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RF manipulations I

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Beyond increasing the energy of charged particles, RF frequency systems in accelerators allow to control longitudinal beam properties like distance between the bunches, their length, position in time, as well as the orbit length in a synchrotron. This is essential to adapt the beam parameters to the requirements of experiments or downstream accelerators. Already with a single-harmonic RF system a variety of manipulations to bunch or de-bunch a beam and to control the bunch length can be performed. More flexibility is reached with multiple RF systems, often at different harmonic numbers of the revolution frequency. For example, a change of harmonic number to merge or split bunches, respectively doubles, or halves the intensity per bunch. A sequential increase of the RF harmonic can also be applied to reduce bunch spacing. Even more evolved RF manipulations become possible with non-sinusoidal RF systems driving wide-band RF cavities, gaining almost full control of the longitudinal beam structure. Special attention is moreover paid to the technical implementation of RF manipulations, complemented by examples of applications in major accelerator facilities.

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