

Crab Cavity system for the LHC high-luminosity upgrade. Proposed LLRF

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In collision, the LHC has so far been operated at 4 TeV/c per beam with up to 0.4 A DC current (per beam) distributed in 1320 bunches at 50 ns spacing. The future is 7 TeV/c, up to 1.1 A DC current and 25 ns spacing (HiLumi LHC). The roadmap to HiLumi LHC includes the installation of Crab Cavities operated at the fundamental accelerating frequency (400.8 MHz), with six cavities per beam at the two high luminosity experiments ATLAS and CMS. The LLRF must reduce the cavity impedance of the deflecting mode, without injecting excessive RF noise on the betatron bands that would result in transverse emittance growth and decrease the luminosity lifetime. Also important is the perfect pairing of crabbing and un-crabbing kicks on each side of an experiment so that the bunch tilt does not propagate to the rest of the trajectory. Following a cavity trip, the field in the companion cavities will follow to minimize the losses till the beam dump has reacted (300 microseconds maximum). The LLRF must also cope with a complex operational scenario. During filling and ramping the cavities will be detuned to make them transparent to the beam. On flat top, the detuning will be reduced, with zero total demanded voltage (probably using counter-phasing between cavities). The generator power needed to compensate the beam loading will be used to guide the beam centering using dedicated corrector magnets. Finally the desired crabbing field will be applied.

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