PRIN 2022: PANTHEON

Report: Sezione Sapienza

People:

- Alessandro Melchiorri (PO)
- Roberto Maoli (PA)
- Ruchika (Postdoc INFN)
- Matteo Forconi (PhD)
- Elisa Fazzari (PhD)
- Anna Chiara Ferri (PhD)
- Alessandro Vadalà (PhD)
- Chiara De Leo (PhD

Budget:

Disponibilità iniziale: 16584 euro.

Spese (Non Rendicontabili):

Conferenza Corfu (Elisa Fazzari): 584, 69 euro
GGI Neutrino (Matteo Forconi): 440 euro

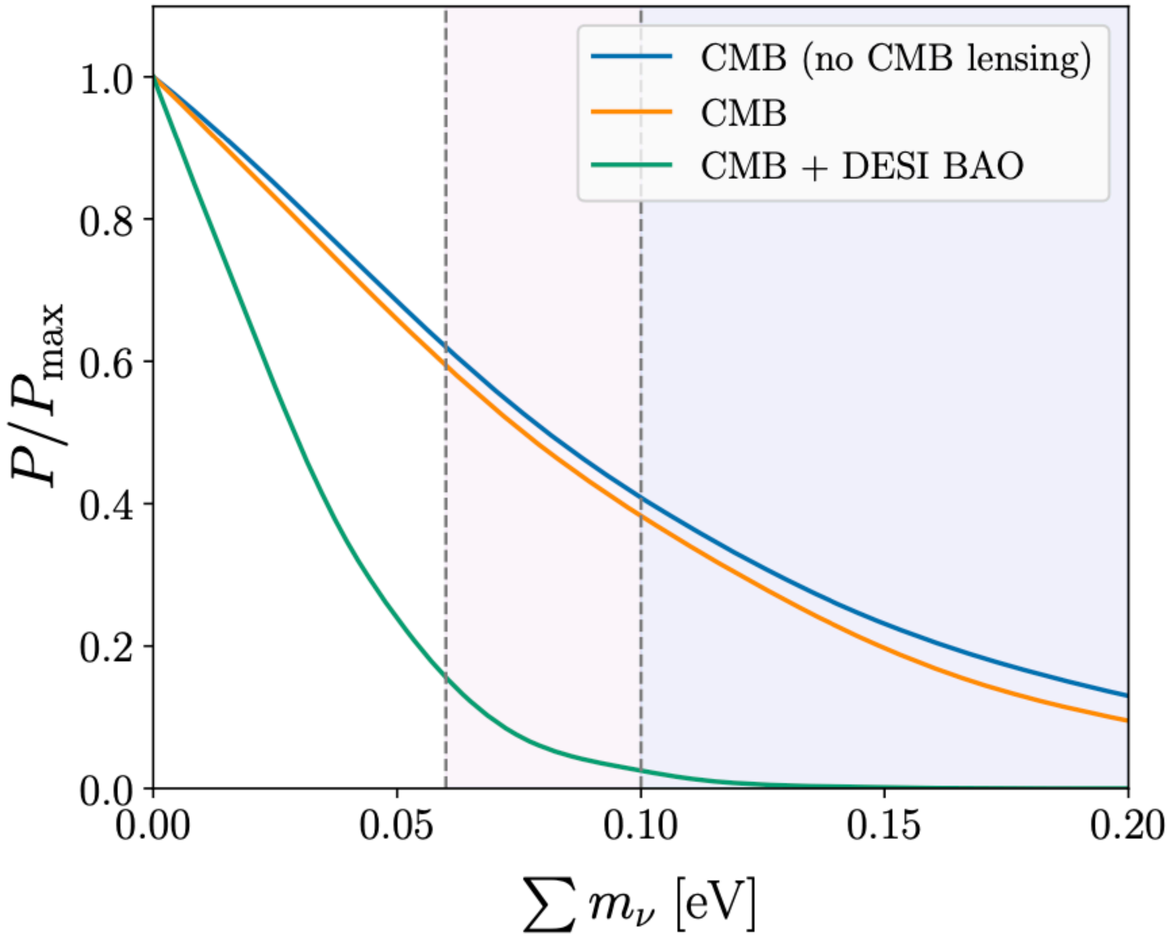
Published papers:

Measuring the reionization optical depth without large-scale CMB polarization,
William Giarè, Eleonora Di Valentino, Alessandro Melchiorri,
Published in: Phys.Rev.D 109 (2024) 10, 103519 • e-Print: 2312.06482

A double take on early and interacting dark energy from JWST ,
Matteo Forconi, William Giarè, Olga Mena, Ruchika ,et al.,
Published in: *JCAP* 05 (2024) 097 • e-Print: 2312.11074

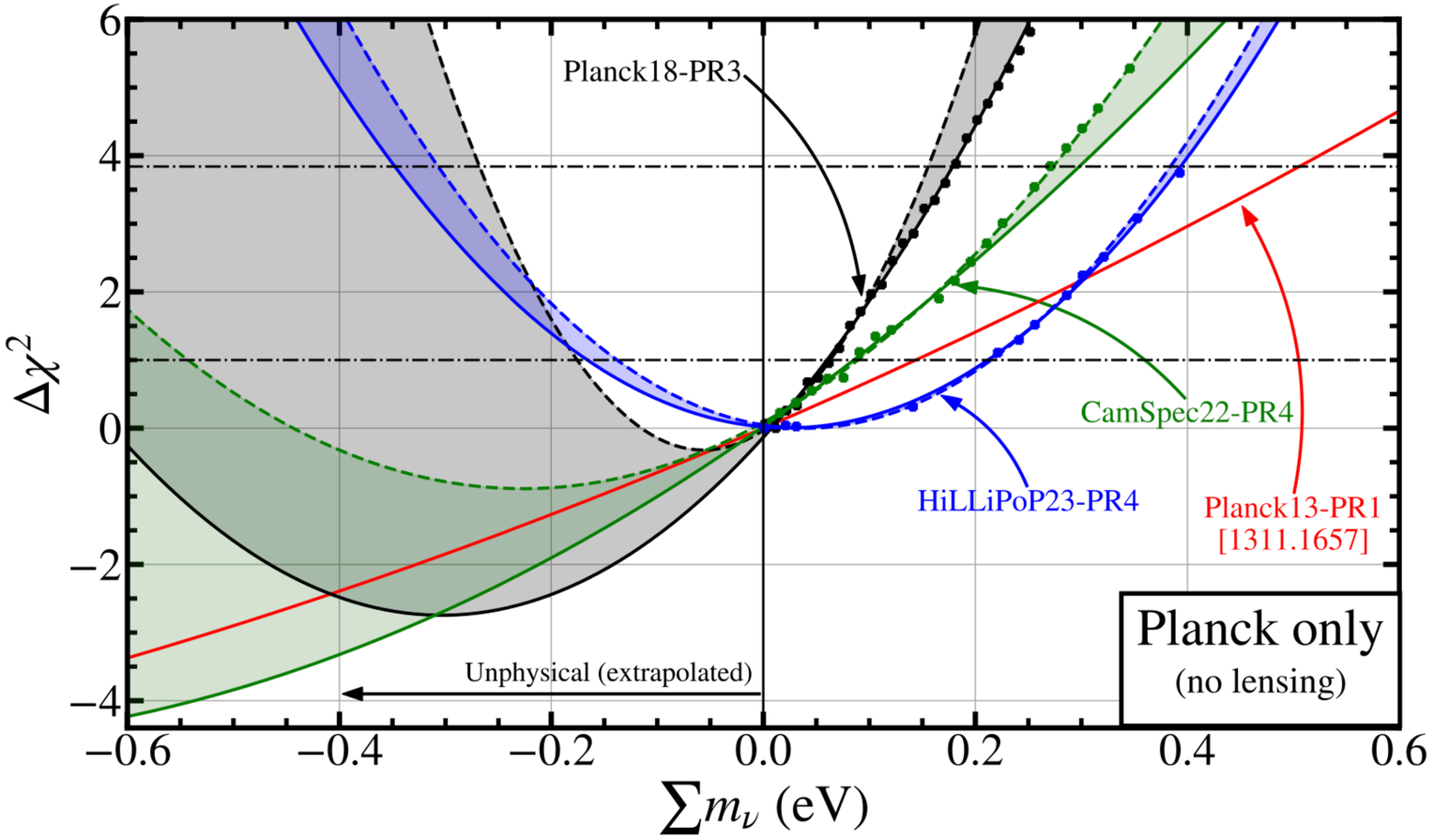
Forecast cosmological constraints from the number counts of Gravitational Waves events,
Giovanni Antinozzi, Matteo Martinelli, Roberto Maoli,
Published in: *JCAP* 05 (2024) 017 • e-Print: 2312.12217

