Task Name: PS2 Beam Instability R&D

Perform a first estimate of single-bunch instabilities in the PS2 reference design. Parametrize against vacuum chamber properties. This includes vacuum chamber impedance estimates based on first guesses at the vacuum chamber properties (dimensions and material).

The frequency spectrum of the RF system impedance is unknown at this time, however, guesses at transverse and longitudinal modes may be made based on the FNAL Booster cavity. Analyze LLRF feedback topologies for the fundamental cavities. Investigate noise sources and mitigation.

Once an impedance model has been created, simulations and/or analytic estimates will be used to estimate the instability growth rates for both single-bunch instabilities and coupledbunch instabilities. Depending on the impedance model, issues like self-bunching of the beam at higher frequency shall be studied.

## **Specifics:**

Build an impedance model of the PS2 vacuum system using the best available guesses for the vacuum system and the best available data for the rf cavities (based e.g. on the FNAL Booster cavity unless better model is available). Estimate single-bunch growth rates and characteristics of instabilities for these conditions.

Where applicable, use simulations to understand the nature of instabilities.

This subtask will naturally lead towards design aspects of the vacuum system. Impedance questions have to be balanced against eddy currents created during ramping of the PS2. HOM damping may not be required due to the long bunches, but this should be checked. Impedance spectra of components with varying apertures (bellows etc.) will be evaluated.

## Why SLAC&LBNL:

SLAC has significant experience in this field and SLAC and LBNL have had very successful collaborations on similar topics in the past. The PS2 investigations would extend this experience towards a different regime in frequency and at the same time potentially open up the opportunity for engineering staff to get involved in the design issues of these vacuum systems. The LBNL experience in impedance measurement could be put to good use.

SLAC: K. Bane, G. Stupakov, C. Rivetta, C. Ng FNAL: V. Lebedev (tbc) LBNL: J. Byrd, S. De Santis, M. Furman

Effort: 1 FTE (FY09), 2 FTE (FY10) Travel: 2 person-weeks (FY09), 3 person weeks (FY10)