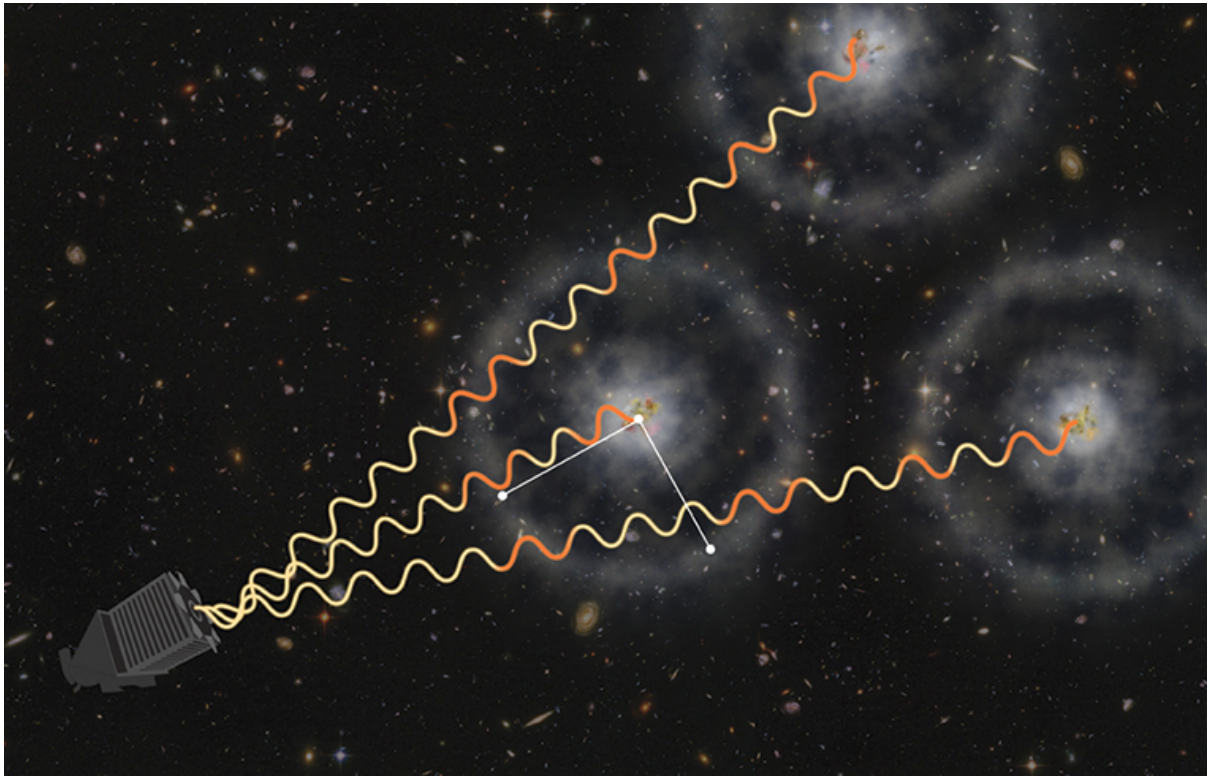

Quasar-Lyman α Forest Cross-Correlation from BOSS survey: Baryon Acoustic Oscillations

Hélion du Mas des Bourboux (CEA)

Outline

- Introduction to BAO cross-correlation
- Matter density tracers
- Simulations and data comparison

