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Proposal for a shared transverse LLP detector for FCC-ee and FCC-hh and a forward LLP detector for FCC-hh

As the particle physics community has explored most of the conventional avenues for new physics, the more elusive areas are becoming increasingly appealing. One such potential region, where new physics might be hiding, involves light and weakly interacting long-lived particles (LLPs). To probe deeper into this region, where the possibility of highly displaced scenarios weakens the role of general-purpose collider detectors, dedicated LLP detectors are our best option. However, their potential can only be fully realized if we optimize their position and dimensions to suit our physics goals. This is possible at the upcoming Future Circular Collider (FCC) facility, where the feasibility and design studies are still ongoing and can accommodate new proposals focused specifically on LLP searches. We propose optimized dedicated detectors in both the transverse and forward directions, significantly enhancing the sensitivity to previously unchartered regions of the new physics parameter space. Our proposed DELIGHT detector can additionally serve as a shared transverse detector during both the FCC-ee and FCC-hh runs. The concept of a shared transverse detector is novel and sustainable, utilizing the proximity of the interaction points of the lepton and hadron colliders at the FCC. This minimizes costs and boosts the LLP physics case at FCC. Furthermore, we emphasize the impact of our proposed forward detector, FOREHUNT, along the FCC-hh beam pipe, in probing LLPs from meson decays.

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