

Generating mock galaxy catalogs for future surveys

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Jet Propulsion Laboratory
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Cosmology: theory + observations + simulations

THEORY

- General relativity
- Copernican principle
- Inflation
- Standard model of particle physics



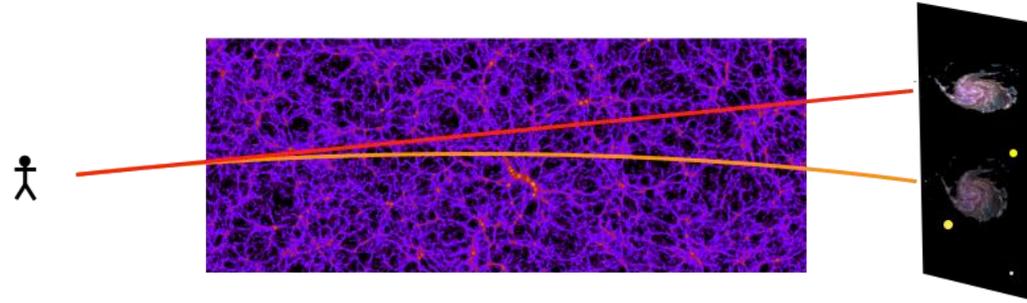
MODELS

- Λ CDM
- (+ model parameters)

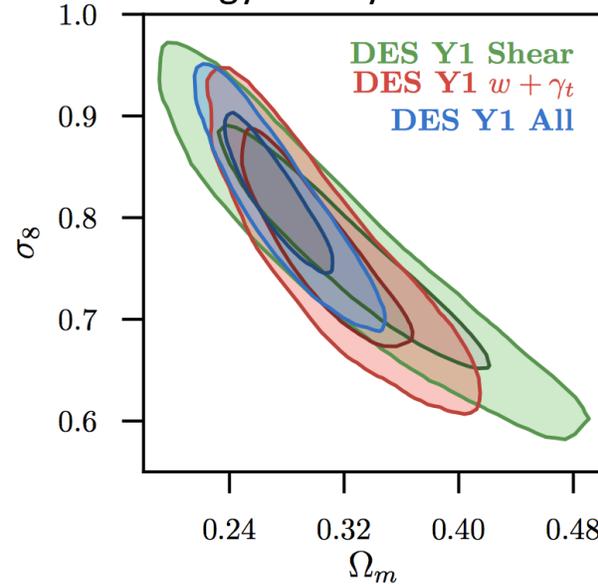


PREDICTIONS

- Expansion rate
- Structure formation



The Dark Energy Survey Collaboration 2017



GALAXY SURVEYS

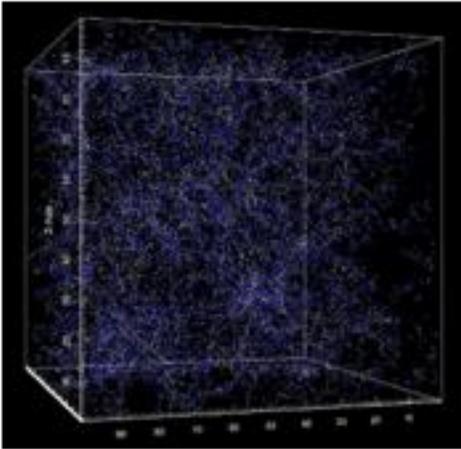


OBSERVATIONS

- Galaxy distribution
- Image distortion by weak gravitational lensing
- Supernovae
- Clusters of galaxies
- Cosmic microwave background

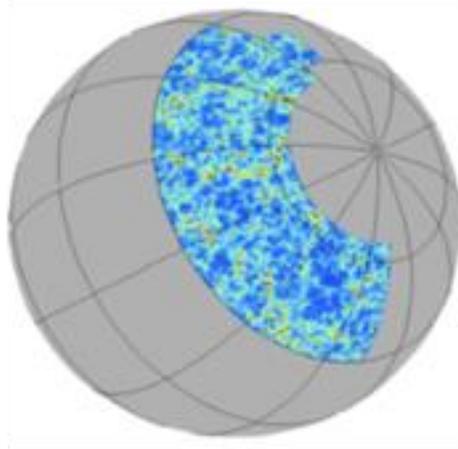
Efficient generation of mock galaxy catalogs for galaxy surveys

N-body simulation



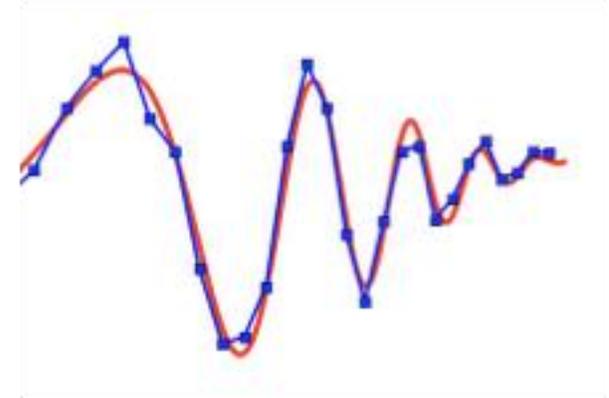
Fast cosmological simulations
Efficient production of data products

