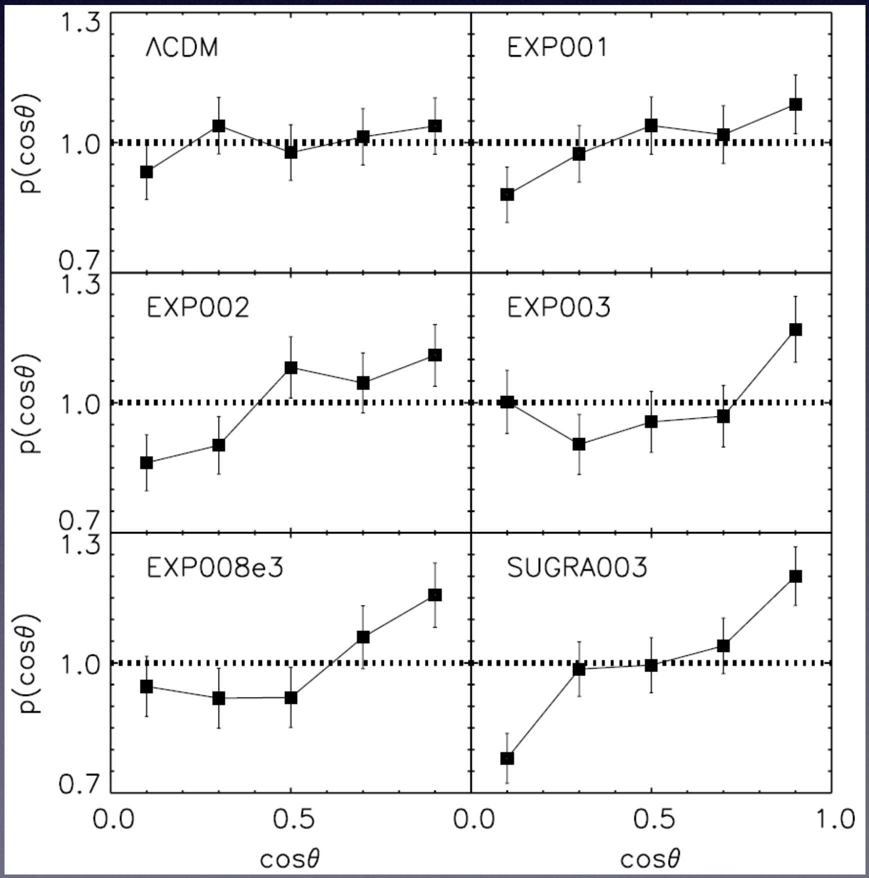


Theoretical and Observational Progress on Large-scale Structure of the Universe
Garching, July 20-24, 2015

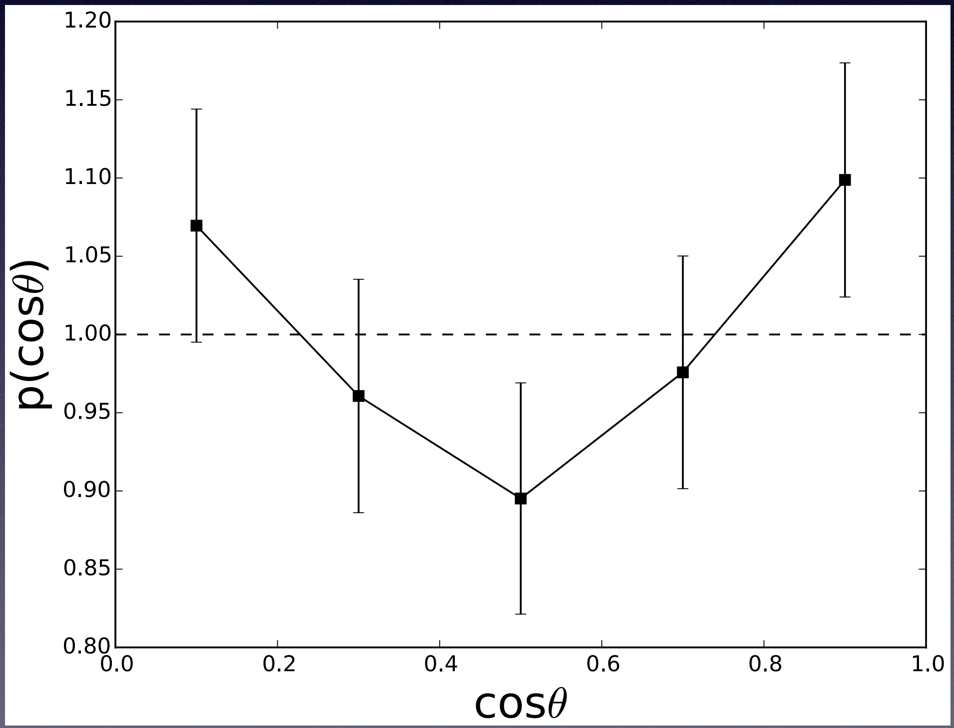
Constraining Coupled Dark Energy by using the Spin Alignments in Galaxy Pairs

Hanwool Koo, Jounghun Lee (Seoul National University)

