Pilot Search for eV-Mass-Region Dark Matter *Via* Stimulated Resonant Photon Scattering Using Three Pulsed-Laser Beams

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Based on space observations, it is estimated that dark matter exists and accounts for approximately 27% of the total energy density balance of the Universe. Among them, axion-like particles (ALPs) are considered to be candidates for low-mass dark matter. Axion is an undiscovered elementary particle originating from the Peccei-Quinn mechanism to solve the strong CP problem in the standard model [1]. Furthermore, a theoretical model, *miracle* [2], can explain both dark matter and inflation with a single ALP and predicts that coupling constant to photons is $g/\mathrm{M} = \mathcal{O}(10^{-11})$ GeV^{-1} at $0.01 \sim 1$ eV mass.

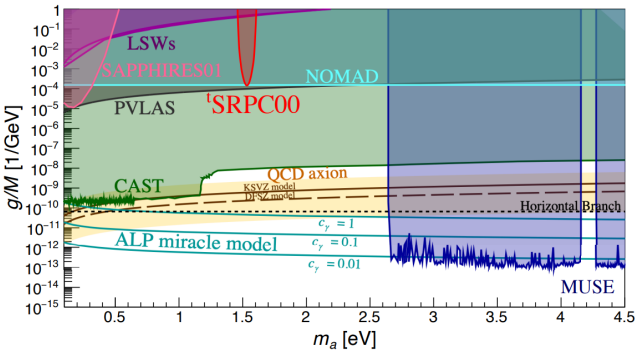

Figure 1: The upper limit (95% confidence level, region enclosed by the red solid curve) in parameter space for the coupling constant g/M *vs* mass $\mathrm{m_a}$ of a pseudoscalar-field ALP achieved with a three-beam stimulated resonant photon collider ($^{\mathrm{t}}$SRPC00)

We proposed a three-beam stimulated resonant photon collider ($^{\mathrm{t}}$SRPC) with focused laser fields in order to directly produce an ALP with the two "creation lasers" and to stimulate its decay by the one "inducing laser" [3]. In this method, the center-of-mass collision energy is varied by changing the collision angle between the two creation-lasers collision, allowing the ALP search continuously in the eV mass region. In order to realize such a collider, we have performed a proof-of-principle experiment with a set of large incident angles between three beams to overcome the expected difficulty to ensure the space–time overlap between short pulse lasers [4]. In this talk, we present a result from the pilot search with the developed system and the method. The search result was consistent with null. We thus have set the upper limit on the minimum ALP-photon coupling down to 1.5×10^{-4} GeV^{-1} at the ALP mass of 1.53 eV with a confidence level of 95 %, as shown in Fig. 1.

References

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