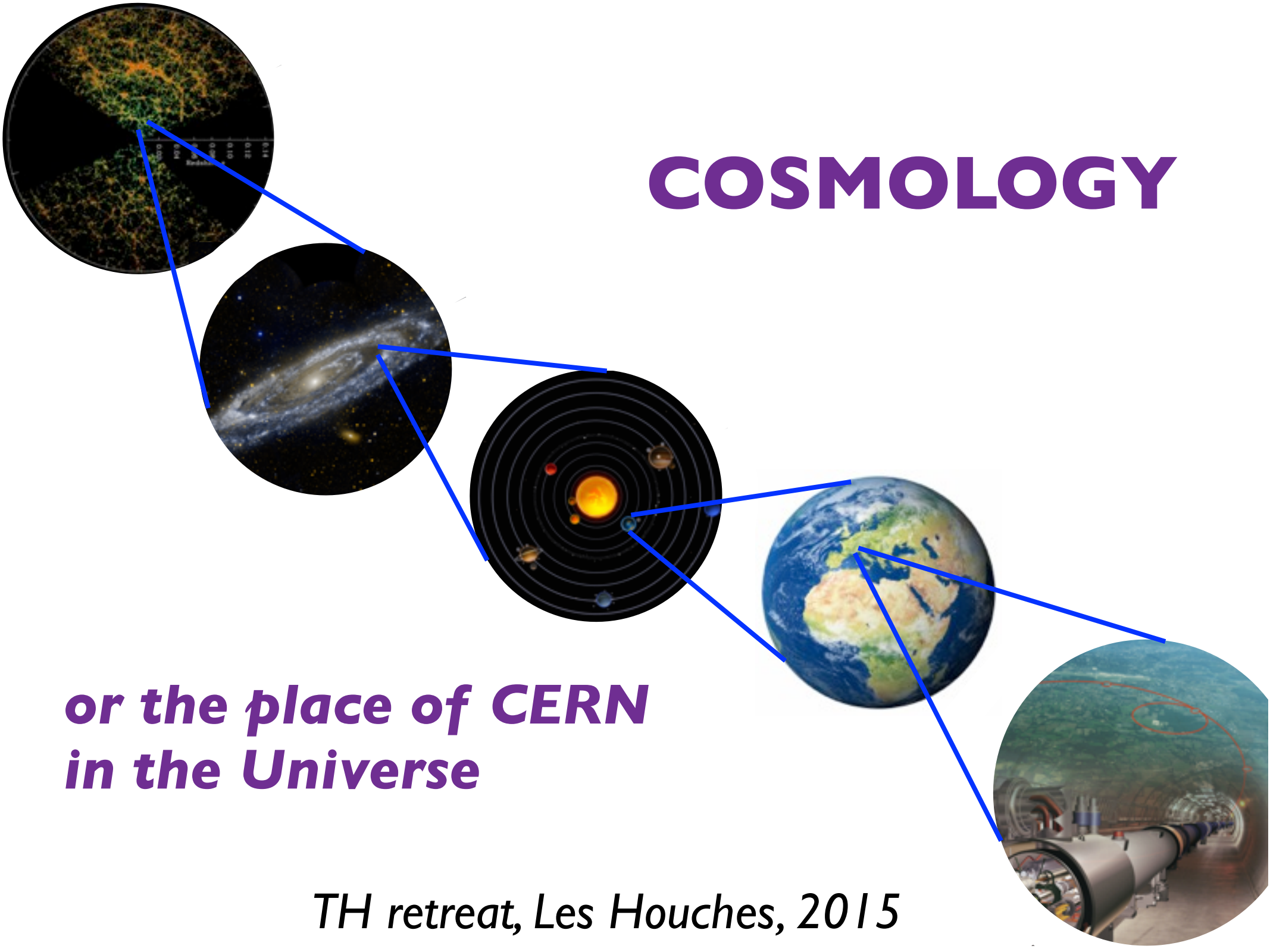
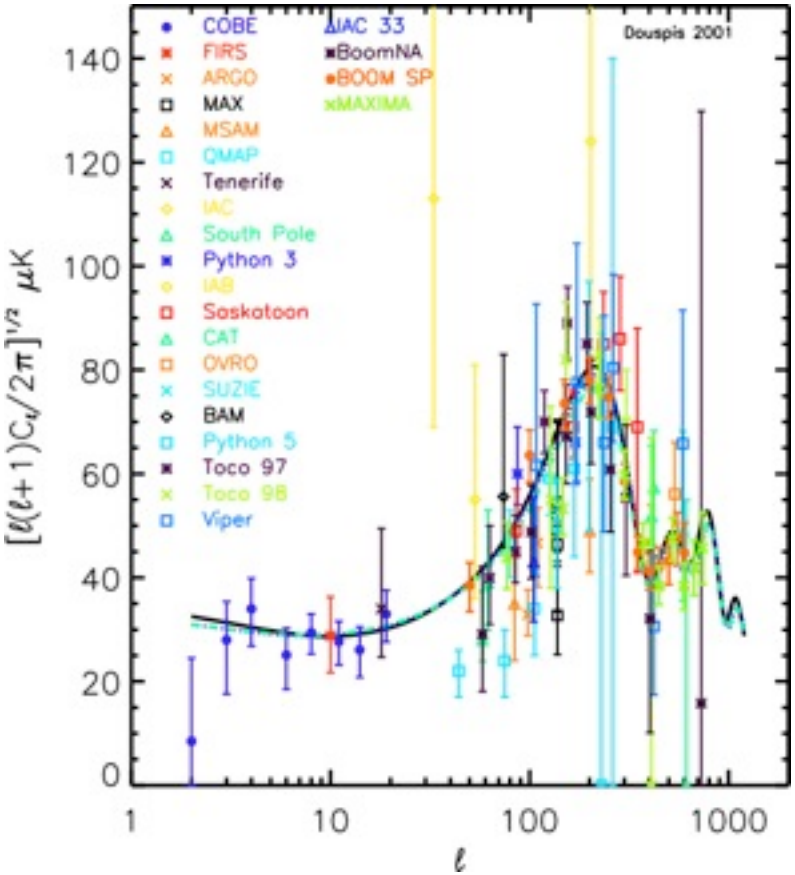


