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Pulsar Polarization Arrays

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Pulsar timing arrays (PTAs) consisting of widely distributed and well-timed millisecond pulsars can serve as a galactic interferometer to detect gravitational waves. With the same data acquired for PTAs, we have proposed Ref. [2] to develop pulsar polarization arrays (PPAs), to explore astrophysics and fundamental physics. As in the case of PTAs, PPAs are best suited to reveal temporal and spatial correlations at large scales that are hard to mimic by local noises.

As one scientific case for the PPAs, we consider the detection of axion-like wave dark matter (WDM). Because of its tiny mass, the axion-like WDM can be generated as a Bose-Einstein condensate, characterized by a strong wave nature. It can also affect the polarization of pulsar light via its Chern-Simons coupling, yielding an effect of “birefringence”. We will particularly address in this context: (1) the excellent capability of the PPAs; and (2) their complementarity with the PTAs. The relevant sensitivities will be demonstrated.

Refs:

- (1) <https://journals.aps.org/prd/abstract/10.1103/PhysRevD.101.063012>
- (2) <https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.130.121401>
- (3) <https://arxiv.org/abs/2304.04735>

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