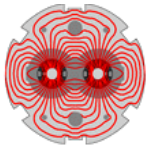


US LHC Accelerator Research Program

BNL - FNAL- LBNL - SLAC

ILC MDI at SLAC
LARP at SLAC

13 September 2010

DOE Site Visit

Tom Markiewicz/SLAC

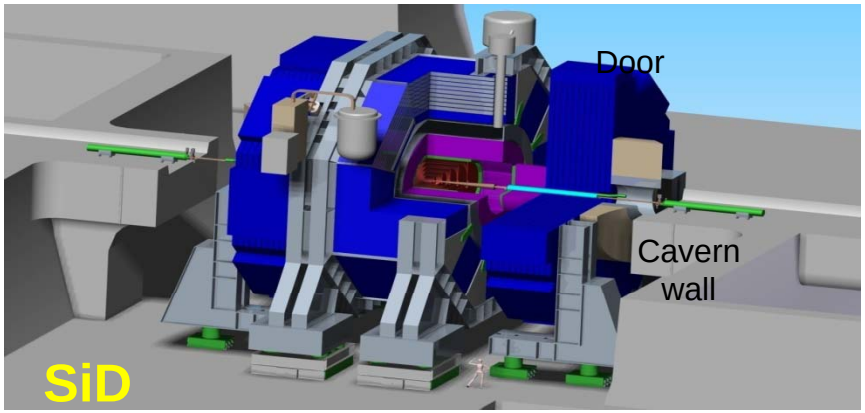
ILC MDI at SLAC

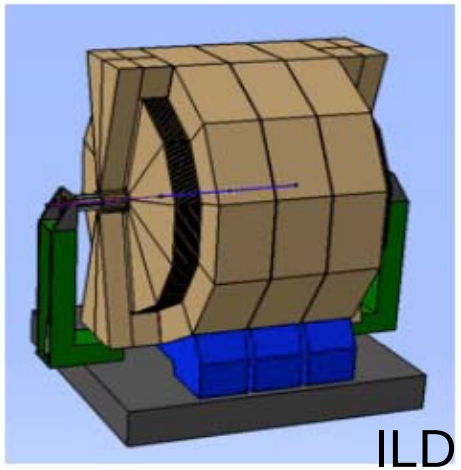
For Push-Pull operation, the 2 validated ILC Detectors both must either

- Sit on platforms with a motion system under each platform
- Move on the pit floor via their preferred motion system

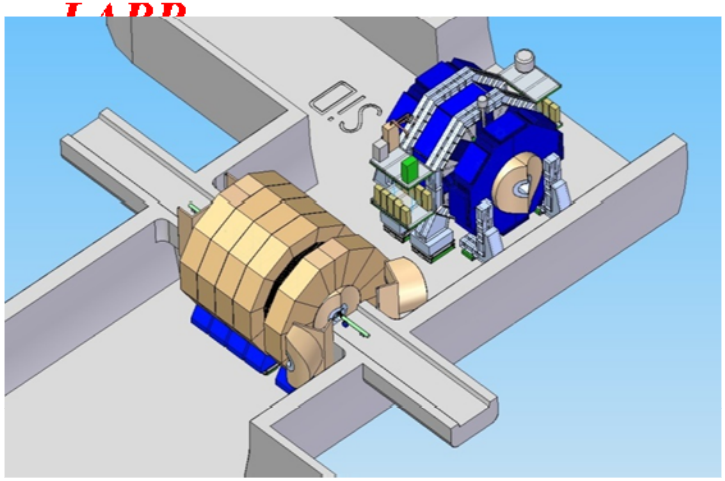
Issues needing study include:

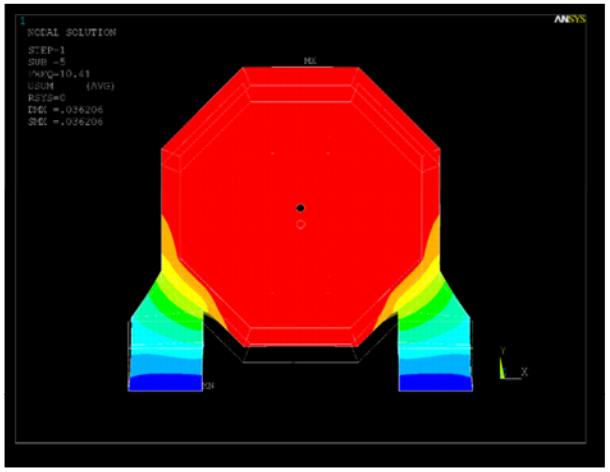
- Vibration analysis, measurements and benchmarking
- Platform design, cost & implication to IR Hall engineering
- Vibration-optimal support for QD0
- Consequences of the 1.7m height difference of the detectors
- Rapid realignment of QD0 and precision detectors after a push/pull exchange

