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Coherent Stability versus Dynamic Aperture – Pushing the High-Intensity Frontier for Hadron Beam Production

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Synchrotrons often employ octupole magnets to Landau dampen coherent transverse instabilities, at the expense of restricting the dynamic aperture due to the excitation of betatron resonances. A very good example is the CERN Large Hadron Collider, where the octupole current required for beam stabilisation strongly impacted beam lifetime during Run 2. At the high-intensity frontier, the situation complicates in the presence of strong direct space charge fields. A notable case is the FAIR heavy-ion synchrotron SIS100 (presently under construction at the Facility of Antiproton and Ion Research), which is designed to accumulate highest beam intensities during a 1-second injection plateau. We discuss these major limitations at the high-intensity frontier and present mitigation strategies, with the goal to ensure coherent stability without affecting dynamic aperture.

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