

Synergistic cosmology across the spectrum

Stefano Camera

Department of Physics, Alma Felix University of Turin, Italy

An era of synergies



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Correlations 1.01

- Cosmological perturbations
[temperature anisotropies, density fluctuations...]

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- Correlation function $\xi_{ff}(t, |\mathbf{x} - \mathbf{y}|) = \langle f(t, \mathbf{x})f(t, \mathbf{y}) \rangle$
- Fourier-space power spectrum $\langle \hat{f}(t, \mathbf{k})\hat{f}^*(t, \mathbf{k}') \rangle = (2\pi)^3 \delta_D(\mathbf{k} - \mathbf{k}') P_{ff}(k)$

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- Cosmological perturbations $f(t, \mathbf{x}), g(t, \mathbf{x})$
[temperature anisotropies, density fluctuations...]

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1. Cross-correlate the same observable measured by two different instruments
2. Cross-correlate two different observables tracing the same cosmological field



1.

**Cross-correlate the same
observable measured by
two different instruments**

Multi-wavelength shear

- Weak lensing
cosmic shear



DARK ENERGY
SURVEY

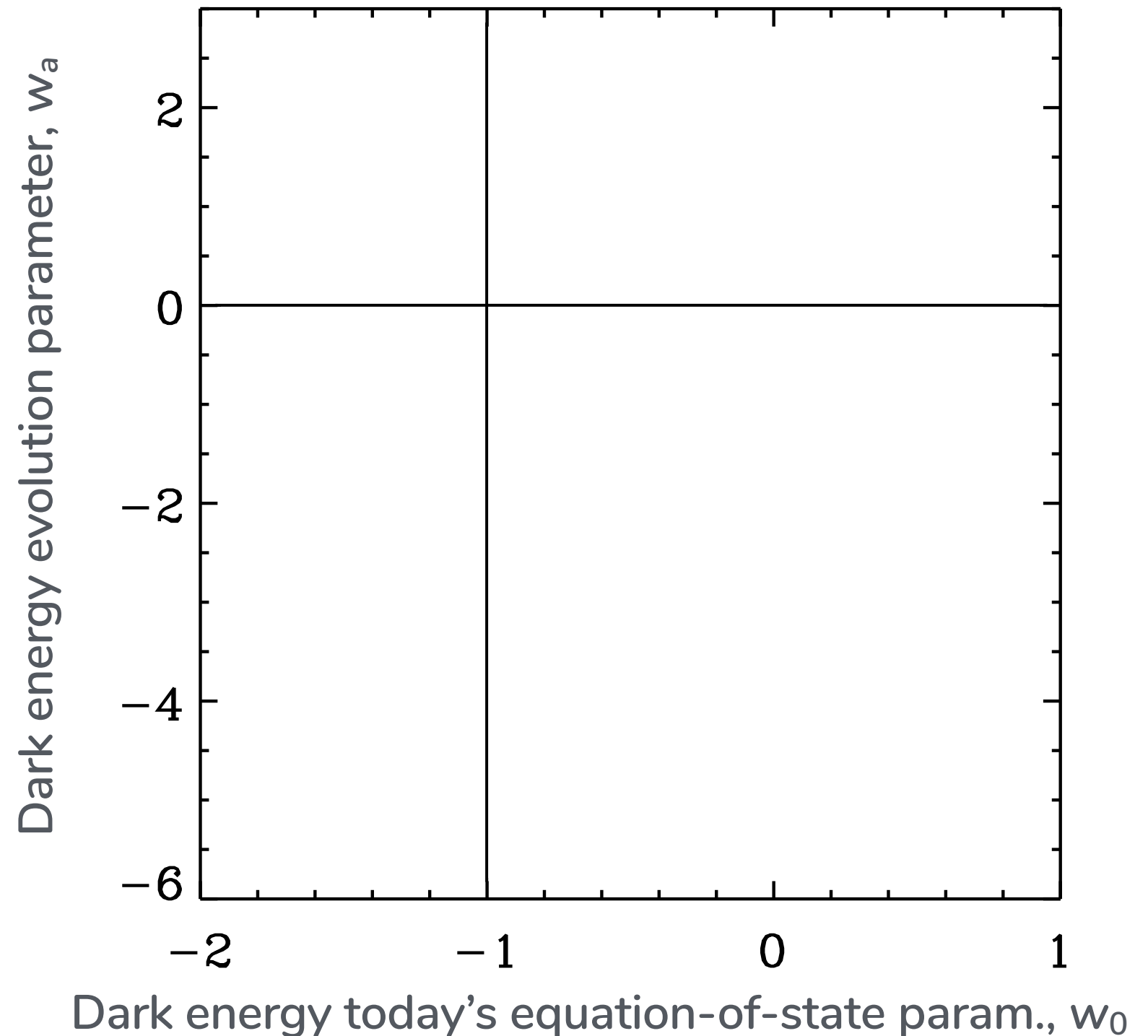


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[SC et al. 2017]

