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Studies of resonances limiting the high-brightness LHC beams in the SPS

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Space charge effects in combination with betatron resonances limit the performance of high-brightness LHC beams in the CERN Super Proton Synchrotron (SPS). Here we report on experimental studies performed with single-bunch proton beams, monitoring transverse emittance evolution and particle losses while performing tune scans across the horizontal and vertical planes. Two significant resonances were identified: a coupled resonance leading to emittance growth in the horizontal plane and a corresponding emittance decrease in the vertical plane, and another coupled resonance directly associated with particle losses. The resonances identified in these studies could explain the limitations of the beam brightness encountered with the multi-bunch LHC-type beams in the SPS, thus providing valuable insights for the optimization of the high-intensity beams performance. In an ongoing effort of mitigating the beam degradation on the SPS injection plateau, these experimental results are compared with a simulation model implemented in Xsuite, taking into account space charge effects and known machine non-linearities and imperfections.

Footnotes

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Author: MASES, Ingrid (European Organization for Nuclear Research)

Co-authors: ASVESTA, Foteini (European Organization for Nuclear Research); BARTOSIK, Hannes (European Organization for Nuclear Research); KOSTOGLU, Sofia (European Organization for Nuclear Research)

Presenter: KOSTOGLU, Sofia (European Organization for Nuclear Research)

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