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Longitudinal phase space control in the Berkeley femtosecond x-ray light source

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The Berkeley femtosecond x-ray light source is a ~2.5 GeV recirculating linear accelerator, where electrons reach their final energy in four beam passes through a 600 MeV superconducting linac after injection at ~ 100 MeV. An important consideration for this machine is the preservation of the electron beam longitudinal emittance through the various stages of acceleration including a chain of injection linacs, bunch compression, and various passages through the recirculating linac magnetic arcs. In this paper we analyze the longitudinal dynamics of the electrons and define a strategy of the electron beam manipulation leading to a successful conservation of the longitudinal emittance. Particular attention is given to the management of the correlated energy spread induced by collective effects such as the space charge, longitudinal wake fields and coherent synchrotron radiation.

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