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PIANO NAZIONALE
DI RIPRESA E RESILIENZA



Centro Nazionale di Ricerca in HPC,
Big Data and Quantum Computing

Make Cosmological Analysis Accessible:

A Unified Pipeline for IV Spectroscopic Survey BAO Analysis
E. Sarpa, M. Viel

Spoke 3 General Meeting, Elba 5-9 / 05, 2024

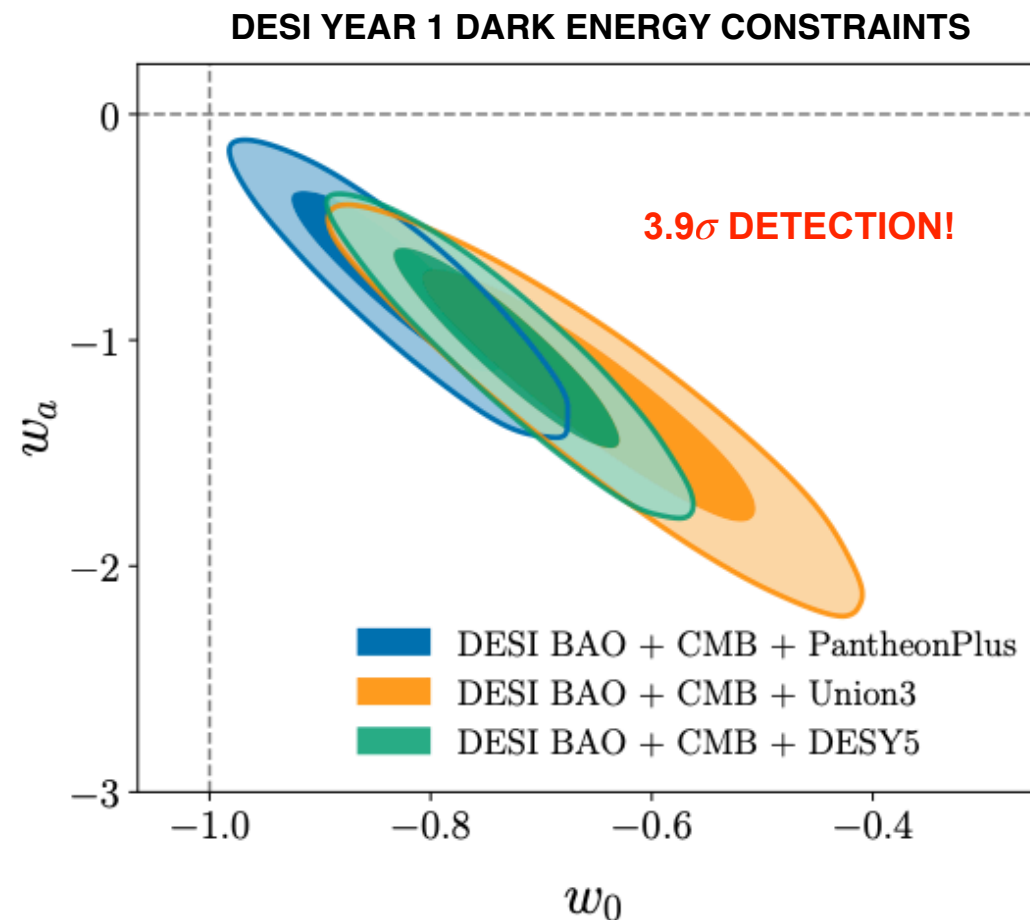
Cosmological Revolution: Rethinking Gravity