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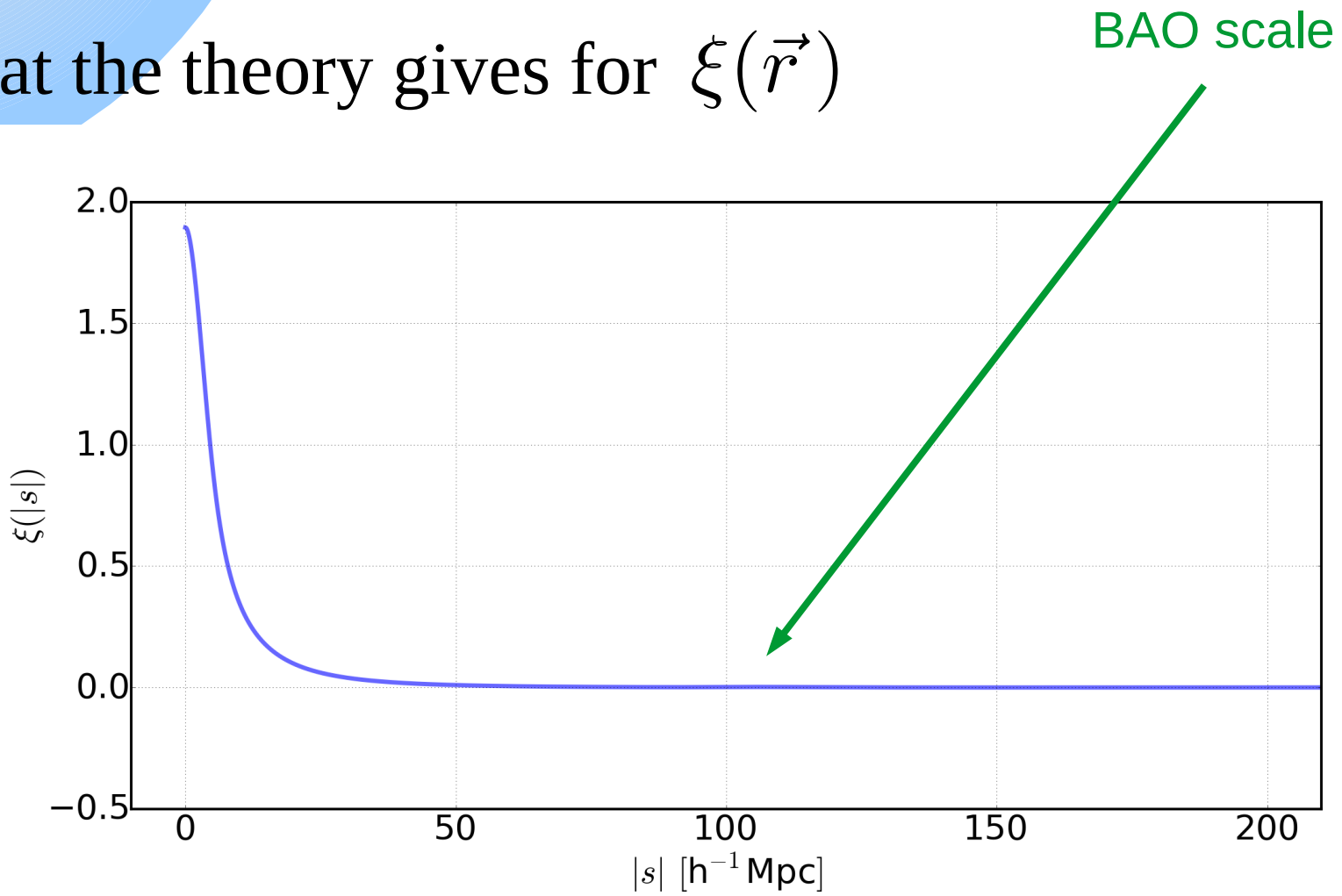
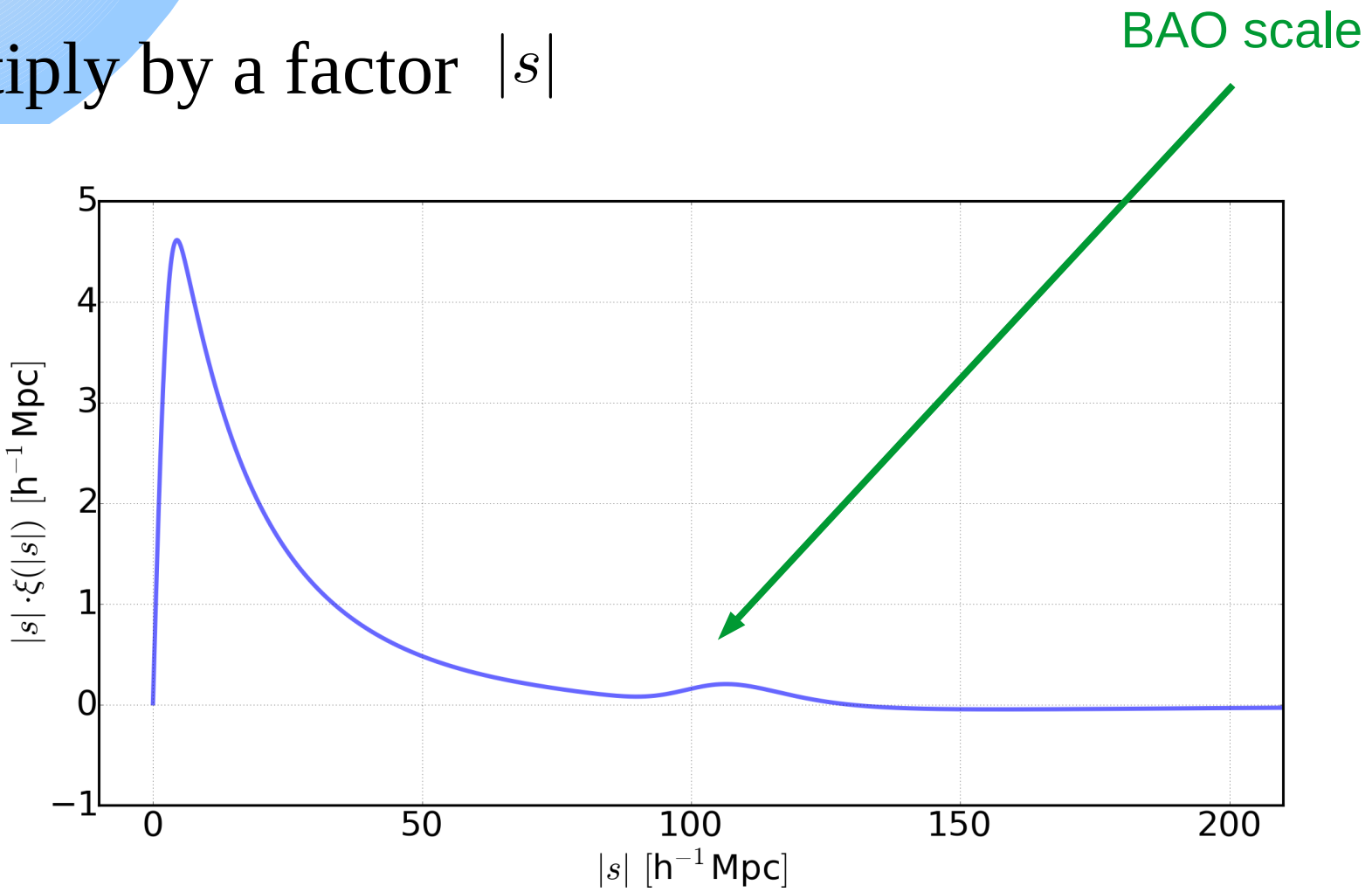
Preface

