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Prospects for ditauonium discovery at colliders

Friday 25 August 2023 09:06 (18 minutes)

Duration: 14'+4'
The bound state of two tau leptons, ditauonium $\mathcal{T}$, is the heaviest and also most compact QED atom, and remains unobserved to date. There are several motivations for its study such as precisely extracting properties of the tau lepton, carrying out novel tests of SM and its basic CPT symmetries, and searching for BSM effects impacting the tau lepton. We will first discuss the spectroscopic properties of ditauonium, including energy levels and decay channels. A systematic survey of search strategies at present and future lepton and hadron colliders will then be provided. The spin-triplet state, ortho-ditauonium, can be observed at a future super tau-charm factory (STCF) via $e^+e^- \to \mathcal{T}_1 \to \mu^+\mu^-$, where a threshold scan with monochromatized beams can also provide a very precise extraction of the tau lepton mass with $\mathcal{O}(25$ keV) uncertainty. Observing $\mathrm{pp} \to \mathcal{T}_1(\mu^+\mu^-) + X$ is possible at the LHC by identifying its displaced vertex with a good control of the combinatorial dimuon background. The spin-singlet state, para-ditauonium, will be observable in photon-photon collisions at the FCC-ee via $\gamma\gamma \to \mathcal{T}_0 \to \gamma\gamma$.

References: arXiv:2202.02316, arxiv:2204.07269. arxiv:2302.07365

Collaboration / Activity

Phenomenology

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