Galaxy Surveys

- IV Generation Spectroscopic surveys
- 30 million galaxies, Full - sky, 10Gyr

DESI Results

- Evidence of Dinamical Dark Energy
- Need for New Gravitational model



DESI Collaboration. 2024

The Importance of Reproducible Results

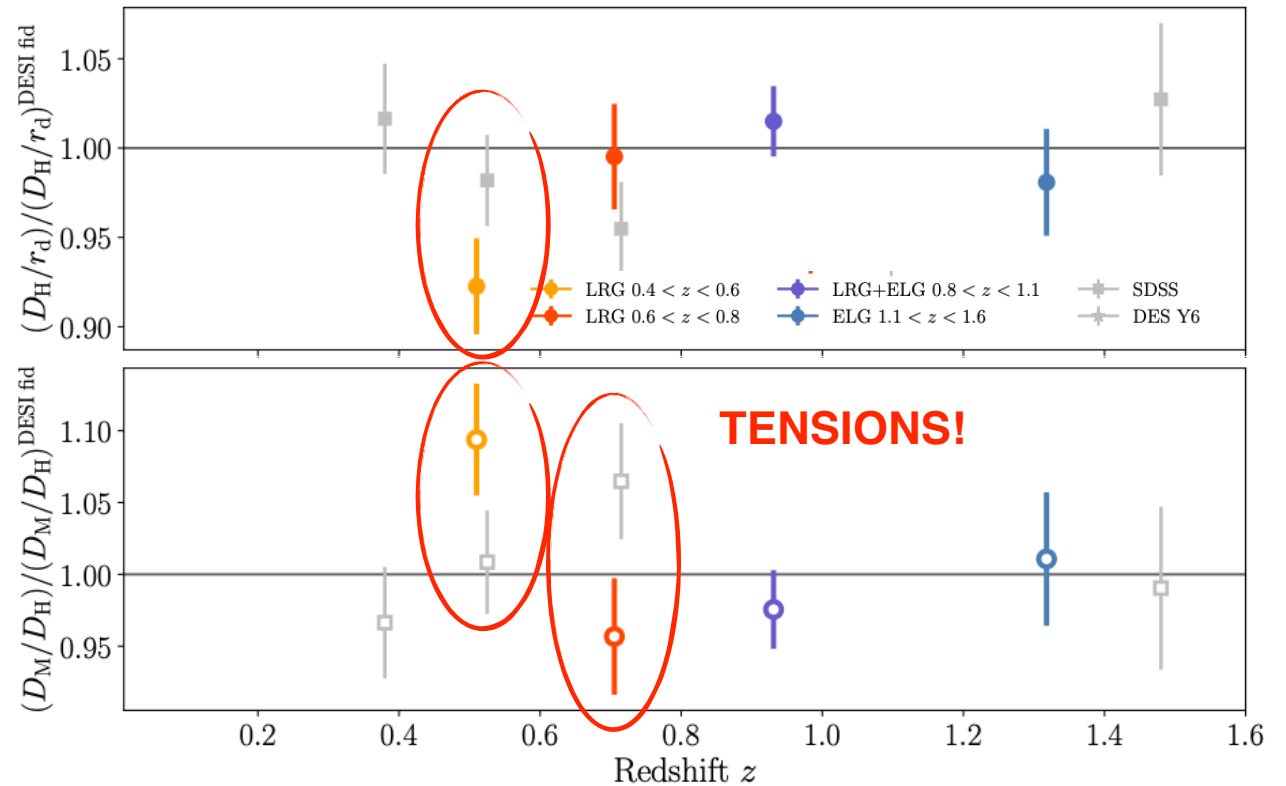
DESI RESULTS

- Comparison with SDSS results
- Tensions on cosmological distances

ACCESSIBLE SCIENCE

- Results should be reproducible
- Analysis pipelines should be public

STATE OF THE ART BAO SCALE MEASUREMENTS



DESI Collaboration. 2024

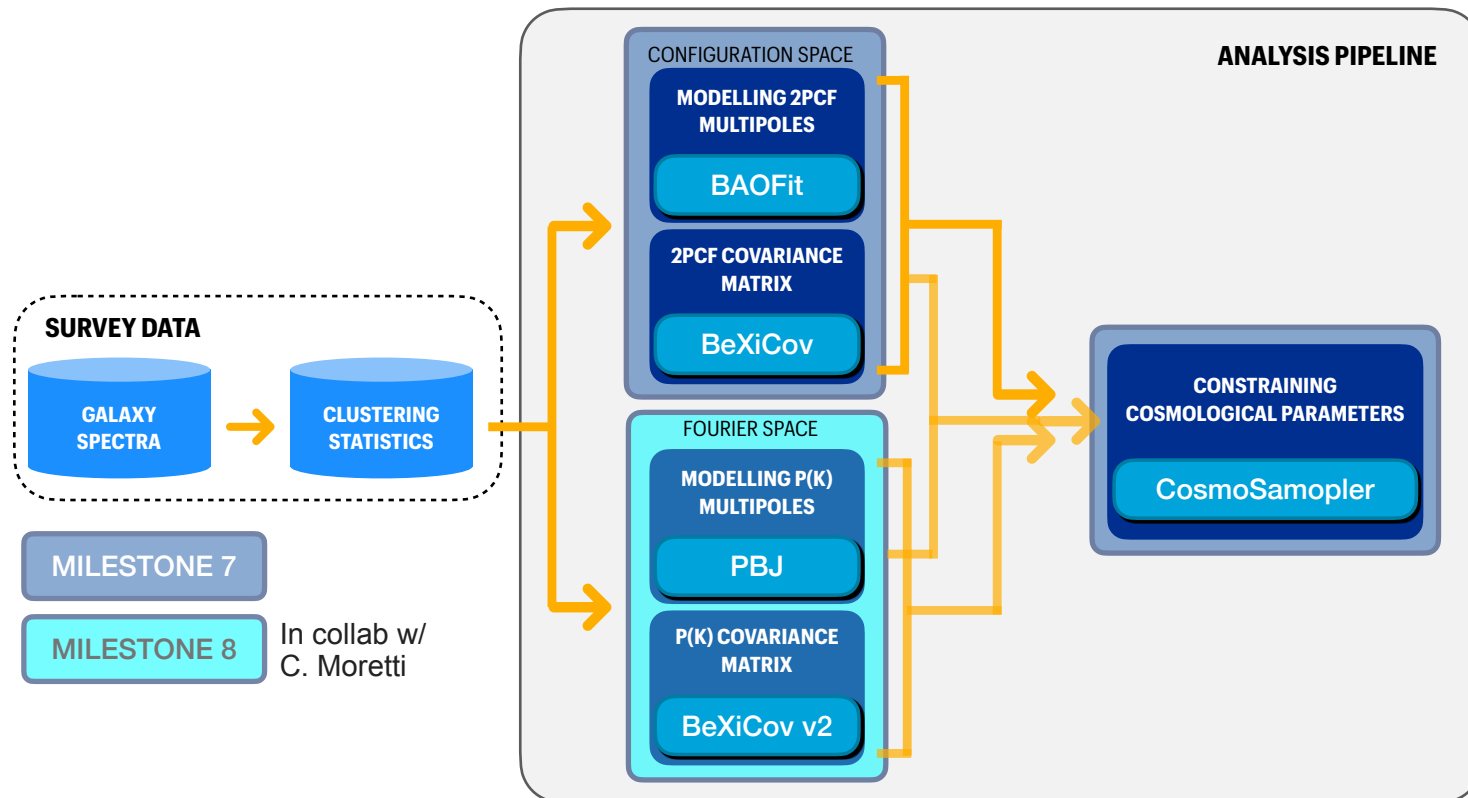
A Comprehensive Analysis Pipeline: From measurements to cosmological constraints