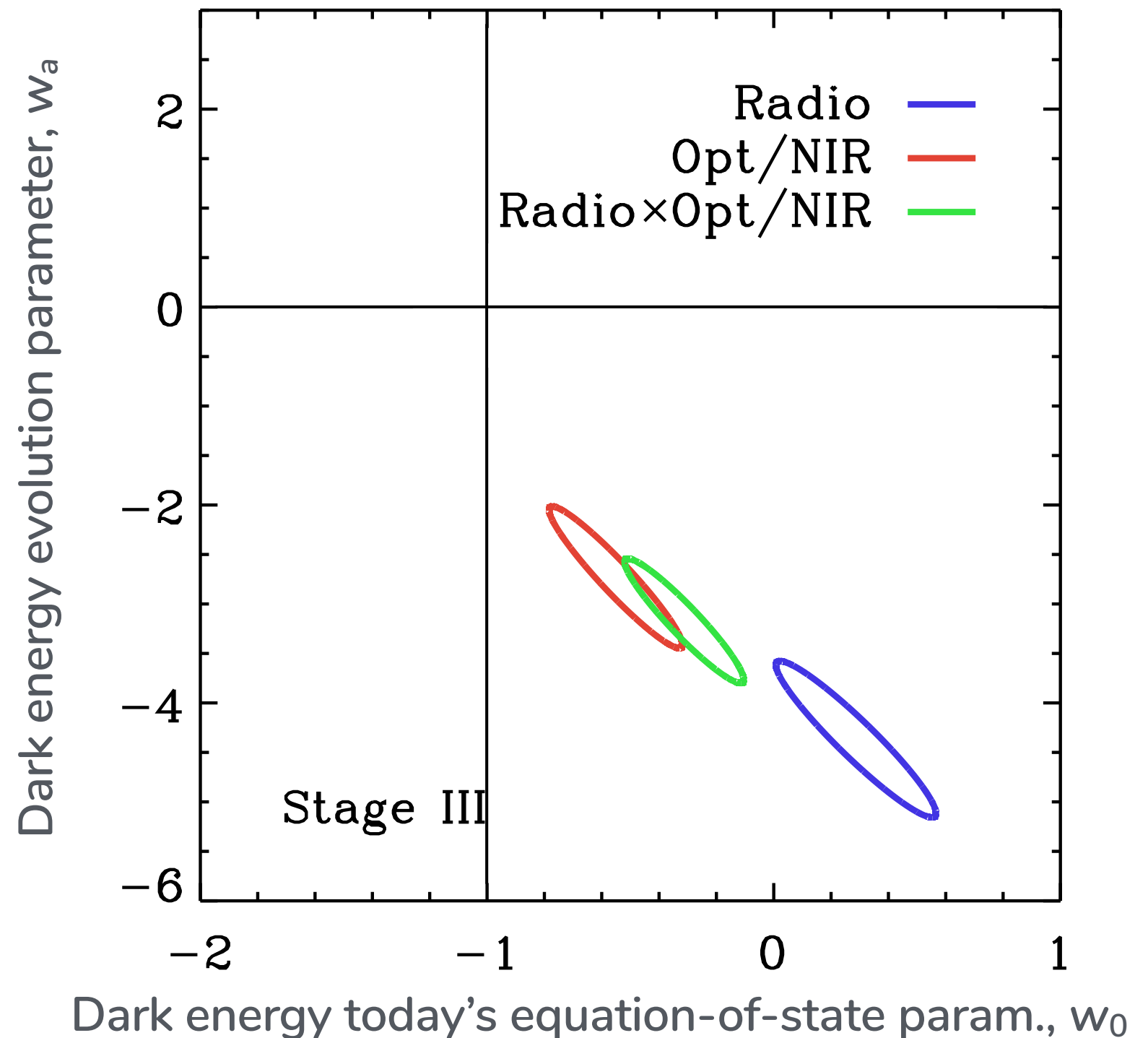


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