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Numerical calculation of the Lorentz force detuning and the pressure sensitivity for the HL-LHC crab cavity

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Crab cavities are fundamental components of the LHC upgrade in the framework of the HL-LHC project. These Radio Frequency cavities, operated at the appropriate frequency, 'tilt'the proton bunches to increase the luminosity at the collision points IP1 (ATLAS) and IP5 (CMS). During operation, the walls of the cavities are deformed due to the loading conditions. This deformation changes the electro-magnetic field inside the cavity and thus its RF frequency. Two different superconducting crab cavities have been developed: RF Dipole (RFD) and Double Quarter Wave (DQW). In the present study, the numerical evaluation of the Lorentz Force Detuning (LFD) and the Pressure Sensitivity (PS) of the DQW cavity, using COMSOL Multiphysics, is presented. The LFD analyses the change in fundamental frequency of the cavity due to the electro-magnetic forces acting on its walls, while the PS investigates the frequency shift when the cavity is subjected to pressure fluctuations of the Helium bath. Finally, a comparison is presented with the results measured during the cold test of the manufactured cavities.

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Footnotes

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