Features

- Models for the non-linear two-point clustering signal of mass tracers
- Semi-analytical covariance matrixes for the two-point statistics
- Cosmological inference

Accessibility

- Publicly available
- Accompanied by documentation and examples
- Results described in Euclid Consortium papers



BAOFit: modelling the 2PCF multipoles

Models

- Physical description of the signal: linear prediction + non-linear corrections
- Parameteric modelling of systematics

Sampler

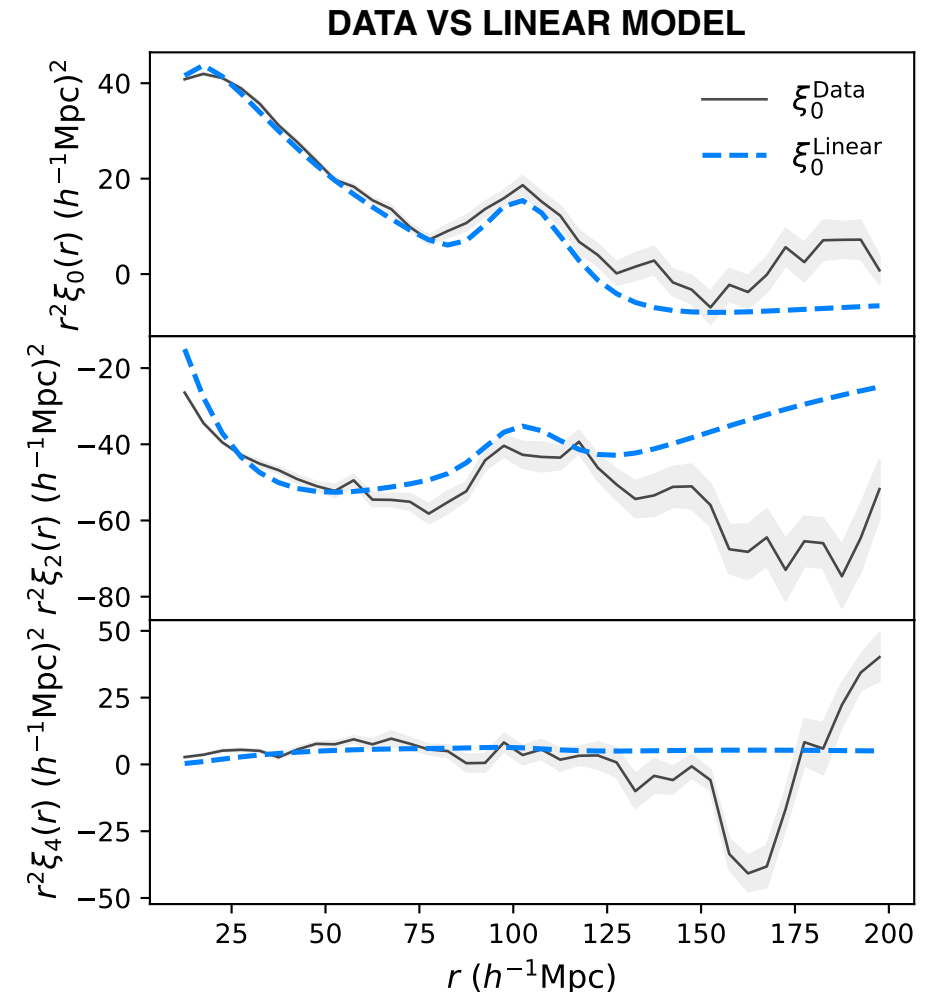
- Parallelized sampling of the Likelihood: emcee
- CPU time: 250k steps, 1 cpuh

KPI

- Publication of the code: <https://gitlab.com/esarpa1/BAOFit>
- Used in Euclid BAO reconstruction forecast paper & Observational systematics paper

Next steps

- Emulators for the 2PCF multipoles estimated gain: 1/20 CPU time (ongoing within Euclid, BORA emulator by M. Bonici)
- Nested samplers