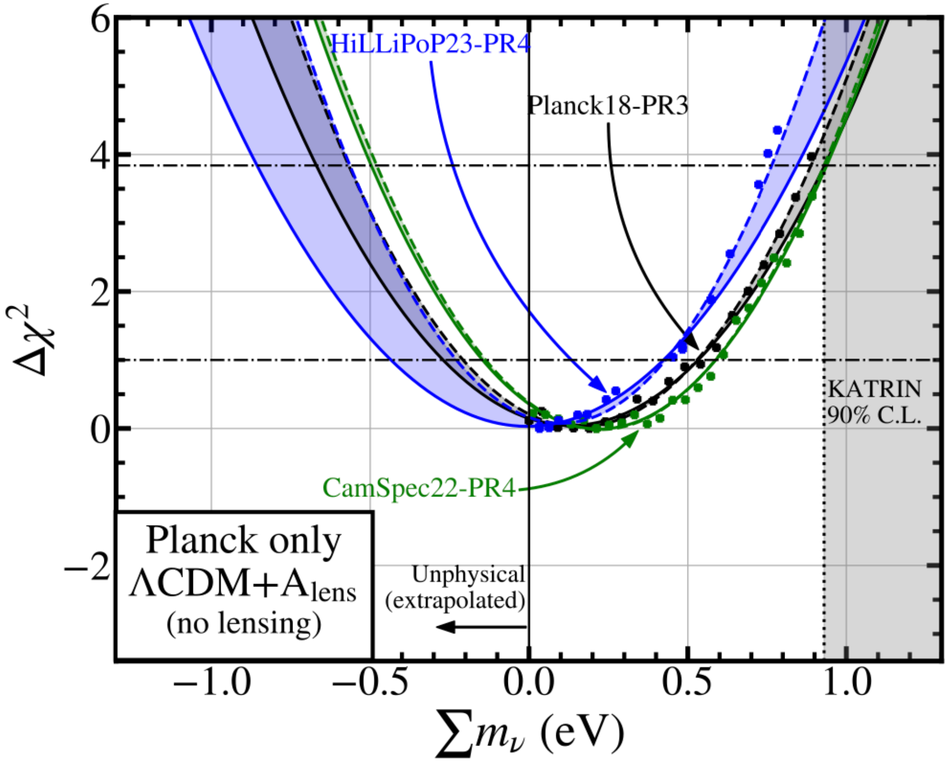
New result: BAO from DESI survey



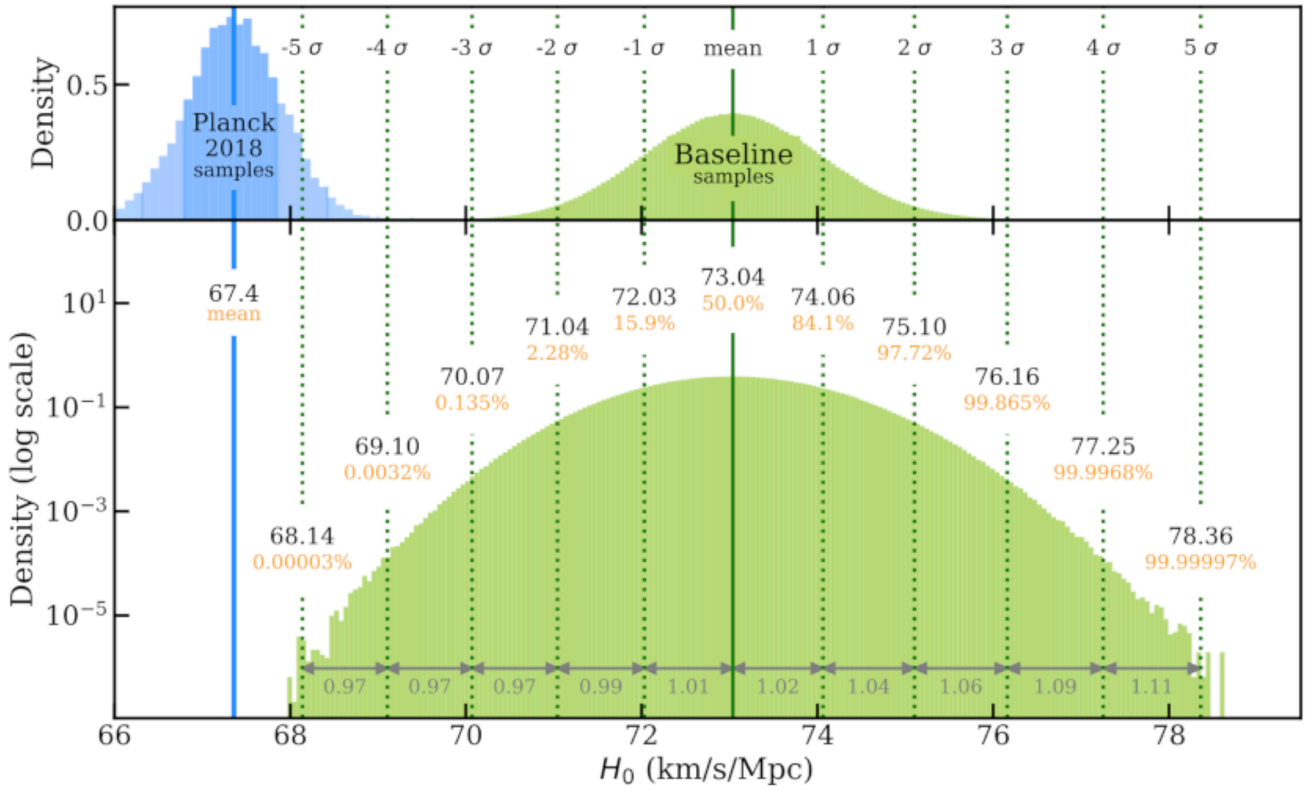
$$\sum m_\nu < 0.072\,\mathrm{eV} \quad (95\,\%,\ \mathrm{DESI\ BAO{+}CMB})$$