Realistic catalogues



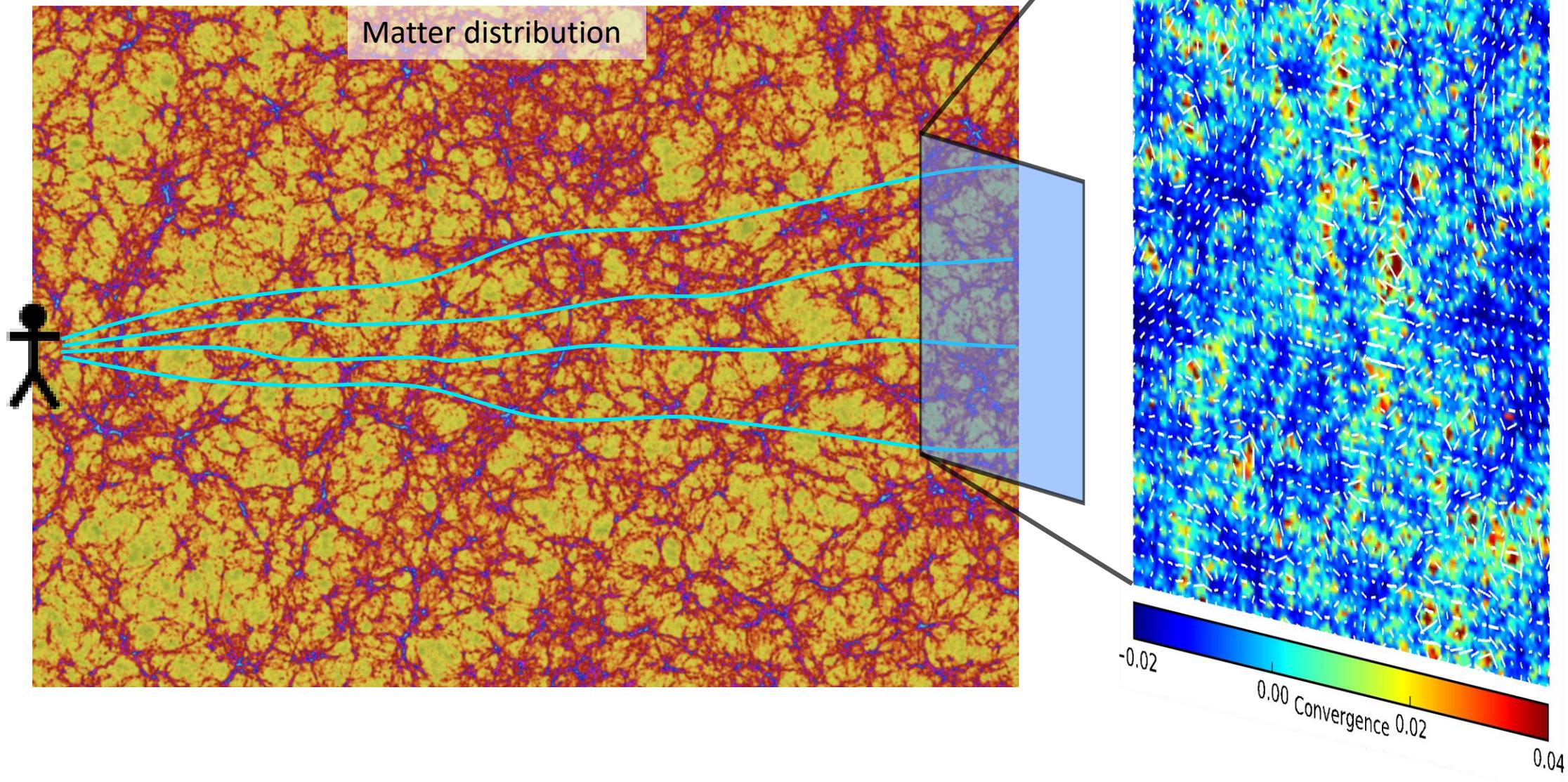
Galaxy formation model

Modelling observables



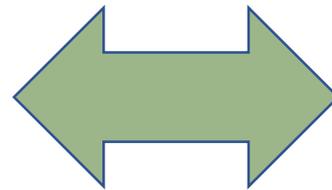
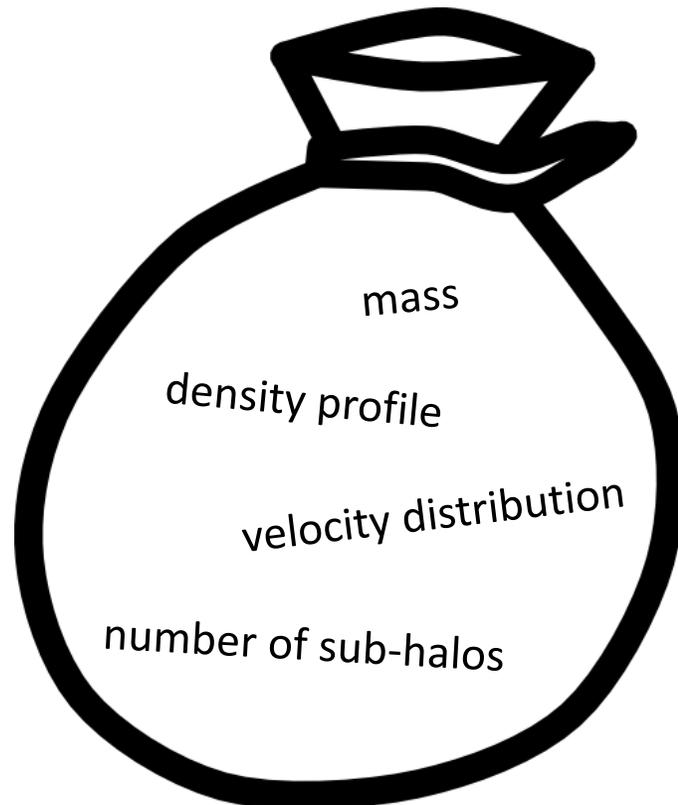
Systematic errors
Survey characteristics

