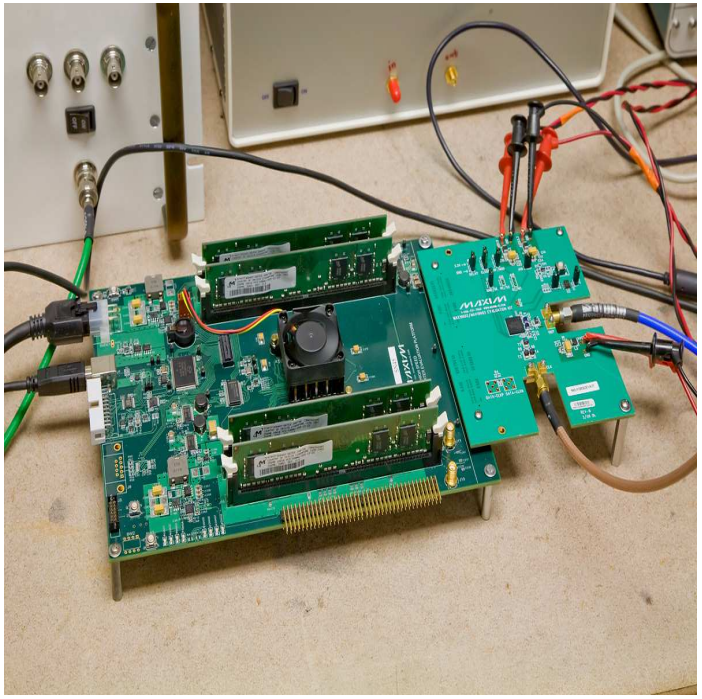
Driven Beam Experiments

Develop excitation technique using existing exponential striplines

requires power amps, hybrids, etc.

Can be frequency domain or time domain study



Idea - use 4 GS/sec DAC hardware to drive noise sequences onto selected bunch(es)

measure excitation, response with two channel fast scope

(avoids synchronization complexity)

Time domain sequences - transform, average (transfer function estimator)

Frequency response of internal structure and modes

Can be done as excitation in simulation, too.

valuable step in development of any possible feedback controller (Back End)

LARP SPS and LHC Ecloud 5 year proposal

Overall Goals - R&D effort in 2009 - 2015

- develop beam dynamics/feedback dynamics simulation models
- validate several simulation codes against accelerator measurements
- develop reduced linear dynamics models useful to design/estimate feedback controllers
- develop experimental techniques to estimate Ecloud effects for stable and unstable systems
- evaluate possible control techniques, understand trade-offs between robustness, controllability, and system complexity
- develop the detailed requirements for a new wideband feedback system architecture
- Proof-of-principal technology R&D on GHz bandwidth (e.g. 2 - 4 GS/sec.) processing, backend
- Prototype proof of principle processing channel, implement feedback algorithm, machine studies and comparisons with models.
- Develop diagnostic and operational tools and codes to understand the system performance via accelerator measurements
- Recommend architecture and technology for a general-purpose wideband feedback system useful to control Ecloud-driven instabilties for SPS, LHC and other facilties. Design Report and recommendations

Goals -FY2008/2009 LARP Ecloud effort

understand Ecloud dynamics via simulations and machine measurements

- Participation in E-Cloud studies at the SPS (June, August 2008), additional measurements 2009
- Analysis of SPS and LHC beam dynamics studies, comparisons with Ecloud models
- Adaptation of SLAC's transient analysis codes to Ecloud simulation data structures

Modelling, estimation of E-Cloud effects

- comparisons of Warp and Head-Tail models, results
- comparisons with machine physics data (driven and free motion), validation of models, estimates of dynamics
- extraction of system dynamics, development of reduced (linear) coupled-oscillator model for feedback design estimation
- develop tools to analyse unstable data, quantify and compare system dynamics
- evaluate feasibility of feedforward/feedback techniques to control unstable beam motion, change dynamics. Estimate limits of techniques, applicability to SPS and LHC needs
- Identify critical technology options, evaluate difficulty of technical implementation
- Participation in LHC transverse feedback system commissioning

Decision Point - late 2009/2010

Is the Ecloud dynamics feasible for feedback control? What techniques are applicable?

Research Goals - 2010 - 2011

- Modelling of closed-loop system dynamics, estimation of feedback system specifications
- Evaluation of possible control architectures, possible implementations
- SPS Machine Physics studies, development of transient-domain instrumentation

Decision point 2011 - Proof of principle design studies, estimates of performance

Research Goals 2011 - 2015

Technology R&D - Specification of wideband feedback system technical components

Technical analysis of options, specification of control system requirements

- Single bunch control (wideband, within bunch Vertical plane)- Required bandwidth?
- Control alogorithm - complexity? flexibility? Machine diagnostic techniques?
- Fundamental technology R&D in support of requirements - Kickers and pickups?
- wideband RF instrumentation, high-speed digital signal processing

Develop proof of principle processing system, evaluate with machine measurements

System Design Proposal and technical implementation/construction project plan

Summary

Lots of progress on improving collaboration effectiveness from the meetings, web-reports, etc.

- now see intial agreement between head tail, WARP
- Similar cases- no Ecloud - tunes agree
- Ecloud effects - for comparable SEY and density, similar tune shifts

Linear Model - first efforts fit well to fastest Eigenfrequencies

- Issue - internal modes, phase relationships
- Work in progress

MD analysis

- impressive effort by W.H. and RDM to post process August data
- Goal - look at this data using FFT and Eigenmode tools
- How do they compare?

Plans for June 2009 MD, ongoing anlaysis and simulation efforts