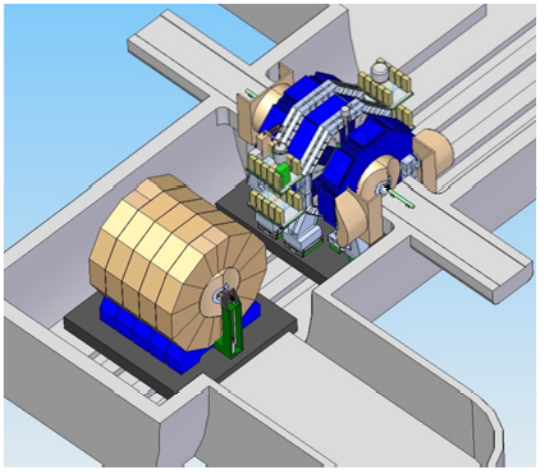


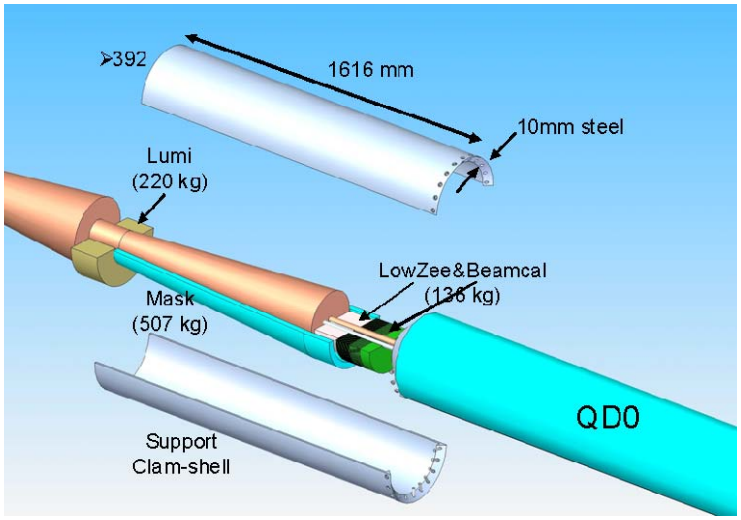


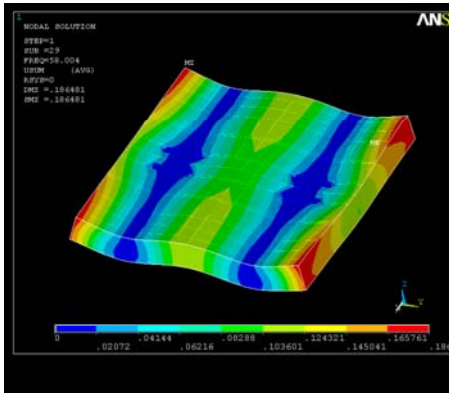
MDI Work in Progress:
Hall Design, Detector & Platform Vibration Analysis, "R20" Package w/ QD0 mover system, Frequency Scanning Interferometry Alignment

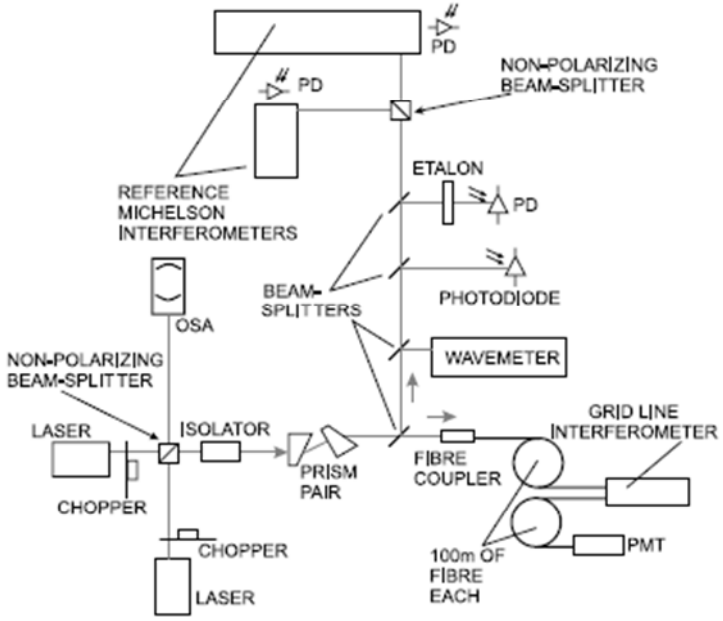












LARP Accelerator Physics Projects

Rotatable Collimator

Crab Cavity Design

RF Control of Ecloud and TCMI Beam Instabilities in the SPS

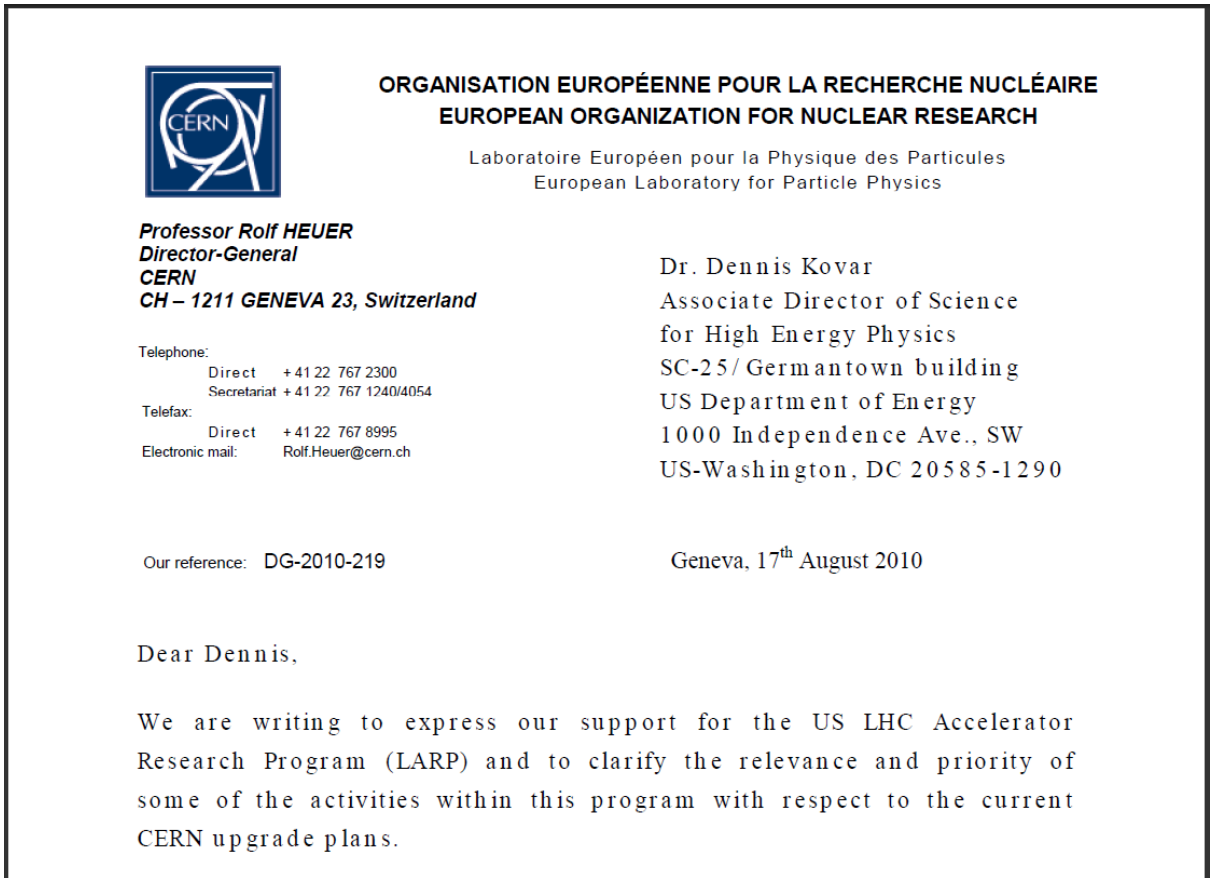
LLRF System Modeling and Commissioning

Synchrotron Light Monitor Design and Commissioning

UA9 Crystal Collimation R&D in SPS (and LHC)

PS2 Design Report: Collective Effects

2010-08-17 Heuer to Kovar Letter



ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Laboratoire Européen pour la Physique des Particules
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Dr. Dennis Kovar
Associate Director of Science
for High Energy Physics
SC-25/ Germantown building
US Department of Energy
1000 Independence Ave., SW
US-Washington, DC 20585-1290