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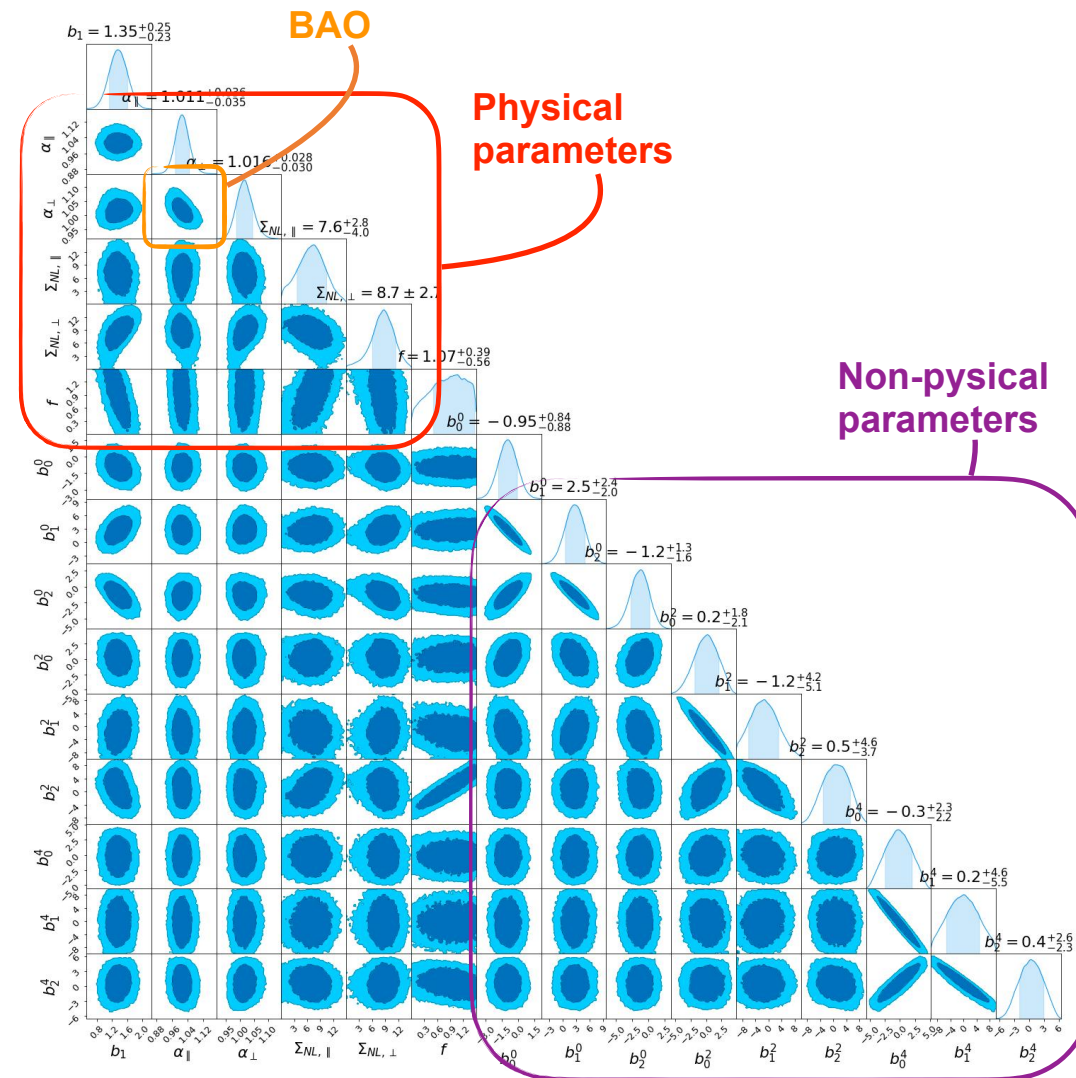
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BAOXiCov: 2PCF multipoles covariance matrix

Models

- Gaussian covariance matrix
- No Window
- Paramtric description of measured clustering signal estimated via iterative fit

Performances

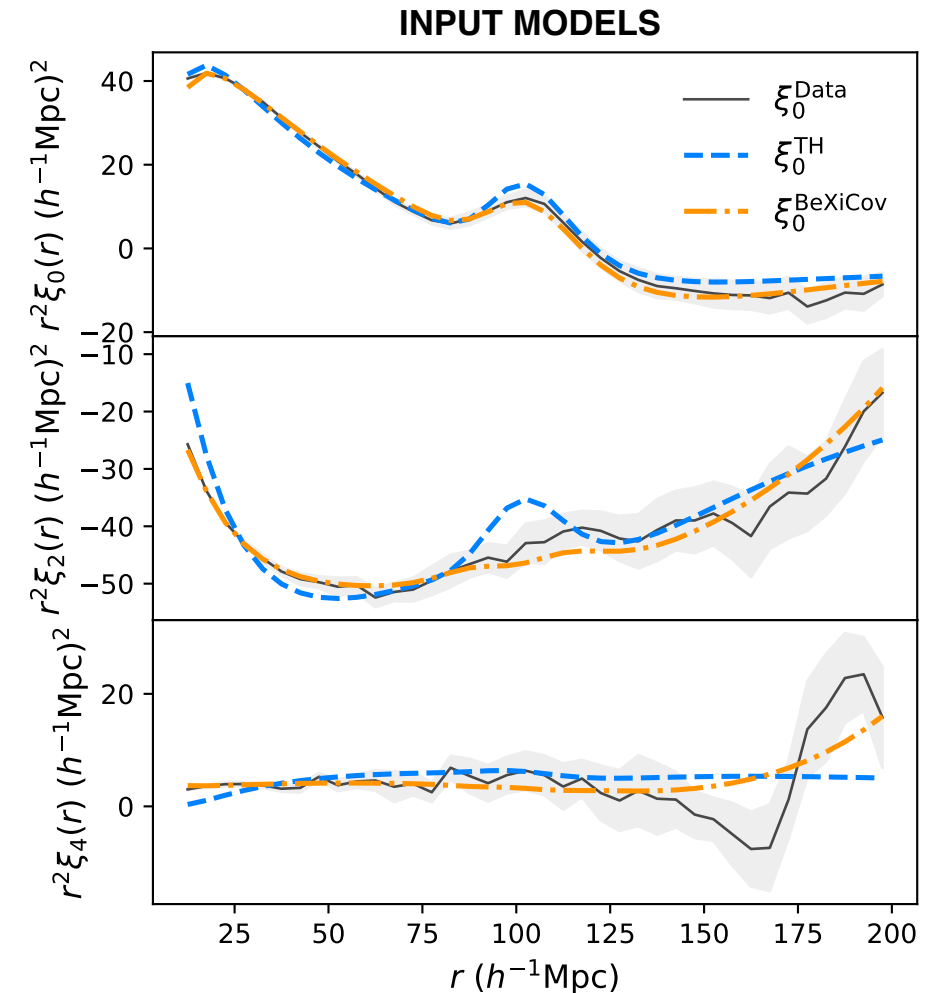
- 0.1 CPUh for 2 iterations of 3 multipoles