Fast cosmological simulations

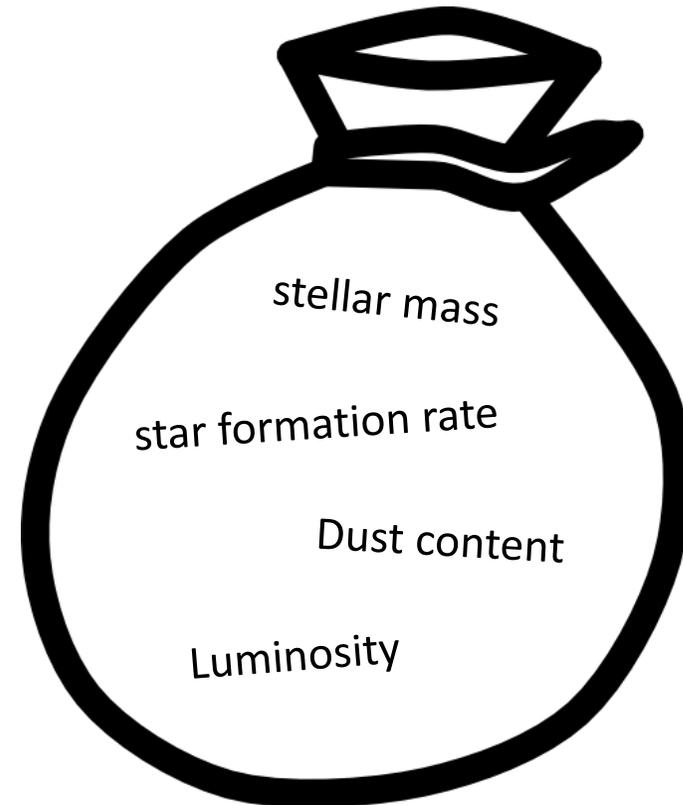


From halos to galaxies

HALOS

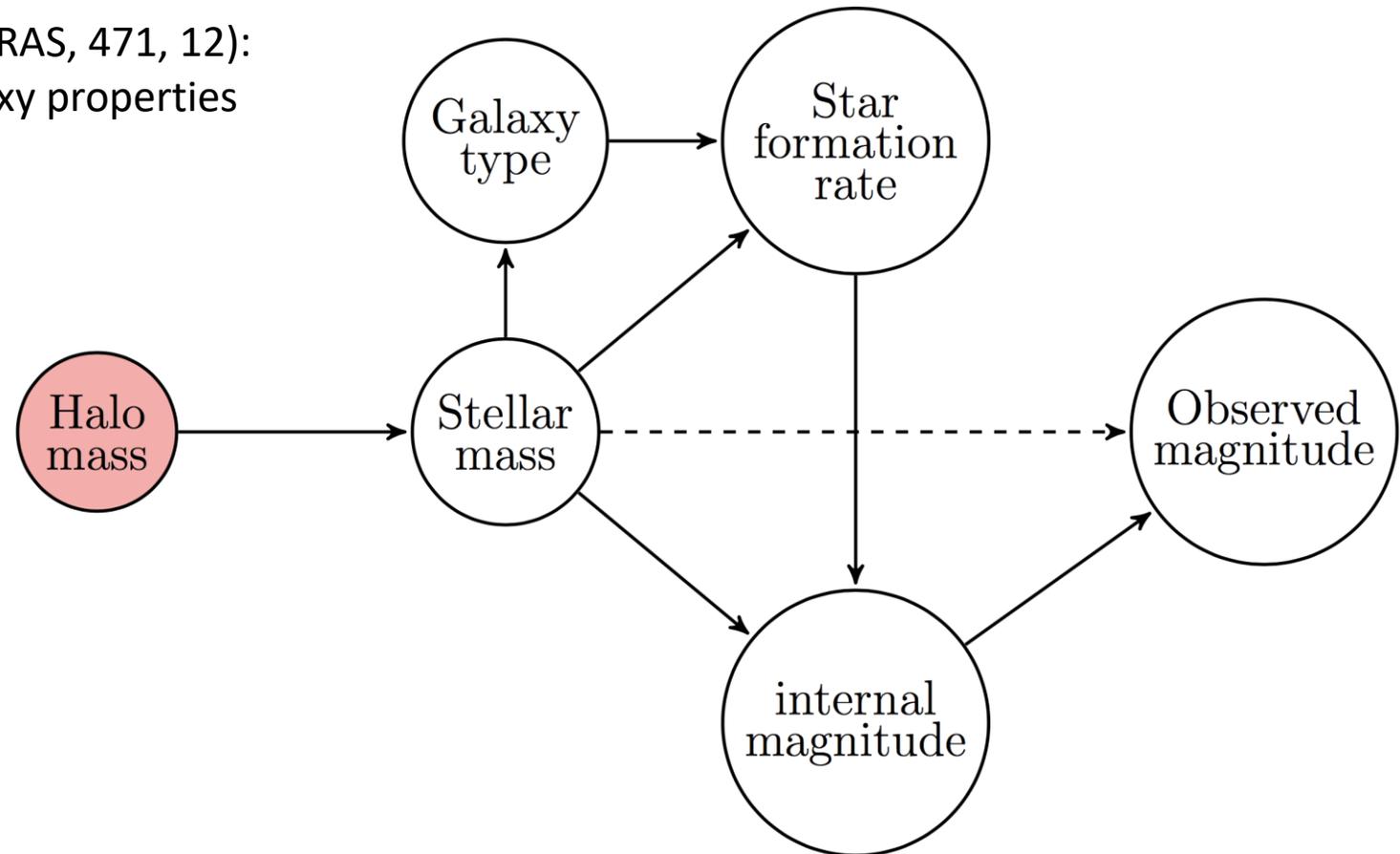


GALAXIES



Galaxy model