Our reference: DG-2010-219

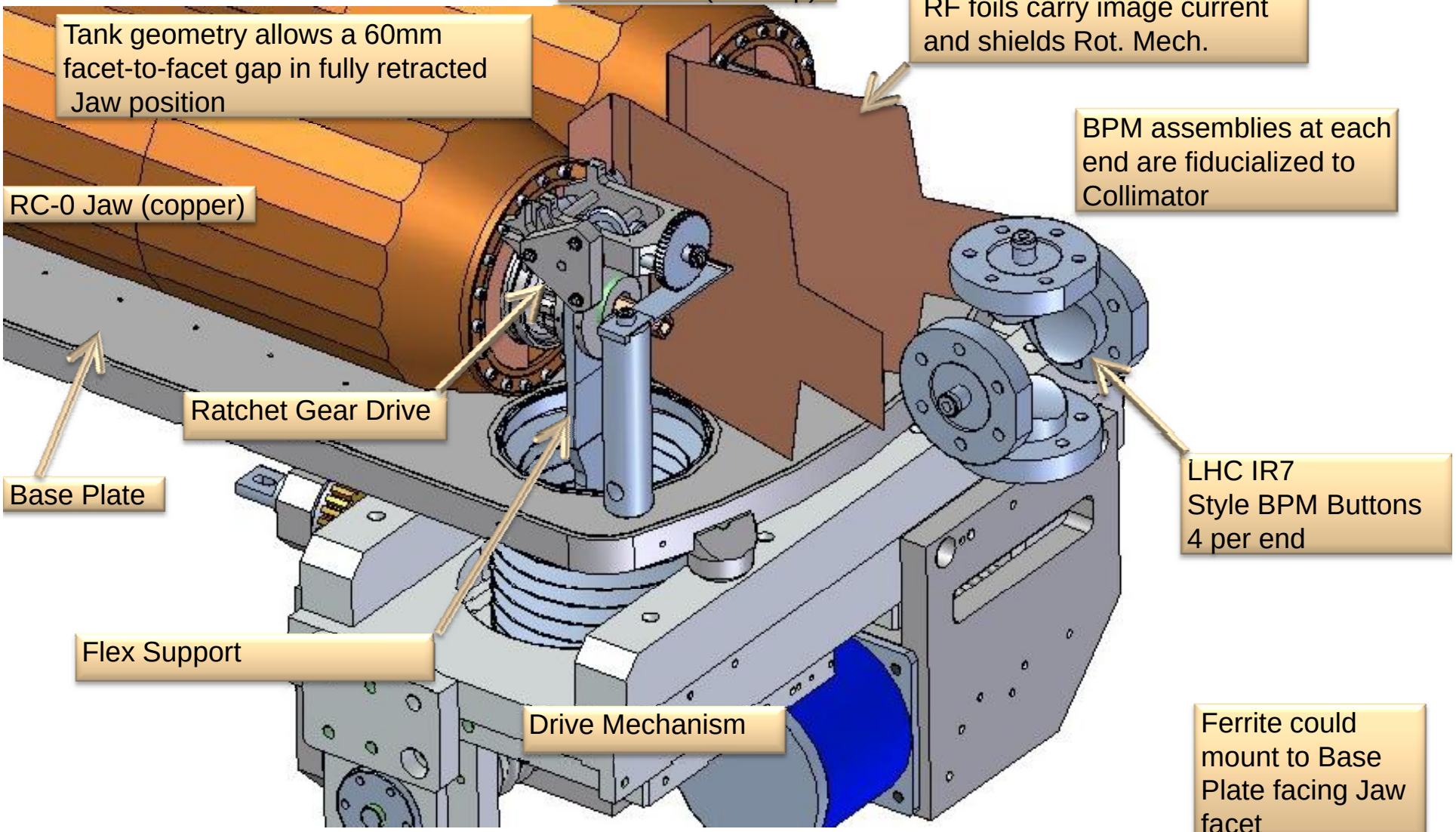
Geneva, 17th August 2010

Dear Dennis,

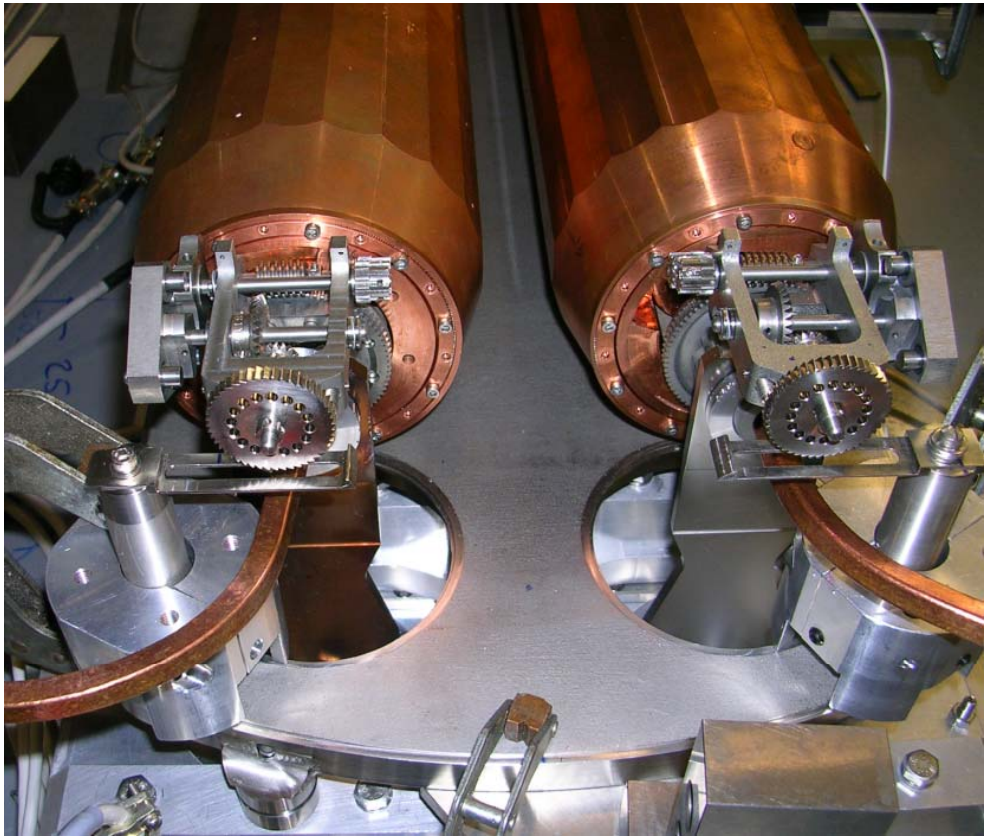
We are writing to express our support for the US LHC Accelerator Research Program (LARP) and to clarify the relevance and priority of some of the activities within this program with respect to the current CERN upgrade plans.