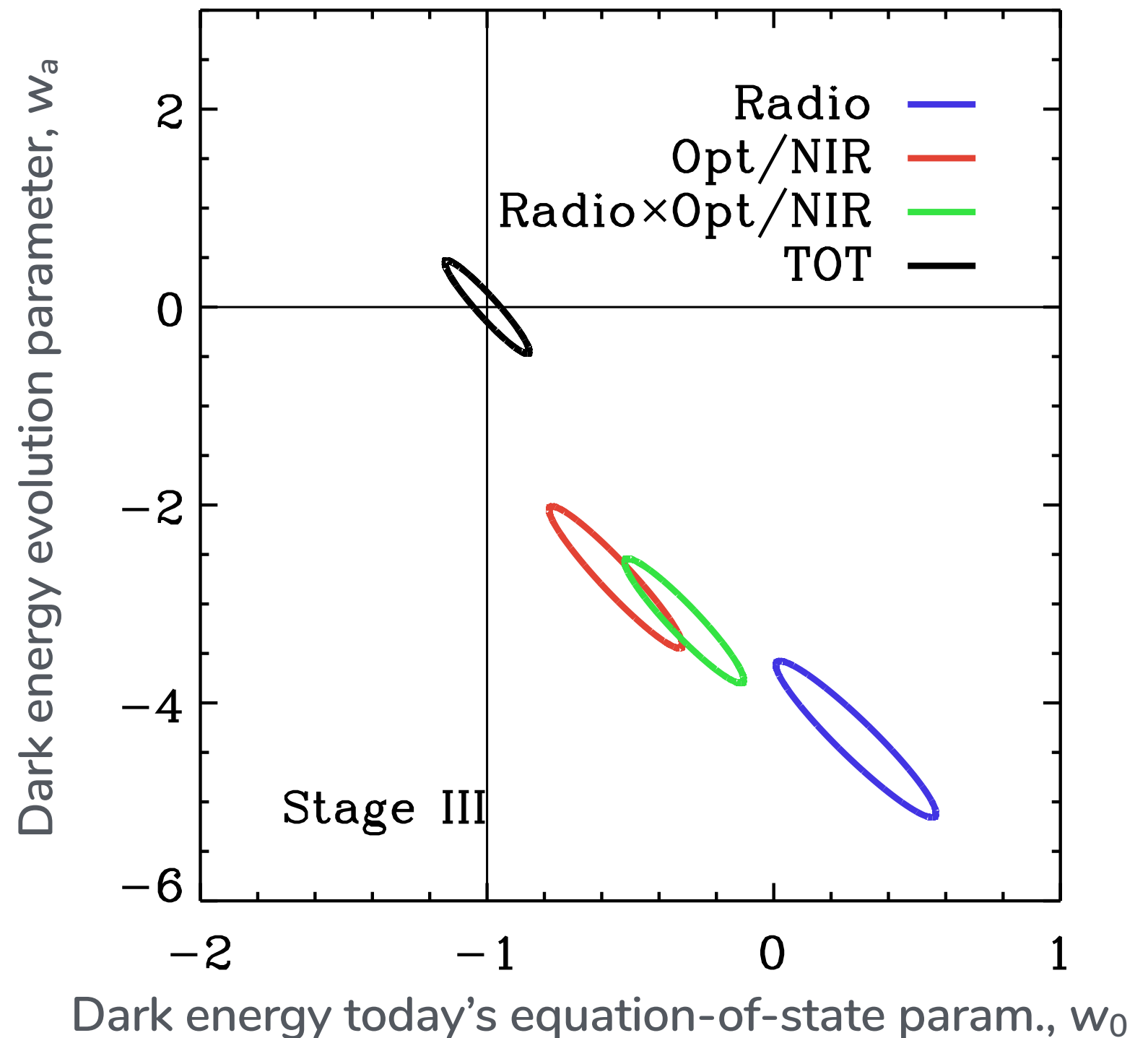


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2.

