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Production of dark photons in electron-nucleus collisions via compton-like process

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Dark photon is a theoretical boson that mediates the interaction between dark matter particles. The dark photon can interact with the Standard Model photon by kinetically mixing with it. In this work, we study the dark photon production via Compton-like process in ultrarelativistic electron-ion collisions. We search for massive dark photons in planned electron-ion collider machines such as the Electron-ion collider in China (EicC), the Polarized Electron-Ion Collider at Jefferson Lab (JLEIC), the Electron Ion Collider (EIC), the Large Hadron Electron Collider (LHeC) and the Future Circular Collider (FCC-eh). The total cross section and number of events for dark photon production in these experiments are computed in terms of the mass, $m_{\gamma'}$, and the kinetic mixing parameter, ε. It is considered the mass range, 100 MeV < $m_{\gamma'}$ < 500 MeV and fixed mixing parameter $\varepsilon \sim 10^{-3}$. The ultrarelativistic heavy ions are treated as sources of quasi-real photons described by the equivalent photon approximation. The cross section is numerically computed as a function of the incident photon energy for fixed dark photon mass and kinetic mixing parameter. We calculated the expected number of events by using the expected luminosities of the experiments. We found that the integrated cross section for dark photon production through the Compton-like process decreases monotonically with the dark photon mass and reaches large values at the small mass region. The cross section of dark photon production reaches units of picobarns and number of events $\sim 10^5$ for a one year run. This study complements existing search strategies for massive dark photons in the investigated mass range.

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