Supermassive black hole binaries as targets for prospective spaceborne VLBI and gravitational wave observatories

Gurvits, Leonid I.; Polnarev, Alexander G.

Publication date
2023

Document Version
Final published version

Citation (APA)
Gurvits, L. I., & Polnarev, A. G. (2023). *Supermassive black hole binaries as targets for prospective spaceborne VLBI and gravitational wave observatories.* Abstract from 74th International Astronautical Congress, IAC 2023, Baku, Azerbaijan.

IAF SYMPOSIUM ON ONGOING AND NEAR FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS (A7)
Science Goals and Drivers for Future Exoplanet, Space Astronomy and Space Physics (2)

Author: Prof. Leonid Gurvits
The Netherlands

Prof. Alexander Polnarev
Queen Mary University of London, United Kingdom

SUPERMASSIVE BLACK HOLE BINARIES AS TARGETS FOR PROSPECTIVE SPACEBORNE VLBI AND GRAVITATIONAL WAVE OBSERVATORIES

Abstract

Over the past several years a number of high-resolution studies conducted with Earth-based and space-borne Very Long Baseline Interferometry (VLBI) systems provided a large volume of experimental data on the phenomenon of Supermassive Black Hole Binaries (SMBHB). These objects manifest themselves as active galactic nuclei, observable in all domains of the electromagnetic spectrum. At the same time, these objects are responsible for generating gravitational waves (GW) with predictable parameters. Synergistic studies of their electromagnetic and gravitational wave emission constitute the essence of multimessenger astrophysics and offer hitherto unavailable opportunities for addressing fundamental questions of physics and cosmology.

As a study case we present recent results of high-resolution monitoring of the high-redshift object J2102+6015 (z=4.575, Titov et al. 2023, Gurvits et al. 2023). This object demonstrates quasi-periodic astrometric variations which might be indicative of the presence of SMBHB in its active nuclei. We analyze parameters of this nuclei and consider various scenarios of its astrophysical evolution which involves GW emission as an important ingredient. This analysis might serve as an input into evaluation of specifications for future GW telescopes able to operate in the sub-millihertz domain of GW spectrum. As a benchmark for this analysis, we consider specifications of the ESA's Laser Interferometer Space Antenna (LISA) mission (Amaro-Seoane et al. 2017).

We present the case for joint investigations of SMBHB by VLBI and GW telescopes as a powerful tool for understanding fundamental properties of gravitation. Since SMBHB are observable within a broad range of redshifts, the combination of VLBI and GW studies will enable decisive cosmological tests. Especial role in these tests will be performed by next generation space VLBI missions at millimeter and submillimeter wavelengths prototyped in the TeraHertz Exploration and Zooming-in for Astrophysics concept (Gurvits et al. 2021, 2022) developed in the framework of the ESA's Voyage 2050 programme.

References

Amaro-Seoane P. et al., 2017, Laser Interferometer Space Antenna, arXiv:1702.00786
Gurvits L.I. et al., 2021, Experimental Astronomy 51(3), 559–554
Gurvits L.I. et al., 2022, Acta Astronautica 196, 314–333
Gurvits L.I. et al., 2023, Proceedings of the IAU Symposium No. 375, arXiv:2301.12283
Titov O. et al., 2023 Astronomical Journal 165(2), id. 69