Outline

• Operational status
  – Beam line
  – RF
  – LLRF
  – Instrumentation
• Scroll pump failure
• Radiation
• Tuning and measurements
• Plans
Operational status

- Operating MEBT-1.1 in a short pulse mode
  - Two doublets, one bunching cavity, and diagnostics
Beam line

• The most common beam conditions
  – 1.2 ms, 10 Hz, 5 mA pulse from the ion source
  – Chopping down to 20 µs with the LEBT chopper
  – LEBT settings were adjusted for the best RFQ transmission
    • The last solenoid needs to be tuned in response to variations in the ion source parameters
  – RFQ at 65 kV inter-vane voltage (vs 60 kV nominal)
    • 40 µs flat top of the RF pulse
    • Transmission is up to ≥95%
  – MEBT quad settings are close to nominal
RF

• There were no problems with RFQ amplifiers
  – Pulse mode only
  – A spare “slice” had arrived and on Apr 28 was installed instead of a working one to verify its performance
    • Looks good
    • Ready to try CW

• Generally, RFQ works reliable
  – Sometimes, there are updates on spark indicator
    • At least some of them are related imperfections in protection circuitry

• No problems with bunching cavity amplifier (COMARC)
  – Was run both in pulsed and CW
LLRF Status (slide from Jonathan Edelen)

- Both the RFQ and buncher are running well together in pulsed
- Beam compensation is working well
  - Adaptive beam compensation is stable to changes in the beam current at the nominal operating phase.
- We have demonstrated a cold turn on of the buncher cavity can be turned in CW
  - ~ 2 min for a manual start
  - High level control can probably decrease this time
- RFQ is ready for CW conditioning
  - Optimization of the frequency tracking loop is needed for resonance control studies and cold start during CW operations
Instrumentation (slide from Vic Scarpine)

Beam Current Measurements
- Front-end electronics installed and running into ACNET
- Two MEBT toroids and one LEBT toroid in readout
- Toroids calibrated
  - Repeatability variation ~ 1.2%
  - Systematics being studied
- Ring pickup installed in MPS

Beam Position Measurements
- Two Quad BPMs and ToF BPM in front-end readout
- Low-beta correction factor calculated and being installed
- Studying systematics

Fast Faraday Cup
- Motion control operational
- Scope and amplifier installed

Energy Measurement
- ToF motion control operational
- ToF software near completion
- First beam energy measurement:
  \[ E = 2.087 \text{ MeV} \]
Scroll pump failure

- Scroll pump behind the upstream ion source turbo pump failed at ~10PM on Sunday Apr 10
  - Beam line pressure increased to 20 Torr; other turbos worked
  - Was found next morning. Pump was replaced, and vacuum recovered in a couple of hours
  - Total loss ~ 2 weeks of beam operation
- RFQ and buncher were re-conditioned in an hour
- Ion source lost its HV strength
  - Required two openings and lengthy conditioning to recover
    - Not clear why
  - Problems with gas controller caused by extensive sparking
  - Sparking frequency is still higher than it is used to be, ~once per 4-hrs shift vs once in several days
Chopper failure

• The chopper was found not responding
  – Wire from the chopper plate to the HV feedthrough got disconnected
  – Chopper plate HV was on during the event. Likely in bad vacuum a continuous discharge to ground heated up the soldered connection.
  – Because the HV is measured inside the modulator, MPS considered the chopper operational

• Several existing layers of additional protection helped
  – The shift crew was careful of not turning on RFQ before verifying chopper operation
  – the ion source has always been run in the pulsed mode
  – RFQ was always in the short-pulse mode
Addressing the issues

• Actions – chopper
  – Will install additional feedthrough to read the chopper voltage from vacuum; discussing how to remove HV is pressure is bad

• Vacuum
  – Servicing the scroll pumps pre-emptively
  – Install gauges and modify valves between scrolls and turbos
    • To close a valve if a scroll fails; similar to Linac’s
  – Replace a manual valve between the ion source and LEBT by a pneumatic valve and close it if pressure is bad
  – Details are in PIP2-DOCDB #83

• Work to improve reliability of ion source electronics
  – Gas controller’s optical receiver has failed for 3 times
    • Right now waiting for a spare, IS is down likely for a week
Radiation

- Radiation survey found a low but measurable radiation around the temporary Faraday Cup
  - ~1 mrad/hr at contact $< 5$ mrem/hr @1'
  - At 0.1% duty factor
  - Being simulated by Energy deposition group (I. Rakhno)
- Should be completely eliminated with installation of “permanent” beam dump for CW operation
  - Need to install it as soon as possible to check
- Difficult to predict accident scenarios in CW
  - Entire 21 kW is lost to the beam pipe; working with Safety
- In parallel, prepare the cave re-configuration if interlocking is found required to ensure safe operation
Tuning and measurements

• So far most of the time is for tuning and calibrating
• Transmission from LEBT to the end of MEBT is up to $\geq 95\%$
  – Any large errors in energy and focusing are unlikely
• Tuning of LEBT for maximum transmission and beam centering in RFQ
• Tested calibrations of MEBT dipole correctors
  – Corrected polarity; look reasonable
  – Tests to % level require better understanding of BPMs and beam
• First emittance estimation with quad scan (~0.1 µm at 2 mA)
• Transverse focusing by the buncher changes with its phase
• First (manual) estimation of beam energy with Time-of Flight
Plans – short term

• Continue operation in pulsed mode when IS is back
  – Diagnostic commissioning
  – Trajectories, envelope estimations
  – Longitudinal measurements
  – MPS

• Start RFQ CW commissioning (with beam off)
  – May start tomorrow and continue for a week

• Install the beam dump (with longitudinal diagnostics in place)
  – May be in parallel with RFQ temperature tuning work
  – Check radiation

• Start preparations for CW beam
  – Diagnostics, MPS, Safety, cave etc.
Plans – transition to CW

• Starting preparations for CW beam
  – RFQ, Diagnostics, MPS, Safety, cave etc.

• Plan to open RFQ
  – Replace the coupler, measure the response of sensing loops, repair air leaks
  – Machine the plug tuners to bring the frequency to nominal

• The biggest uncertainty is with radiation
  – The plan is to re-configure the cave anyway
    • To speed up things if interlocks are required
    • Concurrently with the RFQ work
    • New configuration accommodates all MEBT configurations
  – Continue with radiation measurements and simulations
Plans- FY16

• Switch to CW beam when have Safety permission
  – Continue with pulsed measurements in parallel
• Install the Emittance scanner – delayed
  – Likely may install it around July-August
  – Make measurements in straight LEBT configuration
• Finish the LEBT bending magnet
• Receive 4 triplet assemblies from India (Aug- Sep)
• Recent news: leaks in stems of all 3 bunchers in production
• Shutdown for MEBT-2 installation is likely in Oct 2016
  – Install LEBT bend, 4 triplets, both kickers
  – Move the diagnostics line to the end
  – Duration ~ two months