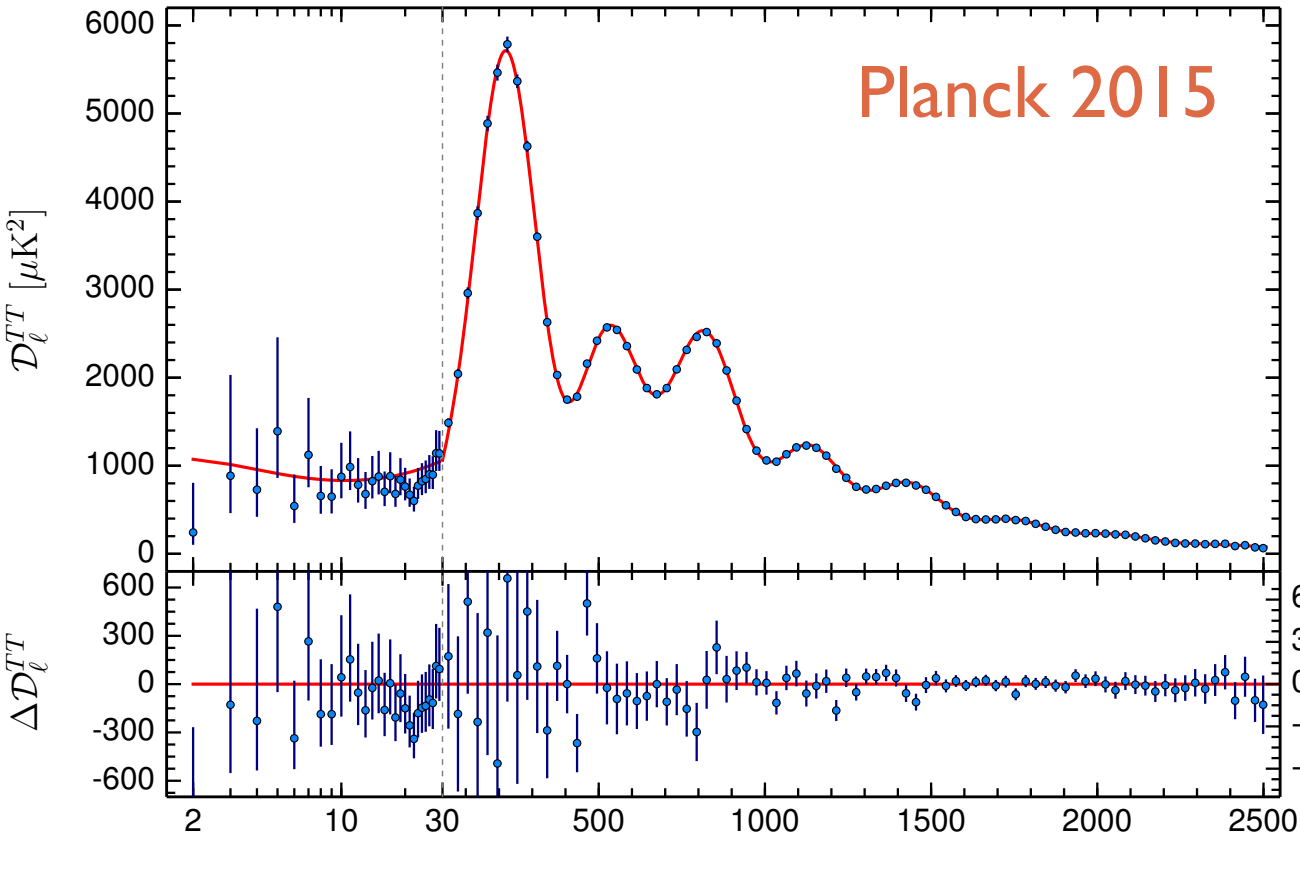
COSMOLOGY

or the place of CERN in the Universe

TH retreat, Les Houches, 2015

From stone age to precision cosmology





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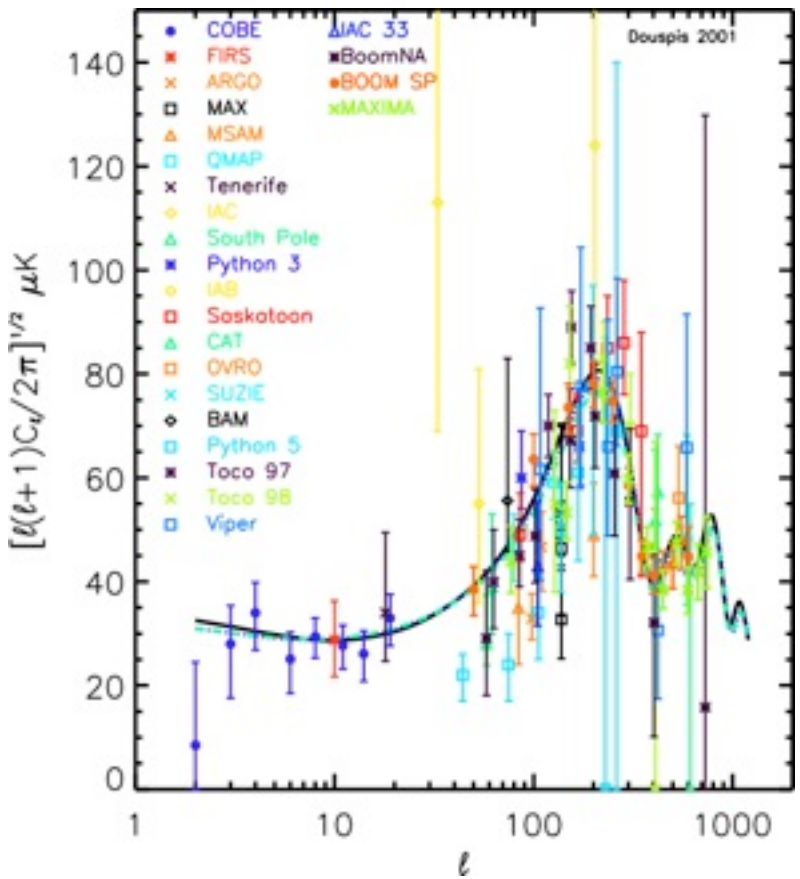