What the theory gives for $\xi(\vec{r})$



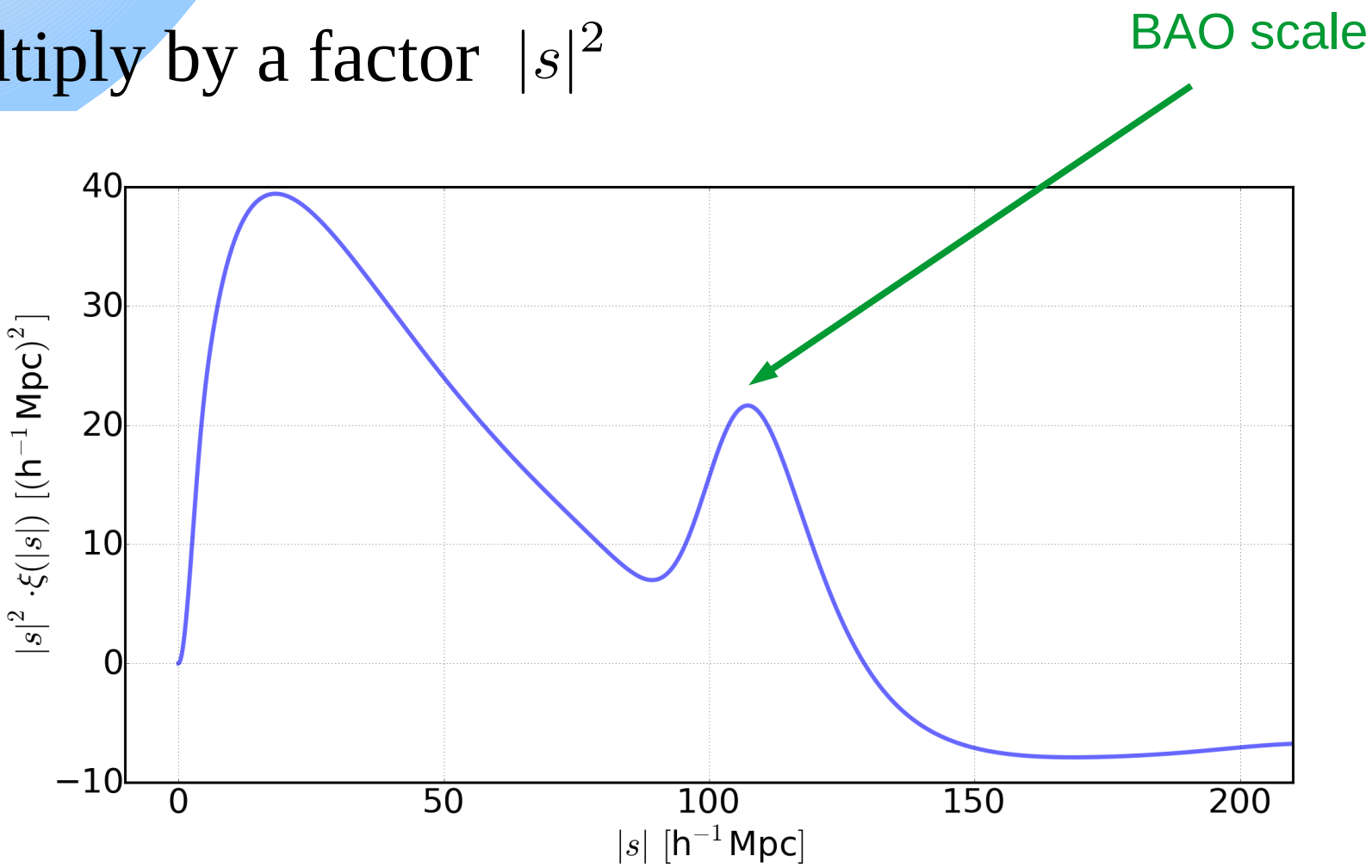
Preface

Multiply by a factor $|s|$



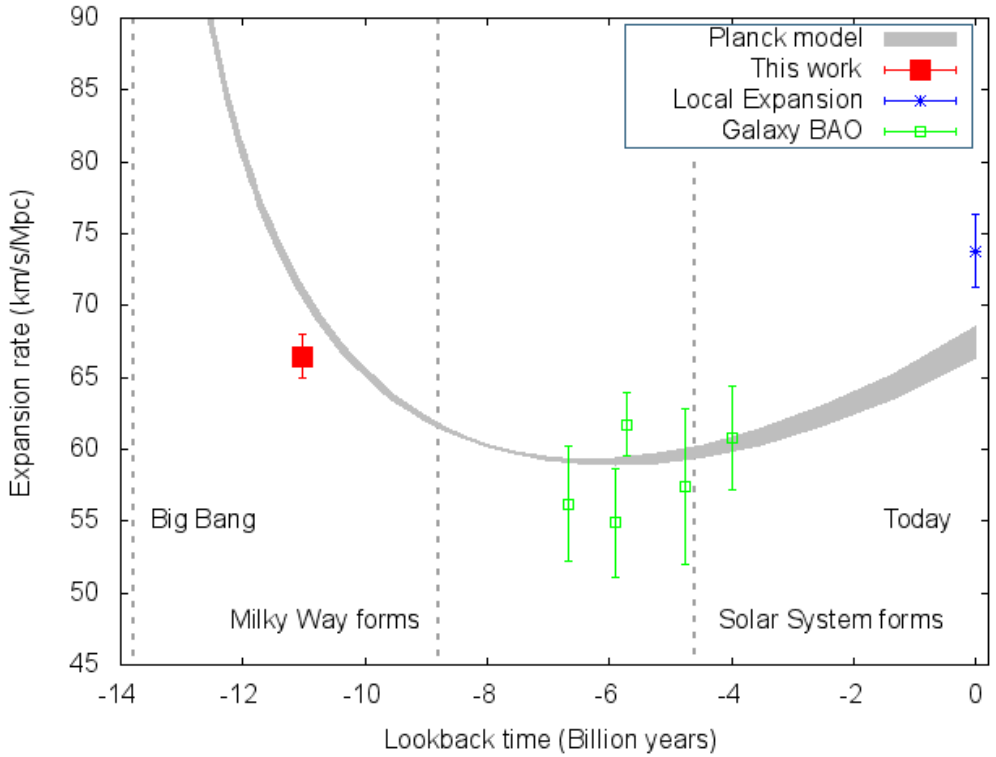
Preface

Multiply by a factor $|s|^2$

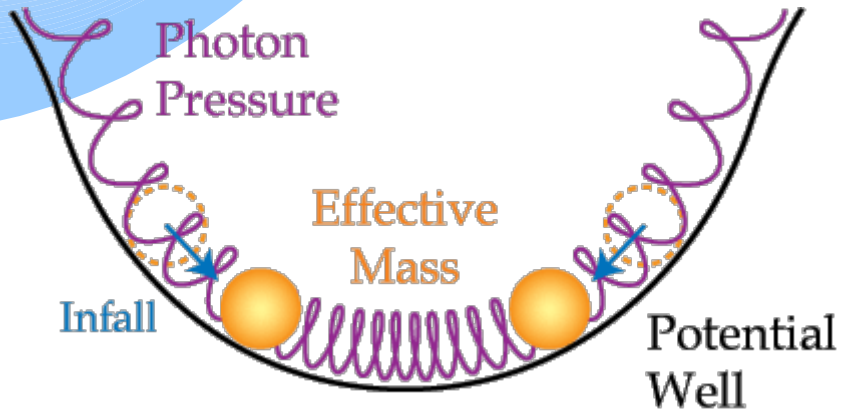


Modern Cosmology

- Modern Cosmology model ΛCDM is very robust
- But uses two unknown components: DE and DM