Cross-correlate two different observables tracing the same cosmological field

Multi-tracer clustering



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- Comparing the relative clustering of different tracers

**[Seljak, PRL 2009;
Seljak & McDonald 2009]**



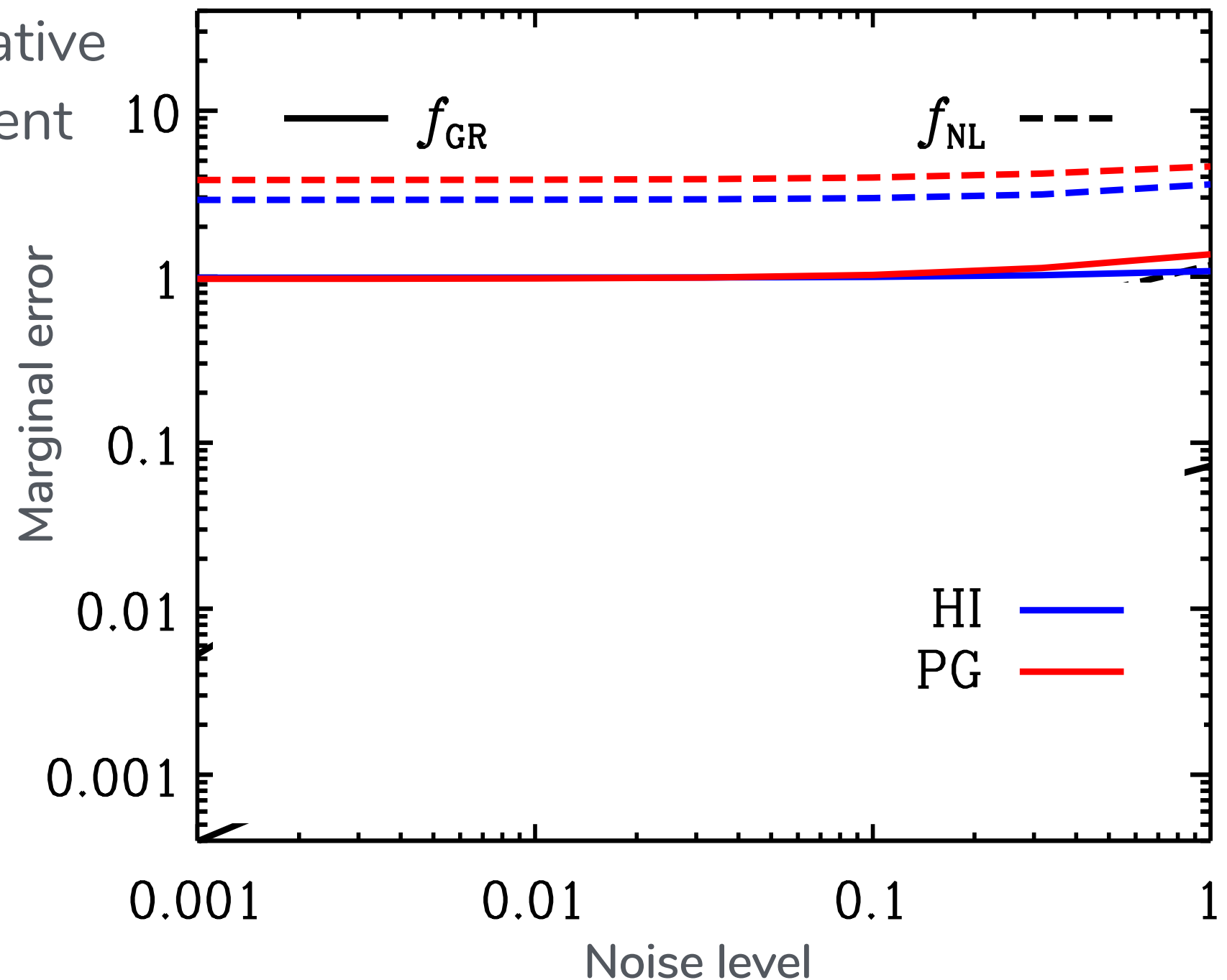
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[Fonseca, SC, Santos & Maartens ApJL 2015]



