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The LHC Low Level RF

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The LHC RF includes eight 400 MHz super conducting cavities per ring. Each cavity is independently powered by a 300 kW klystron via a circulator. The challenges are: very high beam current (more than 1A RF component) and very low RF noise (emittance growth time in excess of 25 hours). To achieve that, the Low-Level RF comprises the following sub-systems:

- We have one Cavity Controller per cavity. It is meant to provide adequate control of the voltage seen by the beam and to keep the power demanded at acceptable levels. It includes a Klystron Polar Loop (that keeps the gain and phase constant from the RF modulator input to the cavity main coupler input), an RF Feedback Loop (that reduces the effects of the cavity impedance) and a Tuner Loop (that maintains the cavity at a tune that minimizes the power transients due to the passage of batches and gaps).
- We have one Beam Control per ring. It includes a Phase Loop and a Synchronization Loop that locks the two beams to a common reference during the acceleration ramp. This loop can be replaced by a Radial Loop for commissioning and machine developments (de-synchronization of the two rings).
- The RF Synchronization implements the bunch into bucket transfer from the SPS into each LHC ring.
- Finally a Longitudinal Damper (one per ring) is planned to reduce emittance blow-up due to filamentation following phase and energy errors at injection. At start-up it will act via the main 400 MHz cavities. It tries to damp both dipole and quadrupole modes.

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