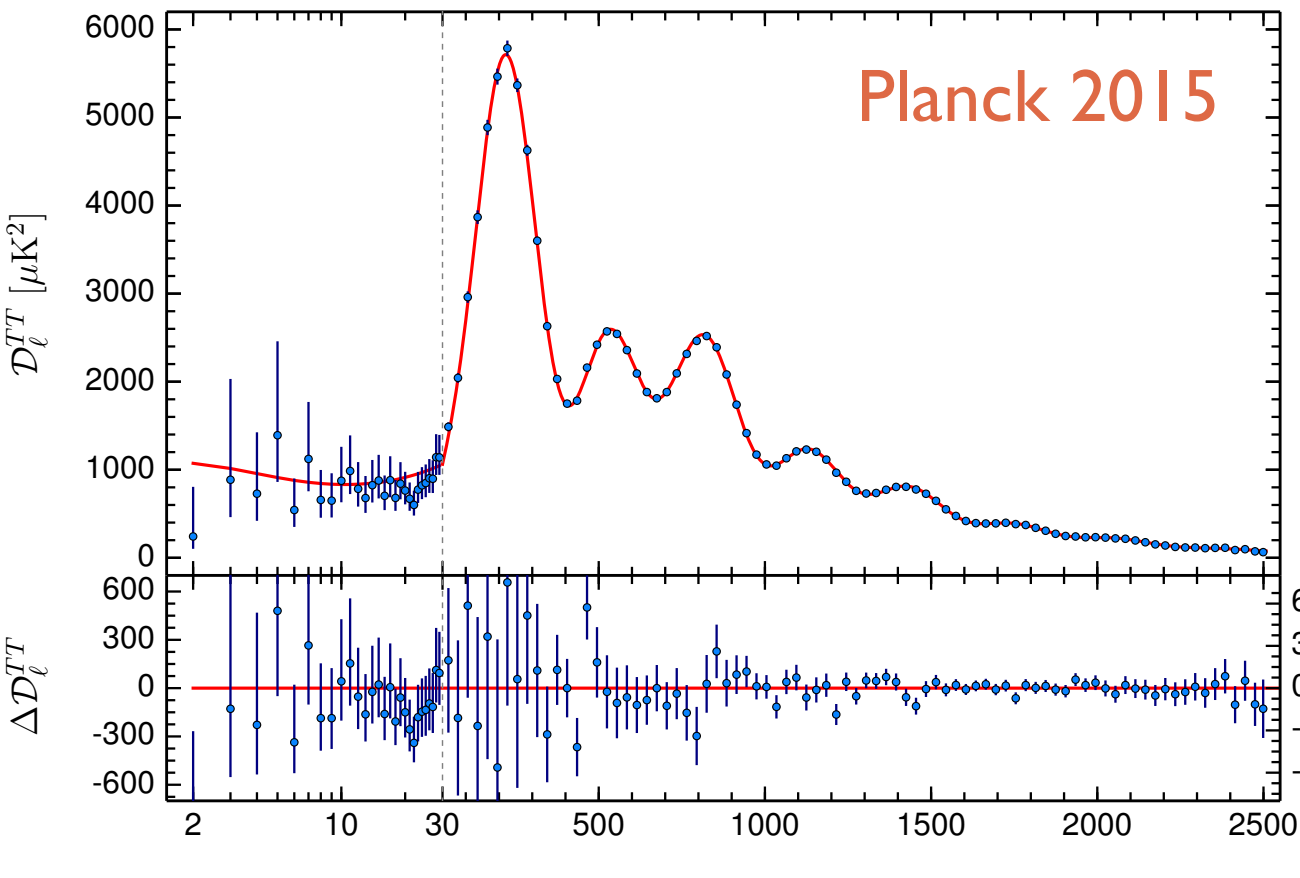

Eldorado of data

today:

- CMB
  - temperature anisotropies
  - polarization anisotropies ⇐ window to primordial GW
- wealth of astronomical / astroparticle data (halo profiles, X-ray, γ , cosmic rays, ...)