BAO+PLANCK gives negative nu mass ?!!??

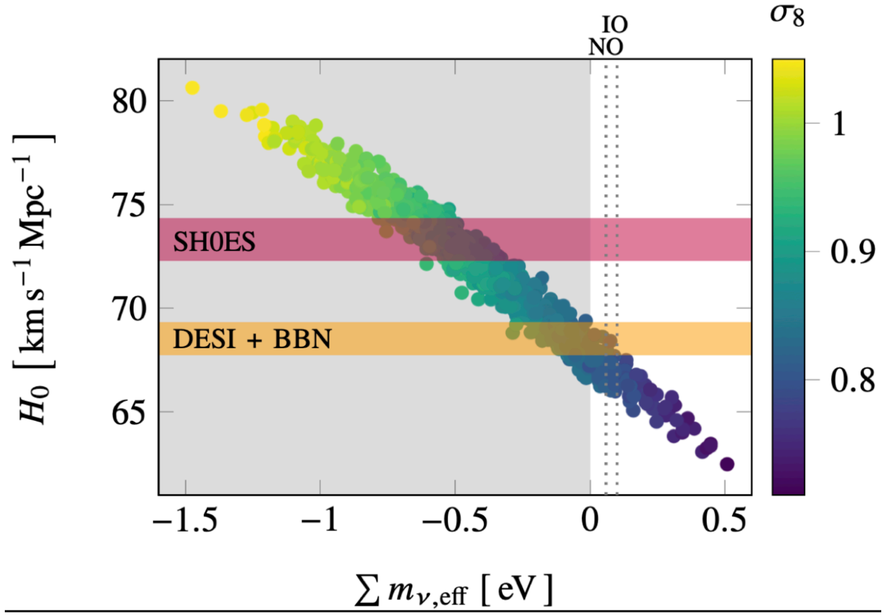




You can solve the Hubble tension with negative neutrino mass ?!!??



$$\sum m_{\nu,\mathrm{eff}} = -0.5 \pm 0.1\ \mathrm{eV}$$



But PLANCK+DESI+DESY5 gives dynamical dark energy

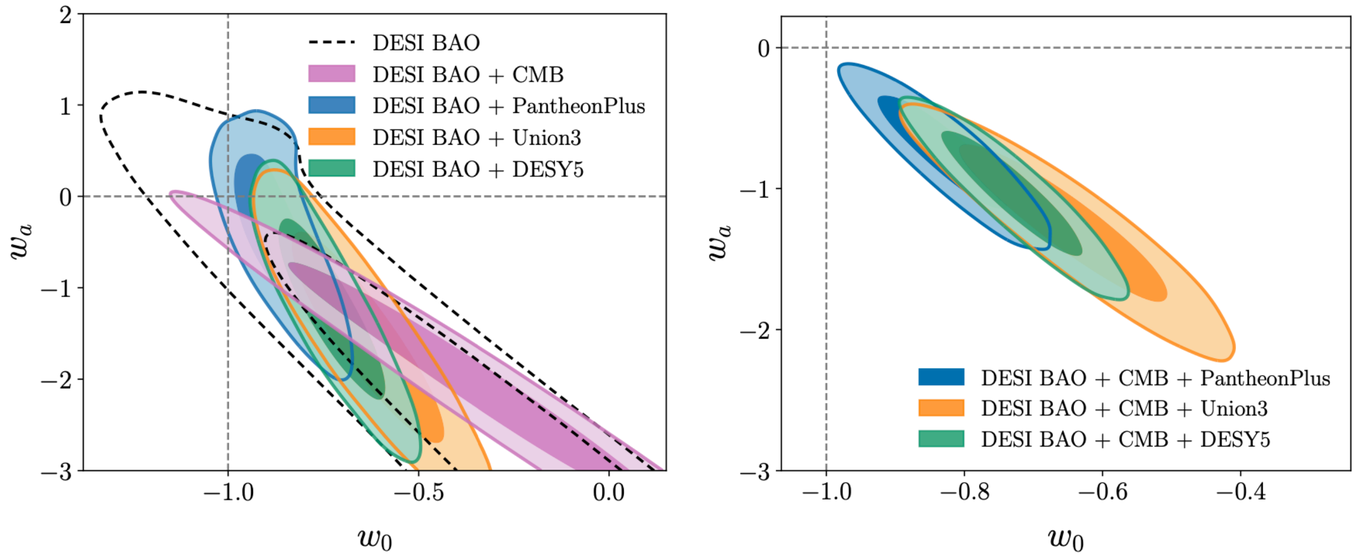
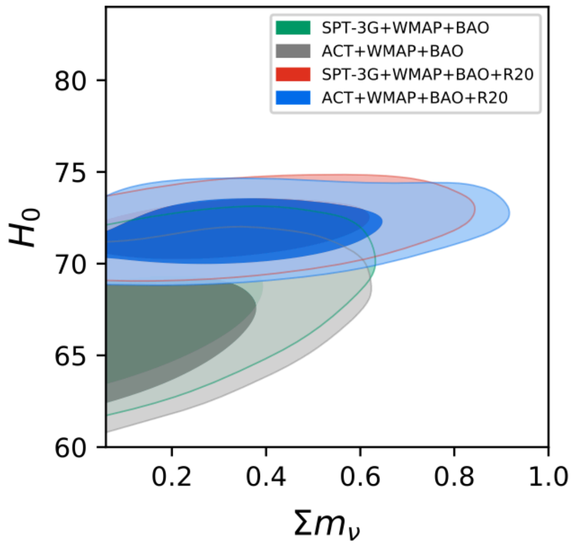


Figure 6. *Left panel*: 68% and 95% marginalized posterior constraints in the w_0–w_a plane for the flat w_0w_aCDM model, from DESI BAO alone (black dashed), DESI + CMB (pink), and DESI + SN Ia, for the PantheonPlus [24], Union3 [25] and DESY5 [26] SNIa datasets in blue, orange and green respectively. Each of these combinations favours $w_0 > -1$, $w_a < 0$, with several of them exhibiting mild discrepancies with ΛCDM at the $\gtrsim 2\sigma$ level. However, the full constraining power is not realised without combining all three probes. *Right panel*: the 68% and 95% marginalized posterior constraints from DESI BAO combined with CMB and each of the PantheonPlus, Union3 and DESY5 SN Ia datasets. The significance of the tension with ΛCDM ($w_0 = -1$, $w_a = 0$) estimated from the $\Delta\chi^2_{\rm MAP}$ values is 2.5σ, 3.5σ and 3.9σ for these three cases respectively.