- Nb_3Sn Magnet Development
- Compact 400MHz Crab Cavity Design
- Rotatable Collimator Development

SLAC RC Design Details



The 1st Prototype Rotatable Collimator at SLAC is ALMOST Ready



Current Near Term R&D Plan

Ship 1st RC Prototype to CERN asap

- Mechanical, Vacuum & Impedance tests by CERN personnel
- Installation in SPS during end-of-2010 technical stop of LHC
  - Location identified
- Beam tests of prototype in SPS in early 2011
  - Impedance
  - Operation

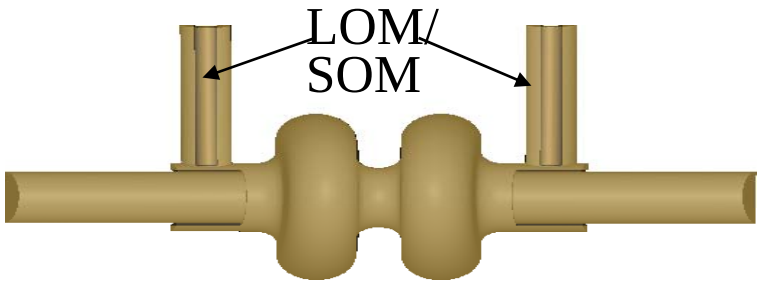
Robustness tests in HiRadMat Facility ~summer 2011:

1 Mjoule per accidental beam-abort

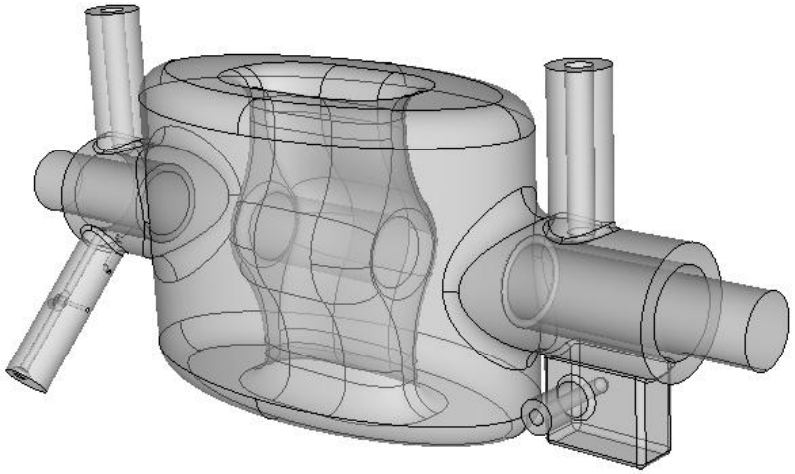
- Test extent of damage: molten & gaseous debris, hit face, adjacent face..
- Permanent shock induced deformation of jaw
- Operation of rotation drive & integrity of water circuits after impact(s)

SLAC Crab Cavity Design for LARP & CERN

Prior to CC-2009-Dec Meeting CERN/LARP baseline was 800 MHz Elliptical Cavity Developed & Extensively studied by SLAC's ACD group:

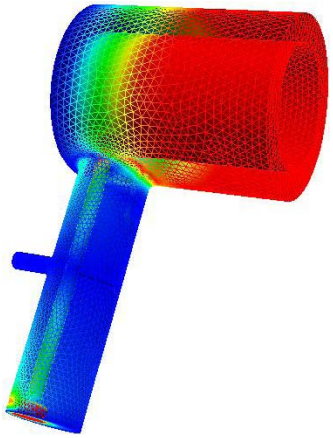


Current baseline is compact 400 MHz cavity useable in both "local" and "global" configurations. SLAC **Half-Wave Spoke Resonator** is a leading candidate

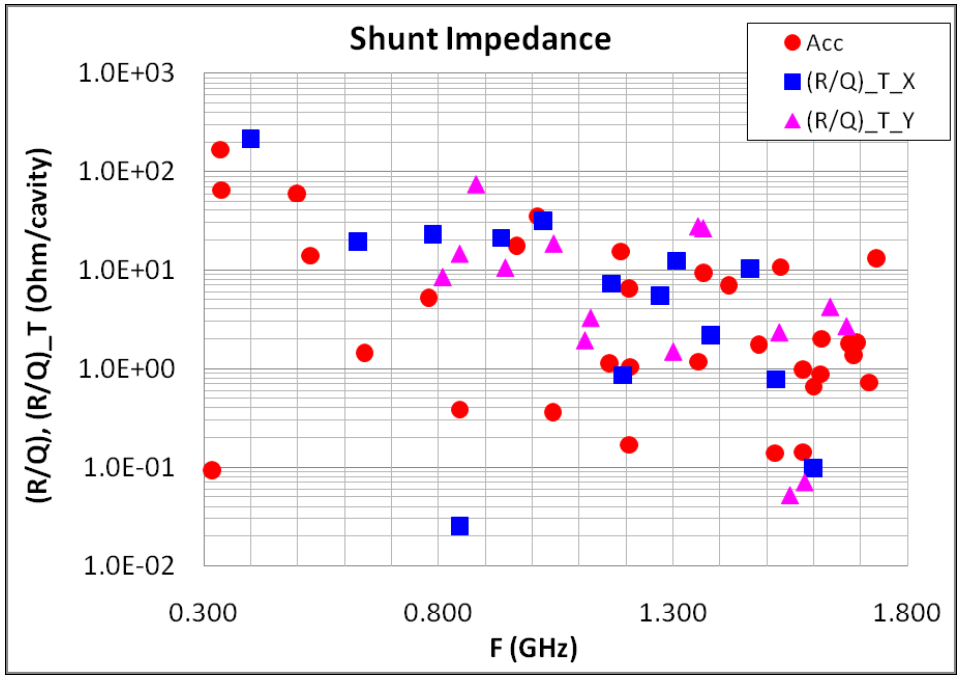


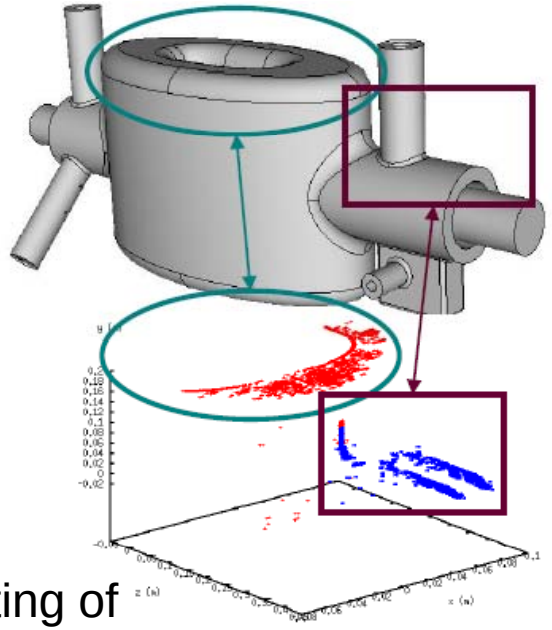
Progress in Half-Wave Spoke Resonator Cavity Studies