Numerical results



Observational result

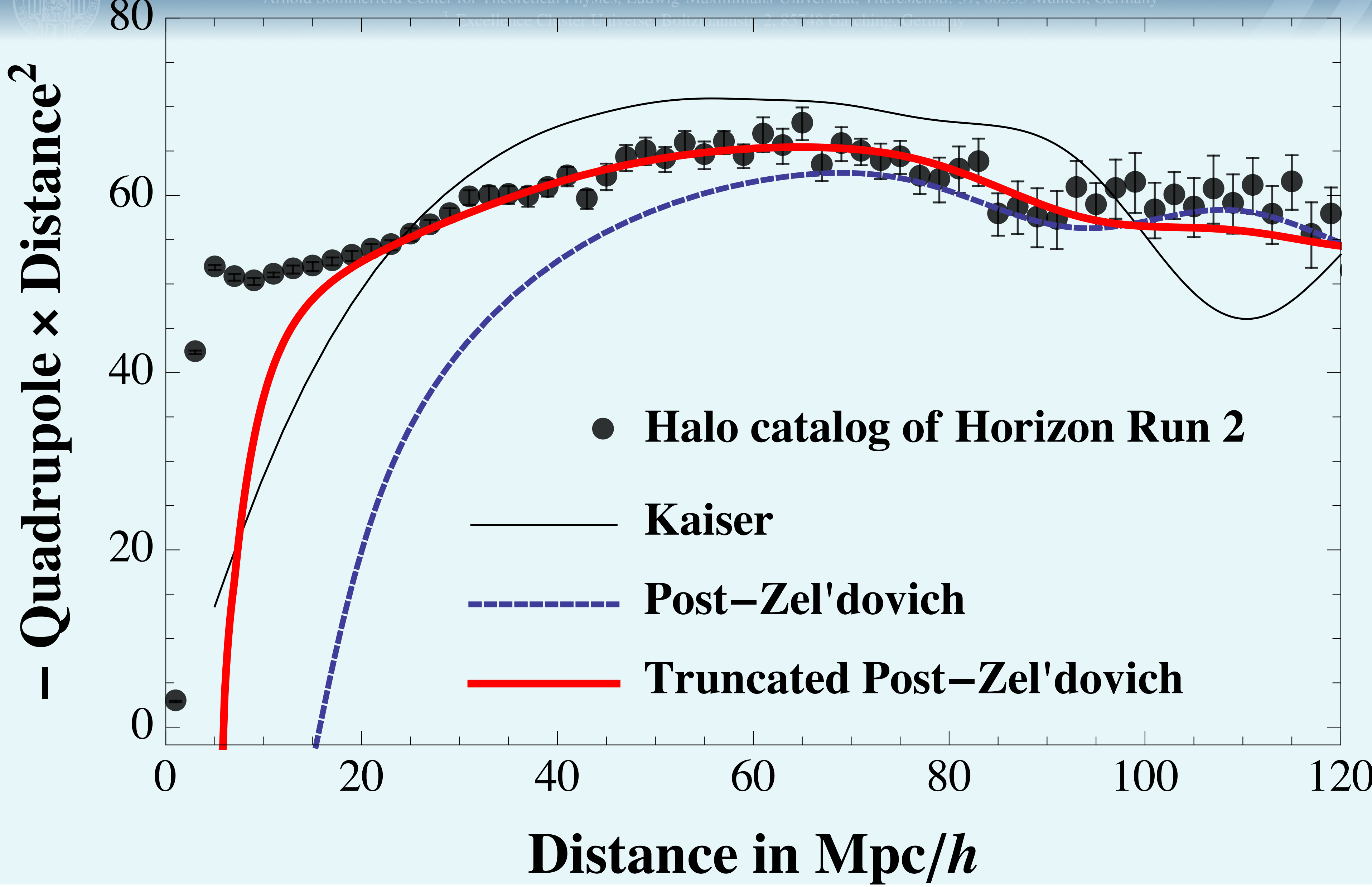


Contact: Hanwool Koo (Graduate student)
khw@astro.snu.ac.kr

Redshift space distortions with the truncated Zel'dovich approximation

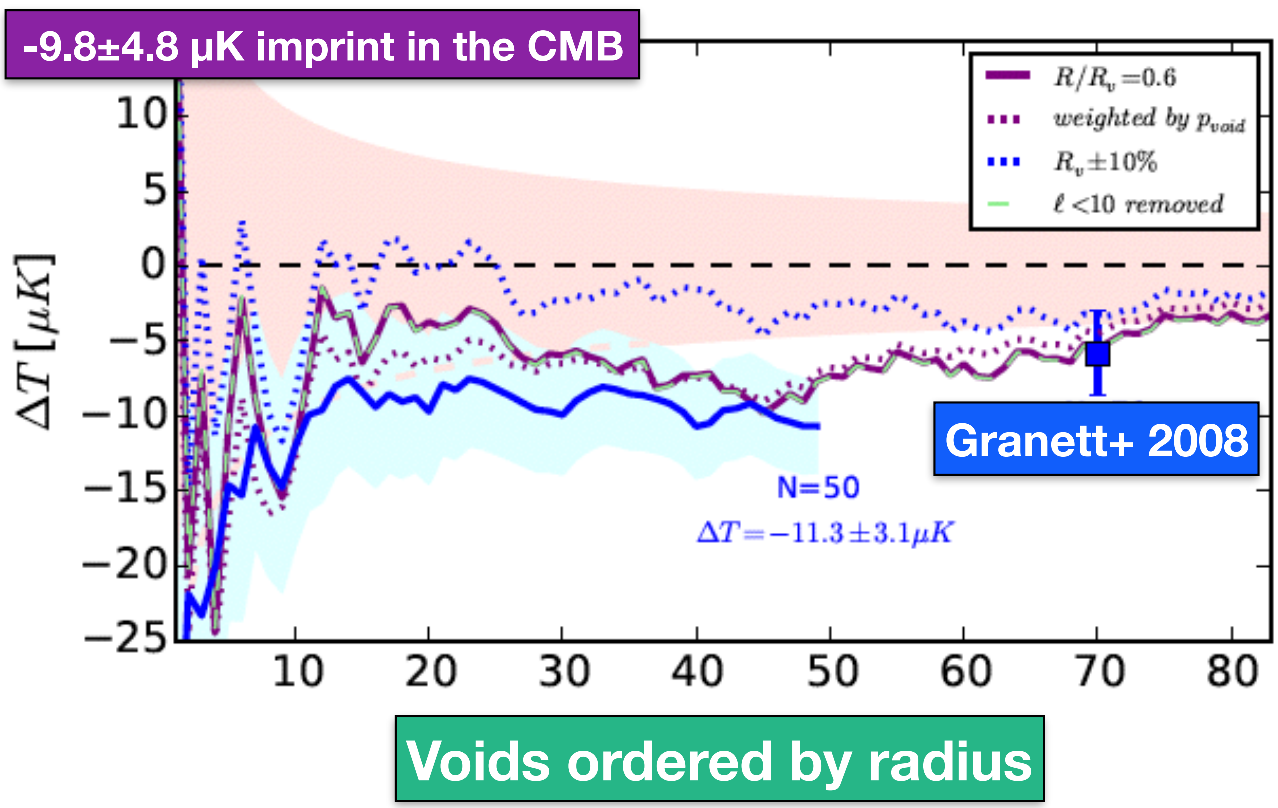
Michael Kopp [1] with Cora Uhlemann [2,3] and Ixandra Achitouv [4]