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- number counts
- velocity statistics
- weak lensing
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after tomorrow:

- 21 cm deep surveys
- spectral distortions
- multi-messenger astronomy (ν, GW)

Theorist's tasks

1. Learn how to extract useful information from the data

2. Understand what Universe is made of at scales from 10^{21} to 10^{26} m

3. Provide self-contained description of the early universe before nucleosynthesis (~ 1 min after the Big Bang)

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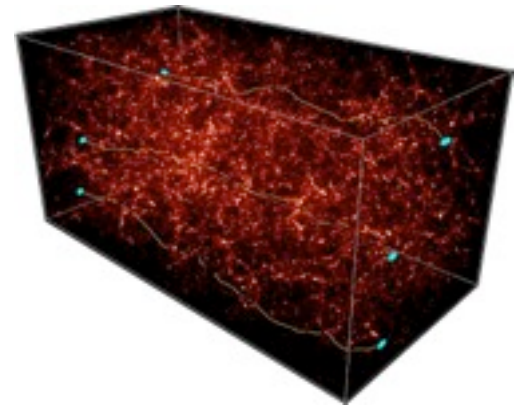

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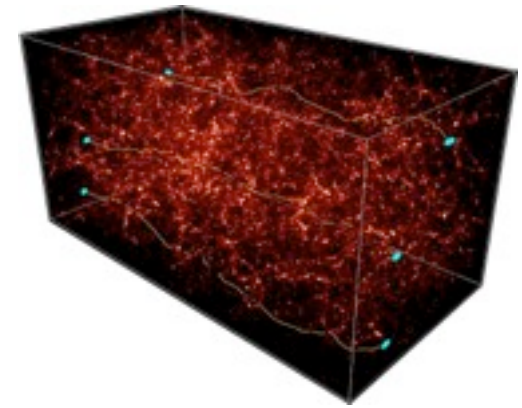

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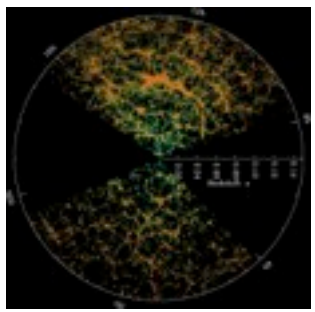

- and non-perturbative regime (halos)

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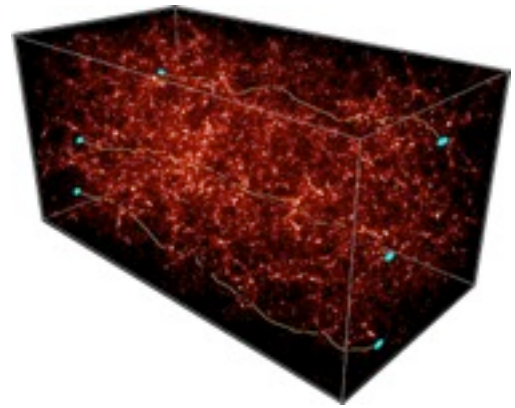

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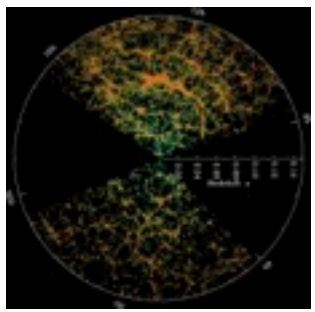

methods of perturbative QFT including effective field theory

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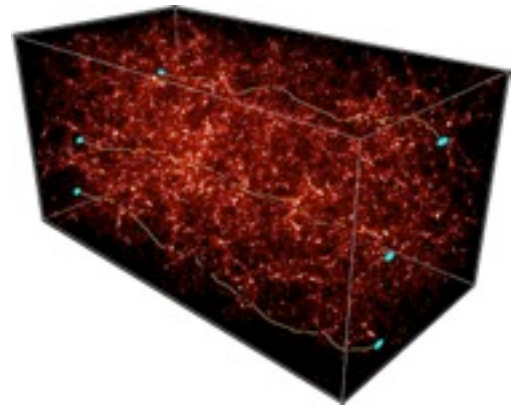

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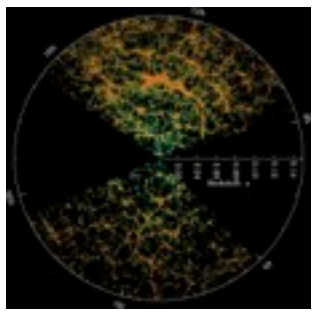