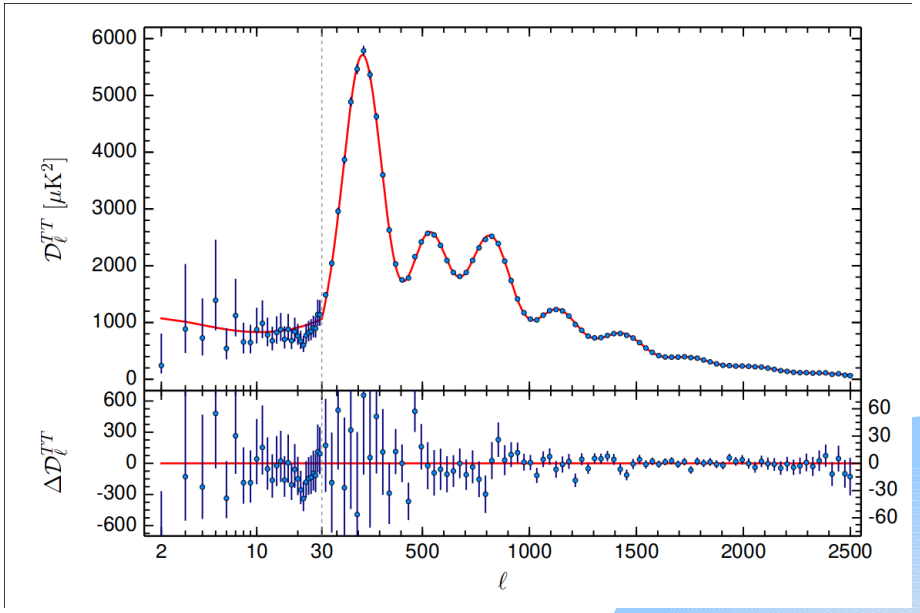


BAO and Cosmology



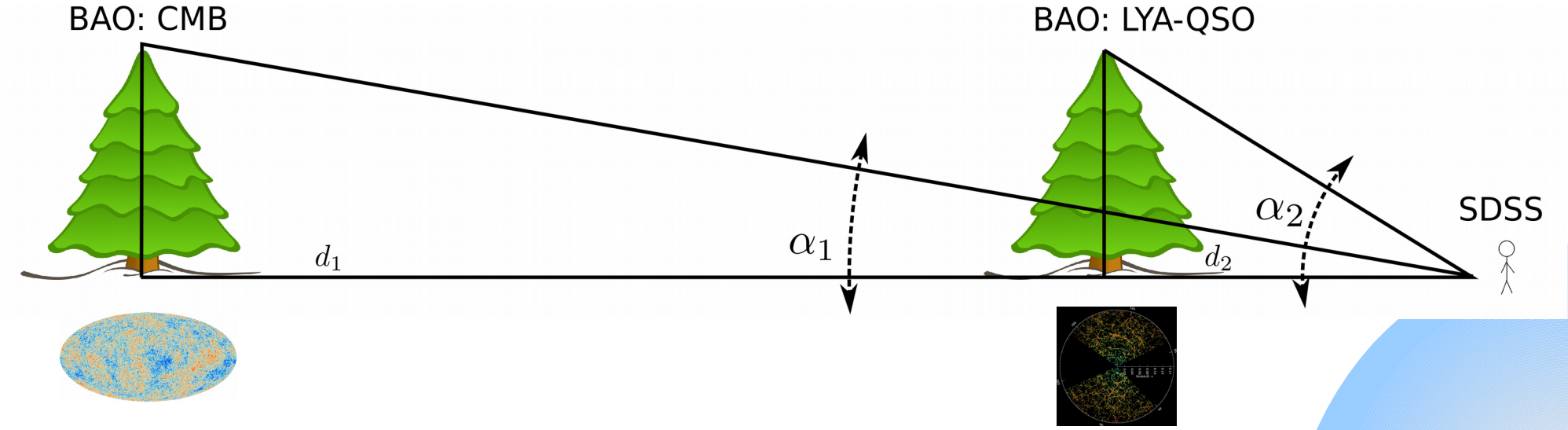
Oscillations of the baryon-photon plasma in potential well.

Detected in the CMB matter power spectrum.



BAO and Cosmology

- A way to understand the nature of DE and DM is to know their density evolution
- Baryonic Acoustic Oscillations allow to do so



