Summary of work done

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17 Jan 2019

Status of PSP projects

Machine	Description	People	Status
Pre-Acc	Improve neutralization in LEBT with N or Xe.	Dan	Should have better results this time because of mass flow controller that we did not have previously.
Pre-Acc	Laser collimation of head/tail of longitudinal beam. (LDRD)	Dave	In contact with vendor for selection of optical engine.
Pre-Acc/Linac	Simulation of PreAcc + Linac	Valeriy/Kiyomi/ Dan	There are vertical exit angles from both source and RFQ. Dan is working on putting permanent magnets into the source to correct this angle. For RFQ, there is not enough dipole strength, but Valeriy's calculations say that quads should also be able to straighten out the beam.
Pre-Acc/Linac	Checking efficiency with increased current in LEBT corrector	Kiyomi/Dan/Pat	As a result of experiments, a power supply has been added to the corrector at the exit of the source to bend the beam more.
Booster	Flat injection porch	Bill/Kiyomi/ George/Howie/ Chris	First experiments were done with $17. RF frequency is still ramping, waiting for one-shot frequency ramp to be installed. More experiments on first study day on 23 Jan 2019. See today's talk.
Booster	Adiabatic capture	Chandra	Analysis continues … See unaccounted phase slip between beam and RF, RF and RF. Looks like phase slip depends on paraphase. Talk next time.
Booster	2nd harmonic	Robyn/Tan	John says moving into test cave by end of the month. Matt Kufer has to program PLC, will have some time soon.
Booster	Wide bore cavities	Salah/Matt	See today's talk.
Booster	2 stage collimators	Valeriy/ Chandra	Had meeting on 12 Dec 2018 to decide on the length of the primary collimator. Work to see amount of shielding needed for tritium control in sump water.
Booster	Injection girder	Dave	First orbump design to be completed in January. This drives size of D magnets.
Booster	Garnet loss improvements	Robyn/Tan	Got LDRD! (14 Jan 2018). Vendor submitted SBIR with help from us.
Booster	Mode 2 longitudinal damper	Nathan	Requires new broadband cavity. Also need specs. (benefits PIP1+)
LLRF	GMPS machine learning (get rid of reference magnet)	Bill	Got LDRD.
LLRF	Complete DDS upgrade, paraphase controller	Brian/Ed	Ed is learning the system.
LLRF	Phase feedback	Brian/Ed/Bill/ Tan/Valeri/Craig	Machine studies on 23 Jan 2019. Possible problem in phase feedback system. Rise time i~3 ms???!!!! (possibly in lead-lag filter).

House keeping

Machine	Description	i/c	Comments
Linac	7835	Kiyomi/Tan	M&S budget settled. However FNAL budget is still not finalized!
Linac	Klystron	Kiyomi/Bill/ Tan	L3 still working on proposal. No production until Q4 2020. See email dated 02 Jan 2019.
Booster	BPM	Salah/Peter	Getting closer … still some timestamp errors that are intermittent. B40 works. Snapshot BPM not working.

Plan to reduce injection losses

1) Understand LLRF. From beam measurements, we do not understand some of the behavior of the beam, especially in its phase behavior. We suspect that the LLRF is doing something to the beam. We are working on understanding the present installed system.

2) Flat injection porch. A flat injection porch during injection should make adiabatic capture of the beam more efficient. This is because the Booster ramp is taken out of the equation during this time. Flat injection is well understood from the physics point of view.

3) Adiabatic capture. In conjunction with flat injection, adiabatic curves will be studied to improve capture of the beam.

4) Improved Bdot triggering (TCLK reset). Circuits have been and will be installed to improve the triggering (TCLK reset) jitter w.r.t. to the ramp. The triggering improvements (installed 08 Jan 2019) have improved the jitter from +/- 20 us to +/- 2 us. This immediately improved losses around the ring.

5) 2nd harmonic cavity. This will both increase the bucket area and flatten the beam distribution to lower space charge. Both these effects should improve capture efficiency. The 2nd harmonic cavity will be in the test cave soon (before end of Jan 2019). Once its performance is certified, installation should happen before the 2019 shutdown.

6) A transverse collimator may be required in the 400 MeV line to remove transverse tails. This is not expensive (copy of a new design being implemented for Muon Campus) , we have a location in the line picked out.

7) Laser LDRD to demonstrate collimating longitudinal tails – should help linac and likely help Booster.

8) Machine learning on GMPS will help keep the injection field and the entire ramp better regulated. (see point 4 above)

9) Out of left field – if losses at the injection region are due to foils/scattering/inefficiency. We may need to put inside the gradient magnet a nonmagnetic material to absorb the H- and neutrals. This may also be helped with a shorter D magnet. Need to understand the trajectory to see if an absorber downstream of the first magnet can help.

There is no magic knob that will fix the injection loss! All the above will help and contribute to the fix.