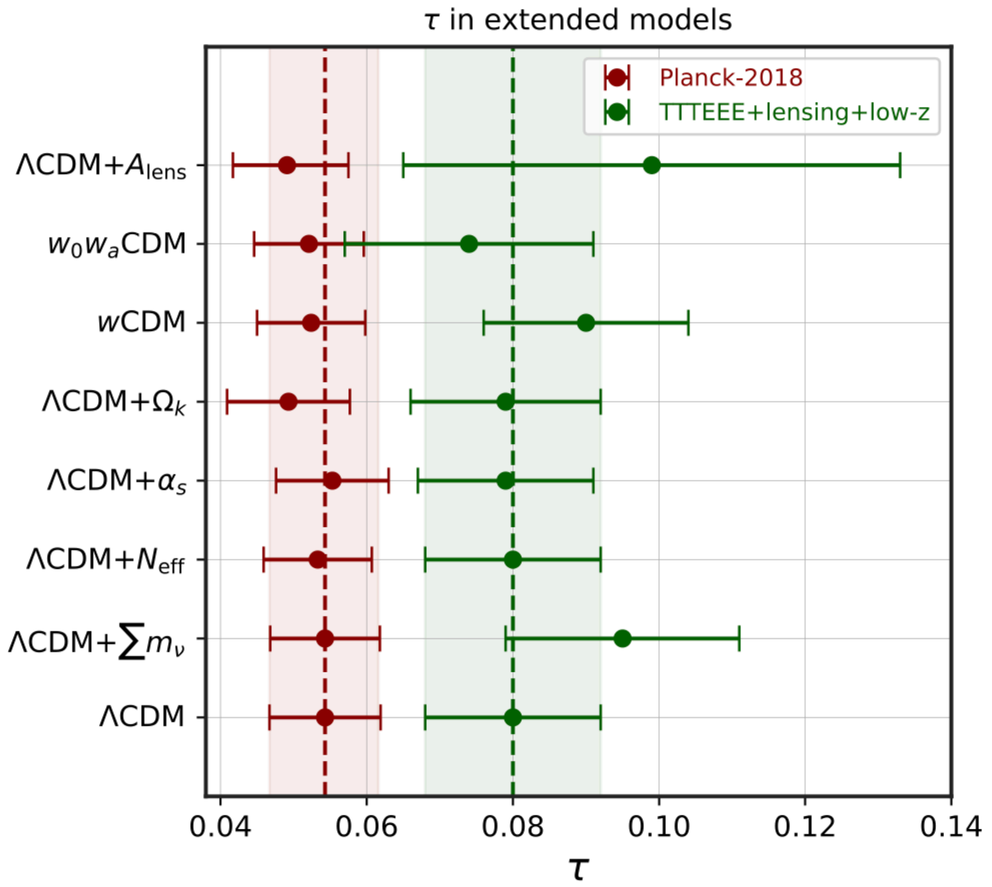
Removing Planck and LCDM can show hint for a ‘positive’ neutrino mass

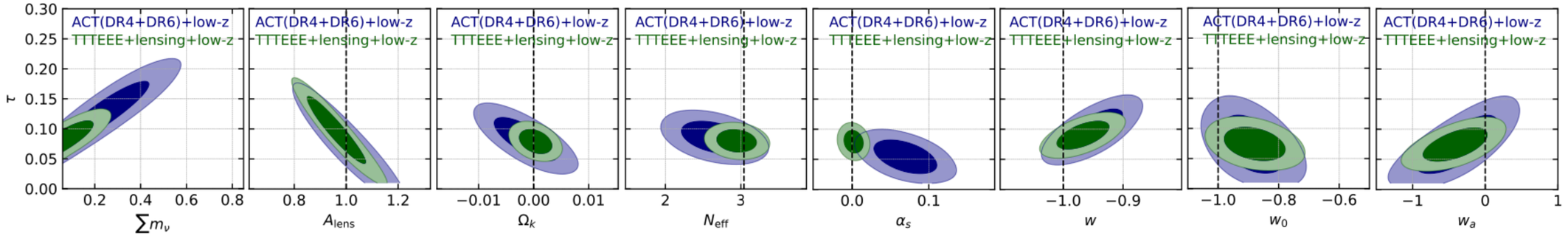
Dataset	Σm_ν [eV]
Planck ($+A_{\rm lens}$)	< 0.51
Planck+BAO ($+A_{\rm lens}$)	< 0.19
Planck+Pantheon ($+A_{\rm lens}$)	< 0.25
Planck+Lensing ($+A_{\rm lens}$)	$0.41^{+0.17}_{-0.25}$
ACT-DR4+WMAP	0.68 ± 0.31
ACT-DR4+WMAP+BAO	< 0.19
ACT-DR4+WMAP+Pantheon	< 0.25
ACT-DR4+WMAP+Lensing	0.60 ± 0.25
SPT-3G+WMAP	$0.46^{+0.14}_{-0.36}$
SPT-3G+WMAP+BAO	$0.22^{+0.056}_{-0.14}$
SPT-3G+WMAP+Pantheon	$0.25^{+0.052}_{-0.19}$
SPT-3G+WMAP+Lensing	< 0.37

