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## FCC-ee: A high-luminosity lepton collider at CERN

The Future Circular electron-positron Collider (FCC-ee), the first phase of the broader FCC program, is a proposed next-generation lepton collider at CERN. Designed to operate in a 91 km circular tunnel, FCC-ee will run at four distinct center-of-mass energies, delivering collisions at four experimental interaction points to enable unprecedented precision measurements of the Standard Model and beyond. Achieving the luminosity targets requires significant innovations in accelerator technology and beam dynamics control. FCC-ee adopts a nano-beam collision scheme, aiming for vertical beam sizes in the nanometer range at the interaction points, which also means high sensitivity to mis-alignment and vibrations. In the presence of errors, displacements and noise effects, it is essential to identify a machine configuration that ensures an acceptable dynamic aperture and momentum acceptance in order to achieve sufficient beam lifetime in operation. To mitigate beam-beam effects, a crab-waist collisions, must be carefully controlled to preserve beam lifetime. Stable intensity in operation will be achieved through top-up injection, which requires synchronization with the High Energy Booster (HEB) located above the Collider ring. Precise energy calibration will be achieved with beam de-polarization techniques. Each of these aspects poses significant challenges and requires thorough studies, detailed simulations and technical developments.

## Secondary track

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