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Longitudinal beam dynamics and RF requirements for a chain of muon RCSs

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A facility for the collision of muons offers a unique path to a compact lepton collider with an energy reach in the multi-TeV regime, well beyond the possibilities of conventional electron accelerators. However, due to the short lifetime of muons, the constraints for acceleration and collisions are very different. An extremely fast energy increase in combination with intense and ultra-short bunches is essential for a high muon survival rate and luminosity. A chain of rapid cycling synchrotrons (RCS) for acceleration from around 60 GeV to several TeV is proposed by the International Muon Collider Collaboration. We study the longitudinal beam dynamics and radio-frequency (RF) requirements for these RCSs with respect to induced voltages from intensity effects. A high synchrotron tune due to the large RF voltages is a particular challenge. We present simulation results of the longitudinal bunch distribution to determine the number of RF stations distributed over the RCS to mitigate that large tune. The impact of the induced voltages from short-range wakefields and single- as well as multi-turn beam loading is analyzed, for both fundamental and higher-order modes.

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Footnotes

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Yes

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