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Steady-state microbunching in storage rings with distributed laser-electron interaction

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Among the new accelerator concepts presently under discussion are electron storage rings with steady-state microbunching to provide coherent emission of synchrotron radiation with high intensity and ultrashort pulses like free-electron lasers with the additional benefits of the excellent stability and high repetition rate inherent in circular machines. Driving storage rings with laser pulses interacting with the electrons in an undulator would provide stable phase-space buckets similar to a radiofrequency system but on a much smaller wavelength scale –micrometers instead of centimeters. The fundamental issue of the required isochronicity of the electrons over one turn can be mitigated by distributing several undulators along the ring circumference. The next logical step would be to omit undulators altogether and perform the laser-electron interaction in all dipole magnets of the ring where each dipole acts like an undulator half-period. While the interaction in a single dipole is weak, the large number of them still provides enough energy modulation to drive the electron beam. Numerical estimates and technical issues of this novel scheme are discussed.

Primary author: KHAN, Shaukat

Presenter: KHAN, Shaukat

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