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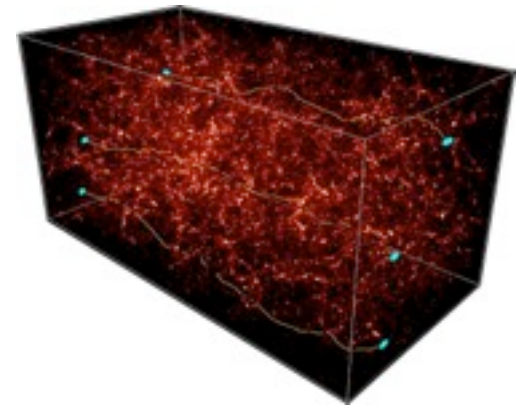

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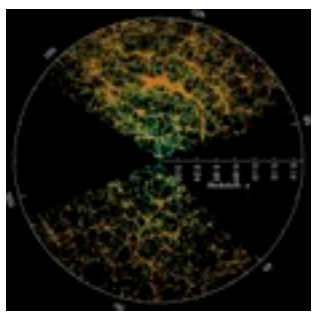

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numerical N-body simulations

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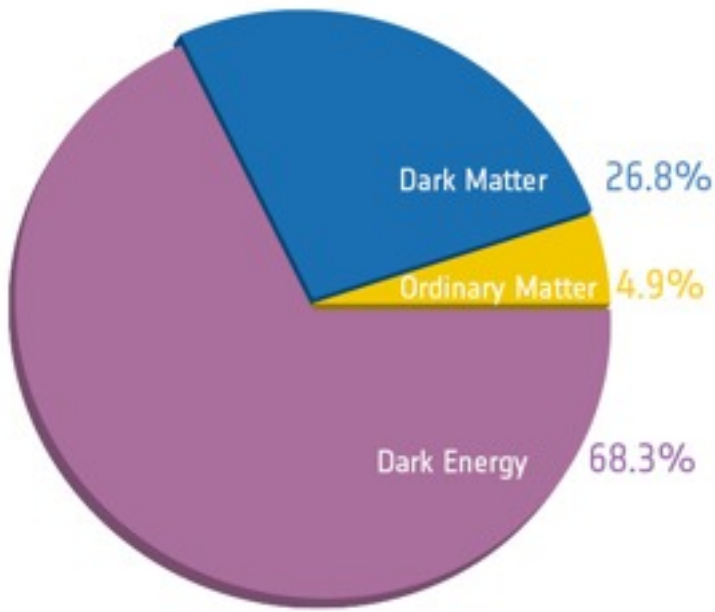

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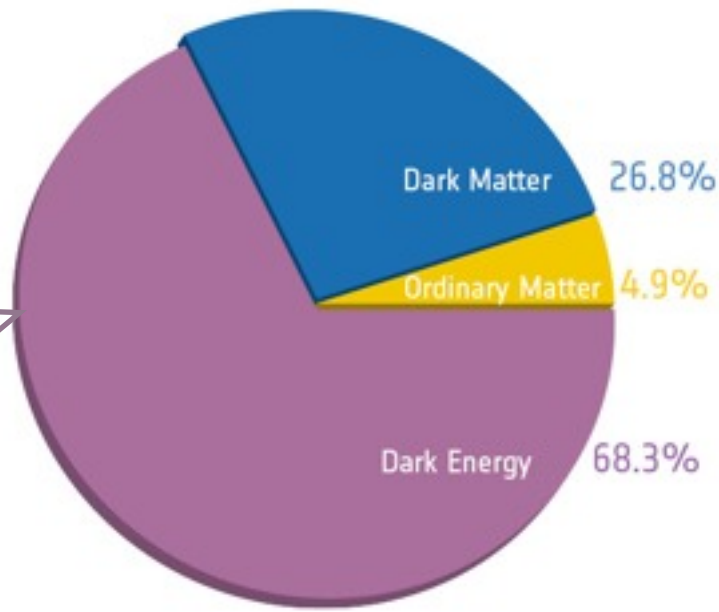

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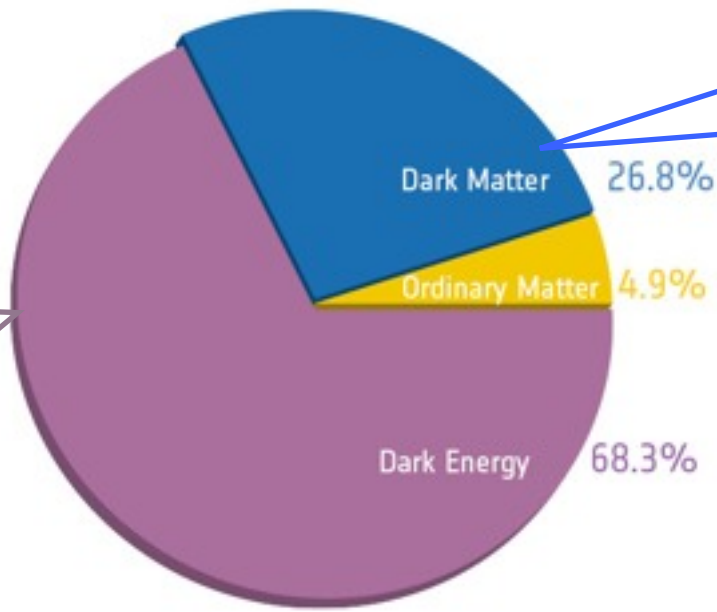