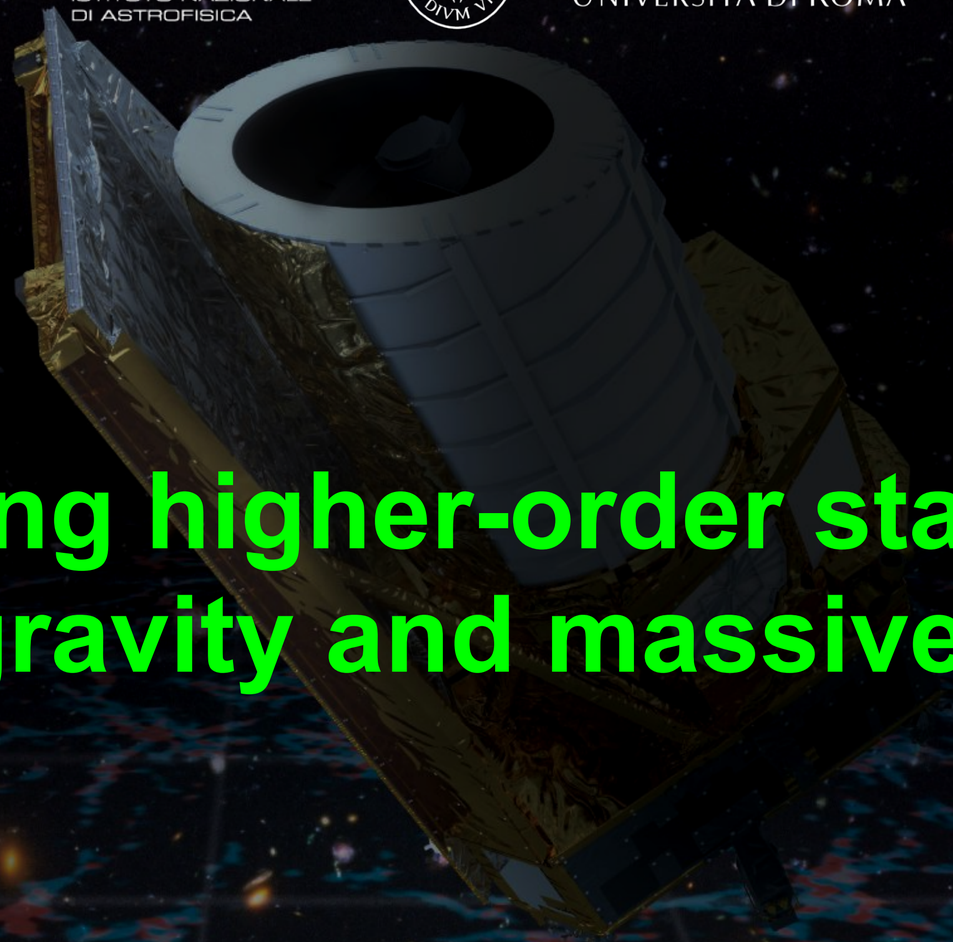
Dataset	Σm_ν [eV]
Planck ($+A_{\rm lens}$)	< 0.50
Planck+BAO ($+A_{\rm lens}$)	< 0.22
Planck+Pantheon ($+A_{\rm lens}$)	< 0.47
Planck+Lensing ($+A_{\rm lens}$)	$0.38^{+0.12}_{-0.28}$
ACT-DR4+WMAP	0.81 ± 0.28
ACT-DR4+WMAP+BAO	< 0.27
ACT-DR4+WMAP+Pantheon	0.71 ± 0.28
ACT-DR4+WMAP+Lensing	0.56 ± 0.21
ACT-DR4+WMAP+R20	0.83 ± 0.230
ACT-DR4+WMAP+F21	$0.85^{+0.27}_{-0.33}$
ACT-DR4+WMAP+BAO+R20	$0.39^{+0.13}_{-0.25}$
ACT-DR4+WMAP+BAO+F21	< 0.34
SPT-3G+WMAP	< 0.56
SPT-3G+WMAP+BAO	< 0.28
SPT-3G+WMAP+Pantheon	$0.46^{+0.11}_{-0.39}$
SPT-3G+WMAP+Lensing	< 0.39
SPT-3G+WMAP+R20	$0.49^{+0.12}_{-0.42}$
SPT-3G+WMAP+F21	< 0.60
SPT-3G+WMAP+BAO+R20	$0.37^{+0.13}_{-0.25}$
SPT-3G+WMAP+BAO+F21	< 0.32



Is the optical depth from Planck low l polarisation correct?







Weak lensing higher-order statistics with modified gravity and massive neutrinos

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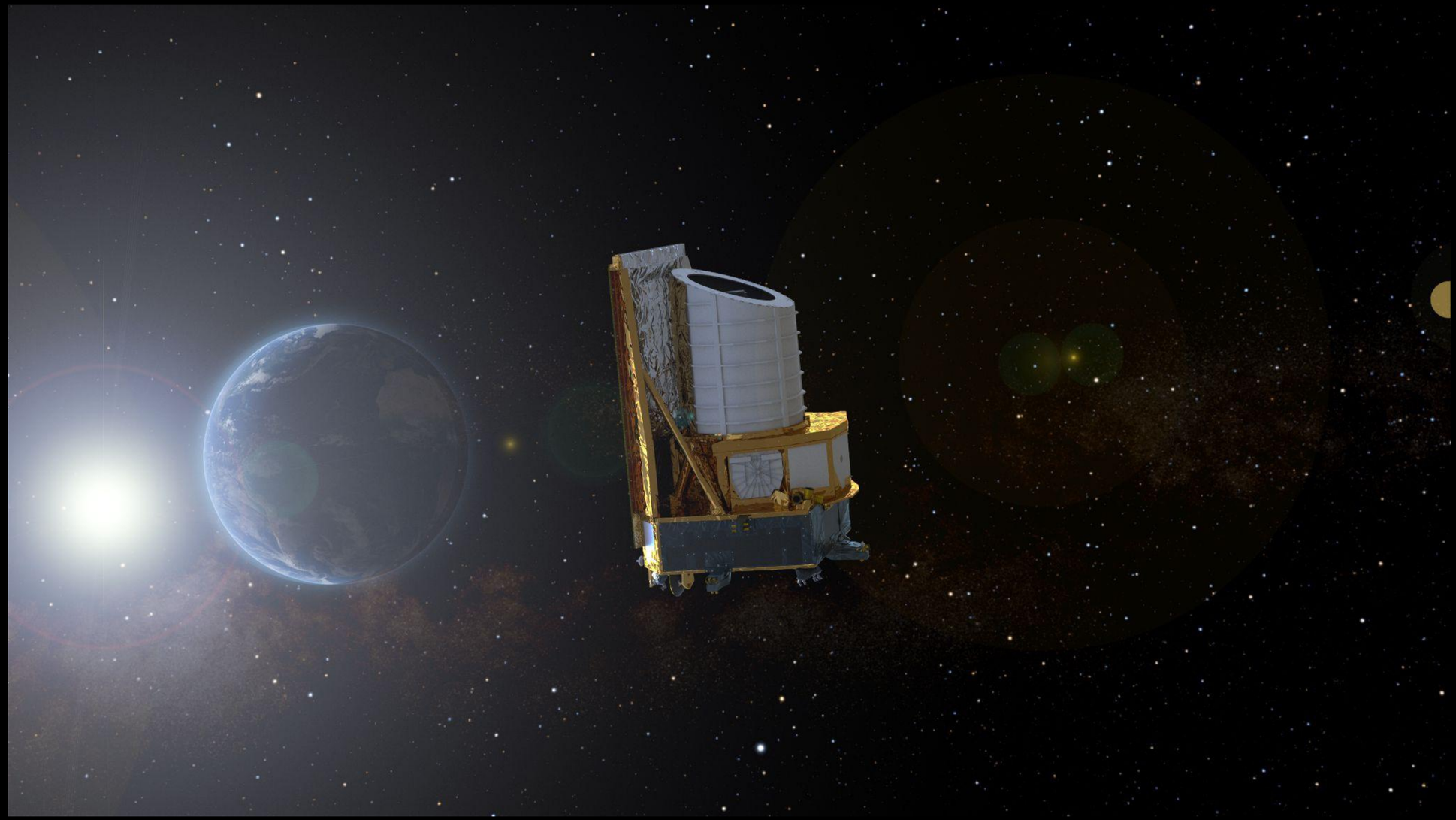
ESA Euclid