Ghost software (Bull 2017, MNRAS, 471, 12):
Enables a fast modeling of galaxy properties



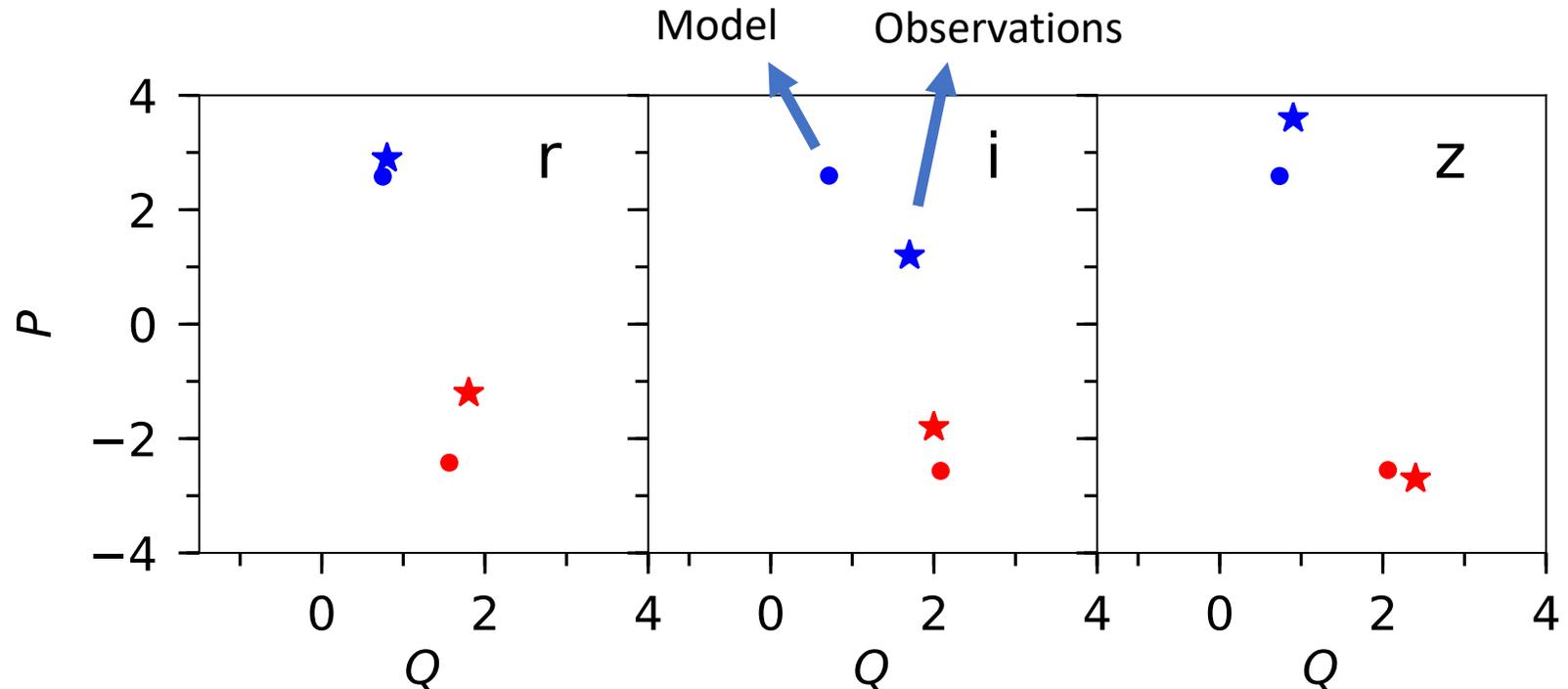
Implementing evolution in the galaxy model