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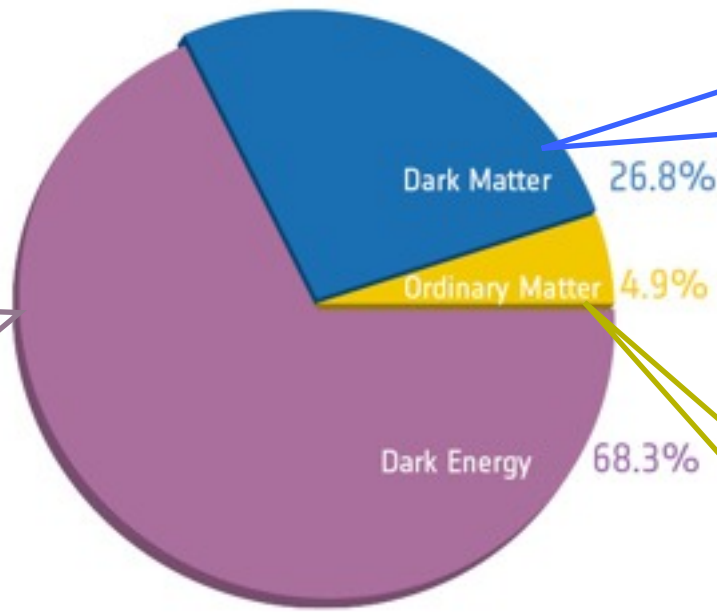

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- what are masses of neutrinos ?

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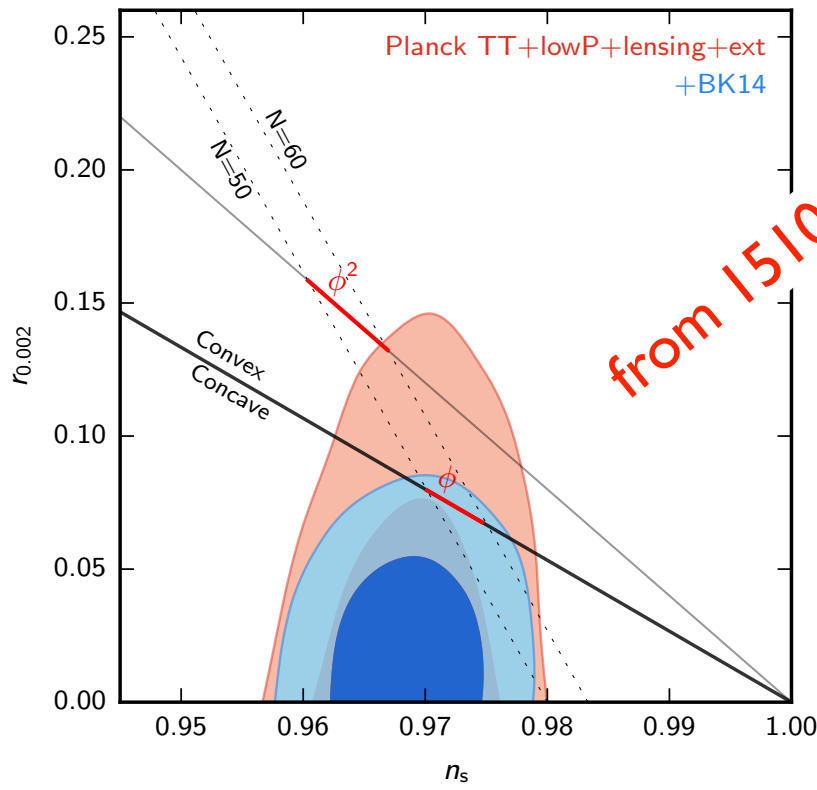
- Inflation: experiments did a good job



from 1510.09217

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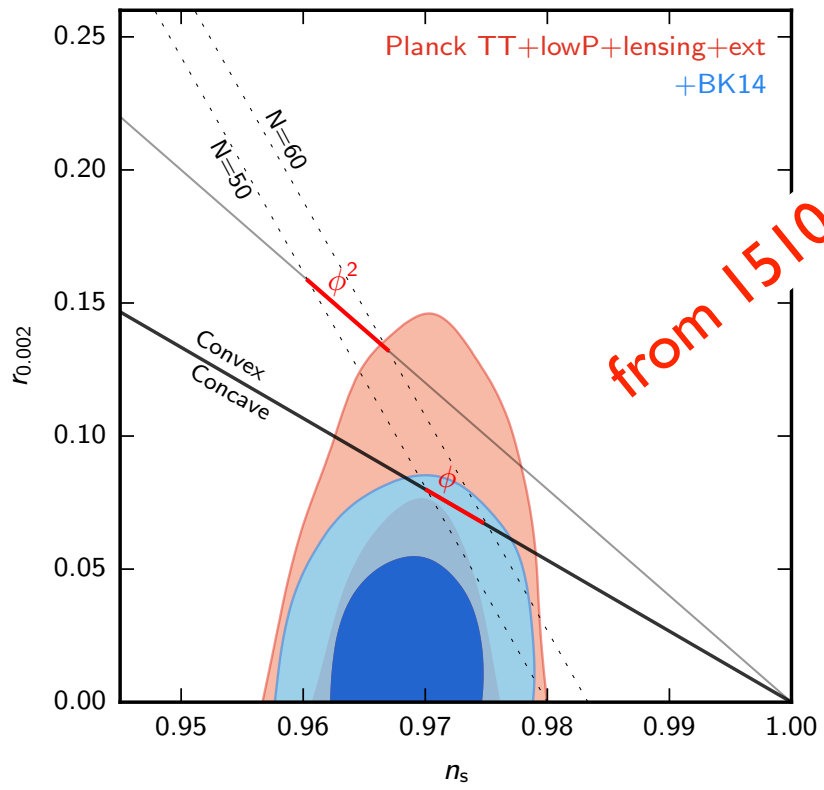

