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Review of linear and nonlinear optics measurements in the CERN LHC

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The LHC is approaching the end of its third operational run, with machine protection and performance having demanded an excellent control of the single-particle dynamics. Additionally, the requirement to rapidly commission multiple diverse sets of optics configurations within each year and from year-to-year, placed clear demands on the measurement and correction methods employed. Tight tolerances on the linear optics have been consistently achieved, with the drive to ever-more pushed optics for the High Luminosity LHC era continuing to introduce new challenges. Routine control of linear coupling has been an operational necessity, while significant progress has also been made extending the understanding and control of the optics into the nonlinear regime. This paper presents the key methods used, the results obtained, and discusses the challenges to control of the beam-optics in the LHC.

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