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Transverse feedback to damp collective beam instabilities, past, present and future

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Starting with my first experience of the transverse feedback damper in the KEK 12 GeV PS in 2006, where we tested with analog system and in addition digital controller from SPring-8 team. Since then, digital systems have come to cover almost all the machines. In J-PARC MR bunch-by-bunch transverse feedback system had been introduced with a collaboration at the proton beam power around 150 kW in 2010. The weaknesses of this system quickly became apparent. It can damp only the center of mass motions of the whole bunches. It could not suppress intra-bunch betatron motion with different betatron phase in a different longitudinal bunch position. This happens in the case of a non-zero chromaticity. Then the intra-bunch feedback system was introduced in 2014 with a proton beam power of approximately 250 kW and has been operating successfully to date. But already this system cannot suppress collective beam instabilities in certain chromaticities over proton beam intensity of 2 - 3E+14 protons per pulse. The higher the sampling rate, the higher the damping efficiency. This system is currently under development. The above is for long bunches of 100-200 ns. Trials in case of much shorter bunches will be also reviewed.

Footnotes

Funding Agency

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Primary author: TOYAMA, Takeshi (High Energy Accelerator Research Organization)

Presenter: TOYAMA, Takeshi (High Energy Accelerator Research Organization)

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