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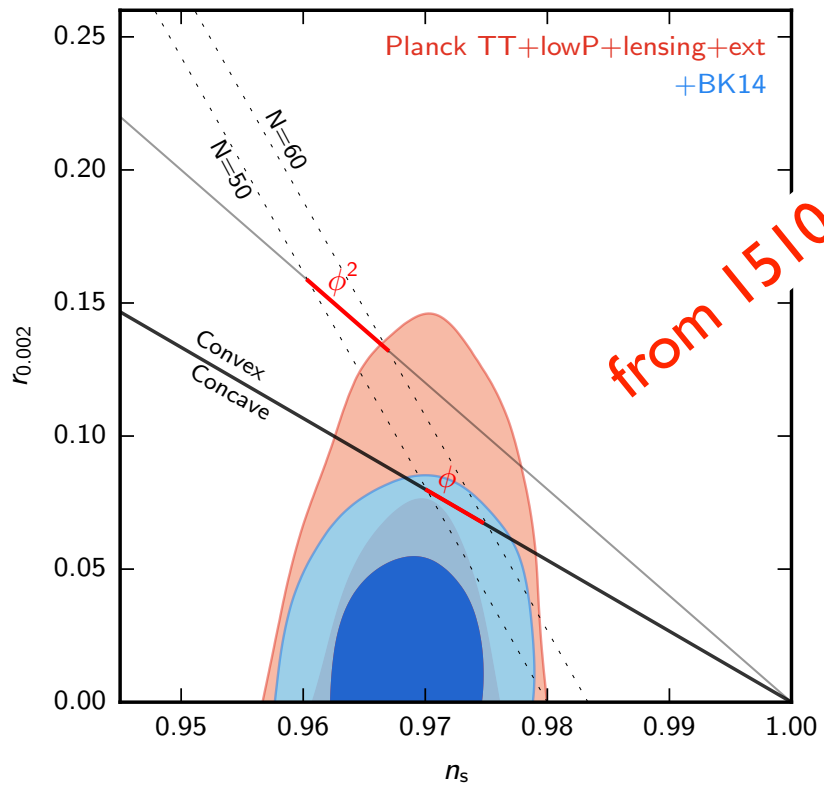

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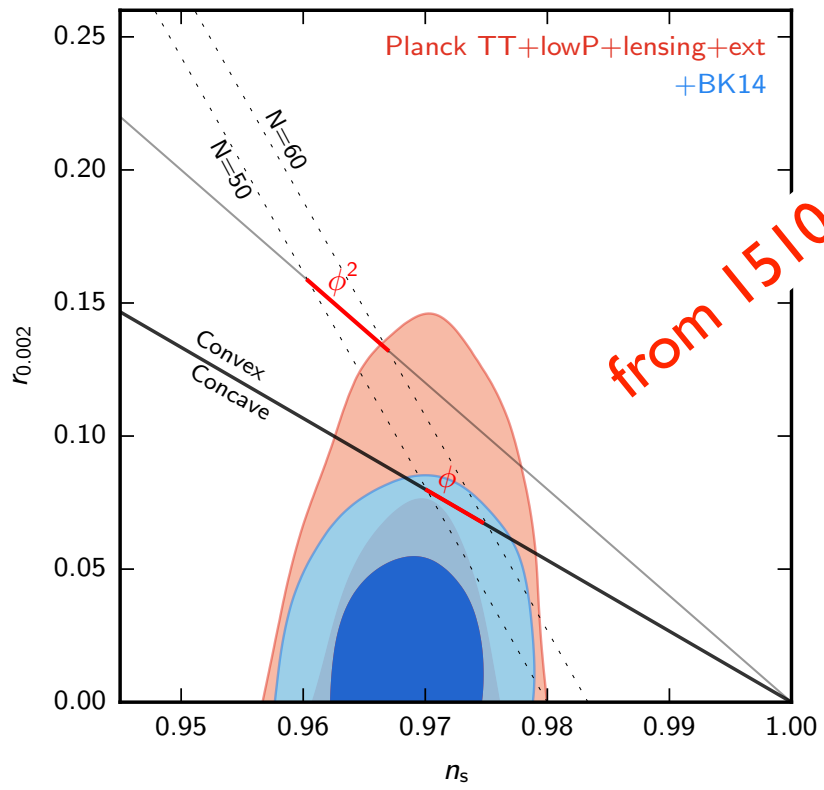