Limitation of Ghost: it is calibrated at the present time
The catalogs of my simulations span a wide range in cosmic time



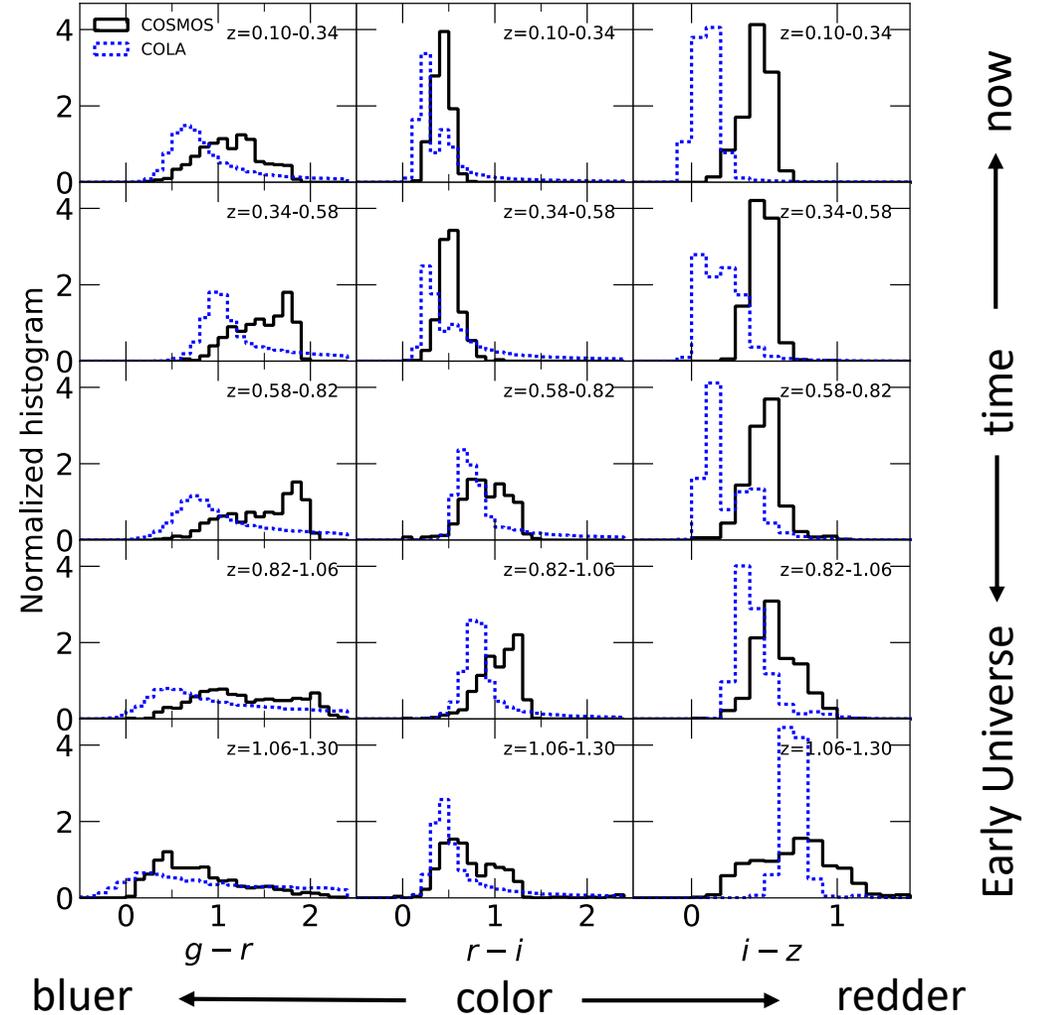
Solution: implement evolution
in the parameters

P and Q characterize
the evolution of the
abundance of galaxies
through cosmic times