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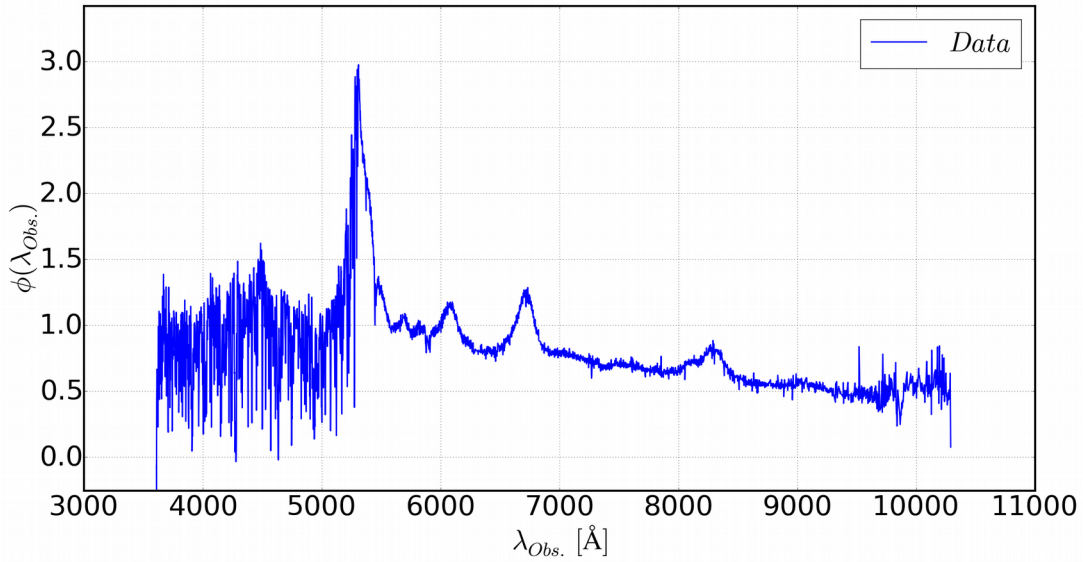
Quasar

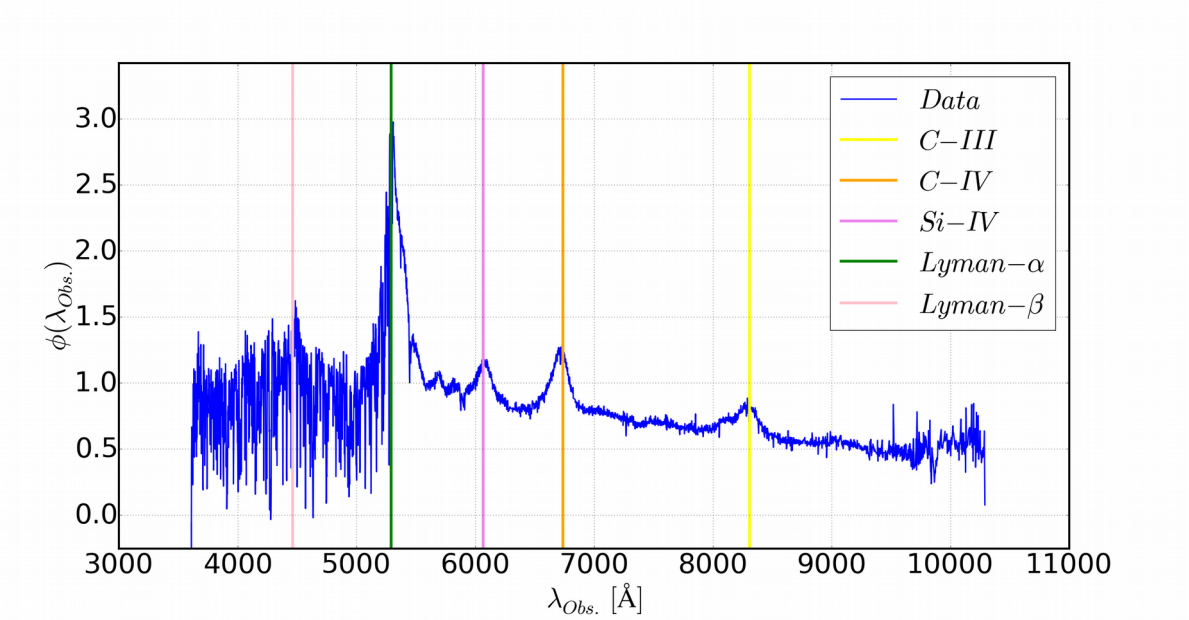
Quasar flux originates from the surrounding of a super-massive black hole



Spectrum of a BOSS Quasar at redshift z = 3.35, the Universe was only 2 billion years old

Quasar

Get redshift from emission lines

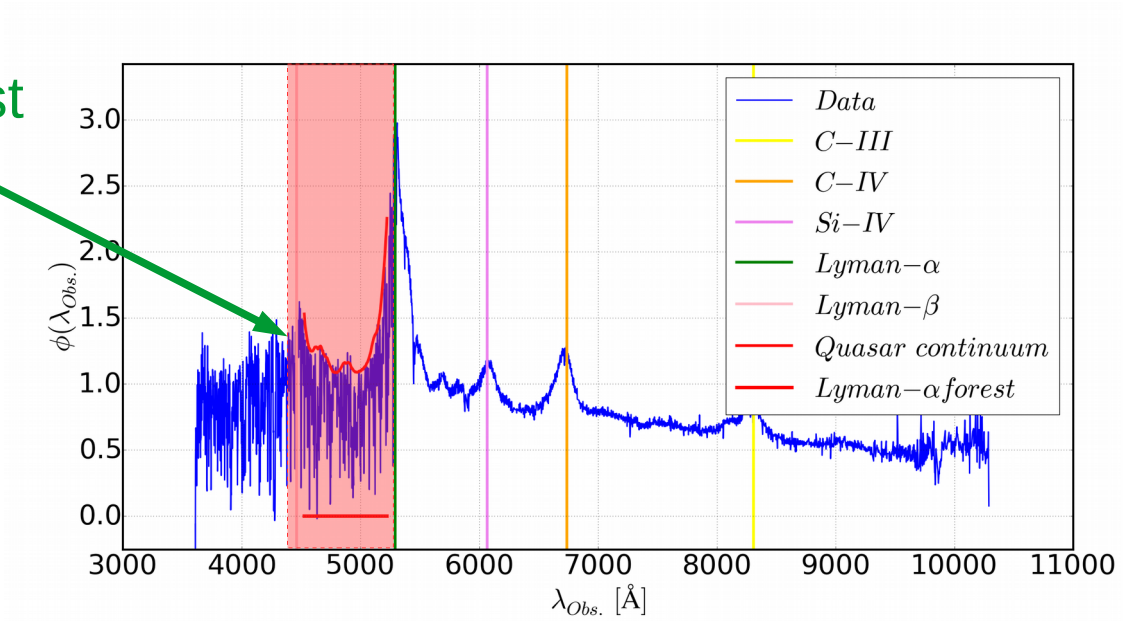


A Quasar is a boolean matter density tracer

Lyman-α forest

Absorption lines from Hydrogen continuum in the Intergalactic Medium (IGM)

