

## 4th LISA Cosmology Working Group Workshop

Organized by Chiara Caprini (Laboratoire AstroParticules et Cosmologie (APC) Paris), Valerie Domcke (Laboratoire AstroParticules et Cosmologie (APC) Paris), Germano Nardini (Bern University), Pedro Schwaller (JGU)

16 -20 October 2017

The topical workshop at MITP was the 4th LISA Cosmology Working Group Workshop. After the selection of the LISA mission by ESA following the call for mission in autumn 2016, and the end of ESA design study in summer 2017, the configuration of the LISA interferometer is substantially fixed. It was therefore necessary to precisely assess the capability of the new LISA configuration to test different aspects of cosmology and fundamental physics. Moreover, the community has to start to focus on new issues connected with data analysis techniques and with the needs of the LISA Consortium to address ESA requests. The goal of the topical workshop was to obtain concrete results in this respect, therefore, it was mostly dedicated to collaborative work in teams, accompanied by a few seminars on new results.

The workshop covered the following main topics: first order phase transitions, detection of stochastic backgrounds, topological defects, standard sirens, testing general relativity, inflation and beyond, primordial black holes and dark matter, structure formation.

The following topics were discussed at the 4th LISA CosWG:

(i) SGWB from phase transitions: The spectral shapes used in the previous LISA paper need to be updated in view of the new knowledge on the runaway condition, the turbulence, and the collisions/sound sources. It is strategic to further diffuse and clarify plots and results resuming all information and forecasts on signals coming from phase transitions. It is strategic to explore the potential of LISA for particle physics.

(ii) Beyond the Standard Paradigms (BSM here): Light degrees of freedom coupled to the mass must be included. It was briefly reviewed how this situation emerges within some BSM models. There was a discussion on how this idea can be connected to light (pseudo)scalars and possibly to dark matter. There are different approaches that can be explored for this topic: modification of emission (different orbits, extra radiation), different properties of propagation and detection. The recent paper published by LIGO/Virgo on constraining additional GW propagation modes and recent theoretical papers connected to this measurement was reviewed.

(iii) Standard Sirens: There were reviews and discussion about MBHB formation models, their rates in LISA, their spins, and counterpart generation. A presentation was given of the last LISA constraints on cosmological parameters together with forecasts on combining several sources at different redshifts. Old results on the statistical method to identify the redshift of the GW emitting binary were presented. There was also a discussion of  $H_0$  constraints by LIGO/Virgo using the NS binary coalescence and em counterparts.

(iv) Inflation and primordial BHs: The latest inflation paper could be updated with the latest power-law sensitivity curve [TBD]. It turned out to be essential to get a very good characterization of the SGWB also beyond the power spectrum. A discussion took place about PBHs and the question how this hypothesis can be confirmed and distinguished from the stellar origin.

(v) Topological defects: The state of the art concerning topological defects versus LISA was reviewed. The ability of LISA to detect cosmic strings and how it depends on the cosmic string model was discussed. There are issues in the subject that need long-term investigations.