Journal of Physics and Astronomy

Short Communication | Vol 11 Iss S1

A Short Communication of the Recent White Paper by the Fundamental Physics Working Group of Laser Interferometer Space Antenna

Philippe Jetzer*

Department of Physics, University of Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland

***Corresponding author:** Philippe Jetzer, Department of Physics, University of Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland, E-Mail: jetzer@physik.uzh.ch

Received: 13-Apr-2023, Manuscript No. TSPA-23-95781; **Editor assigned:** 17-Apr-2023, Pre QC No. TSPA-23-95781(PQ); **Reviewed:** 01-May-2023, QC No. TSPA-23-95781; **Revised:** 09-May-2023, Manuscript No. TSPA-23-95781(R); **Published:** 16-May-2023, DOI. 10.37532/2320-6756.2023.11(S1).002

Abstract

We give a short overview of the recently appeared white paper on fundamental physics with LISA. In view of the adoption by ESA of the LISA (Laser Interferometer Space Antenna) mission the working groups for the different scientific topics, which will be addressed by LISA, have produced so called white papers. The aim of the white papers is to present the today's knowledge on the various scientific goals which are expected to be investigated by LISA. Among the scientific questions LISA will address there are also issues on the fundamental nature of gravity. LISA will probe it in the regime where the gravitational interaction is both strong and dynamical

Keywords: Gravitational waves; LISA; Dark energy; Black hole

About the Study

LISA will probe it in the regime where the gravitational interaction is both strong and dynamical. This and further issues are discussed in the white paper produced by the Fundamental Physics Working Group (FPWG) of the LISA Consortium [1,2]. All white papers are published (or will be in near future) in the Living Reviews in Relativity [3].

Indeed, gravity is at the forefront of many of the most relevant questions in fundamental physics, which include the classical dynamics and quantum nature of black holes, the matter and antimatter asymmetry of the observable universe, the processes at play during the expansion of the universe and during cosmological structure formation, and, of course, the intrinsic nature of dark matter and dark energy, and perhaps of space time itself. The answers to these questions will clearly require cross-disciplinary explorations. The recent observations of Gravitational Waves (GWs) are beginning to help us to go deeper into these questions, opening new research directions at the interplay between fundamental theory and observation. GWs have the potential to examine largely unexplored regions of the universe that are otherwise electromagnetically obscure, such as the

Citation: Jetzer P. A Short Description of the Recent White Paper by the Fundamental Physics Working Group of LISA. 2023;11(S1):002

vicinity of black hole horizons, early phases in the formation of large-scale structure, and the hot big bang. LISA has the potential to contribute enormously in this quest, as this instrument is uniquely positioned to observe, for the first time, long-wavelength GWs [1,4] and therefore, new sources of GW radiation.

It consists of eight chapters, which include the discussion on tests of general relativity, on the nature of black holes, and on the ΛCDM model and dark energy. A chapter is devoted to the waveform modelling taking into account beyond general relativity effects. Many of the ideas discussed are still in a very preliminary stage and will require detailed studies such as to lead to verifiable tests with LISA. In particular the modelling of the waveforms, such as to confront them with real LISA data will require substantial studies. It will turn out that only some of the proposed modifications of general relativity will be verifiable with LISA. As mentioned the white paper is an attempt to give an overview of the present best knowledge on the possible modifications of general relativity and on the nature of black holes. Undoubtedly these views will evolve and change in the next decade or more till LISA will fly and take data. The white paper of the FPWG and of the other working groups should also inspire future research directions as well as establish connections between them. It is forseen to have regular updates of the white papers such as to take into account the ongoing developments both coming from the new observations with the Earth bounded gravitational wave detectors and all the other instruments such as the James Webb Telescope, and the theoretical advancements in the field.

REFERENCES

1. Amaro SP, Audley H, Babak S, et al. Laser interferometer space antenna. LISA collaboration, Astro-ph IM. 2017;1702:00786.
2. Arun KG, Belgacem E, Benkel R, et al. New horizons for fundamental physics with LISA. Living Rev Relativ. 2022;25:4.
3. Amaro SP, Andrews J, Arca SM, et al. Astrophysics with the laser interferometer space antenna. Living Rev Relativ. 2023;26:2.
4. Barausse E, Berti E, Hertog T, et al. Prospects for fundamental physics with LISA. Gen Rel Grav. 2020;52:81.