Lyman-α forest



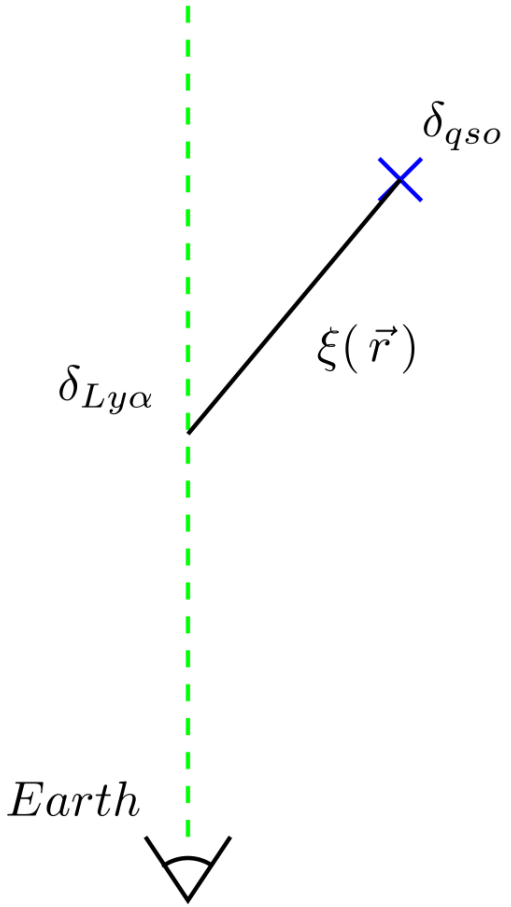
A Lyman-α pixel gives a continuous matter density tracer

Two matter density tracers

Quasar: $\delta_{qso}(\vec{x}) = \begin{cases} 0 \\ 1 \end{cases}$

Lyman-α forest pixel:

$$\delta_{Ly\alpha}(\vec{x}) = \delta_{\alpha}$$



Outline

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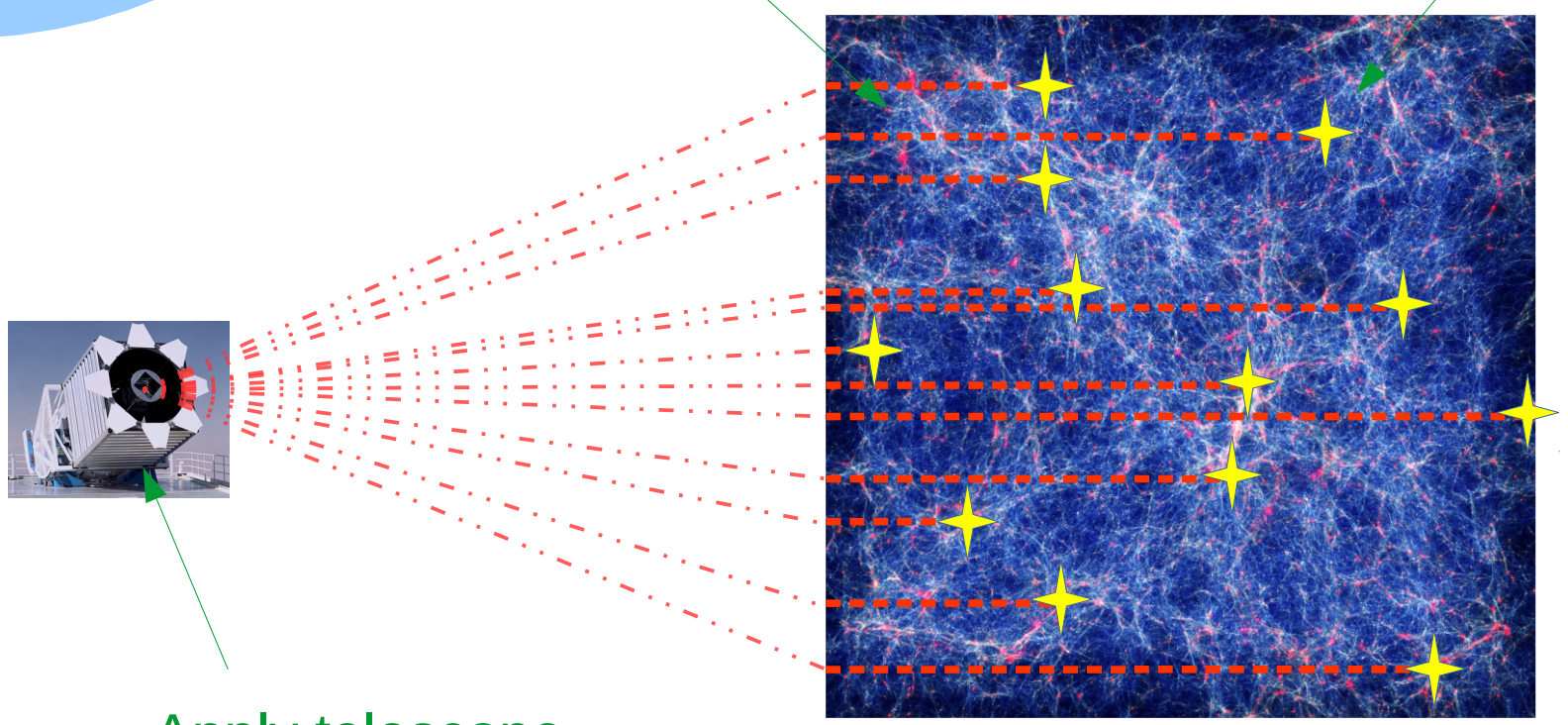
Simulations

- In order to study the robustness of the correlation function:
  - Covariance matrix
  - Bias in measures
  - Error bars of the measures