[ESA/Euclid]

July 1st, 2023
⅓ Sky

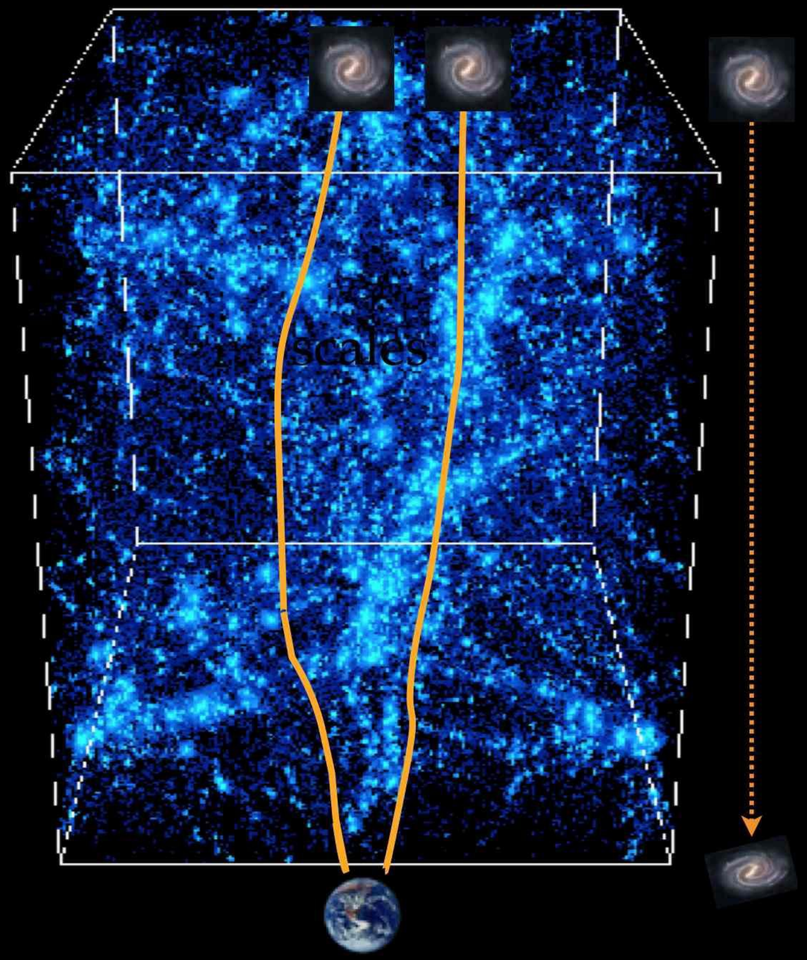
- **Dark Energy**
  Dark Matter

➔ **Weak lensing**
➔ Galaxy clustering

[arXiv:2405.13491]

Weak gravitational lensing

[CEA]

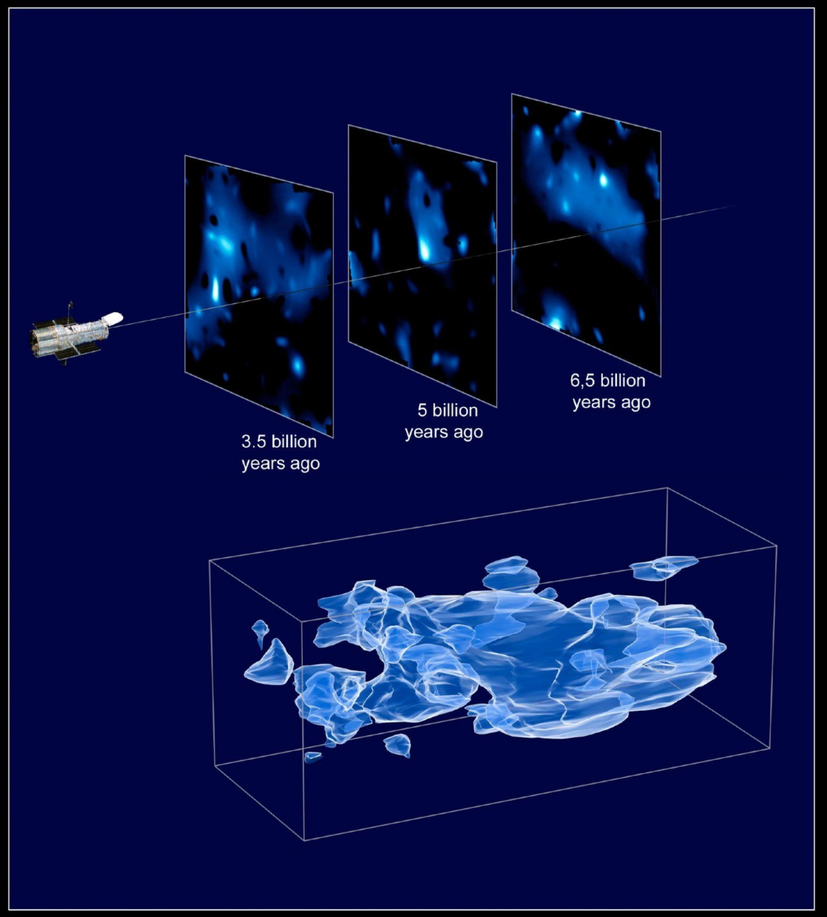


$$\gamma_1 = \frac{1}{2}(\partial_1^2 - \partial_2^2)\psi$$

$$\gamma_2 = \partial_1 \partial_2 \psi$$

$$\kappa = \frac{1}{2}(\partial_1^2 + \partial_2^2)\psi$$

[ESA/Euclid]



Cosmic shear
(coherent deformation)

Convergence maps
(projected mass)

Why? Discriminate between **ΛCDM** and alternative models

What? $f(R)$ Hu & Sawicki gravity (DUSTGRAIN simulations)