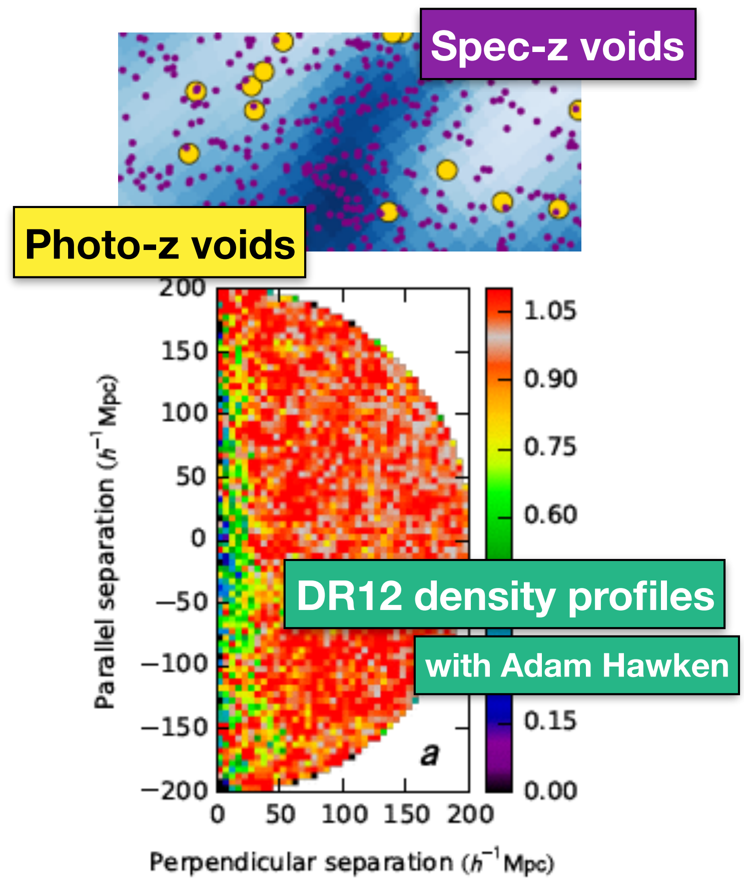
[1] Department of Physics, University of Cyprus, 1, Panepistimiou Street 2109, Aglantzia, Cyprus
[2] Arnold Sommerfeld Center for Theoretical Physics, Ludwig-Maximilians-Universität, Theresienstr. 37, 80333 Munich, Germany
[3] Excellence Cluster Universe, Boltzmannstr. 2, 85748 Garching, Germany



