555.

Author

Filippetto, D Bellaveglia, M Castellano, M Chiadroni, E Cultrera, L Di Pirro, G Ferrario, M Ficcadenti, L Gallo, A Gatti, G Pace, E Vaccarezza, C Vicario, C Bacci, A Rossi, AR Serafini, L Cianchi, A Marchetti, B Giannessi, L Labat, M Quattromini, M Ronsivalle, C Marrelli, C Migliorati, M Mostacci, A Palumbo, L Serluca, M

Tittle

Phase space analysis of velocity bunched beams

Source

PHYSICAL REVIEW SPECIAL TOPICS-ACCELERATORS AND BEAMS vol.14 no.9 092804 DOI: 10.1103/PhysRevSTAB.14.092804 SEP 29 2011

Abstract

Peak current represents a key demand for new generation electron beam photoinjectors. Many beam applications, such as free electron laser, inverse Compton scattering, terahertz radiation generation, have efficiencies strongly dependent on the bunch length and current. A method of beam longitudinal compression (called velocity bunching) has been proposed some years ago, based on beam longitudinal phase space rotation in a rf field potential. The control of such rotation can lead to a compression factor in excess of 10, depending on the initial longitudinal emittance. Code simulations have shown the possibility to fully compensate the transverse emittance growth during rf compression, and this regime has been experimentally proven recently at SPARC. The key point is the control of transverse beam plasma oscillations, in order to freeze the emittance at its lowest value at the end of compression. Longitudinal and transverse phase space distortions have been observed during the experiments, leading to asymmetric current profiles and higher final projected emittances. In this paper we discuss in detail the results obtained at SPARC in the regime of velocity bunching, analyzing such nonlinearities and identifying the causes. The beam degradation is discussed, both for slice and projected parameters. Analytical tools are derived to experimentally quantify the effect of such distortions on the projected emittance.