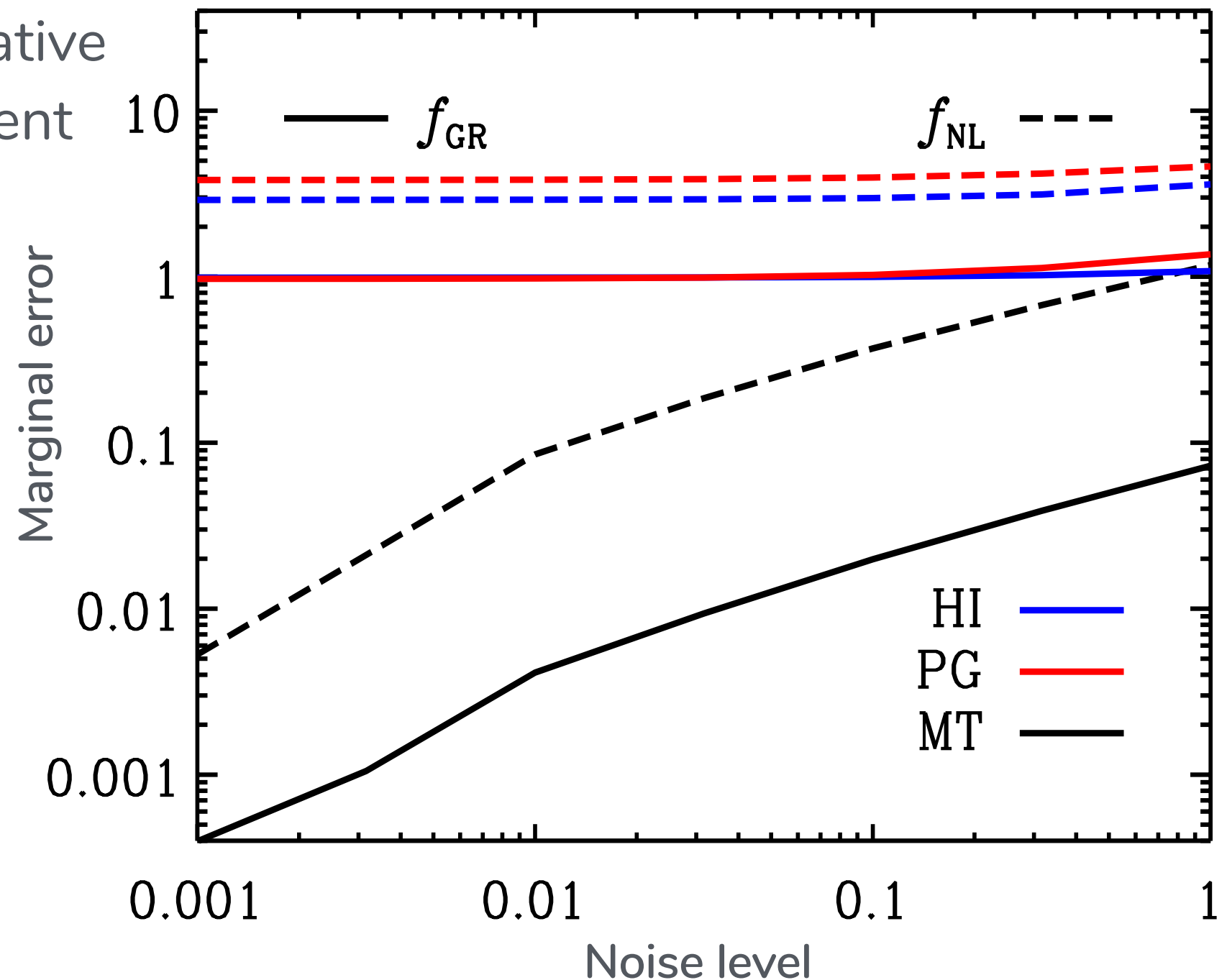
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