KPI

- Pulication of the code: <https://gitlab.com/esarpa1/BeXiCov>
- Used in Euclid BAO reconstruction forecast paper

Next steps

- Emulators for the 2PCF multipoles within iterative fit
- Inclusion of the window (ongoing merging with WinCov code by A. Veropalumbo)



BAOXiCov: 2PCF multipoles covariance matrix

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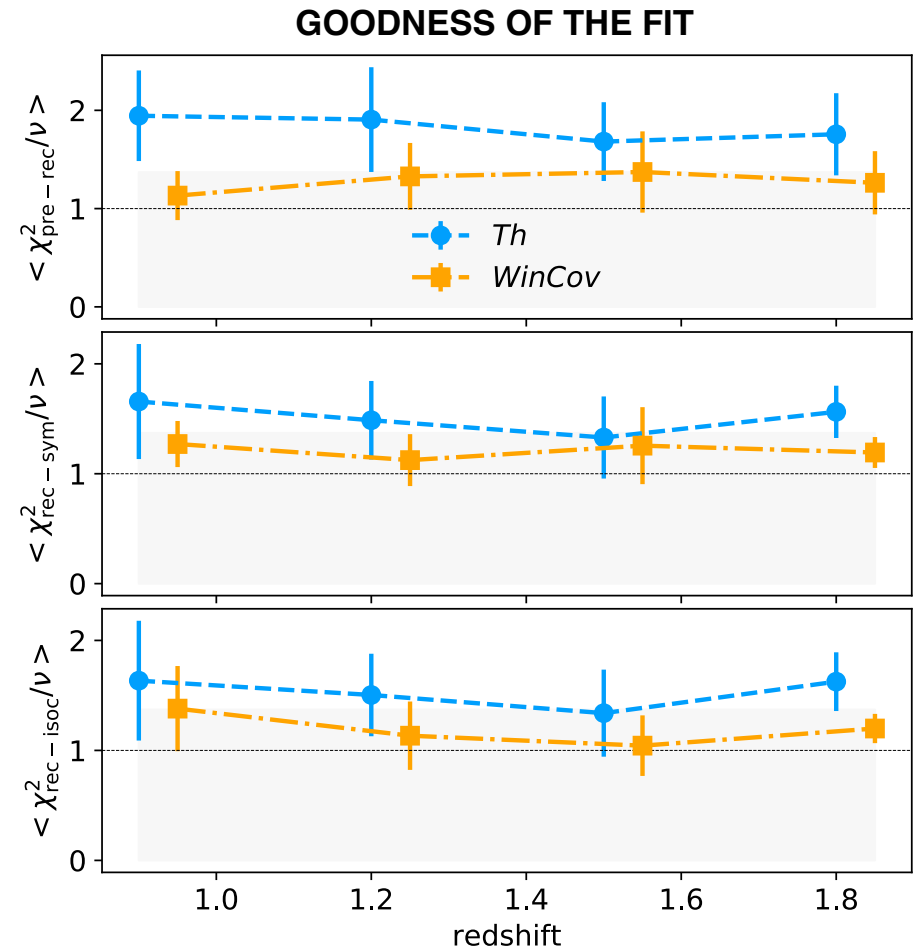
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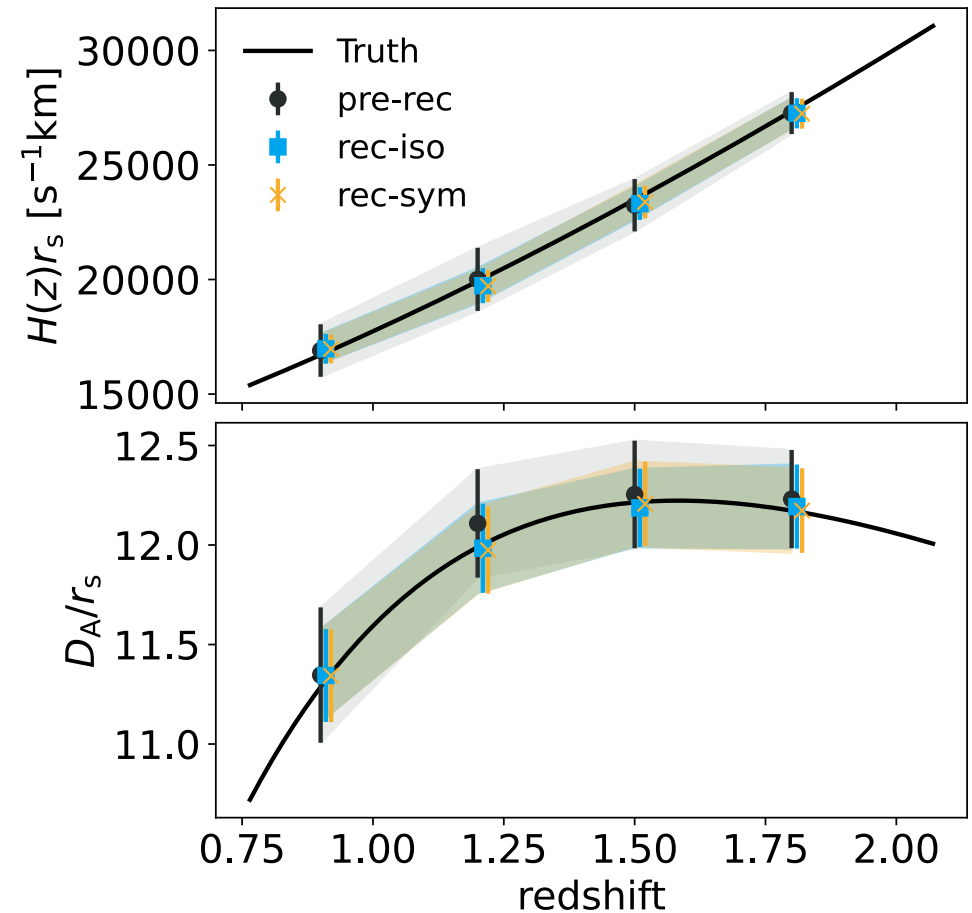
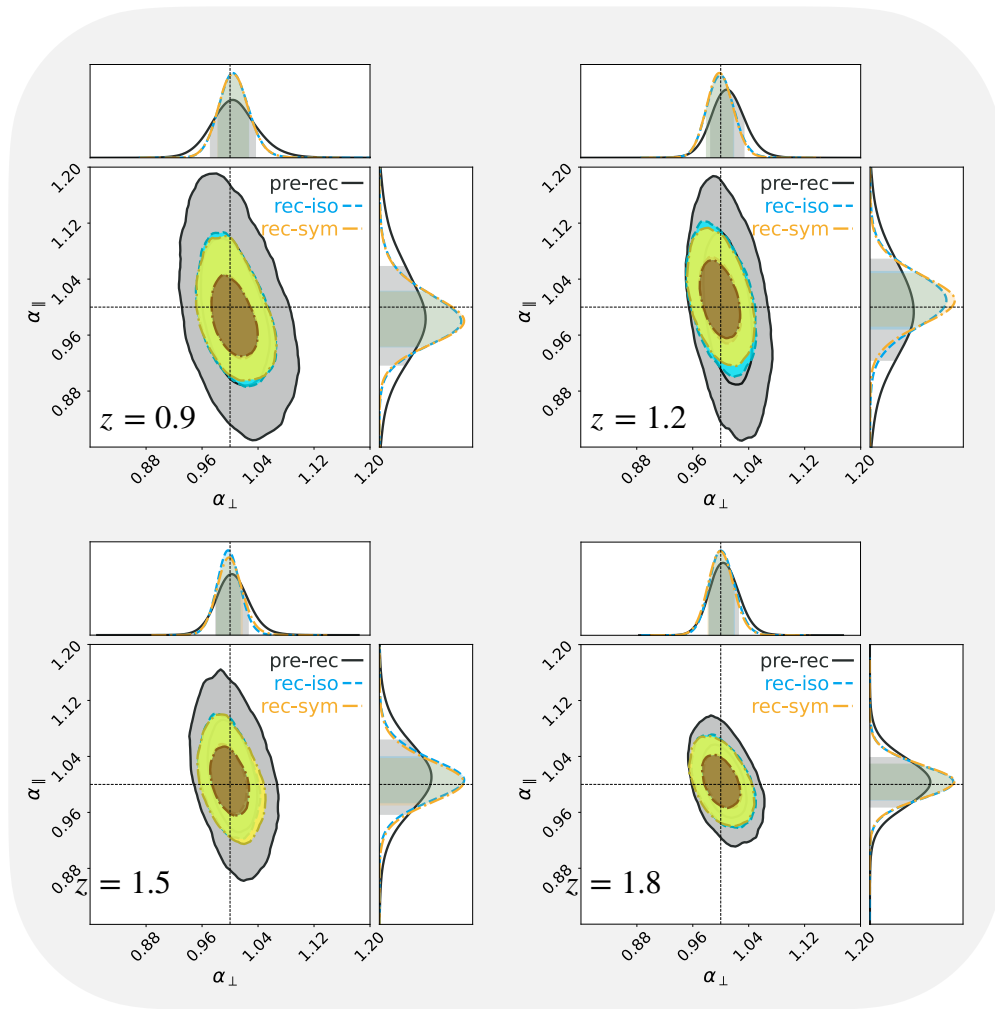
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BAOFit + BAOxCov: lightcone results