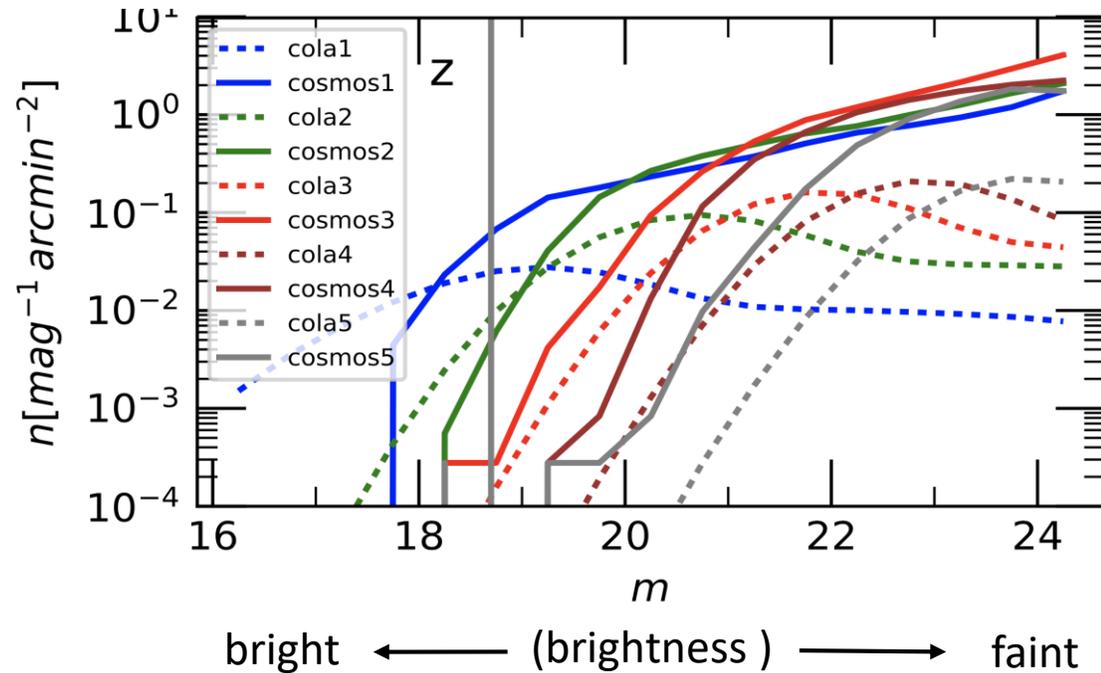


Validation of the mock galaxy catalogs

Histograms of galaxy colors
(my galaxy mocks vs real observations)



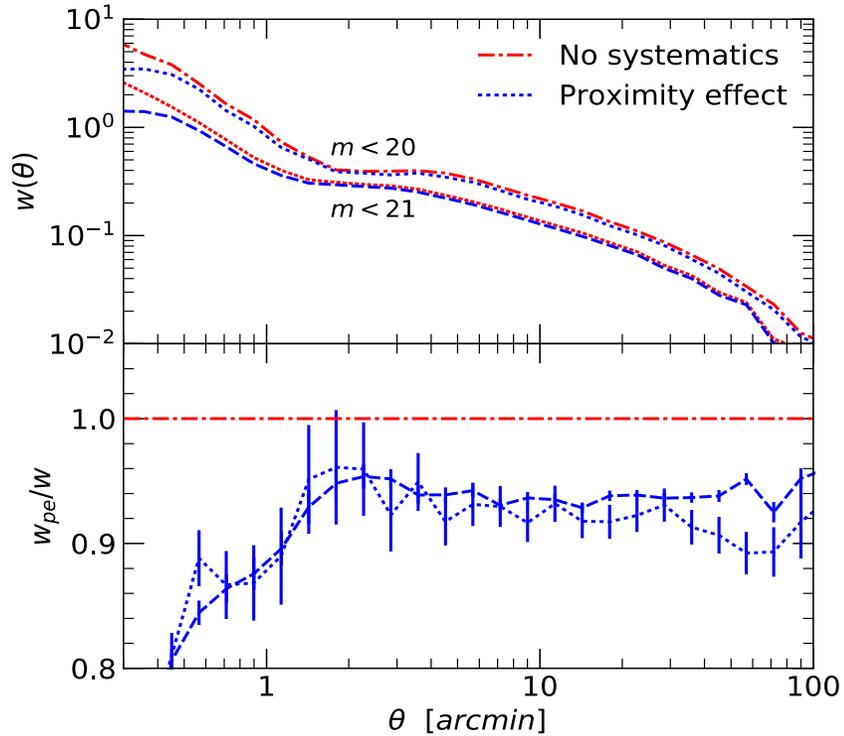
Abundance of galaxies as a function of brightness
(my galaxy mocks vs real observations)