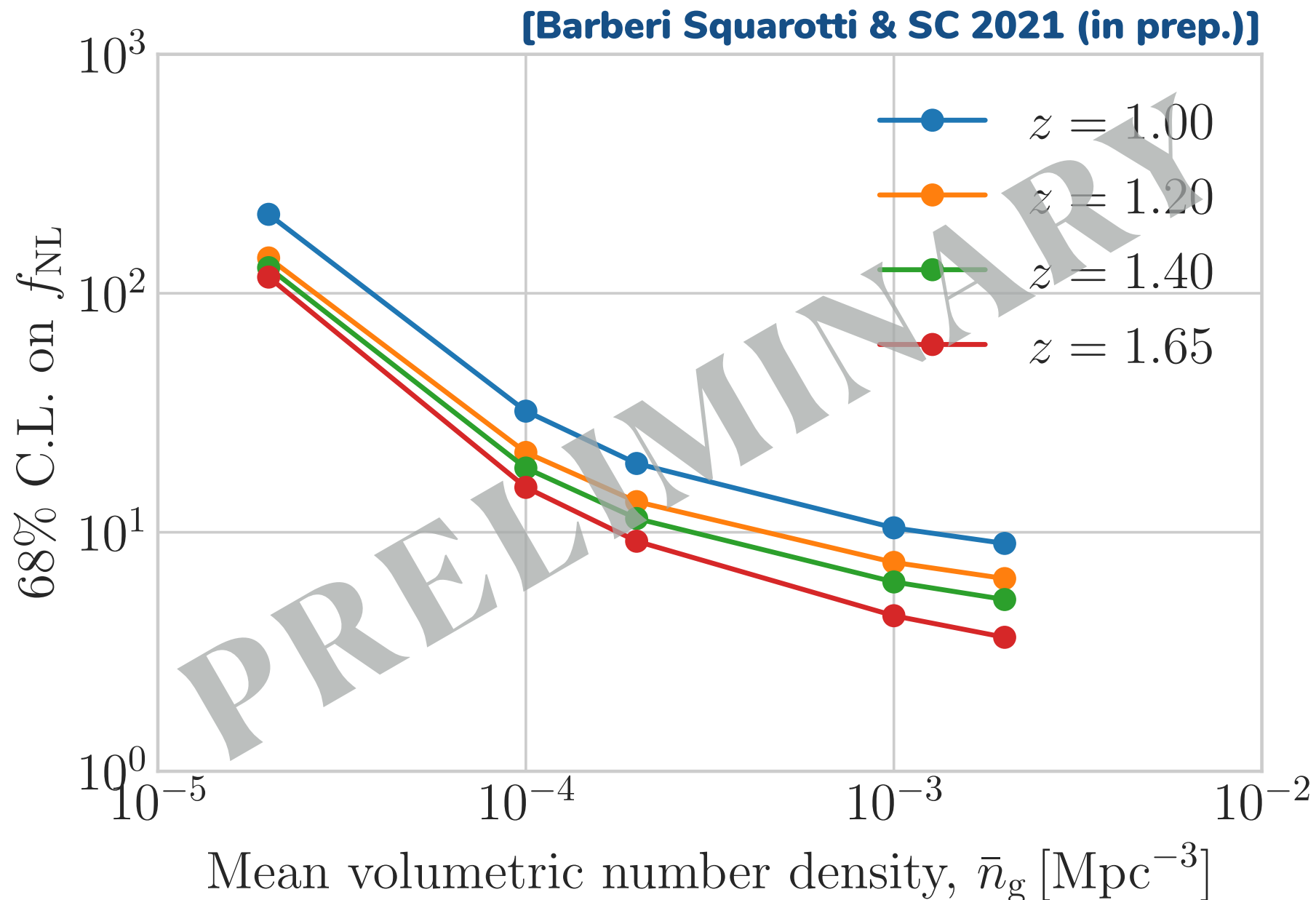