Cold imprint of supervoids in the CMB reconsidered with Planck and BOSS

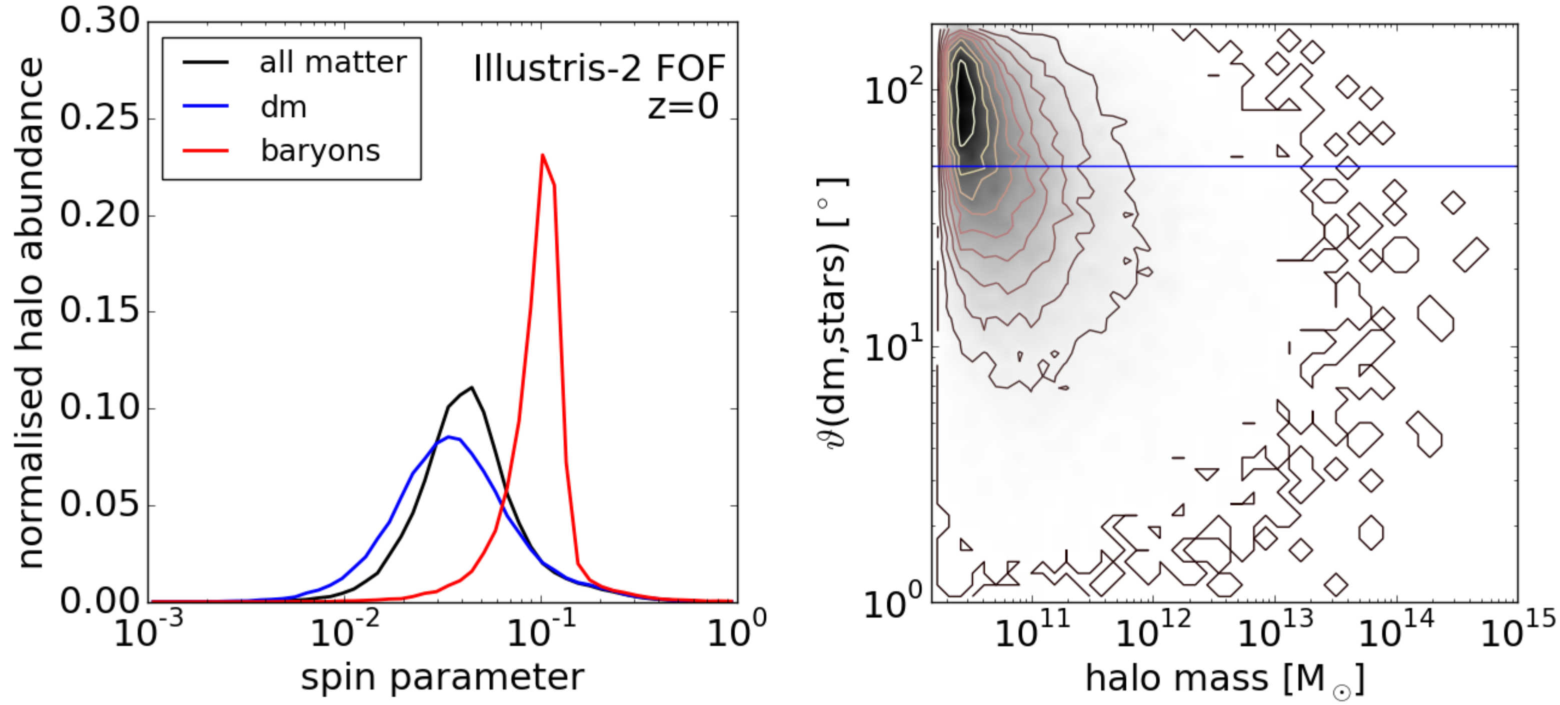
András Kovács & Benjamin R. Granett





Angular Momentum Properties of Haloes in the Illustris Simulation

J. Krzyszkowska, V. Springel, in prep.

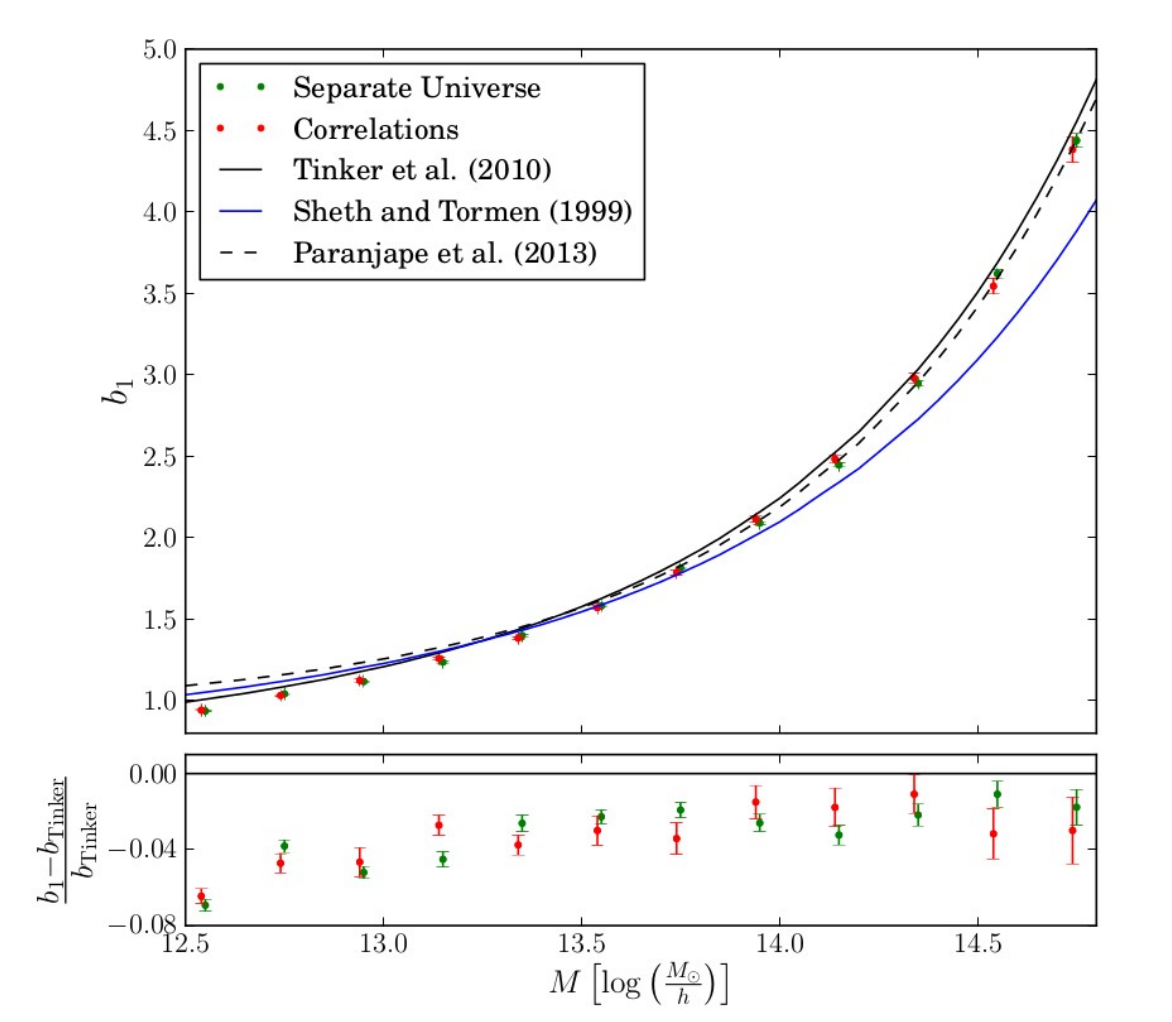


What causes the baryonic spin to be different from the dark matter spin?

