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Damping of quadrupole oscillations with bunch-by-bunch longitudinal RF feedback for FAIR

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To damp undesired longitudinal oscillations of bunched beams, the main synchrotron SIS100 of FAIR (Facility for Antiproton and Ion Research) will be equipped with a bunch-by-bunch longitudinal feedback (LFB) system. It will consist of new broadband kicker cavities and a dedicated low-level RF (LLRF) system. The LFB helps to stabilize the beam, to keep longitudinal emittance blow-up low and to minimize beam losses via damping dipole and quadrupole oscillations for up to 10 bunches individually. The topology of the LLRF signal processing is validated in closed loop with beam in the heavy-ion synchrotron SIS18 at GSI for future integration into SIS100. In a recent SIS18 machine development experiment with two bunches at flattop, quadrupole oscillations were excited for one bunch and then damped with a prototype setup of the LFB system using an existing magnetic alloy cavity as dedicated kicker cavity. This paper presents the test setup, the results of this experiment, and the proposed LLRF topology of the closed-loop LFB system. This validates a core part of the final SIS100 system.

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