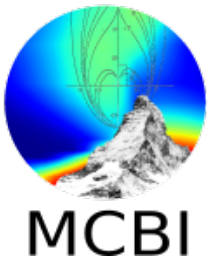

Contribution ID: **97** Type: **not specified**

* Consequences of longitudinal coupled-bunch instability mitigations on power consumption during the HL-LHC filling

Tuesday 24 September 2019 17:00 (10 minutes)

During the filling of the Large Hadron Collider (LHC), it is desirable to keep the rf cavity voltage constant both in amplitude and phase to minimize the emittance blow-up and injection losses. To have a constant voltage and to minimize power consumption, a special beam-loading compensation scheme called half-detuning is used in the LHC, for which the cavity fundamental resonant frequency needs to be detuned from the rf frequency by an appropriate value. This, however, can result in fast coupled-bunch instabilities caused by the asymmetry of the fundamental cavity impedance. To mitigate them, a fast direct rf feedback and a one-turn delay feedback are presently used in the LHC.
The semi-analytical model that describes the dynamics of the low-level rf system in the LHC shows that, depending on the mitigation scenario, the required rf power during injection could significantly exceed the steady-state value. This means that for High-Luminosity LHC (HL-LHC) beam intensities, one can potentially reach the limit of available rf power. In this paper, the model is described and benchmarks with LHC measurements are presented. We also revisit the damping requirements for the longitudinal coupled-bunch instability at injection energy, to find a compromise between longitudinal stability and rf power consumption for the HL-LHC beam.

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Session Classification: Poster Session