Precision measurement of the local bias of dark matter halos

Titouan Lazeyras

with C. Wagner, T. Baldauf and F. Schmidt



Optimization of kSZ measurements with a reconstructed cosmological flow field

Ming Li NAOC CHINA

cluster samples

CMB maps

$$\hat{\Psi}(\boldsymbol{k}) = \sigma^2 \frac{\hat{\tau}(\boldsymbol{k})\hat{B}(\boldsymbol{k})}{P(\boldsymbol{k})}, \sigma^2 = \left[\int \frac{|\hat{\tau}(\boldsymbol{k})\hat{B}(\boldsymbol{k})|^2}{P(\boldsymbol{k})} \frac{\mathrm{d}^2 k}{(2\pi)^2}\right]^{-1}$$

K200

extra velocity field from LSS survey

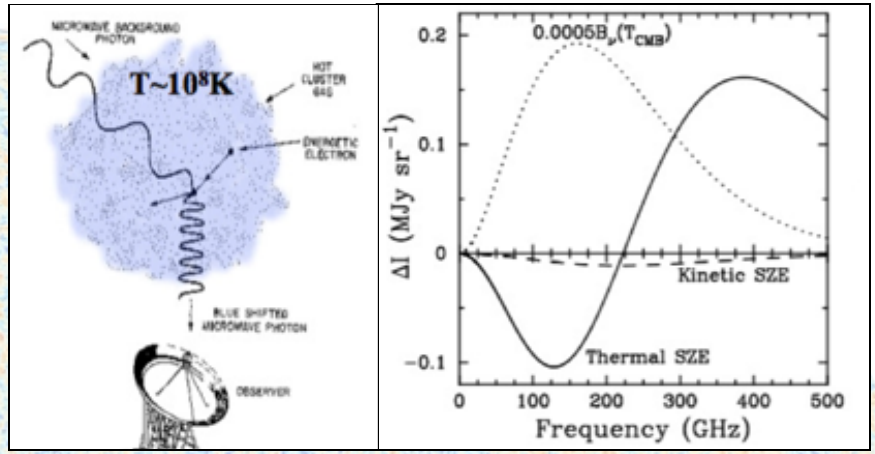
$$\boldsymbol{v}(\boldsymbol{k}) = -\boldsymbol{i}\beta(z) H_0 \delta_{\mathrm{g}}(\boldsymbol{k}) \frac{\boldsymbol{k}}{k^2}$$

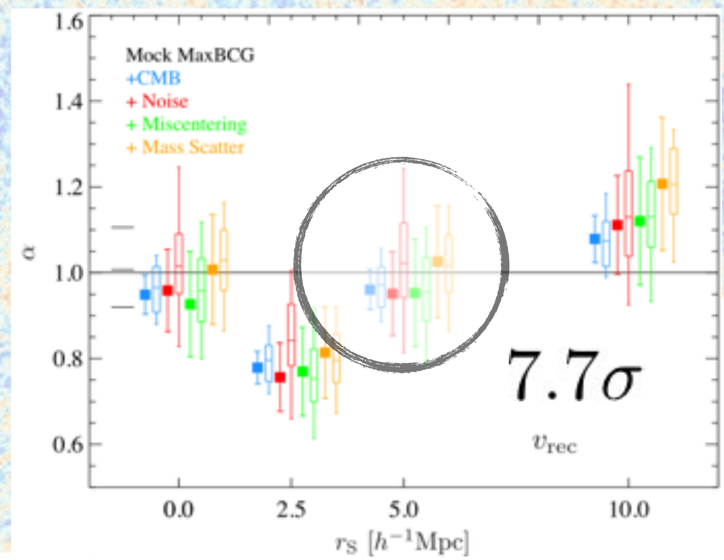
Vrec

$$\alpha_i = -\frac{c}{\sigma_T\, f_{\mathrm{b}}\, \mu} \frac{K_{200,i}}{M_{200}} \frac{1}{v_{\mathrm{rec},i}}$$

$$\alpha = \frac{\sum_i \alpha_i w_i}{\sum_i w_i} \sigma_\alpha = \left[\frac{1}{\sum_i w_i}\right]^{1/2}$$