[Fonseca, SC, Santos & Maartens ApJL 2015]



Multi-tracer clustering

- Marginal forecast errors on f_{NL} (factorising $\sqrt{f_{\text{sky}}}$)



Take-home message

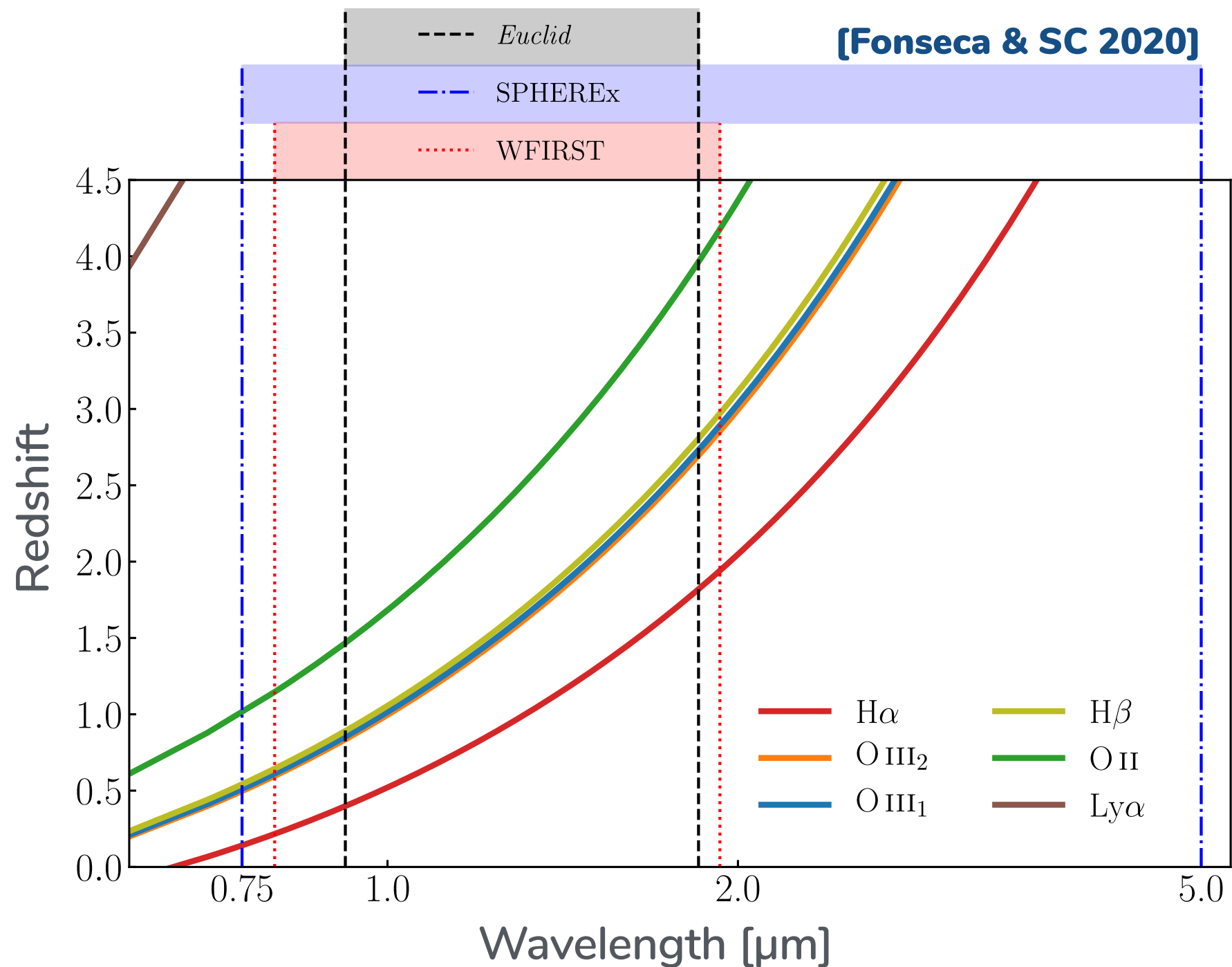
- The era of **synergies** among cosmological observables is nigh!
- Cross-correlations are going to be crucial for not only **precise** but also **accurate** cosmology
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- Pushing to **higher redshift** exploiting **oxygen-line galaxies**
[Fonseca & SC 2020]

ELGs in *Euclid* and *Roman*

- H-alpha [656.5 nm]
- OIII₂ [500.7 nm]
OIII₁ [495.9 nm]
- H-beta [486.1 nm]
- OII [372.7/9 nm]



ELGs in *Euclid* and *Roman*

- O lines (+others) well known **contaminants** for H-alpha:
 - 0.15–0.3% interloper fraction could bias growth rate >10% of error
[Pullet et al. 2015]
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[Addison et al. 2019; Grasshorn-Gebhardt et al. 2019]

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- Can we turn **contaminants** into **signal**?