- Design Concept
- Cavity -surface field and RF parameters optimized
- Couplers: -LOM/HOM-v, HOM-h couplers optimized
- Multipacting -analyzed



HOM Coupler w/Notch Filter





Multipacting of Operating Mode

Extract from Myers to Kovar Letter 25 June 2010

25 June 2010

Possible special US contributions

SPS High Frequency Transverse Feedback Proposal (W. Hofle)

We need the new SPS feedback system in order to increase the intensity in the LHC to the "ultimate". (1.7e11protons per bunch)

The SPS is equipped with a powerful transverse feedback system working in baseband which covers a frequency range up to 20 MHz.

Higher frequency vertical instabilities are observed in the SPS, are limiting its performance and

..... The observed within-bunch motion suggests that a resistive transverse feedback system with sufficient bandwidth can cure these instabilities. Indeed, modelling already done for the case of the electron cloud instability, has shown that this is feasible.

We propose to rapidly complete the study and launch the construction of a wideband transverse feedback system. .....

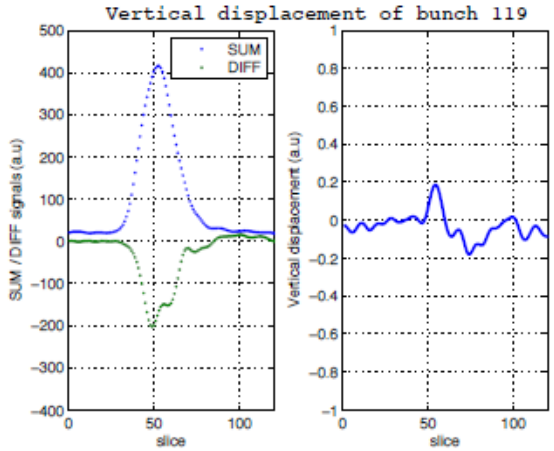
A new pick-up and sampling system, synchronous with the RF frequency, is one of the essential building blocks of such a feedback system and a logical starting point, too. It in itself constitutes an added value, as it would permit to better characterize the observed instabilities. .....

It is believed that this system can be built with strong support from US labs (SLAC/LBNL).

2010 LARP Ecloud/TMCI effort

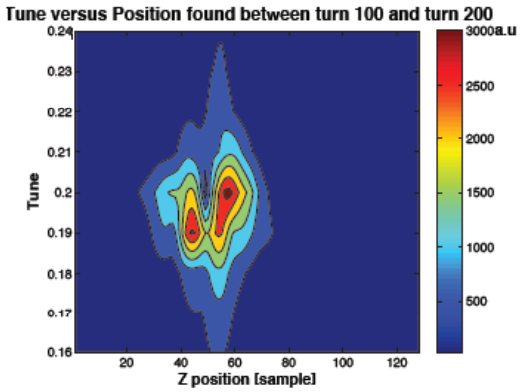
LARP

- Understand Ecloud dynamics via simulations and machine measurements

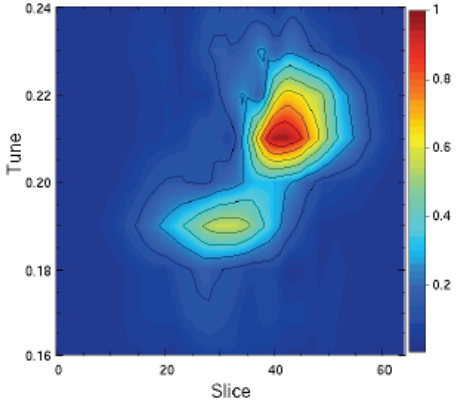


Vertical Instability develops after injection of second batch, within 100 turns. Time domain shows bunch charge, and transverse displacement 1E11 p/bunch

- Modeling, estimation of E-Cloud effects, extraction of system dynamics, & development of linear coupled-oscillator model for feedback design

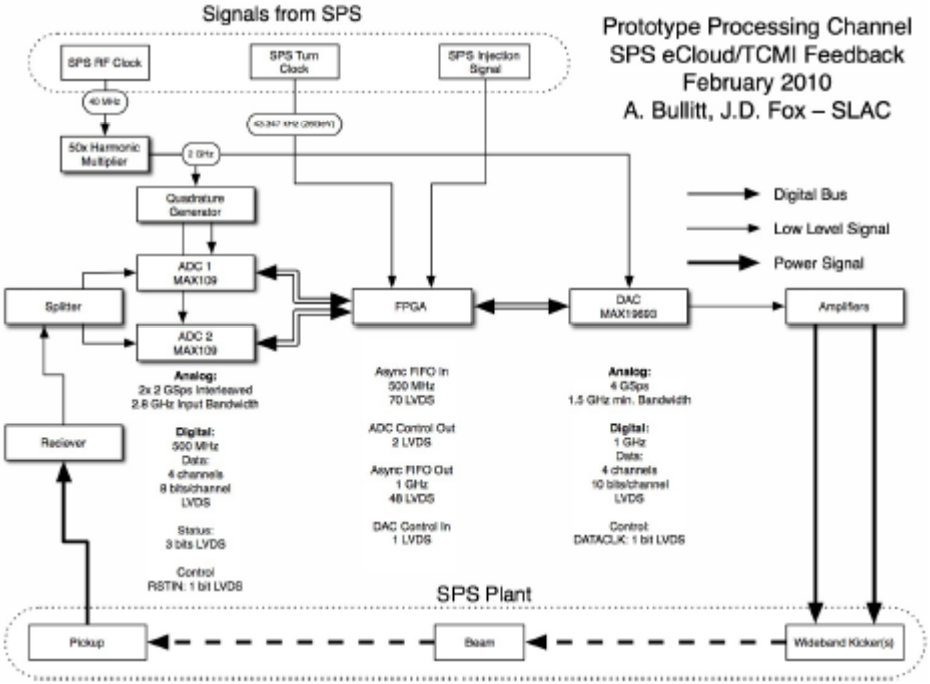


MD data June 2009



WARP simulation

2011 Plan: 4 GS/sec. SPS feedback channel via evaluation boards and SLAC-developed Vertex 5 FPGA processor



Modify existing system to synchronize with selected bunches

Identify critical technology options, evaluate difficulty of technical implementation