Gaussian Random Field Simulations

Lyα forest along the line-of-sight

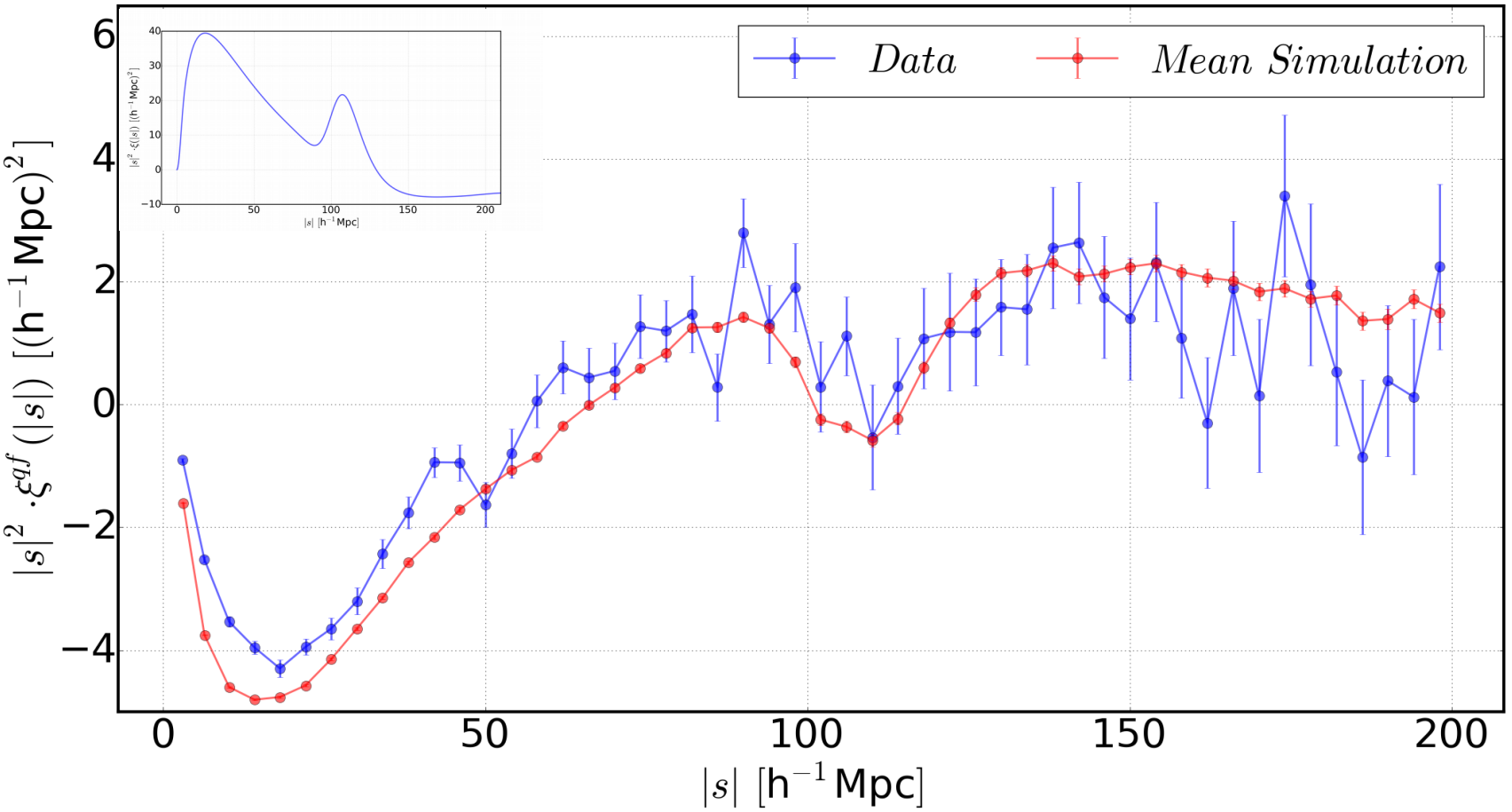
QSO set on big Over-density



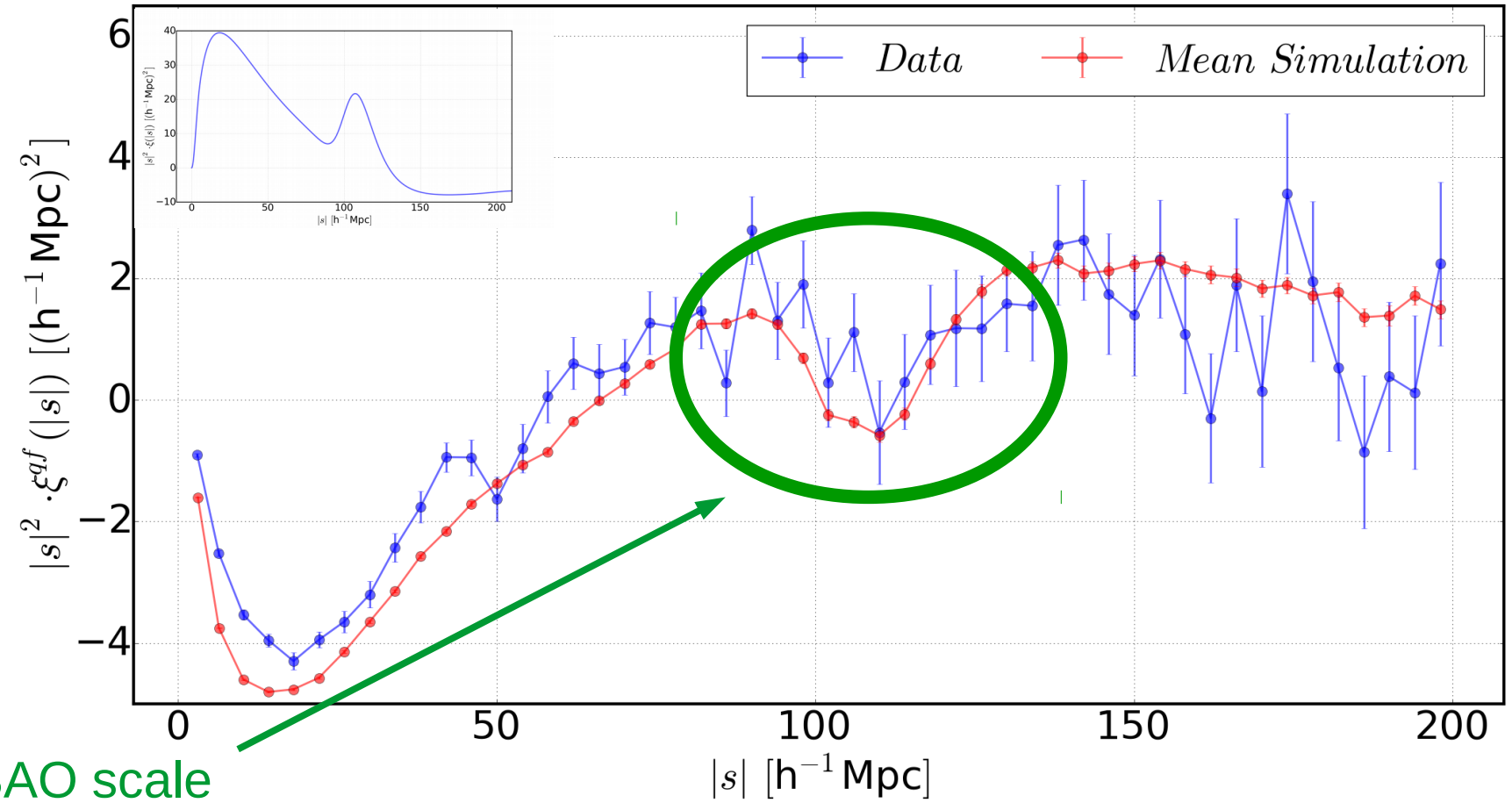
Apply telescope properties

IGM image provided by Julien Baur

Simulations and data

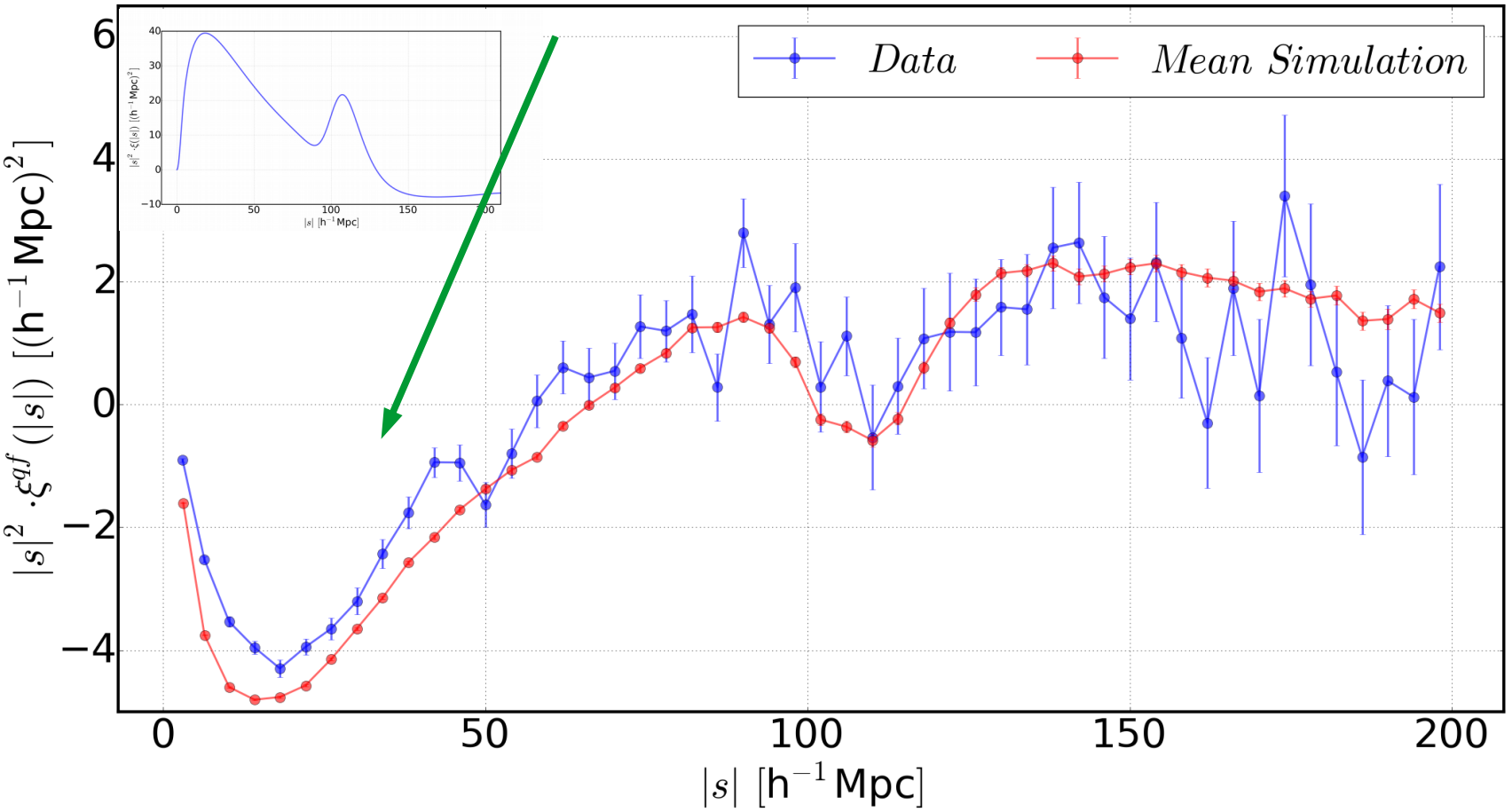


Simulations and data



Simulations and data

Lyα is an absorption
=> Correlation is negative



Conclusion

- BAO scale measurements give the DE and DM density evolution.
- Lyman-α forests and quasars give the furthest measures of BAO scale.
- I have developed simulations of the measure. They allow to test its robustness.

Thank you for your attention