Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **113** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

Low mass visible dark photon search at Belle II

Tuesday 10 June 2025 15:15 (15 minutes)

The Belle II experiment has accumulated 575 fb^{-1} of data from the SuperKEKB asymmetric electron-positron collider. We present the current status of the search for low-mass dark photons (A′) from $e^+e^- \to A'\gamma \to e^+e^-\gamma$reaction based on collision data recorded by the Belle II experiment. The dark photon is a hypothetical gauge boson that would appear as a narrow resonance in the electron-positron invariant mass spectrum. This analysis targets masses ranging from the electron pair production threshold up to the muon pair production threshold, with a particular focus on the sub-20 MeV region. This low-mass range is of special interest due to the presence of the X17 anomaly and the lack of strong constraints on the kinetic mixing parameter (ϵ). The major challenge in this mass region is the photon conversion background, which mimics the signal signature. Belle II's high-luminosity dataset and excellent vertex reconstruction capabilities provide enhanced sensitivity in this difficult low-mass regime. To mitigate background contamination, we employ a Boosted Decision Tree (BDT) classifier that leverages advanced features derived from vertex fitting. The trained model was validated using radiative dimuon events with a photon conversion $e^+e^- \to \mu^+\mu^-\gamma \to \mu^+\mu^-[\gamma \to e^+e^-]$. We will present the event selection criteria, validation and optimization strategies, and preliminary sensitivity projections based on Monte Carlo simulations.

Keyword-1

dark photon

Keyword-2

hidden sector

Keyword-3

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Session Classification: (PPD) T2-9 Particle physics at colliders I | Physique des particules aux collisionneurs I (PPD)

Track Classification: Technical Sessions / Sessions techniques: Particle Physics / Physique des particules (PPD)