Explore 4 Gs/sec. 'small prototype' functional feedback channel for 2011

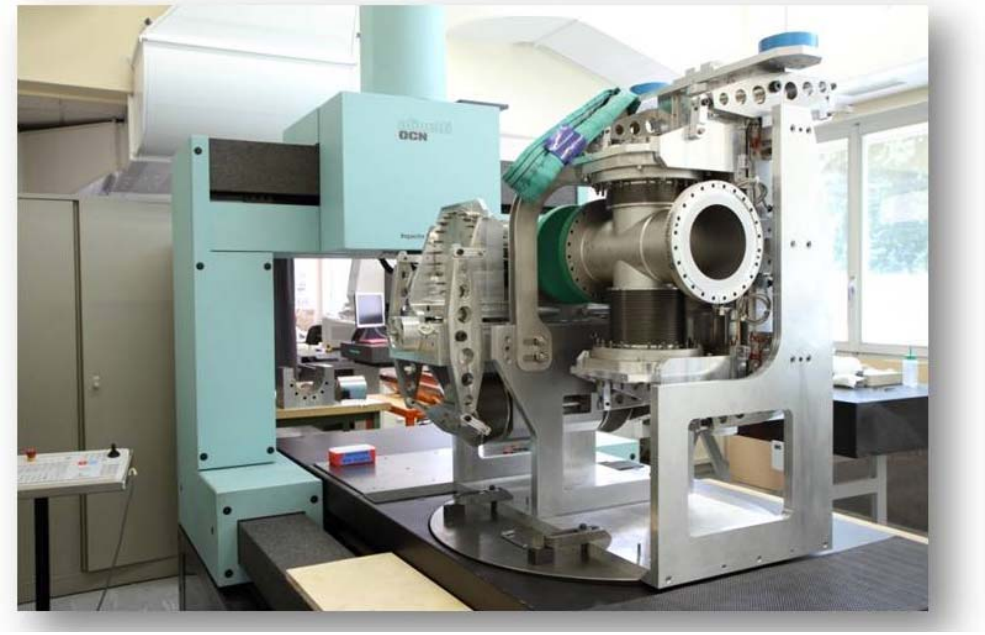
- fab and MD use

Evaluate SPS Kicker options re: CERN request, 2012 shutdown window

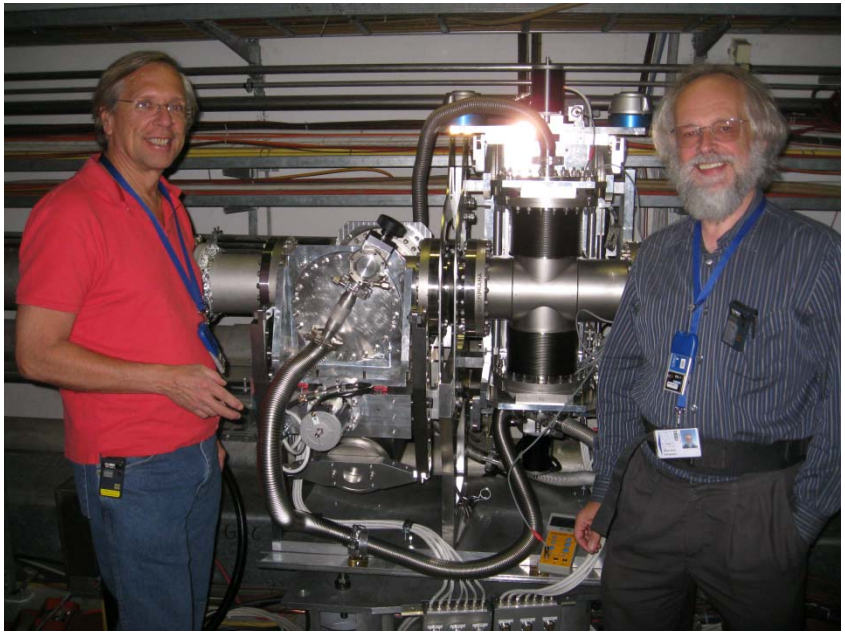
UA9 Crystal Collimation Experiments in the SPS

