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Searching for ultralight vector dark matter with the cryogenic gravitational wave telescope KAGRA

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Recently, a considerable amount of attention has been given to the search for ultralight dark matter by measuring the oscillating length changes in the arm cavities of gravitational wave detectors. Although gravitational wave detectors are extremely sensitive for measuring the differential arm length changes, the sensitivity to dark matter is largely attenuated, as the effect of dark matter is mostly common to arm cavity test masses. In Phys. Rev. D 102, 102001 (2020), we proposed to use auxiliary length channels, which measure the changes in the power and signal recycling cavity lengths and the differential Michelson interferometer length. When our method is applied to a cryogenic gravitational wave detector KAGRA, the sensitivity to U(1)_{B−L} gauge boson dark matter with masses below 7x10^{−14} eV can be greatly enhanced, since KAGRA employs sapphire test masses and fused silica auxiliary mirrors. We showed that KAGRA can probe more than an order of magnitude of unexplored parameter space at masses around 1.5x10^{−14} eV, without any modifications to the existing interferometer. In this talk, we present the status of the data analysis pipeline development and discuss the prospects of our analysis using the data from KAGRA's first observing run in 2020.

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