Monthly Notices
of the

ROYAL ASTRONOMICAL SOCIETY



MNRAS **495**, 1340–1348 (2020)
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doi:10.1093/mnras/staa1136

High-redshift cosmology with oxygen lines from H α surveys

José Fonseca ^{1,2}★ and Stefano Camera ^{3,4,5}★

Expected no. of O-galaxies

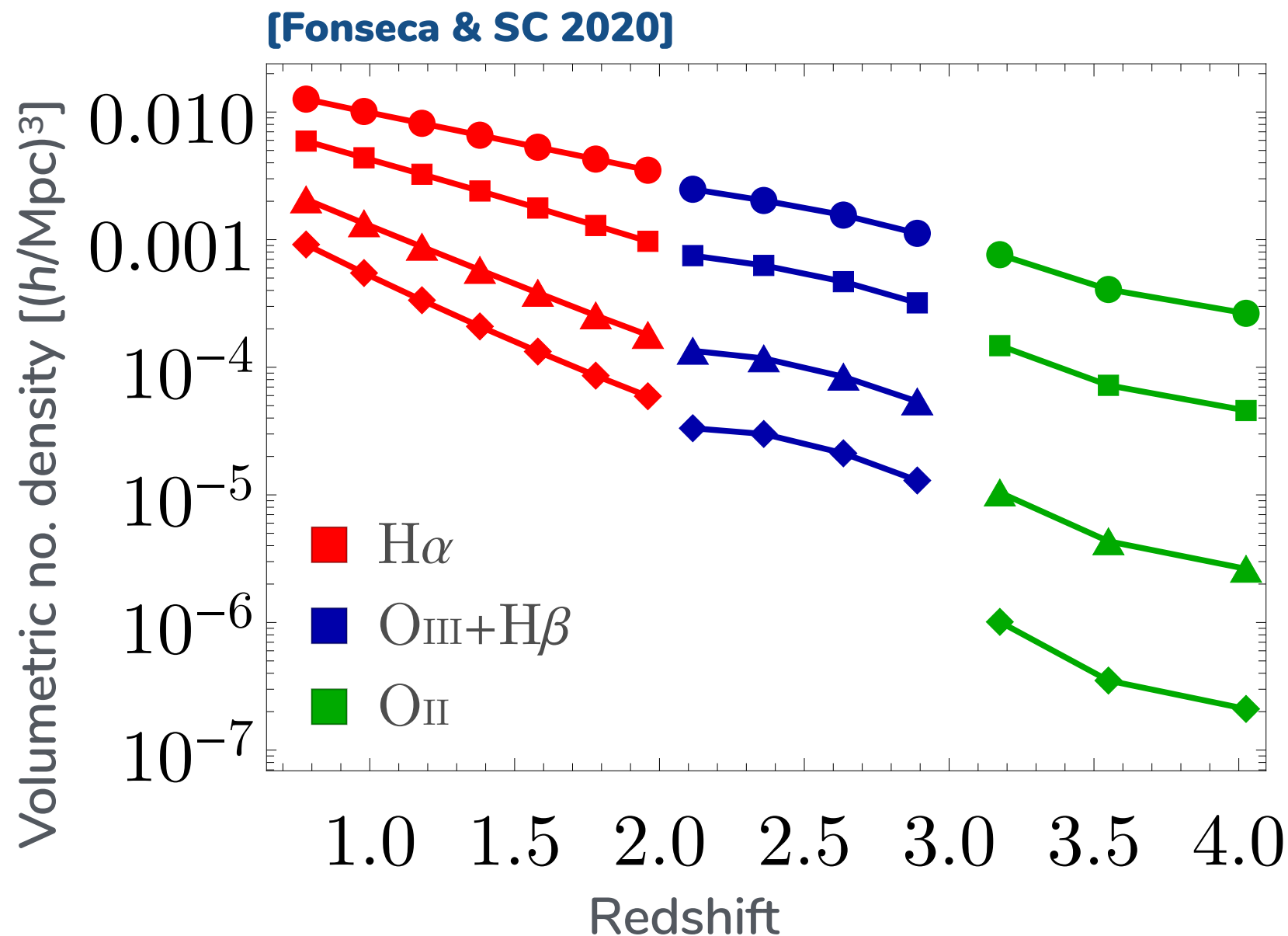


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- State-of-the-art calibrated **Schechter** luminosity functions
[Sobral et al. 2013; Khostovan et al. 2015;
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Constraining cosmology

- Measurements of **growth** parameter $f\sigma_8(z) := f(z)D(z)\sigma_8$

[Fonseca & SC 2020]

