

LISA Cosmology Working Group

- I. LISA Science of Cosmological Interest
- II. Role of the Cosmology Working Group
- III. Main Activities
- IV. Plans for the future

On behalf of the Cosmology Working Group
Robert Caldwell, Germano Nardini – co-chairs

I. LISA Science Objectives

- A. Sirens
- B. Stochastic Backgrounds
- C. But there is much more!

“LISA” + “cosmology” is growing since 2015
...very rapidly since 2019!

Development of general GW cosmology literature

II. Role of CosWG

- A. Membership through LISA consortium
- B. Identify new science opportunities
- C. Develop new methods of analysis
- D. WG projects, Work Package projects

III. Main activities

- A. Workshops – there have been eight!
- B. Projects – see examples
- C. Research White Paper – in progress

Cosmology Working Group meetings

More than a themed workshop;
Planned topics and guided discussions

CERN: April 2015

Stavanger, Norway: Oct 2015

DESY: Oct 2016

Benasque, Spain: May 2017*

Mainz: Oct 2017 (<https://indico.mitp.uni-mainz.de/event/110/overview>)

Helsinki: June 2018 (<https://indico.in2p3.fr/event/16923/>)

Madrid: January 2019 (<https://workshops.ift.uam-csic.es/lisa2019>)

Padua: September 2019 (<https://agenda.infn.it/event/19104>)

Paris: July 2020 (<https://indico.in2p3.fr/event/20350/>)

8th LISA Cosmology WG meeting

Agenda: LISA update /
Science and the LISA sensitivity curve / Alberto Sesana
LISA Data Challenges / Stanislav Babak

discussion: LSG / CosWG reorganization
CosWG White Paper

project reports: PBHs, Modified Gravity, SGWB analysis,
Maximum Likelihood Map-Making

planning: ongoing projects
White Paper: topics, assignments

Cosmology Working Group projects

Recent Examples

- Maximum likelihood map-making with LISA (2006.03313)
- Detecting gravitational waves from cosmological phase transitions with LISA: an update (1910.013125)
- Probing the gravitational wave background from cosmic strings with LISA (1909.00819)
- Reconstructing the spectral shape of a stochastic gravitational wave background with LISA (1906.09244)
- Testing modified gravity at cosmological distances with LISA standard sirens (1906.01593)

LISA Cosmology: 2021 White Paper

As originally proposed, LISA has two science objectives of cosmological bearing:

- To probe the expansion rate of the Universe, and
- To understand stochastic backgrounds and their implications for early universe and TeV-scale particle physics

Cosmology WG: *Investigate*

- models of cosmology that may be tested by LISA,
- methods of analysis to reveal or constrain these models.

Research White Paper

- Present the “state of the art”
- Opportunities → Objectives → Priorities



LISA Cosmology: 2021 White Paper

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Tests of Cosmic Expansion and Acceleration with Standard Sirens

Coordinators: Jose Maria Ezquiaga, Alvise Raccanelli, Nicola Tamanini

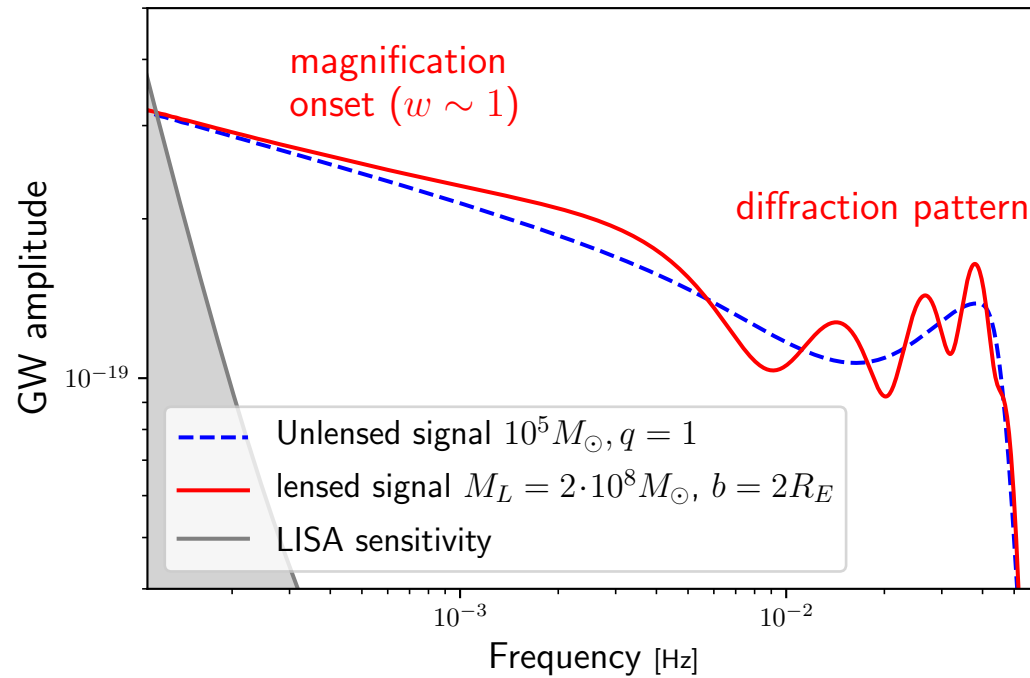
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GW Lensing

Coordinators: David Bacon, Miguel Zumalacarregui

Contributors: Giuseppe Congedo, Giulia Cusin, Jose Maria Ezquiaga, Suvodip Mukherjee

Gravitational-lensing wave effects can reveal information about large scale structure along the line of sight



Miguel Zumalacarregui

Phase Transitions

Coordinators: Jonathan Kozaczuk, Marek Lewicki

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Strings

Coordinators: Marek Lewicki, Lara Sousa

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Constraints on Modified GR

Coordinator: Daniele Vernieri

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SGWB pipeline tools

Coordinators: Nikolaos Karnesis, Mauro Pieroni, Marco Peloso

Contributors: Nicola Bartolo, Carlo Contaldi, Vincent Desjacques, Raphael Flauger, Sabino Matarrese, Arianna Renzi, Angelo Ricciardone, Mairi Sakellariadou, Lorenzo Sorbo, Jesus Torrado

Transient signal pipeline tools for cosmology

Coordinator: Lucas Lombriser

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LISA Cosmology Working Group

2021 White Paper

– *coming soon!*

Cosmology with the Laser Interferometer Space Antenna: 2021
LISA Cosmology Working Group
Author List TBD
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Abstract
The Laser Interferometer Space Antenna (LISA) has two scientific objectives of cosmological focus: to probe the expansion rate of the Universe, and to understand stochastic backgrounds and their implications for early universe and TeV-scale particle physics. However, the range of potential cosmological applications of gravitational wave observations extends well beyond these two objectives. This research white paper presents a summary of the state of the art in LISA cosmology, theory and methods, and identifies new opportunities to use gravitational wave observations by LISA to probe the universe.

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IV. Future plans

- A. “Recent” Reorganization
 - 1. CosWG and Work Packages
 - 2. New, additional co-chairs
 - 3. Mode of operation
- B. Tentative Fall workshop (virtual)