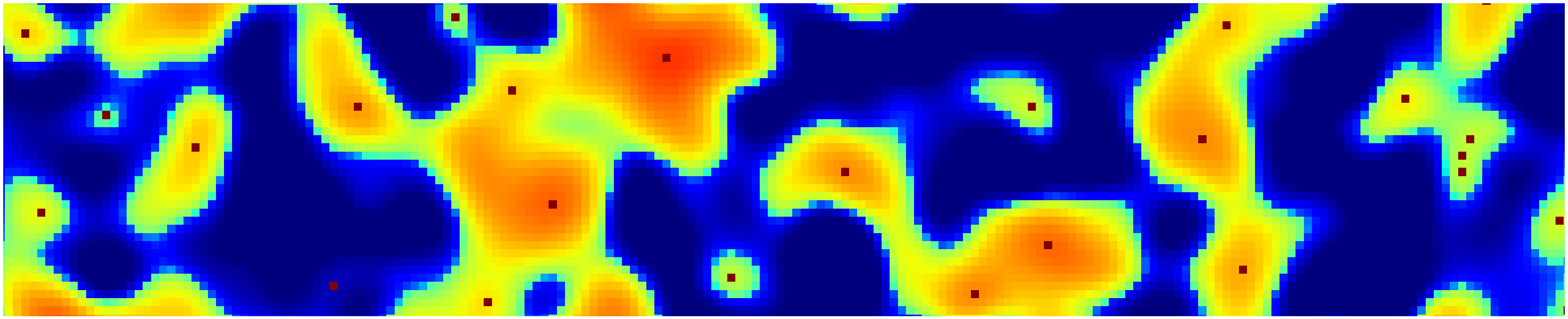
$$w_i^{-1} = \left(\frac{1}{v_{\mathrm{rec,i}}}\right)^2 (\sigma^2_{\mathrm{kSZ,i}} + \sigma^2_\epsilon + \beta^2_{\mathrm{fid}}\sigma^2_{\mathrm{rec,i}})$$





MNRAS 443, 2311–2326 (2014) and an ongoing work with application to PLANCK, redMaPPer and Jens Jasche's velocity data

A fast stochastic approach for cosmological constraints using weak-lensing peak counts



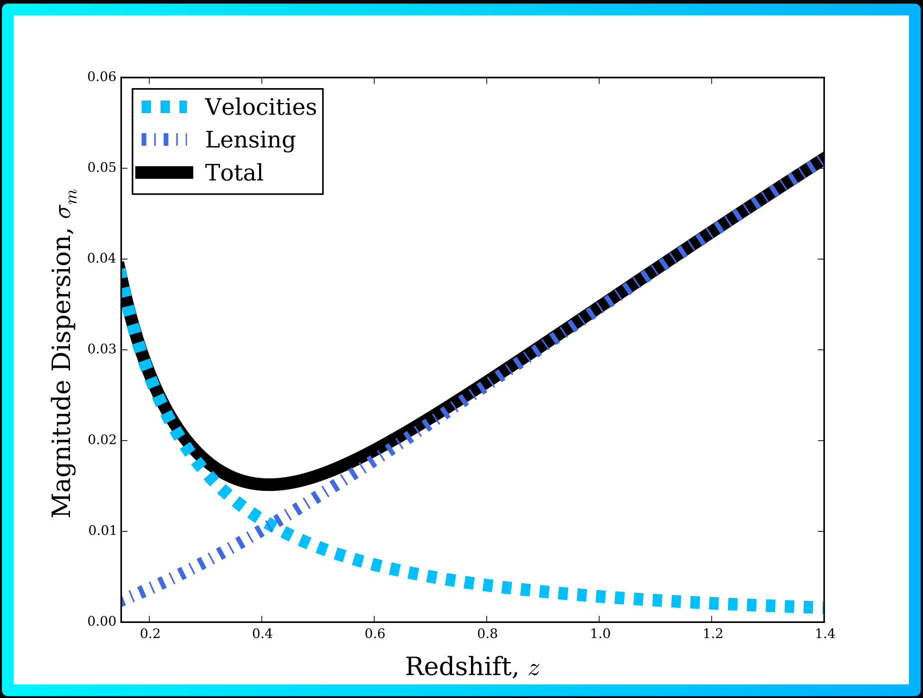
A new model to predict WL peak counts:

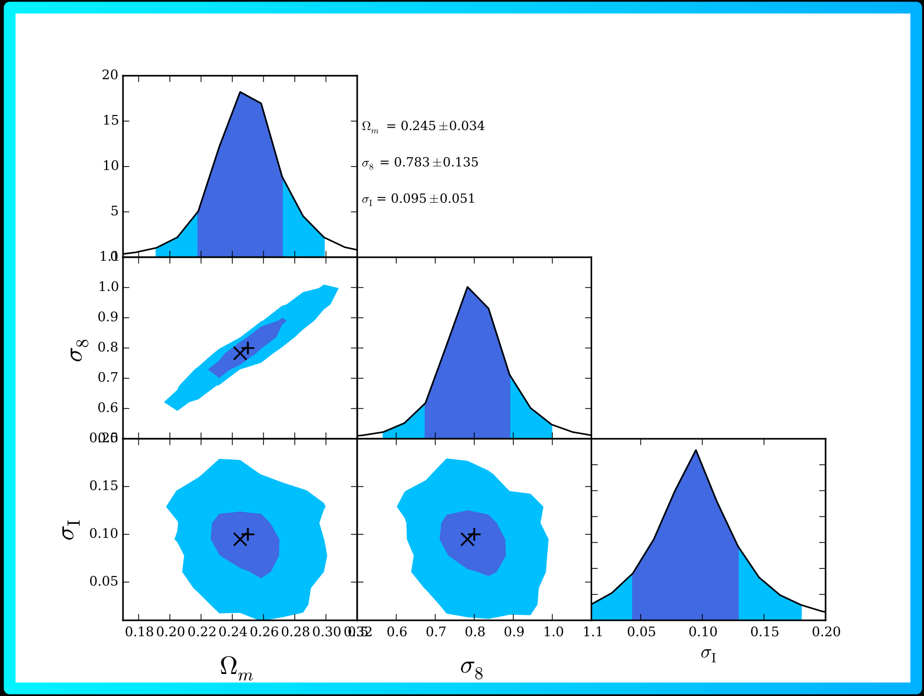
Fast, Flexible, Full PDF information

A robust and efficient constraining method:

Approximate Bayesian computation

Gravitational Signals from Noise in the Hubble Diagram





Ed Macaulay
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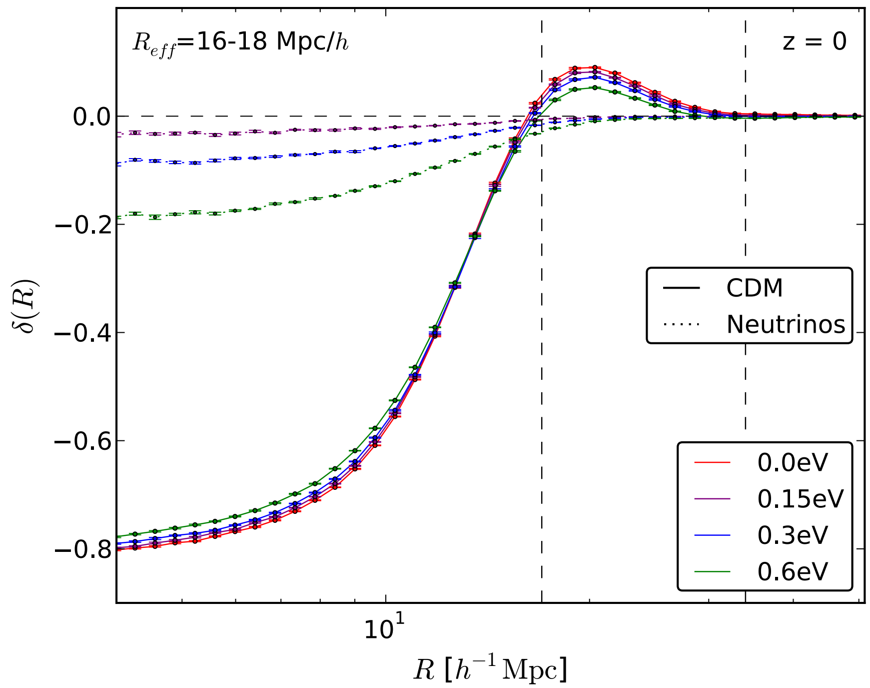
Modelling the Large Scale Structure in massive neutrino cosmologies

Elena Massara
SISSA - Trieste - Italy

Supervisors: Ravi Sheth, Matteo Viel
Collaborators: Paul M. Sutter, Francisco Villaescusa-Navarro



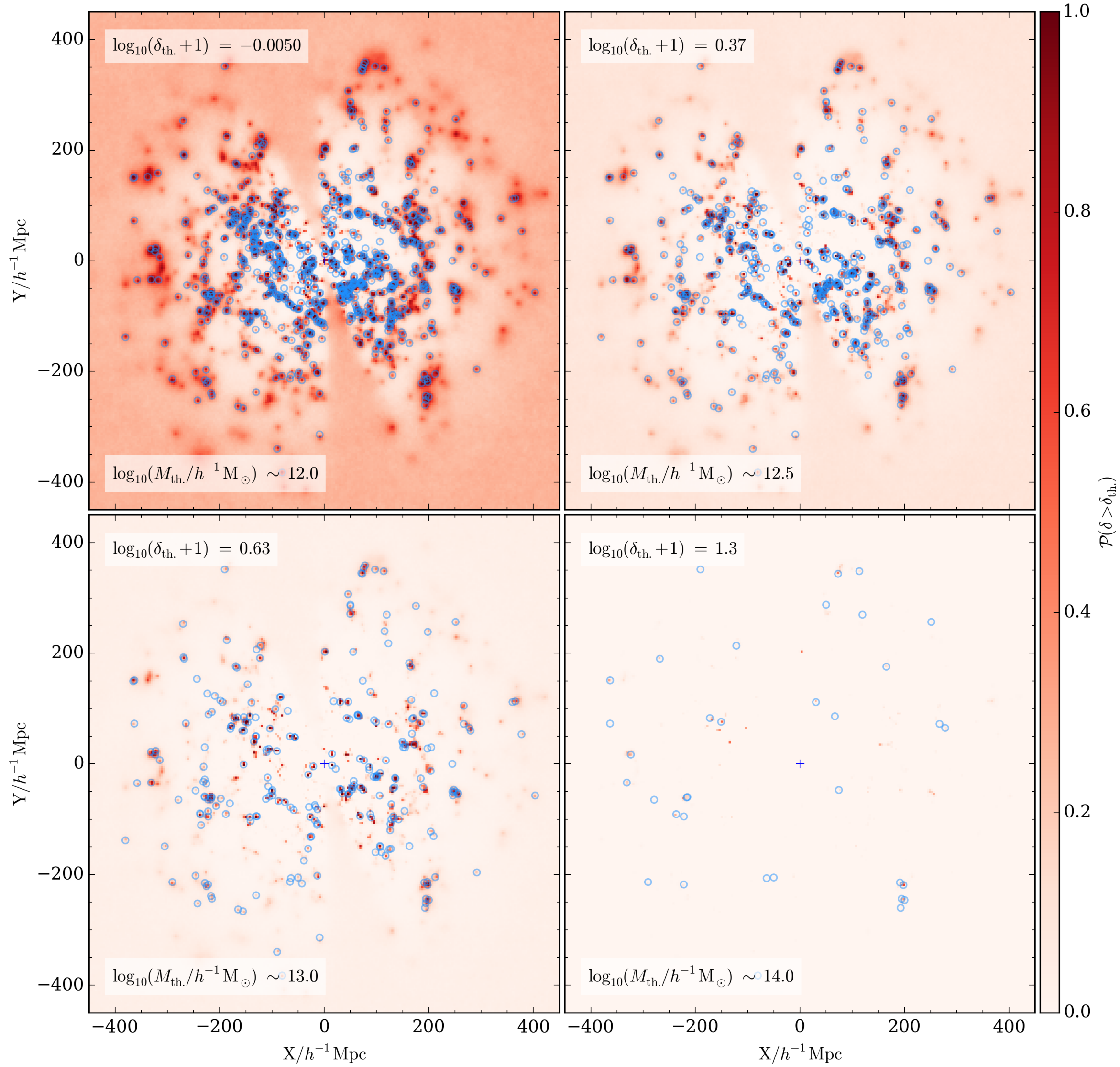
Halo detection via large-scale structure inference