CosmoSampler: from BAO constraints to Dark Energy

Models

- Cosmologies: Flat LCDM, w_0 LCDM (dynamical DE)
- Possibility to include CMB constraints (Planck)

Sampler

- Parallelized sampling of the Likelihood: emcee
- CPU time: 500k steps, 1 cpuh

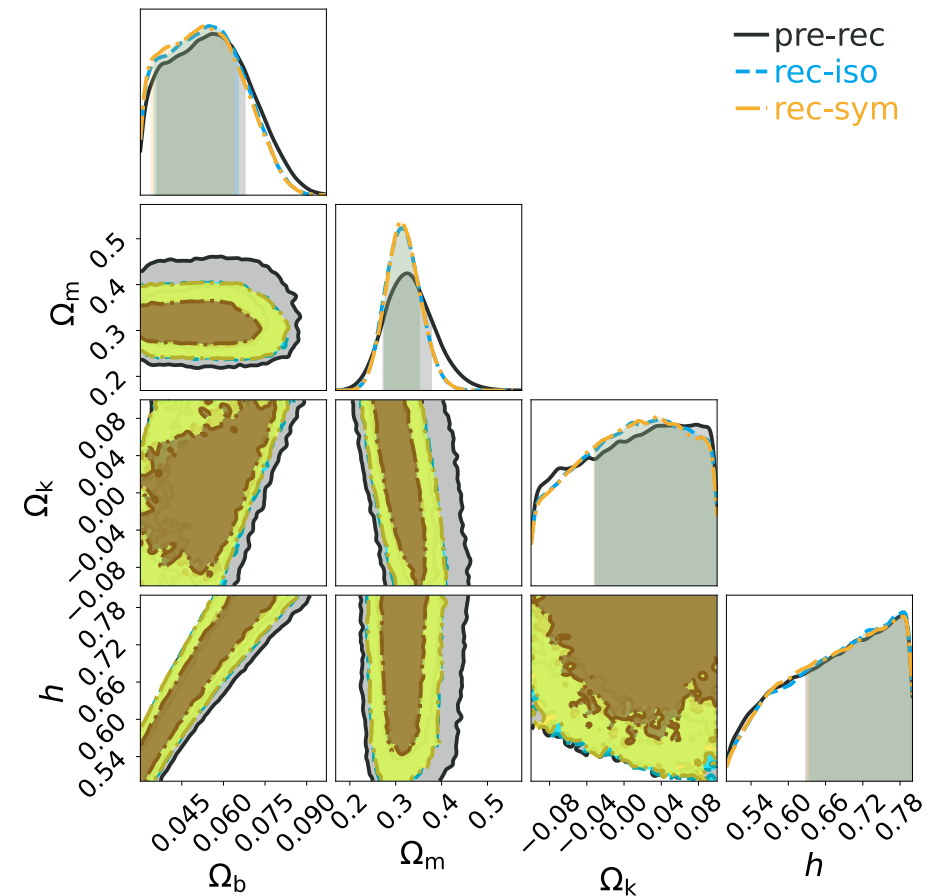
KPI

- Publication of the code: <https://gitlab.com/esarpa1/cosmosampler>
- Used in Euclid BAO reconstruction forecast paper & Observational systematics paper

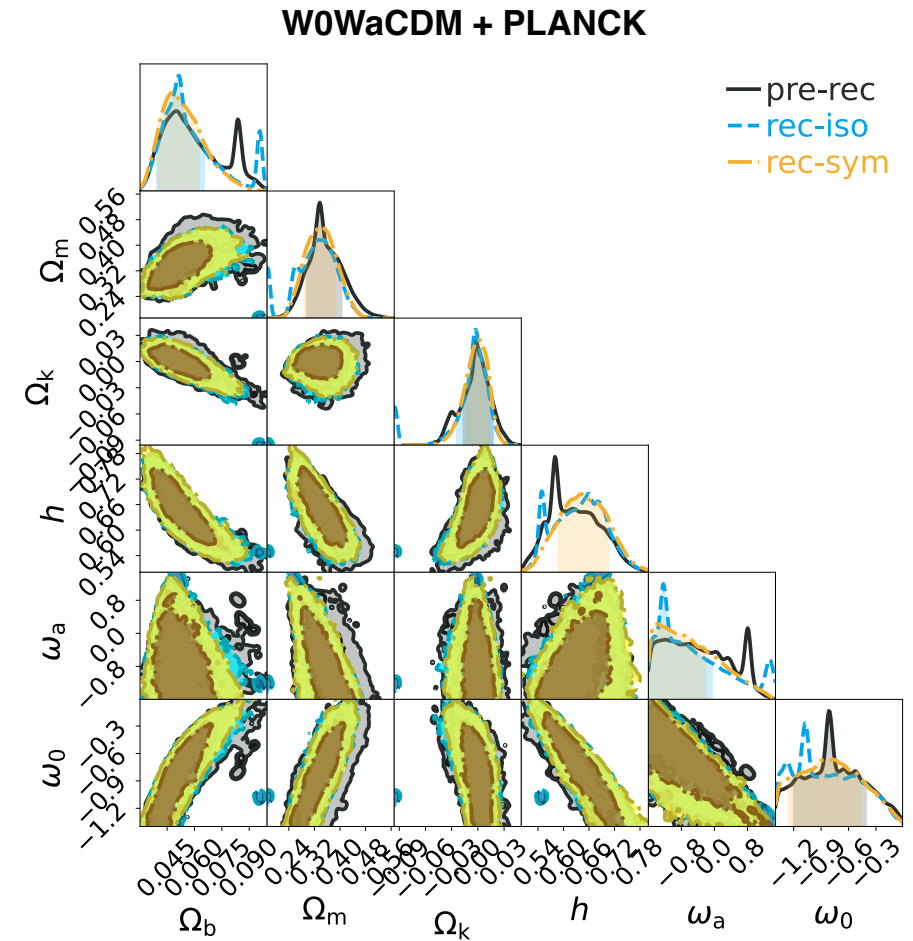
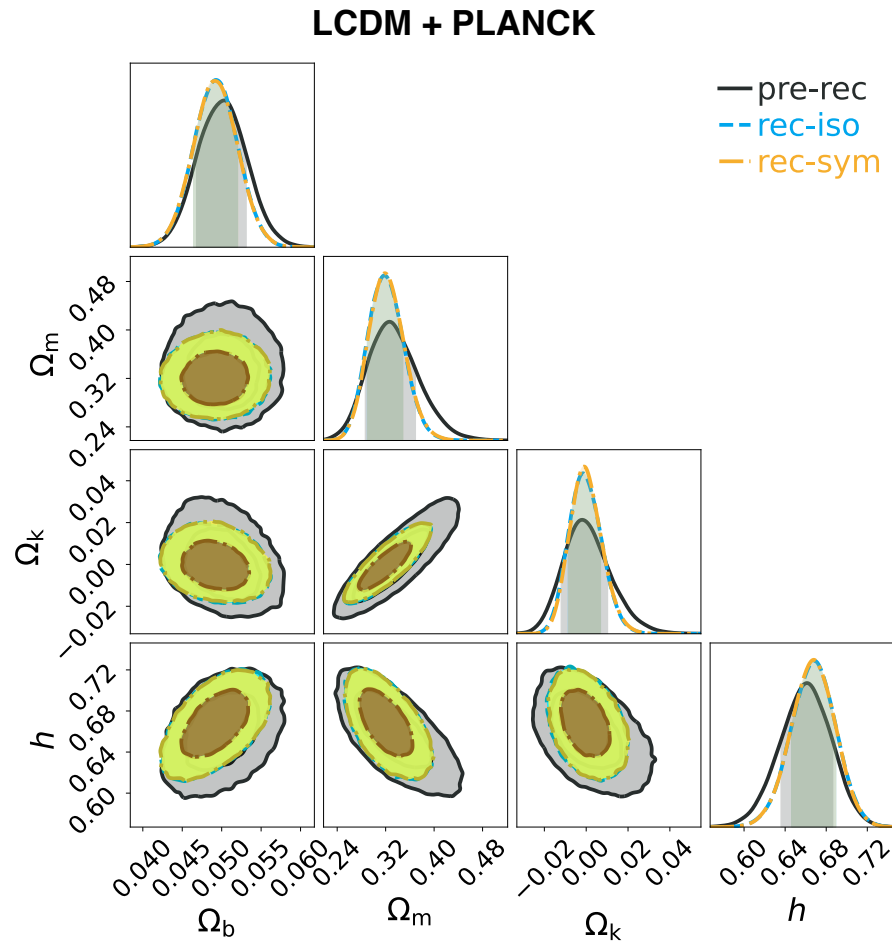
Next steps

