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Systematic study of longitudinal excitations to influence the microbunching instability at KARA

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Radio-frequency (RF) modulations can influence the microbunching instability dynamics and serve to eventually control them with reinforcement learning (RL) methods. Implementing such a feedback system at the Karlsruhe Research Accelerator (KARA) will require that the action decided by the RL agent, in this case an RF modulation, is applied effectively to the electron beam. Such a modulation can be carried out at KARA by two different devices: the kicker cavity of the bunch-by-bunch feedback system and the accelerating cavities of the main RF system. The Low-Level RF (LLRF) feedback system would require hardware and firmware modifications to accept the continuous action signal given by the RL agent, so systematic measurements were performed to decide which system should be used in the future. Modulations around different harmonics of the synchrotron frequency were applied and the coherent synchrotron light emitted due to the microbunching dynamics analyzed. These measurements were also performed at negative momentum compaction optics, a regime in which the control of the microbunching instability could yield especially intense light.

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Footnotes

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Yes

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