



Contribution ID: 79

Type: Oral

A hybrid, asymmetric, linear Higgs factory based on plasma-wakefield and radio-frequency acceleration

Monday, 15 May 2023 09:40 (20 minutes)

The construction of an electron-positron collider “Higgs factory” has been stalled for a decade, not because of feasibility but because of the cost of conventional radio-frequency (RF) acceleration. Plasma-wakefield acceleration promises to alleviate this problem via significant cost reduction based on its orders-of-magnitude higher accelerating gradients. However, plasma-based acceleration of positrons is much more difficult than for electrons. We propose a collider scheme that avoids positron acceleration in plasma, using a mixture of beam-driven plasma-wakefield acceleration to high energy for the electrons and conventional RF acceleration to low energy for the positrons. We emphasise the benefits of asymmetric energies, asymmetric bunch charges and asymmetric transverse emittances. The implications for luminosity and experimentation at such an asymmetric facility are explored and found to be comparable to conventional facilities; the cost is found to be much lower.

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Session Classification: Joint Plenary

Track Classification: Accelerator: Advanced Accelerator Concepts