[arXiv:0705.1158] [arXiv:1806.04681]

How? **Convergence** higher-order statistics:
higher-order moments, topological estimators, 1PDF, peak statistics

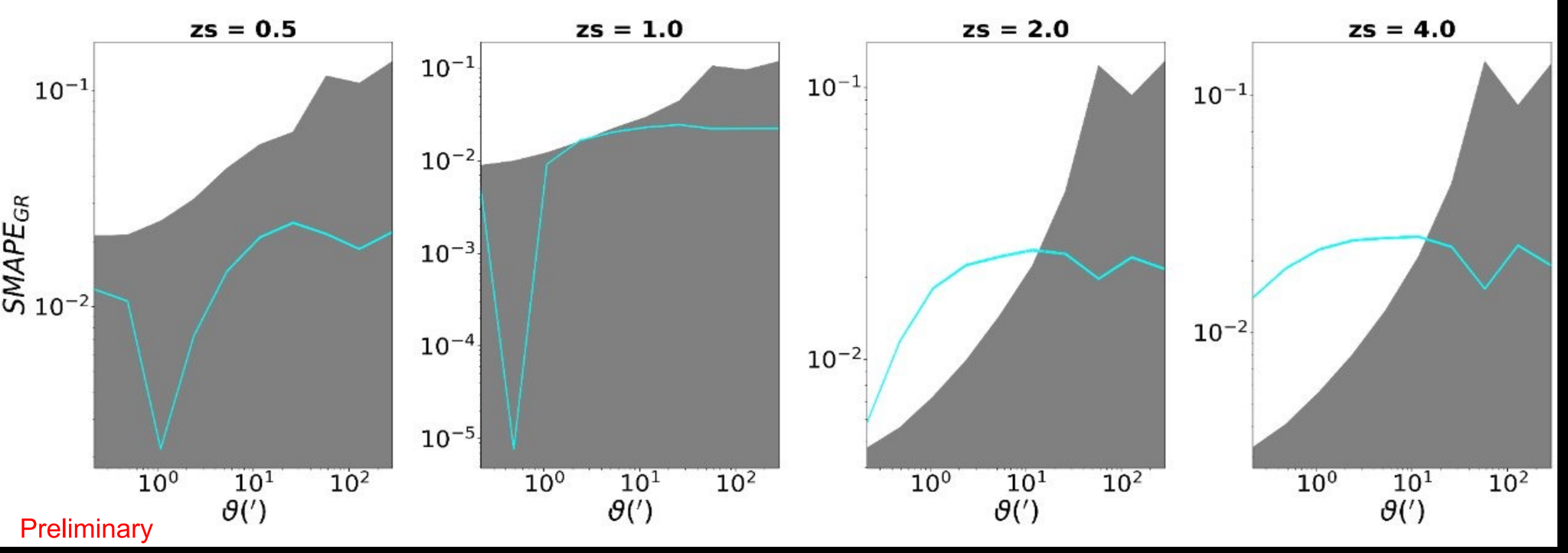
[arXiv:2301.12890]

$$f(R) = -m^2 \frac{c_1 \left(\frac{R}{m^2}\right)^n}{c_2 \left(\frac{R}{m^2}\right)^n + 1} \qquad f_R = \mathrm{d}f/\mathrm{d}R$$

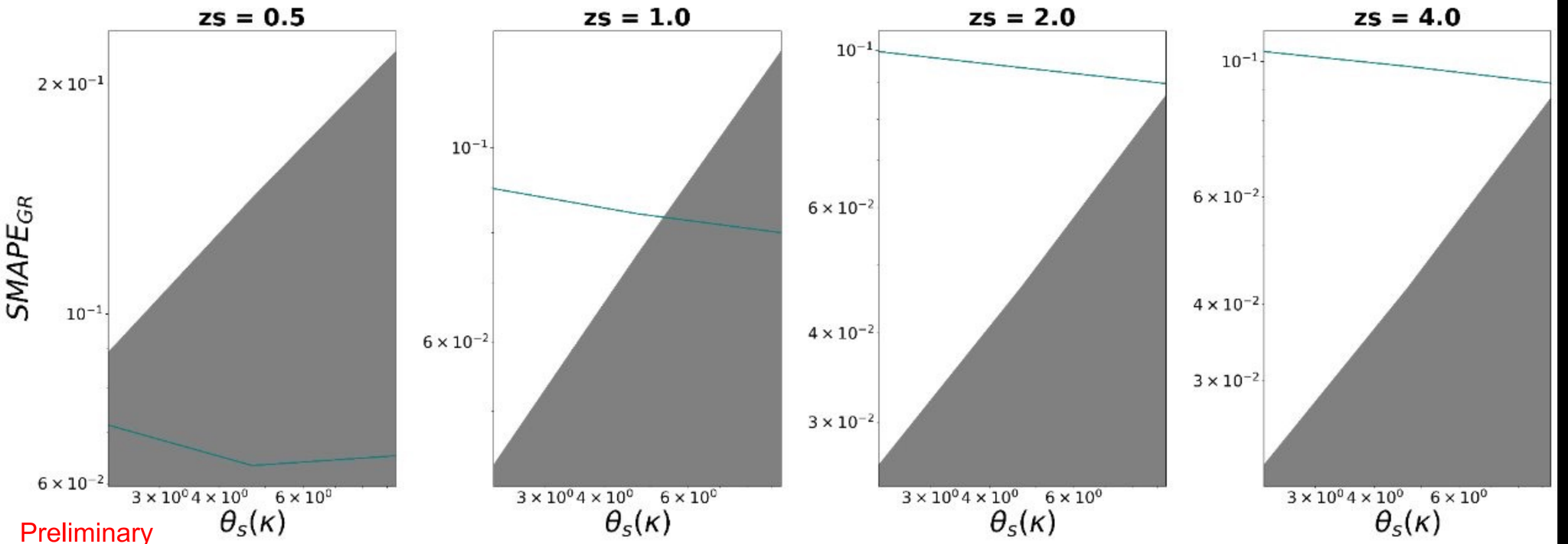
MG effects in one parameter

$$f_{R0} \longleftrightarrow m_\nu = \sum_i m_{\nu,i}$$

enhancement structure formation — **high degeneracy** — suppression structure formation