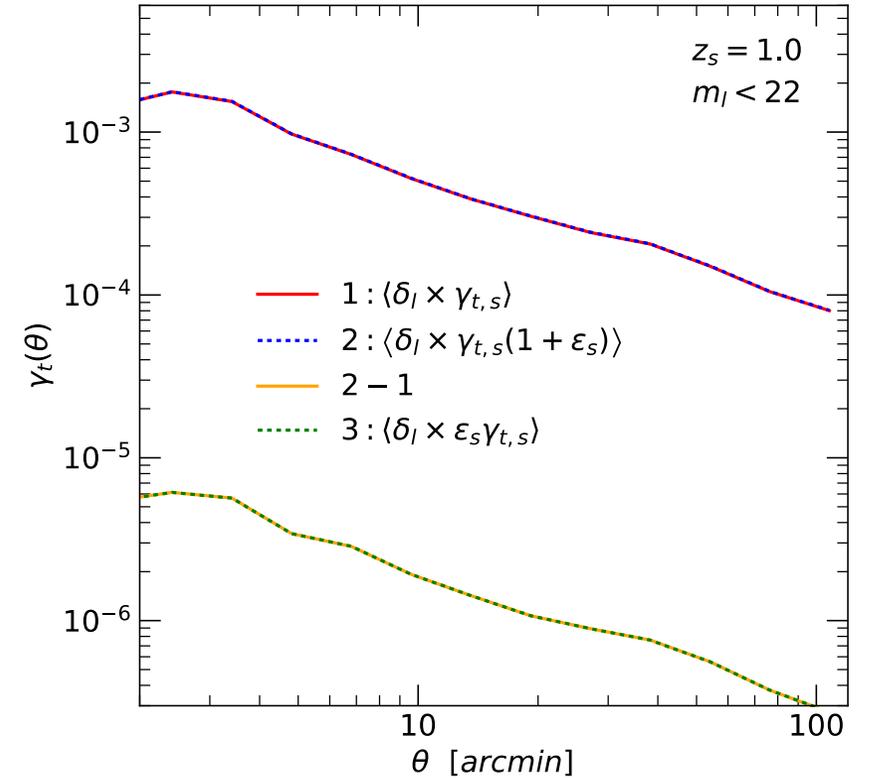
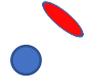
Implementing systematic effects: proximity effect



Correlation function



Galaxy shape alignment with the position of other galaxies



Is there cross talk of errors in a multi-probe analysis?

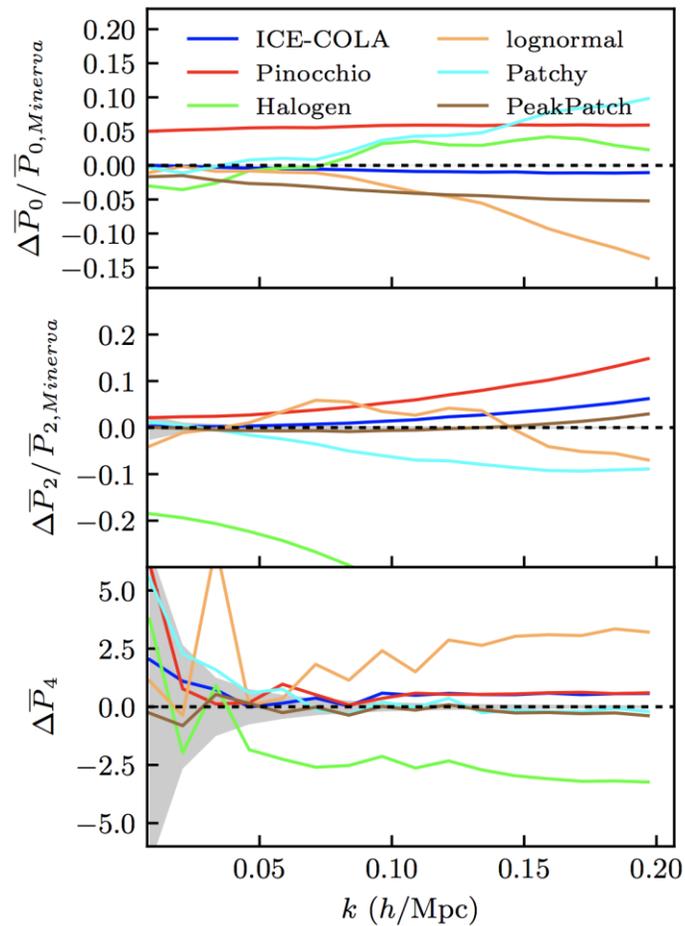
Publications and conferences

- Joint Euclid meeting of the Cosmological Simulations and Weak Lensing Science Working Groups. Talks:
 - *Studying observational systematics with fast mock galaxy catalogs*
 - *Small scale structure in approximate methods*
- Published paper: *ICE-COLA: fast simulations for weak lensing observables*, Izard A., Fosalba P., Crocce M., 2018, MNRAS, 473, 3051.
- Papers in prep:
 - Izard et al. *Cross-talk of systematic errors in multi-probe surveys*
 - Co-author in: *Comparing approximate methods for mock catalogues covariances I, II, III*