SLAC Built Roman Pot

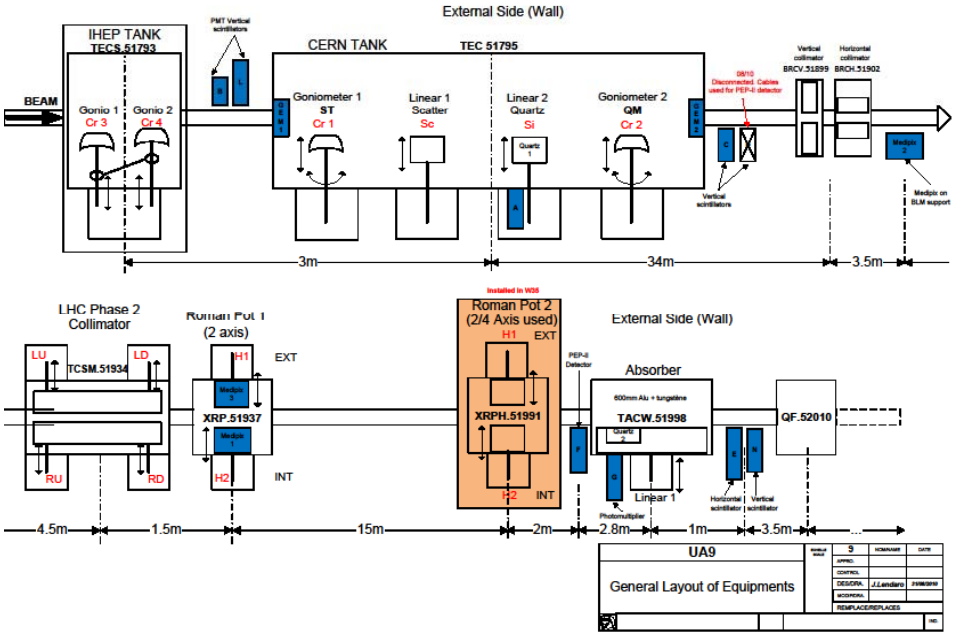
4 June 2010 at CERN CMM



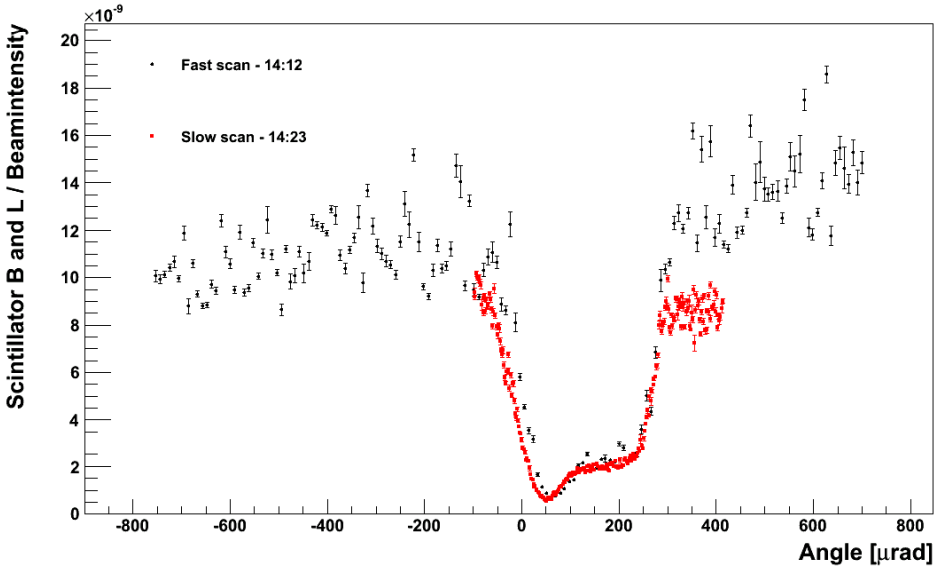
Installed in SPS 31 Aug 2010



1 September 2010 UA9 Layout with RP#2 & On-Line Angular Scan of Crystal



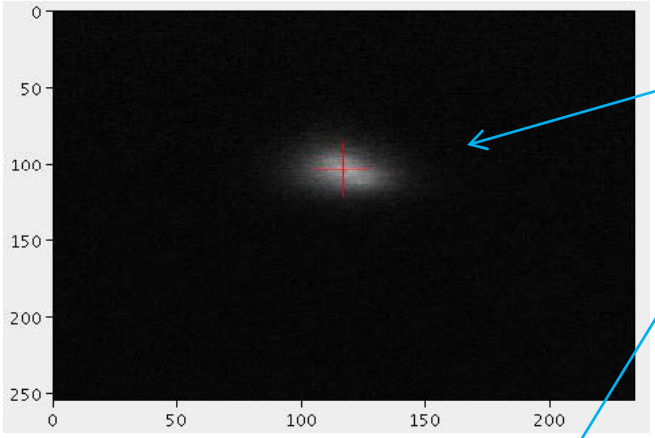
New 4-year MOU soon to be signed
LHC crystal experiments likely



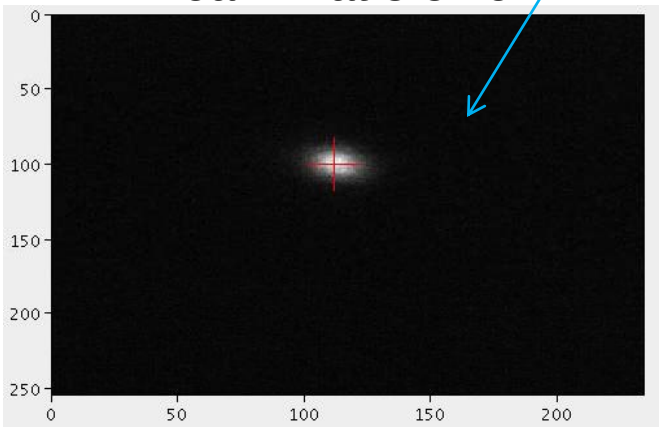
Synchrotron-Light Monitors

SLAC experience with electron SLM valuable & appreciated: LTV project

Beam 1 at 450 GeV



Beam 1 at 3.5 TeV



Three light sources:
Undulator radiation at injection (0.45 to 1.2 TeV)
Dipole edge radiation at1.2 to 3 TeV
Central dipole radiation at 3 to 7 TeV)
Spectrum and focus change during ramp

System came up extremely quickly and provides very good data
- Some discrepancies are under investigation
- Cross calibrating with other instruments

Setting up duplicate system on the bench to better characterize the optics

Sync light from protons is a world's first
Light from heavy ions later in this run!

PS2 Design Study

With Chamonix 2010 re-orientation work will finish with a report this CY

- 1st draft due by 30-Sept-2010, editing by Uli Wienands

Report elements all in good shape

- Space-charge simulations (LBNL, FNAL)
- e-cloud simulations (LBNL,SLAC)
- Impedance and instability evaluations (SLAC)
- Bunch-by-bunch feedback design/specs (SLAC)

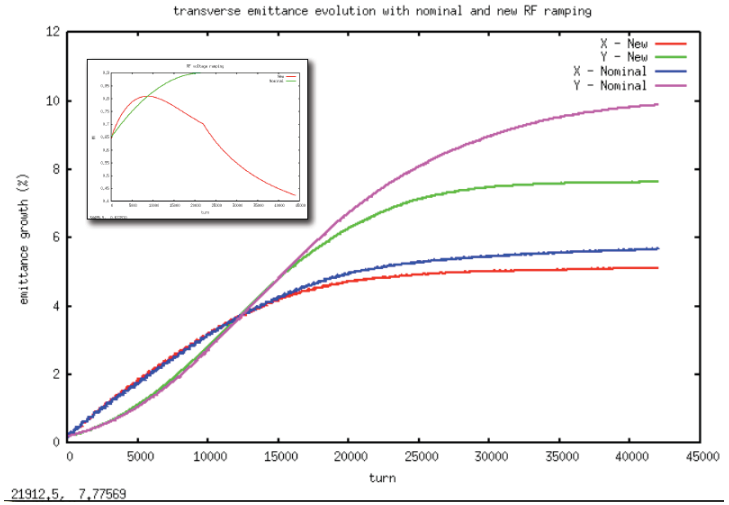


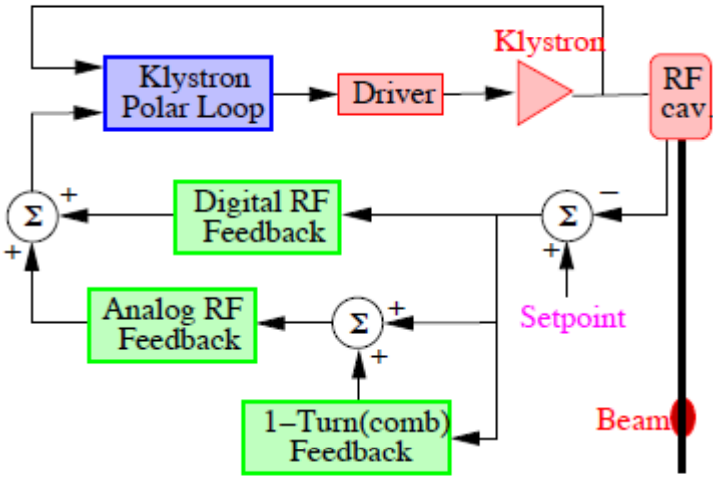
Table 2: Impedance budget for the PS2, including objects considered so far, assuming no Cu plating of the beam pipe.