Alexander Merson

(+ Jens Jasche, Filipe Abdalla, Ofer Lahav, Benjamin Wandelt, Heath Jones & Matthew Colless)

- Proof of concept of a Bayesian methodology for halo detection in galaxy survey data.

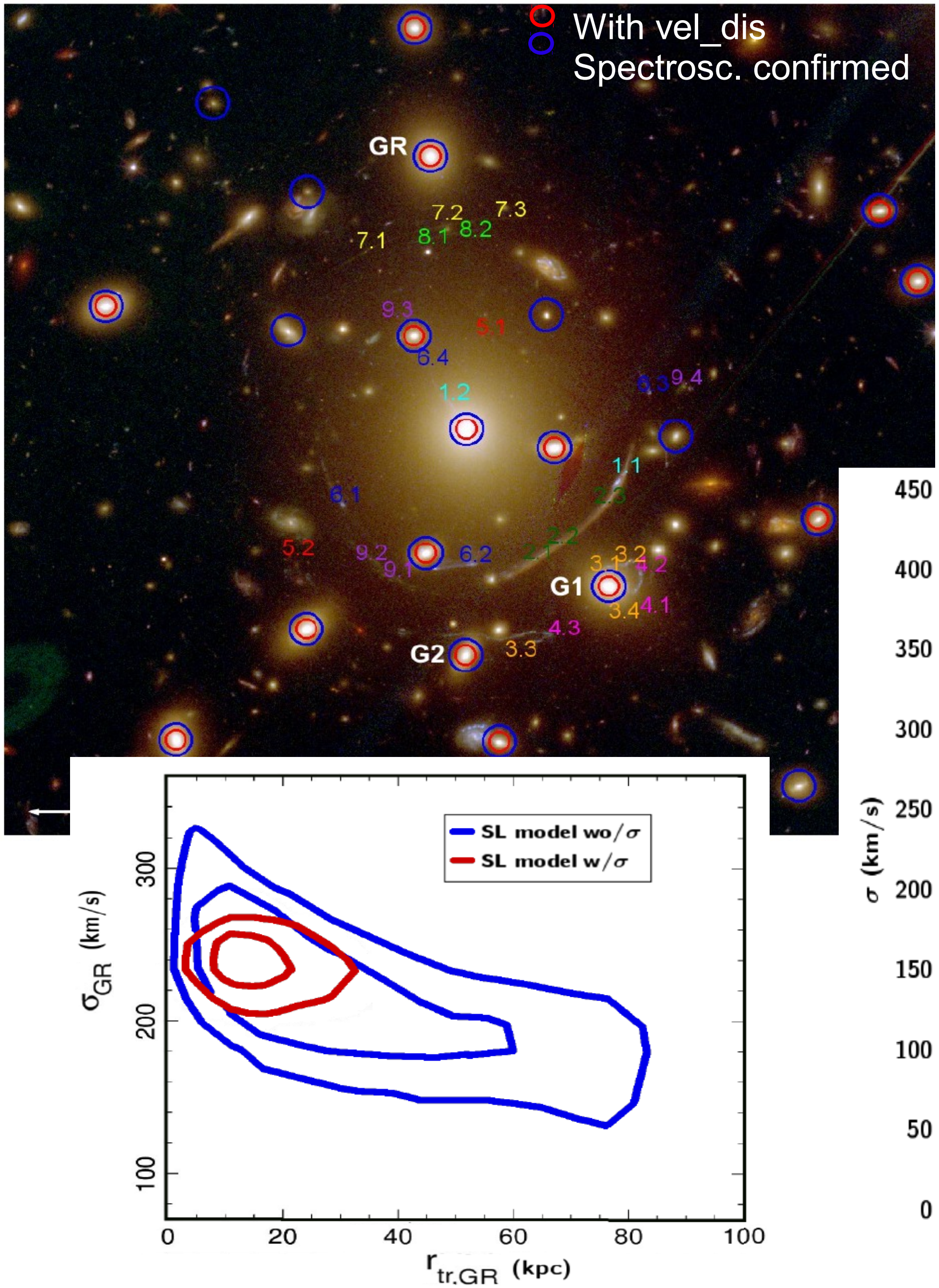
- Use large-scale structure inference algorithm (HADES) applied to semi-analytical galaxy mock catalogue to build maps of halo detection probability.



Submitted to MNRAS (arXiv:1505.03528)

UCL

Constraining the Galaxy mass content in cluster cores using Strong Lensing and velocity dispersion measurements



Monna A., Seitz S., Zitrin A. et al. 2015
(2015MNRAS.447.1224M)

Constraints on the Galaxy Scaling Relations