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# Circular-Linear energy recovery accelerator to probe the energy-frontier

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Energy-frontier particle accelerators are among the most exciting, complex, challenging, and expensive research instruments performing high precision measurements confirming the fundamentals of the physics and broadening new research horizons. Currently the highest energy machines, from multi-GeV to several TeV, (ILC, FCC, CLIC) capable of searching for the most basic building blocks of matter are either driven by circular or linear accelerators. The circular machines, having the centre-of-mass (CM) energy values reaching 200 GeV (for leptons) and above, experience beam energy loss and quality dilution, for example, due to synchrotron radiation, limiting the overall CM energy achievable and requiring a constant energy top-up to compensate the loss and the beam quality dilution. Linear colliders overcome these limitations, while the finite capabilities of generating high average current beams limits the luminosity. This is partially compensated by the quality of the colliding beams. Most of the accepted state-of-the-art designs, while reaching the energies required, have very large footprint and show the same signs of limitations and drawbacks and in this work, we suggest a novel design of circular-linear accelerator based on the merging of the weakly emitting, low-energy storage rings and energy recovery linear accelerators. To enable the operation of such a system and in particular the energy recovery from spent, high-intensity beams the use of the dual-axis asymmetric cavities is suggested. The merging of circular and linear systems, and applications of dual axes cavities, aim to maintain high beam quality, high luminosity, and high energy efficiency, while simultaneously offering a flexible energy management. The concept presented can be potentially used to reach ultimate energy frontiers in high-energy physics as well as to drive next generation light sources combining tools for fundamental and applied studies. The numbers which will be presented are for illustration purpose and can be improved further.

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