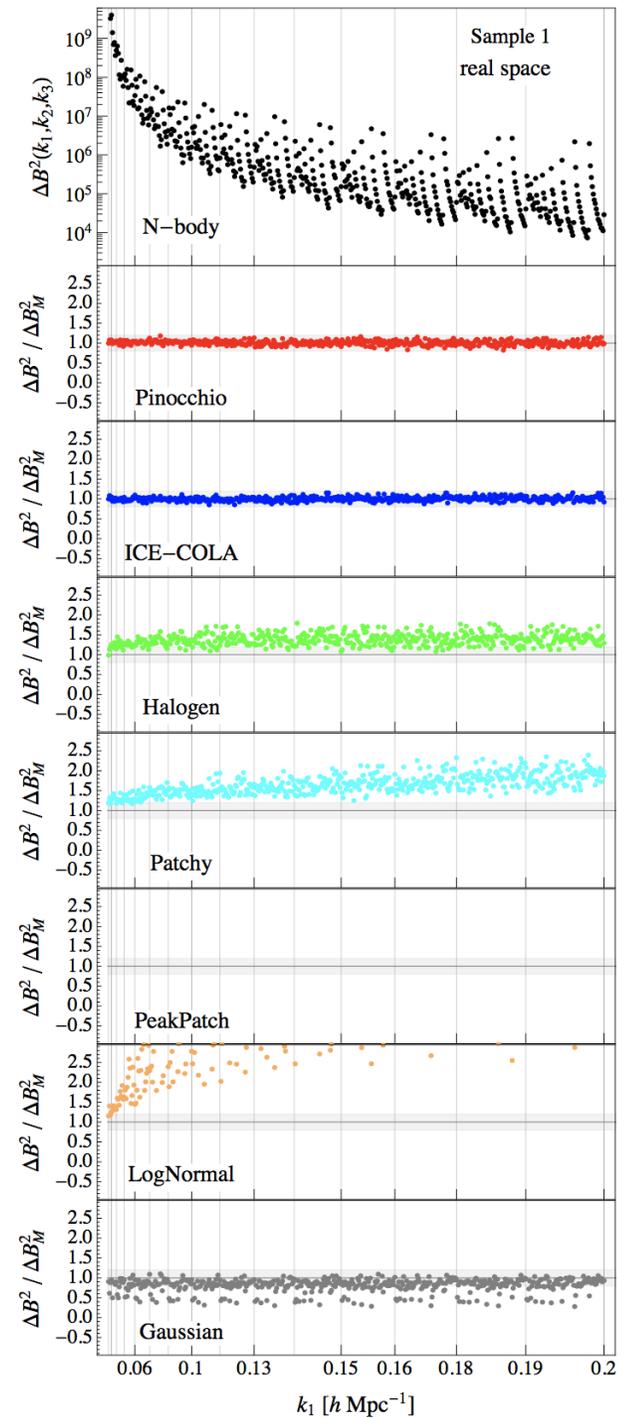
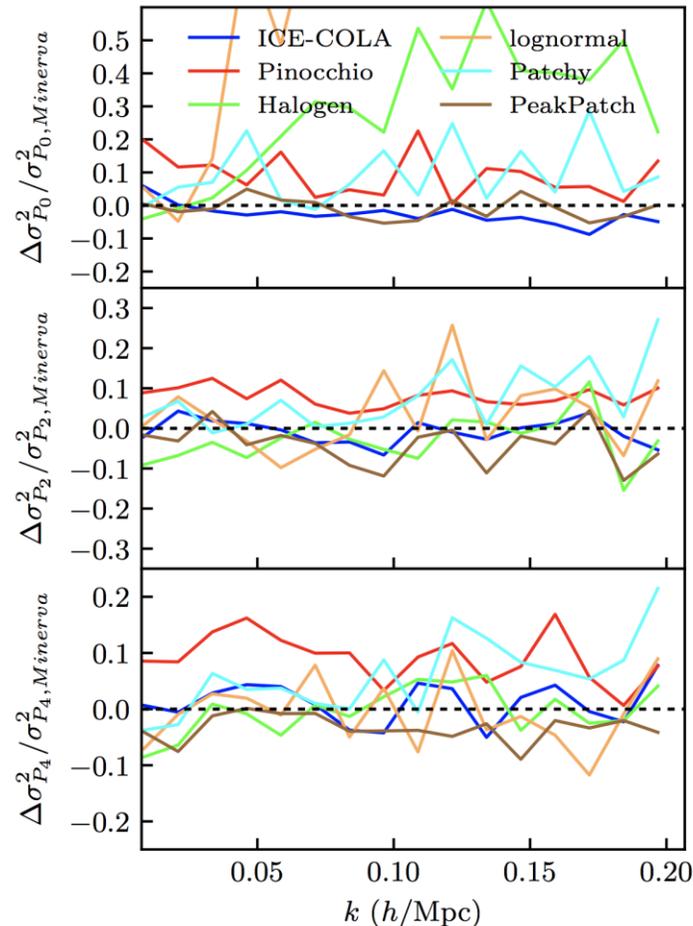
Comparing approximate methods for mock catalogs covariances

Bispectrum:

Power spectrum multipoles



their variance



Thanks!