8-27-12: Instrumentation needs for g-2 operations:

Here are a few notes from today's g-2 Instrumentation Meeting:

* Material for the meeting can be found on Indico at <https://indico.fnal.gov/conferenceDisplay.py?confId=5854>.
  + Slides - Contains all of the slides used for the talk
  + Document - Is a draft of the g-2 CDR for Controls and Instrumentation.  Instrumentation starts on page 6.
  + We talked about how this will be a high level meeting to get the "big picture" as clear as possible.  There will have to be additional, more focused meetings to deal with the technical details for each piece of instrumentation.
* Discussed the beam requirements for g-2 and contrasted that to Mu2e operations.
  + All costing and planning that we did for Mu2e beam still is valid for g-2 beam until we get to the target station at AP0.
  + Downstream of the target station at AP0, beam intensities are very different between the two experiments.
  + Discussed how we will have to complete a CDR and BoE documents, much like we did for Mu2e.
    - Mu2e has CD1
      * In the upcoming year we need to go from Conceptual to Technical Design.  This will require more engineering details.
    - g-2 is working toward CD1.  The steps will be similar to what we went through with Mu2e last year.
      * CDR complete and polished by Oct. 1
      * BoEs complete and polished by Nov. 1 (CDR and BoE work will be going on in parallel).
      * Internal Director's review ~ Dec. 1
      * Lehman Reveiw for CD1 ` Jan 1
* Talked about the four areas of g-2 beam that we must instrument
  + Primary Proton (RR, RR Stub, P1, P2, M1):  1E12, 8.9GeV/c protons, a single 120nsec 2.515MHz bunch, in bursts of 10msec apart.
  + Mixed Secondary Beam (M2, M3, Delivery Ring):  3.1GeV/c positively charged secondaries, ~5E8 decaying to ~1E7 total particles.  Single bunch travels around the Delivery Ring three to five times before the entire bunch is extracted.  The beam lines and Delivery Ring are just being used as a decay line and to give the protons and muons enough time to separate out in time.
  + Proton Secondary Beam (Abort Line):  ~1E7 protons is sent to the Delivery Ring Dump.  The abort line is the former AP2 line between the IQ26 and the Delivery Ring.
  + Muon Secondary Beam (M4, g-2):  ~2E5 muons are extracted to the upstream M4 line.  The g-2 line then forks off of the M4 line and sends beam to the g-2 experiment.
* Talked about how the costing for various parts of the two experiments are being funded.  CDR, BoEs and other important documents are found in different locations depending on how the item is being paid for.   We can provide guidance on where to put your FTL efforts depending on what you are working on.   The costing profile may change, but we will keep you informed.
  + Mu2e (http://mu2e-docdb.fnal.gov/) - Currently DCCT and Delivery Ring Tune Measurement
  + AIPs (http://beamdocs.fnal.gov) - Currently all Instrumentation common to both experiments, but this may move.
  + g-2 (http://gm2-docdb.fnal.gov/) - This is what we need to work on.  All of the Instrumentation issues specific to g-2.
* Talked about how there are other things that we need to work on in addition to the CDR and BoEs for g-2.
  + Mu2e Technical Engineering Design (DCCT and Delivery Ring Tune Measurement).
  + Costing for beam studies when we turn on after the long shutdown.
* Did an overview of what instrumentation we expect to use in each beam area.   See the slides for details.
  + Our priority is to get intensity, position and profiles in each beam line.
  + Differentiating between particle species is not a priority under the current funding profile.
* **To do list:**
  + **CDR Document**:  Our first priority at this time is completing our CDR.  I have made a draft of what I believe is an instrumentation plan.  I am asking all of you to review this document and make any suggestions, corrections or additions you see fit.  I would like to get some feedback from everyone in a week on what areas of this document need the most work.
  + **BoEs**:  Our next priority is to start coming up labor and M&S costing information based on the plan we layout in the CDR.  These items can the the topics of future more technically focused meetings.   There are two kinds of costs I see:
    - Costs for items not covered by our previous BoE work.
      * Permanent ion chamber (or two) in the M2 line, and a retractable ion chamber for both the M3 and Delivery Ring.
      * Wall Current Monitor to measure beam intensity for M3 and Delivery Ring?
      * High Gain preamps for SEMS:  4 in the M2 line, 2 in the Abort line, 7 in the M3 line, 2 in the Delivery Ring.
      * Additional SEMs in the Delivery Ring (since BPMs won't work for g-2).  We could use the one from the Accumulator, two that won't be used from the AP2 line and see if any other spares are available from the former AP4 line.
    - Costs for items that were partially covered in other BoE work, but also making them work for g-2 adds cost.
      * Delivery Ring BLM detectors are different between Mu2e and g-2, so we need a way to switch back and forth.
      * Abort Line intensities will be too low during g-2 operations to use the instrumentation already costed in this area for Mu2e.
  + **Beam Studies Plan**:  What instrumentation do we want to test in the upcoming beam studies period.  The biggest problem we will have is our beam source will be the MI, which can only deliver 53MHz beam.
    - Install and calibrate two ion chambers in the AP2 line?
    - Get at least two working SEMs with high gain preamps in the AP2 line (We had an additional mini-meeting after the main meeting to discuss SEMs)?
      * Test both AD/Controls preamp boards, and maybe a sample of the more costly box from industry?
      * AD/Controls may have a cost effective solution to the problem, but more work is needed.
    - Peter Prieto talked about getting a SY style resonant detector in the AP2 line for studies.
      * Rick Coleman has some knowledge of these detectors.
      * {Not brought up at the meeting} What is the aperture of one of these detectors?
    - Someone brought up the idea of testing 2.5MHz beam using the RR dump?  It is unclear if this would be an option.
    - {Not brought up at the meeting} Testing instrumentation with SY120 beam?
    - BPMs were discussed.
      * It appears that M2, M3 and Delivery Ring BPMs will not be able to see 2.5MHz beam at g-2 intensities even if 2.5MHz electronics is implemented.  Delivery Ring BPMs are being upgraded to allow 2.5MHz for Mu2e, but there will be no way for them to see g-2 beam.
      * I had brought up the option of having 1e12 at higher energy beam on target to get higher intensities in the M2/M3/Delivery Ring.  This would mean the Delivery Ring and M3 BPMs would need to see 53MHz beam, which was not part of the original plan.  *{Further discussions after the meeting with other experts determined that we will not get enough additional intensity to the Delivery Ring to make this worth while.   So we will likely NOT be asking to add 53MHz capability to these BPMs}*.
      * Since BPMs will not be used in the Delivery Ring, we will need to add more SEMs.
  + **Mu2e Instrumentation Changes (Delivery Ring Tune Measurement)**:  In our original costing for the Delivery Ring tune measurement, we had multiple options - See Mu2e-doc-1573.  Originally, the default option was assumed to be a system where we kick the beam and measure the response with BPMs.  As this is a destructive measurement being done during resonant extraction, we would like to more seriously explore the feasibility of the backup option of designing a new larger aperture Schottky detector to measure the tune.   We are looking for a tune resolution of ±0.001 with a few 100Hz update rate.
    - Need Engineering design work to see if the Schottky option is feasible.
    - Technical design would need to be developed before CD2.