

## Exploring the Axiverse by Gravitational Waves and Gamma Rays

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It has passed almost five years since the concept of the Axiverse was proposed by Arvanitaki and others [1,2]. During these five years, there have been various interesting new developments in investigations of phenomena related to the Axiverse both in the theoretical side and in the experimental/observational side. In the present talk, among these new developments, I overview results of our studies related to two aspects of the Axiverse. The first one is the black hole superradiance instability. We present in detail the result of our numerical simulations on the growth of an axion cloud by superradiant instability around a Kerr black hole and its collapse by bose nova explosion and of numerical estimations of gravitational wave emission from the axion cloud. On the basis of these results, we discuss constraints on superstring axion mass obtained from the null detection of the gravitational wave emissions from such an axion cloud by LIGO [3,4]. The second one is the effect of the Primakov process on the high energy gamma rays from blazars. We show that we can derive a strong constraint on the mass and axion decay constant if we assume that the contradiction between the Fermi measurements of the gamma-ray spectra of blazars and the cosmic infrared background observed by the recent CIBER experiment are resolved by axions.

### References:

- [1] A. Arvanitaki, S. Dimopoulos, S. Dubovski, N. Kaloper and J. March-Russell, Phys. Rev. D 81, 123530 (2010).
- [2] H. Kodama, Int. J. Mod. Phys. Conf. Ser. 7, 84 (2012).
- [3] H. Yoshino and H. Kodama, Prog. Theor. Phys. 128, 153 (2012).
- [4] H. Yoshino and H. Kodama, Prog. Theor. Exp. Phys. 2014, to be published. [arXiv:1312.2326]