- Beyond BAO analysis
- Inclusion of neutrino cosmologies

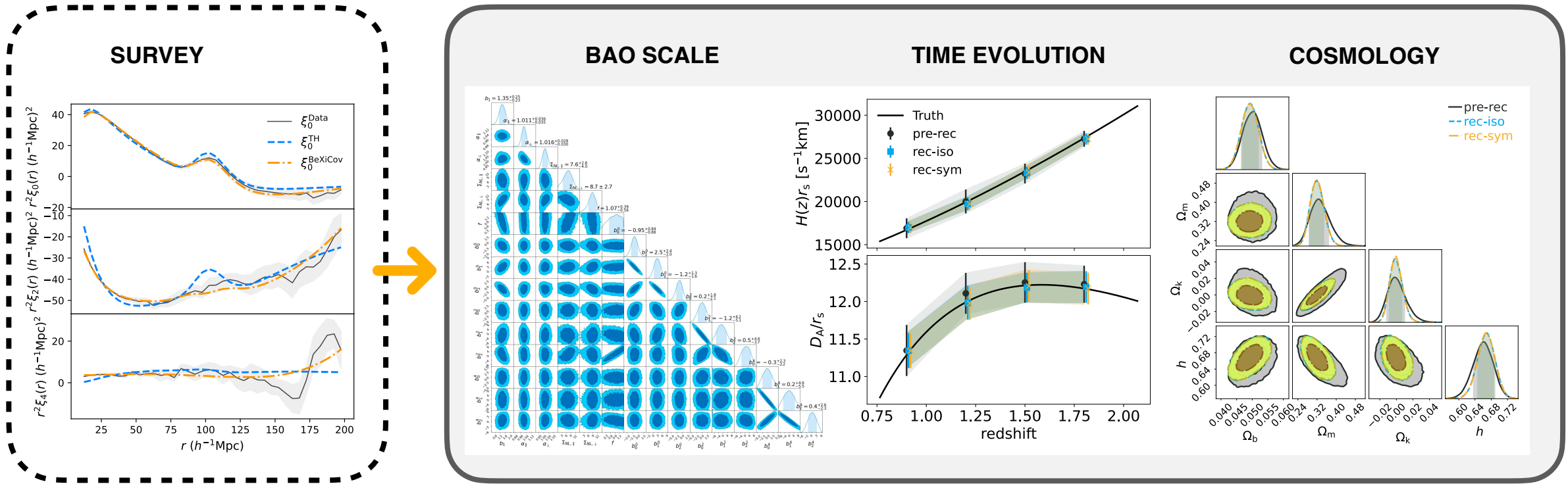
COSMOLOGICAL CONSTRAINTS: BAO ONLY



CosmoSampler: Exploring different scenarios



Summary: Full Pipeline Run



READY FOR EUCLID & DESI DATA!

Next Steps:

- **Improving performances with Emulators for the clustering signal**
Statuts: ongoing within Euclid Consortium
Milestone: 8
KPI: publication of Euclid BAO paper
- **Implementing analysis in Fourier-space**
Statuts: ongoing in collaboration w/ C. Moretti (PBJ)
Milestone: 8
KPI: inclusion in PBJ code
- **Bayond BAO analysis: BAO + full-shape joint fit**
Statuts: ongoing in collaboration w/ C. Moretti (PBJ)
Milestone: 9
KPI: inclusion in PBJ code

Thank you!