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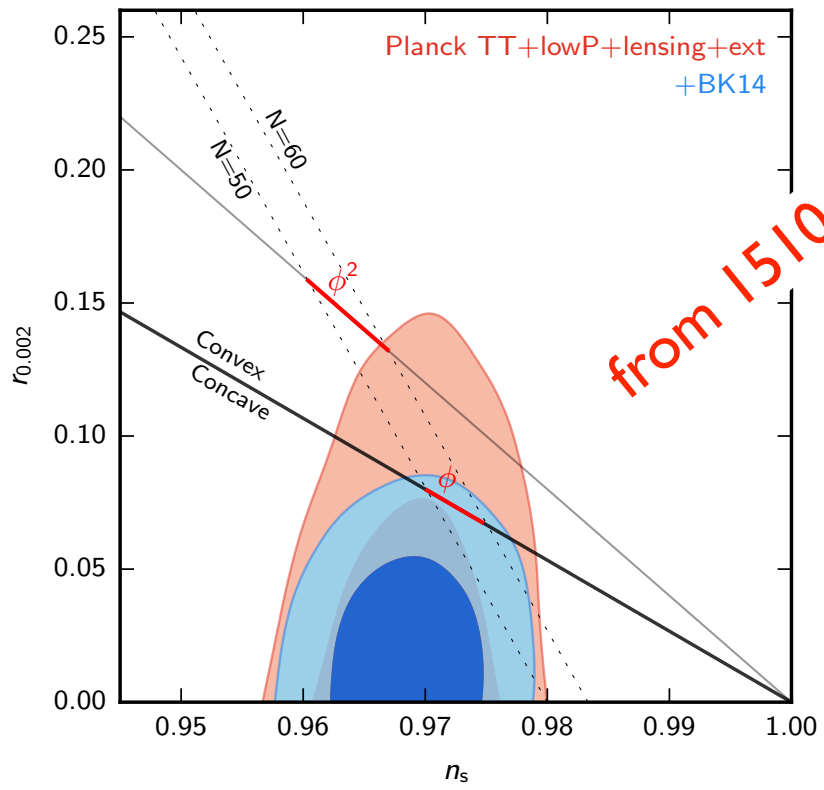

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} - how de they constrain inflationary models ?
- observable signatures ?

Our group

Staff

Diego Blas

Sergey Sibiryakov

Associate

Filippo Vernizzi

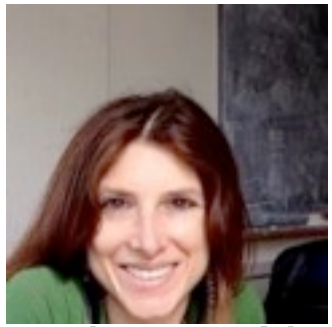
Fellows

Camille Bonvin

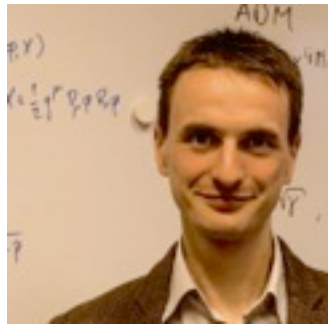
Guido D'Amico

Daniel Figueroa

Mathias Garny



Diana Lopez Nacir



Wessel Valkenburg

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Close interactions / long-term collaborations:

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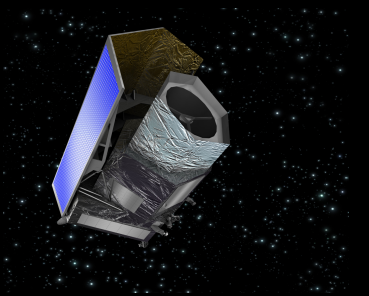
Wednesday, at 11.30 in TH Common Room:

informal seminar about
anything related to cosmology

Filippo Vernizzi (IPhT) - CERN Associate 01/07/2015–30/04/2016

4) General parametrization of effects of dark energy andmodified gravity on structure formation: constraints, forecasts, numerical Boltzmann code, etc

Euclid 2020



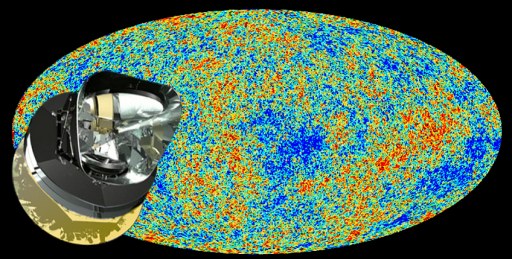
Inflation

1) Primordial non-Gaussianity from inflation

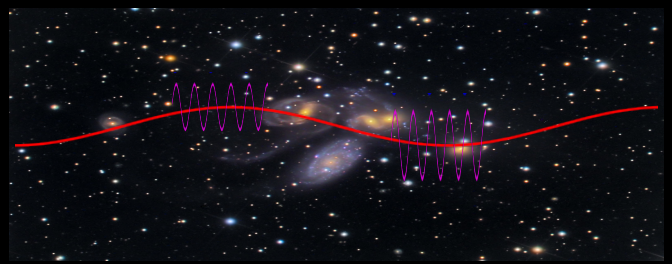
5) New classes of theoretically consistent scalar-tensor theories of gravity

2) “Intrinsic” non-Gaussianity in the CMB

Planck 2013



3) Consistency relations in the LSS and tests of EP violation



About myself

- Staff at CERN & EPFL since 12.2013, on leave from INR RAS (Moscow)
- Organization of CosmoCoffee, Wednesday seminar, Academic Training
- Current research interests:
  - application of QFT / statistical physics methods to LSS
  - the role of Higgs in the early universe
  - non-stringy UV completions of gravity as renormalizable QFT (have to sacrifice Lorentz invariance or unitarity)
  - tests of Lorentz invariance in visible and dark sectors
  - RG flows with emergent space-time symmetries (Lorentz invariance, SUSY)
  - semiclassical methods for description of black hole production