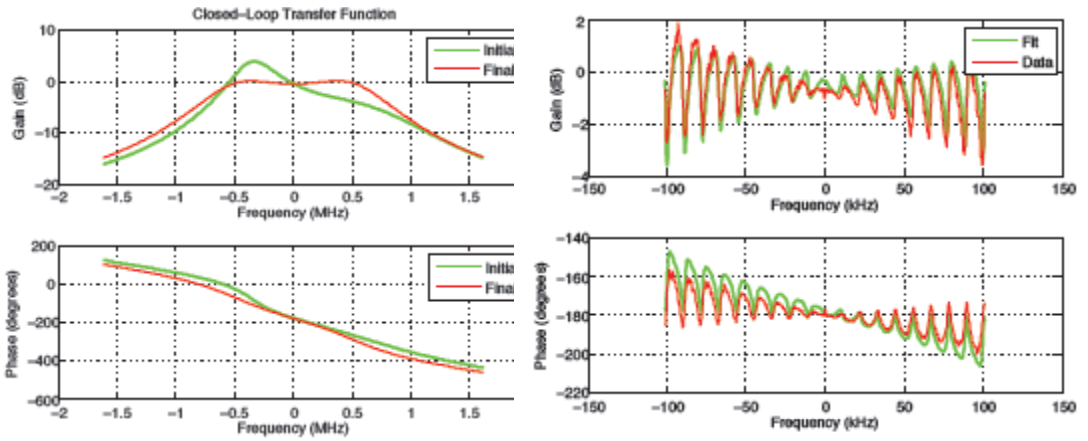
Item	Z/n [Ω] Inj.	Z/n [Ω] Extr.	k_y [V/pC/m] Inj.	k_y [V/pC/m] Extr.
RW	$0.39(1-i)$	$0.20(1-i)$	24	47
Flanges	$-0.17i$	$-0.17i$	5	19
SC	50i	0.5i		
Total	0.39+49i	0.20+0.13i	29	66

LLRF Tools and Models

Model-based beam/LLRF commissioning tools first developed for PeP-II

- Operate remotely to allow identification of the RF station transfer function and the design of feedback loops
  - Remote operation crucial under the new stricter CERN access policies





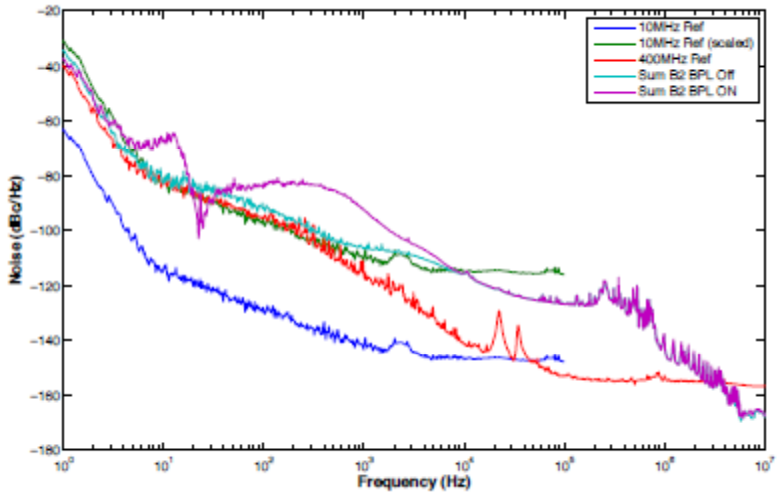
Tools used by the CERN BE-RF group during start up November 09 / February 10.

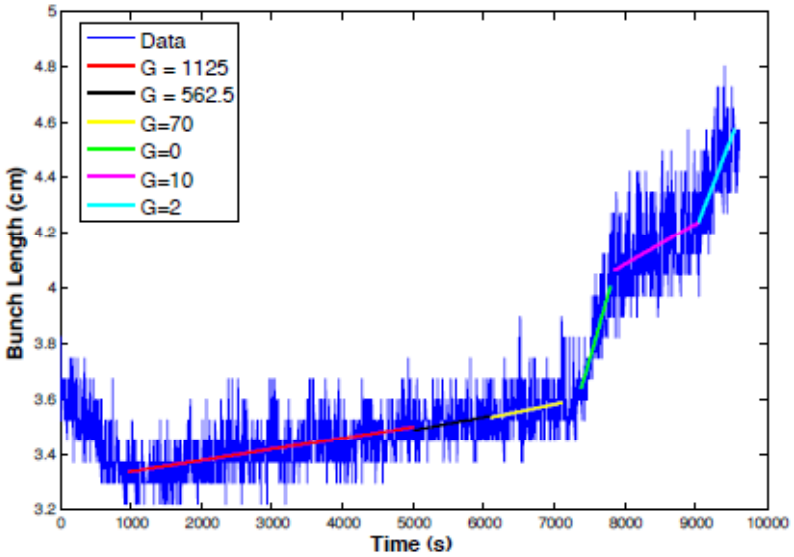
- Reduced commissioning from 1.5 days/station to 1.5 hours/station.
- The 1-Turn Feedback routines of the optimization suite will be commissioned as currents increase

An early result from the LLRF program: RF Noise Effect on Beam Diffusion

A formalism was developed relating the equilibrium bunch length with beam dynamics, accelerating voltage noise, and RF system configurations

- Anticipated a close relationship between RF station noise spectrum and beam diffusion rate.
- April 2010 measurements showed clear correlation between the bunch length **as estimated by theoretical formalism and the longitudinal emittance growth**
  - Studies are being conducted to identify alternative technical Local Oscillator implementations to reduce this effect.





SLAC Personnel within the LARP Organization

Deputy LARP Leader & Accelerator Systems Head: TWM

Long Term Visitor Coordinator: Uli Wienands

Toohig Fellow Committee Leader: John Fox

Two SLAC “Long Term Visitors”: Alan Fisher & Uli Wienands

One Ph.D. (LLRF) (also awarded Toohig Fellowship):

Themis Mastorides

Two Graduate Students: SPS Ecloud

Alex Bullitt & Ozhan Turgut