CDEX collaboration reports new results on dark photon searches

Supported by the National Natural Science Foundation of China and the Ministry of Science and Technology of China, CDEX collaboration led by Tsinghua University published an article entitled "Direct Detection Constraints on Dark Photons with CDEX-10 Experiment at the China Jinping Underground Laboratory" in *Physical Review Letters* (2020, 124: 111301).

Extensive cosmological and astrophysical observations at different scales indicate the existence of dark matter which makes up over a quarter of the energy density of our universe. The dark matter is believed to be made up of some undiscovered particles. Despite many years of efforts, the favorite candidate, called Weakly Interacting Massive Particle or WIMP, has not been detected in experiments. The dark photon, a hypothetical invisible particle, is another attractive dark matter candidate, and can in addition be a new interaction mediator between dark matter and normal matter.

The dark photons can be experimentally detected through their absorption and conversion to electrons in the germanium detectors, in a process analogous to the photoelectric effect of SM photons. Intense photon sources, e. g. the Sun, provide an excellent platform to look for dark photon. The low energy threshold, in a range of 100 eV, of point-contact germanium detectors are particularly suitable for the studies of dark photons. The China Dark Matter Experiment (CDEX) uses the 10 kg p-type point contact germanium detector array to search for light dark matter at the China Jinping Underground Laboratory (CJPL) with a rock overburden of 2400 meters — the deepest underground research facility in the world.

In this work, CDEX data taken from February 2017 to August 2018 are analyzed to search for solar dark photon and dark photon dark matter. No significant signals on either channel were observed. Constraints were set on the effective kinetic mixing parameter between dark photons to SM photons. The upper limits of the mixing parameters (κ) of solar dark photon at 90% confidence level (C. L.) have been determined based on the data set of 205. 4 kg • day exposure from C10-B1 detector with a minimal Chi Squared method. Meanwhile, combined with data set of 244. 2 kg • day exposure from the C10-C1 detector, the upper limits of κ of dark photon dark matter at 90% C. L. are also analyzed. The results of this work probe new parameters both for the κ of solar dark photon, which is the best limit from direct detection experiments, and dark photon dark matter. This study also reinforces the current worldwide interest of exploring other dark matter candidates beyond WIMPs and their detection channel of elastic scattering with the nucleus.

The original link: https://doi. org/10. 1103/PhysRevLett. 124. 111301

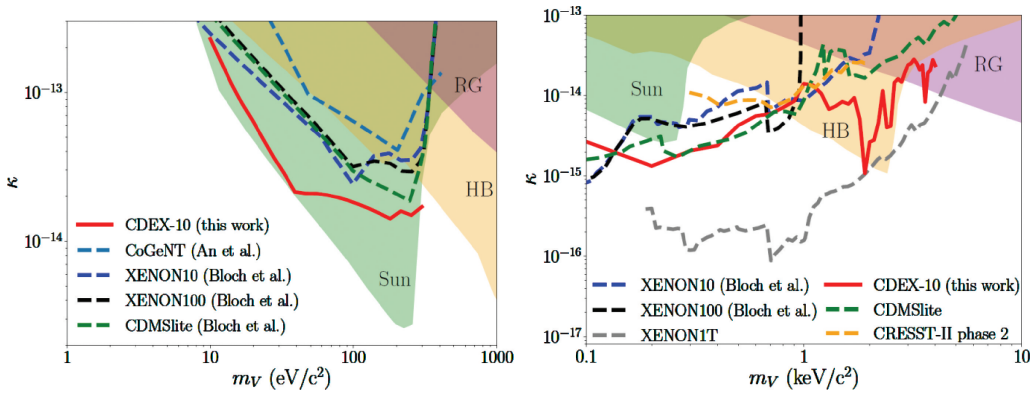

Figure The upper limits on κ of solar dark photons (left) and dark photon dark matter (right).