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Summary of past researches

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I have been studying the construction of the gravitational wave detection theory and the dark matter search using pulsars. A pulsar is a neutron star that emits pulses to Earth with a very precise period. Since the accuracy of the pulse period is comparable to that of an atomic clock, the detection of gravitational waves is expected by analyzing the deviation of the pulse period.

【Construction of gravitational wave detection theory】

Article : Ryo Kato and Jiro Soda, “Probing circular polarization in stochastic gravitational wave background with pulsar timing arrays”, Phys. Rev. D, American Physical Society Journals, Vol.93, pp.062003-1-062003-18, (2016).

In this study, we devised a method to detect the polarized stochastic gravitational wave background using pulsars. The stochastic gravitational wave background is superpositions of gravitational waves coming from various directions and is treated statistically. Detection of the polarized stochastic gravitational wave background is a evidence of the space-time symmetry breaking. The results obtained by this study are the following two.

1. Circular polarization of background gravitational wave can be detected using pulsar.
2. When the stochastic gravitational wave background is distributed isotropically, it was found that the polarization could not be detected.

【Dark matter search】

Article : Ryo Kato and Jiro Soda “Search for ultralight scalar dark matter with NANOGrav pulsar timing arrays”, arXiv:1904.09143.

In this study, we attempted to detect the ultralight scalar dark matter (so called axion), using a pulsar. The axion can solve the core cusp problem which is an unsolved problem in astrophysics. The results obtained by this study are the following two.

- (1) As a result of data analysis, it was found that axion signals could not be rejected. However, we concluded that the noise from Jupiter mimicked the axion signals.
- (2) When the axion mass is in the range from 0.945×10^{-23} to 1.34×10^{-23} eV, the energy density of the axion can be more strongly restricted than in previous studies.