Title:
Design of the new wideband RF system for the CERN PS Booster.
Authors:
M.M. Paoluzzi, S. Albright, M.E. Angoletta, L. Arnaudon, E. Chapochnikova, A.J. Findlay, M. Haase, M. Jaussi, A.J. Jones, D. Landre, J. Molendijk,
Abstract:
For the renovation and upgrade of the CERN PS Booster (PSB) RF systems a development project was launched in 2012. The design, based on a new approach, aimed at replacing the existing tuned, narrowband RF systems with wideband, modular, solid-state driven units. A wide range of issues had to be addressed spanning from RF power production, radiation hardness of solid-state devices, active cancellation of beam-induced voltages, dedicated low-level electronics allowing multi-harmonic operation and beam stability.
Following a three years prototyping and testing campaign and two international reviews, the project endorsement came at the end of year 2015. It foresees the complete removal of present h1, h2 and h10 systems and the deployment of a new one covering all the frequency ranges from 1 MHz to 18 MHz. The four PSB rings will be equipped with 144 identical acceleration cells providing 24 kV total RF voltage per ring.
This paper describes the design concepts, the retained solutions, the expected performances and includes the procurement and implementation strategies. This activity is part of the LHC Injectors Upgrade project (LIU).

Title:
Preparations for Upgrading the RF Systems of the PS Booster
Authors:
S. Albright, E. Shaposhnikova, D. Quartullo
Abstract:
The accelerators of the LHC injector chain need to be upgraded to provide the HL-LHC beams. The PS Booster, the first synchrotron in the LHC injection chain, uses three different RF systems (first, second and up to tenth harmonic) in each of its four rings. As part of the LHC Injector Upgrade the current ferrite RF systems will be replaced with broadband Finemet cavities, increasing the flexibility of the RF system. A Finemet test cavity has been installed in Ring 4 to investigate its effect on machine performance, especially beam stability, during extensive experimental studies. Due to large space charge impedance Landau damping is lost through most of the cycle in single harmonic operation, but is recovered when using the second harmonic and controlled longitudinal emittance blow-up. This paper compares beam parameters during acceleration with and without the Finemet test cavity. Comparisons were made using beam measurements and simulations with the BLonD code based on a full PS Booster impedance model. This work, together with simulations of future operation, have provided input for the decision to adopt a fully Finemet RF system.

Title:
Evolution of high intensity beams in the CERN PS Booster after H- injection and phase space painting
Authors:
M.Kowalska, J.Abelleira, C.Bracco E.Benedetto,
Abstract:

With the LHC Injector Upgrade project (LIU), the injection energy of PS Booster (PSB) – first circular accelerator in the LHC injector chain – will be raised from 50 MeV to 160 MeV and present multiturn injection will be upgraded to H-injection with the transverse and longitudinal painting. In scope of the project, it is planned to double the beam intensities, profiting from the fact that $\beta\gamma^2$ factor will be two times larger (0.35 at 50 MeV and 0.71 at 160 MeV), so the resulting tune spread driven by a direct space charge should remain similar. This paper describes the feasibility to double the intensity of high intensity and large emittance beams, looking into the evolution under space charge and taking into account losses constrains in the ring and in the extraction lines.

Title:

3D emittances tailoring techniques and optimization with space charge for the future CERN PS Booster operations with Linac4

Authors:

V. Forte, J. Abelleira, E. Benedetto, C. Bracco (presenter), M. Kowalska

Abstract:

In the frame of the LIU (LHC Injectors Upgrade) project, the CERN PS Booster is going to be renovated to host a new H- charge-exchange injection from the Linac4. One important feature of the new injection scheme is the possibility to tailor a wide range of 3D emittances for the CERN different users in an intensity span in the order of 1e9 to 1e13 protons. This paper gives an overview of 3D multi-turn injection techniques, focusing on the future LHC beams, which aim at reaching high brightness, and on highest intensity beams (ISOLDE), where losses are the main issues of concern. Complete RF capture simulations and transverse injection maps, including space charge effects, are presented and intended to be also useful to the operations during the commissioning with Linac4.