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Beam Instrumentation Department

Main Injector BPM Project Overview

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Computing Division Meeting

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Active BPM Projects

- **Tevatron Ring**
 - In progress with CD providing most of the project management, hardware engineering and fabrication, software engineering and implementation, and installation manpower under Accelerator Division guidance
 - Completion expected by ~April '05 (see Stephen Wolbers talk)
- **NuMI Beam Line**
 - In progress, with project management by NuMI Project and design and implementation by AD Instrumentation and Controls Departments
 - Completion expected by ~January '05
- **Antiproton Transfer Lines (Accumulator to Main Injector, to Recycler and to Tevatron)**
 - In early development and design stage with Elvin Harms (Antiproton Source) as Project Manager and Nathan Eddy and Claudio Rivetta leading effort in AD Instrumentation Department
 - Will employ NuMI /Recycler software and Tevatron EchoTek boards
 - Completion expected by ~April '05



Main Injector BPM Project

- **Scope**
 - Replace signal processing electronics and front-end data acquisition systems for ~208 beam position monitors located around the Main Injector and in six buildings
- **Objectives**
 - Eliminate obsolete Multibus II hardware and ACNET communications protocol
 - Accommodate measurement of beam in 2.5MHz RF buckets
 - Provide improved measurement resolution
- **Beams Document #471, dated February 2003, specifies system requirements**
- **Scheduled to follow on the heels of the currently active BPM projects**

Organization and Status

- Run II Luminosity Upgrade Project WBS 1.1.3.2
- Alberto Marchionni is identified as project leader within the Main Injector Department (the role Mike Martens plays in Tev project)
- Dave Johnson and Dave Capista will likely serve as beam physics and machine operations consultants respectively
- Main Injector Department is now re-reviewing the requirements document
- Decision to design around Tev style EchoTek boards has been made within MI and Instrumentation Departments and requisition to procure those boards is in process
- Other current activity is only organizational, planning, or peripheral



Similarities to Tevatron BPM System

- General system design and implementation
- Beam information to be obtained and types of measurements, i.e. first turn, closed orbit, and turn-by-turn
- Anticipated hardware, except more complicated analog circuitry upstream of digitizer
- Scope of DAQ, on-line, and off-line software, although different in detail
- Coupling between BPM and BLM systems



Differences from Tevatron BPM System -- All in the Details --

- Main Injector operating cycles are more varied in type than in Tevatron and dynamically interwoven in time
- Both 2.5MHz and 53MHz signal frequencies must be processed (in different Nyquist bands)
- Measurement data is to be stored separately, in parallel front-end data buffers, for each operating cycle type
- Both protons and antiprotons must be measured, but
 - Do not circulate simultaneously (but fine timing is different)
 - Pickups are not directional (no separate p/pbar cables)
- Measurements are required from user selectable segments (batches) of the circulating beam
- Each BPM location is switchable between horizontal and vertical measurement with respectively different scaling



My Vision of System Implementation

- Analog front-end electronics will leverage heavily off Transfer Line BPM project (common requirement to deal with 2.5MHz and 53MHz signal frequencies)
- VME and VXWORKS front-end DAQ systems will be employed as in Tevatron
- Tevatron style EchoTek digital receiver boards
- Tevatron style digitizer clock and timing boards
- Front-end software probably dependent on group implementing the system (different in details from both Tevatron and Recycler)



How I See the Project Playing Out

- Little dedicated effort other than clarification and refinement of requirements will be applied prior to completion of NuMI BPM project (~January)
- Personnel and timing of system design effort is not well in-hand
 - Should begin prior to anticipated completion of Transfer Line and Tevatron projects
 - Main Injector lacks "in-department" engineering person, ala Jim Steimel in Tevatron; will need to be covered by Instrumentation Dept. personnel
- Most NuMI engineering, software, and technical support will transition to Transfer Line project by year end until ~May '05
- Software support from Tevatron project might become available in ~March
- Analog front-end design will flow from Transfer Line project
- Commodity procurements can begin in ~February '05 (EchoTek boards already in the queue)
- Install development system with either Tevatron or Recycler software in MI by February
- Latest Run II Luminosity Upgrade schedule shows MI BPM complete 11/21/05



Possible Roles for Computing Division

- Total effort level between that provided for Recycler and Tevatron BPM Projects might be considered
 - Less engineering design effort than in Tevatron project
 - Software not included in Recycler project
- Administrative management (Steve-ish and Bakul-ish)
- Analog circuit board layout and fabrication based on AD designs
- Support for procurement, incoming component inspections and testing, production testing, equipment tracking, etc.
- Supply Tevatron BPM style timing boards
- DAQ, on-line, and off-line software components after successful completion of Tevatron system
- Installation manpower
- To serve all these roles, CD effort should be estimated as on the scale of that remaining to complete the Tevatron project (large fraction of 60 FTE months, see Wolber's presentation)
 - Learning curve (AD language, machine operational issues, ACNET) has already been largely traveled by CD personnel on Tevatron project
 - Details will be different
- Alternative resources to cover any of these areas are TBD