Preliminary



Preliminary

2PCF

Reference cosmology

$$f_{R0} = 10^{-6}$$

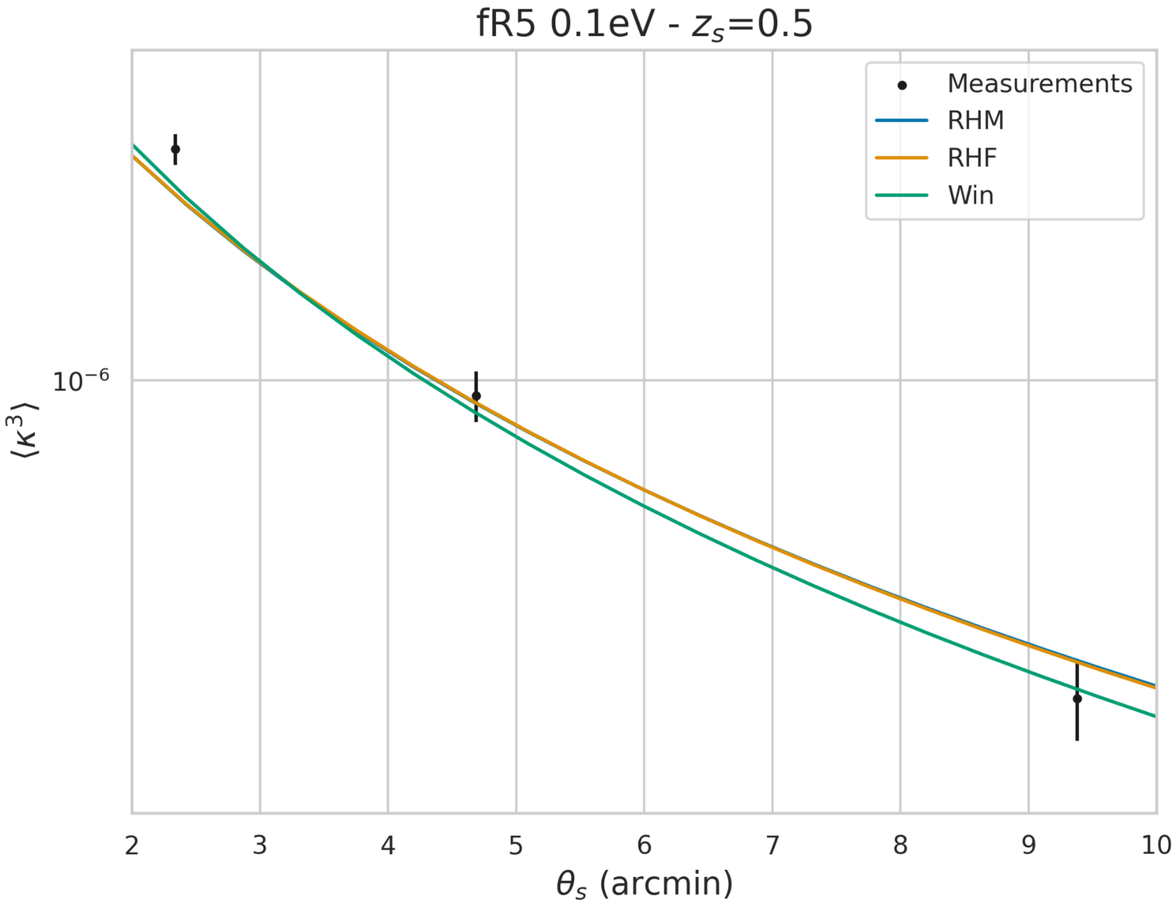
$$m_\nu = 0.1\,\mathrm{eV}$$

HOS better at distinguishing models

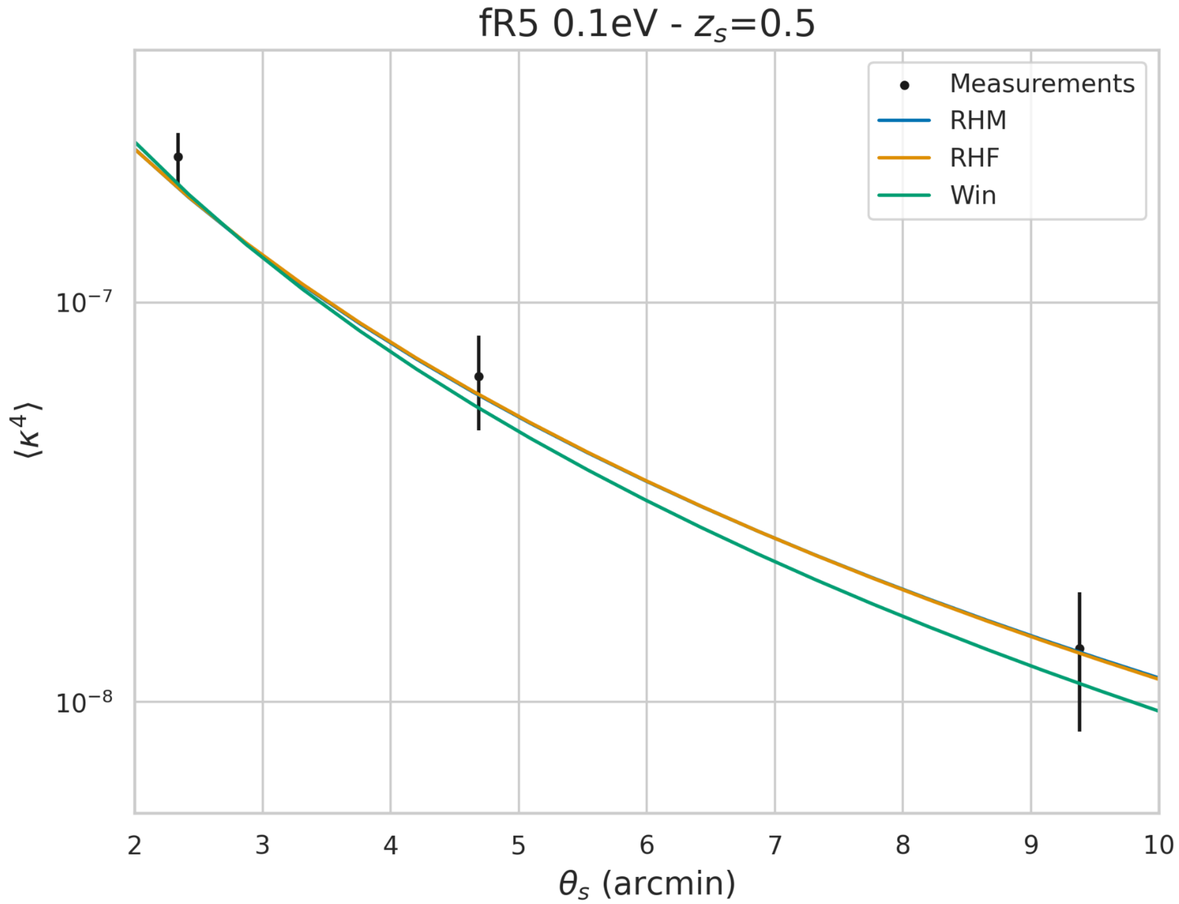
3rd moment

Theory

Preliminary



Preliminary



Vadalà et al. [in prep]