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Search for sub-eV ALP via quasi-parallel stimulated resonant photon collision with “coronagraphy”to mitigate background photon based on spatial distribution characteristics

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The identity of dark matter (DM) remains one of the major mysteries of modern physics. The QCD axion, arising from the Peccei-Quinn mechanism that solves the strong CP problem, is a well-motivated low-mass DM candidate.
The SAPPHIRES collaboration searches for the QCD axion and axion-like particles (ALPs) using two-color, high-intensity, short-pulse lasers [1]. Our approach targets signal photons from stimulated resonant photon-photon scattering via ALP exchange. The dominant background photons, originating from nonlinear photon-atom interactions in optical elements, have been verified to be spatially concentrated near the beam axis, in contrast to the expected distribution of signal photons. Exploiting this spatial distinction, we developed a “coronagraphy”method that introduces an eclipse filter to effectively mitigate background photons while maintaining sensitivity to signal photons. We further acquired data with deliberately degraded spatial overlap of the two beams at the focus and found no statistically significant excess. With this technique, we have achieved the highest laboratory sensitivity to date in the sub-eV mass range. In this presentation, we report the results of this search.
[1] Y. Kirita, A. Kodama, K. Homma, C. Chiochiu, M. Cuciuc, G. Giubega, T. Hasada, M. Hashida, S. Masuno, Y. Nakamiya, L. Neagu, V. Phung, V. Rodrigues, M. Rosu, S. Sakabe, S. Tazlauanu, O, Tesileanu, and S. Tokita, [SAPPHIRES collaboration], “Search for sub-eV axion-like particles in a quasi-parallel stimulated resonant photon-photon collider with “coronagraphy””, JHEP, 06(2025)138”

Presenter: KODAMA, Airi

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