Tasks for the PIP-II RDR

Valeri Lebedev

PIP-II weekly meeting
July - 1, 2014
Fermilab

U.S. DEPARTMENT OF ENERGY

Fermilab

Major Choices

- Booster at 20 Hz
- RDR assumes 900 MeV maximum energy (measured in tunnel length)
- Possibility to make straight linac tunnel for 2 GeV => ??? m
  - To achieve 2.4 MW in MI without tricks (no slip-stacking, second harmonic, KV-distribution) we need injection energy to the RCS of 2 GeV
- Linac to Booster transfer line with electro-magnets
- Future linac extension in a straight line to 2 GeV (?)
  - Detailed study can reduce this number

Table of Contents for PIP-II RDR

3. ACCELERATOR FACILITY DESIGN

3.1. SC Linac (V. Lebedev)

3.1.1. Warm Front End (ion source, LEBT, RFQ & MEBT)

3.1.2. SC Linac physics design (Choice of break-points, Acc. grad., cryomod. param.)

3.1.3. SC Linac – Beam Dynamics (add beam loss)

3.1.4. SC Linac – Pulsed operation (LFD compensation, Requirements to RF power and cryogenics)

3.2. Beam Transport to Booster and Beam Dump (D. Johnson) (beam line design, beam loss (additional to 3.1.3), beam dump requirements, beam switch to mu-to-e upgrade, future RF separation and beam transport to the next stage)

3.3. Booster Modifications (B. Zwaska)

3.3.1. Injection

3.3.2. Transition crossing

3.3.3. Modifications for 20 Hz operation

3.3.4. Beam instabilities (I. Burov)

3.4. Recycler/Main Injector (I. Kourbanis)

3.4.1. Recycler Modifications (+slip stacking and beam stability)

3.4.2. Main Injector Modifications

3.4.3. Beam instabilities (A. Burov)

3.4.4. Electron Cloud Mitigation

3.4.5. Low energy operation for MI (60-120 GeV)

4. DESIGN CONCEPTS OF MAJOR SUBSYSTEMS

4.1. SC Linac (V. Yakovlev)

- 4.1.1. Ion source, LEBT, RFQ and MEBT
- 4.1.2. CW Accelerating Structures Requirements
- 4.1.3. Low-beta section (2.1-10 MeV, 162.5 MHz)
- 4.1.4. Low-beta section (10-160 MeV, 325 MHz)
- 4.1.5. Medium-beta section (160 – 800 MeV, 650 MHz)
- 4.1.6. RF power
- 4.1.7. LLRF (B. Chase)

4.2. Booster (B. Zwaska)

- 4.2.1. Injection girder
- 4.2.2. RF cavities and High power RF
- 4.2.3. Changes required for 20 Hz operation

4.3. MI/RR (I. Kourbanis)

- 4.3.1. Hardware for Main Injector transition crossing
- 4.3.2. RF Systems (beam loading compensation)

4.4. Cryogenics (A. Klebaner)

4.5. Instrumentation (V. Scarpine)

4.6. Controls (J. Patrick) Includes Booster and MI, 20 Hz

4.7. Safety and radiation shielding (A. Leveling)

4.7.1. Radiation Limits

4.7.2. Radiological Design Requirements and Consequences of Project X Radiation Limits (TLM use in Booster)

4.8. Machine Protection System (J. Steimel & A. Warner)

4.8.1. MPS Configuration

4.8.2. Protection System R&D

5. SITING AND CONVENTIONAL FACILITIES (J. Hunt)

5.1. Siting Options

5.2. Conventional Facilities

5.3. Site Power Requirements

APPENDIX I: Near term accelerator upgrades

1. Beam delivery to Mu-to-e (Johnson)
2. Cryo-plant for CW operation (Klebaner)

REFERENCES

Requests for work (No writing assignments yet)

Linac

- Slava Yakovlev
  - Signed FRSs for SSR2, LB650 and HB650 – July end
- Warren Schappert
  - Stability margin of microphonics suppression with large LFD (theory help?)
- Arun Saini - July end
  - Pictures for beam dynamics in linac and RFQ
    - Beam envelopes in RFQ
    - Beam envelopes through the rest of the linac
    - Emittance growth through RFQ
    - RF phases and voltages through SC linac (and separate file with data)
- Dave Johnson (Booster)
  - Proposal for injection girder (optics and magnets) – July end
  - Simulations of beam painting (no Space charge) – mid August
  - Transfer line optics – August end

- Bob Zwaska (Booster)
  - Transition crossing simulations with RF voltage jump and final bunch rotation (space charge + impedances)
  - RF for 20 Hz operation
  - Stability boundaries for Booster
- Alexei Burov – end of August
  - Total tr. and L. impedances including HOMs for Booster, Recycler and MI
  - Theoretical analysis and comparison to experiment for the beam stability in Booster, Recycler and MI
  - Effect of octupoles (located at zero dispersion) on transverse beam stability in the course of slip-stacking in Recycler
- Ioanis Kourbanis
  - Measurements of transverse instability thresholds
  - Transition crossing in MI
  - Recycler dynamic aperture
  - Slip-stacking at 20 Hz