Introduction and Aims; Integration Issues

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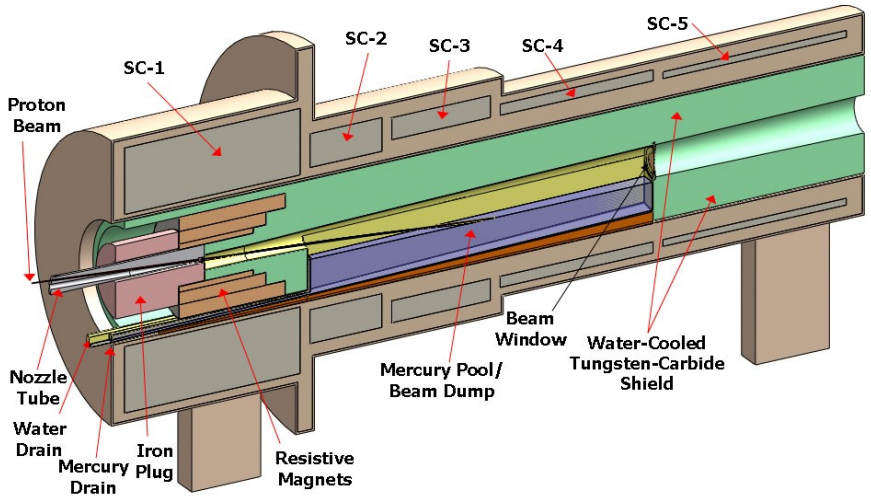
Muon Cooling and Production

- Muon cooling and production (MPC)
  - Multi-MW target with solenoid focusing
  - Collection of resultant pions and decay to muons
  - Clean-up of beam impurities
  - Sorting muons into (several) RF buckets
  - Cooling
  - Separating mu+ and mu-
  - Merging RF buckets into one bunch
  - More cooling
- Key technologies
  - High power targetry
    - Solenoid capture with multi-MW target
  - Ionisation cooling
    - RF
    - High field solenoids

Aim

- Aim is to build a **prioritised** R&D list
- Where are there potential problems?
  - How severe?
  - Can we fix with paper studies? Hardware studies?
  - Do we need to develop a “plan B”?
- Where are there opportunities?
  - Can R&D investment deliver improvement on the MAP baseline?
    - Paper studies?
    - Hardware studies?
  - Can we exploit new or alternate technologies?

Target

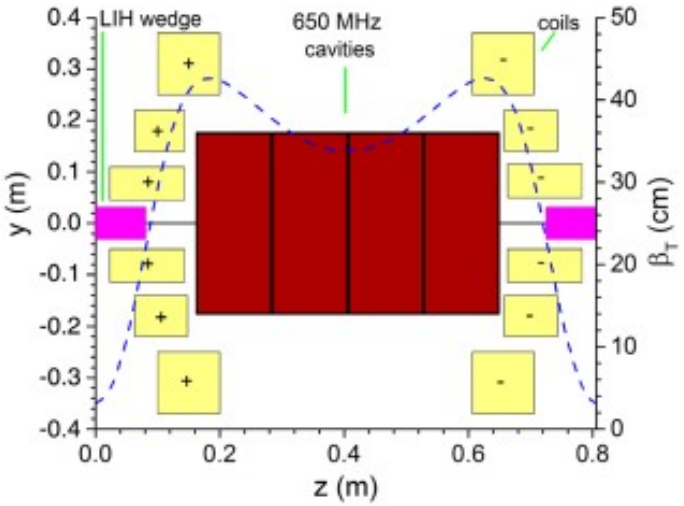


- High power target **in solenoid** very challenging
  - Factor 100 beyond state-of-the-art in power
  - Factor 10 beyond state-of-the-art in field
- Challenges
  - Power deposit on target
  - Radiation load on the solenoid
  - Extraction of residual beam/heat
- Mitigations
  - Do we need a prototype? If so what?
  - Do we need to develop a plan B (target + horn)?

Capture and Cooling

- Solenoids
  - Minimum emittance ~ $1/B_z$
  - Field flips/etc
  - What is the maximum field?
- High gradient RF
  - Large bucket required
  - What is the maximum gradient that can be achieved?
- Integration
  - RF tends to break down in solenoids
  - Mitigations
    - Gas filled cavity
    - Beryllium walled cavity
- Other issues? Space charge, beam loading, etc etc
- What should go in the “test facility?” Other tests/prototypes?

muons

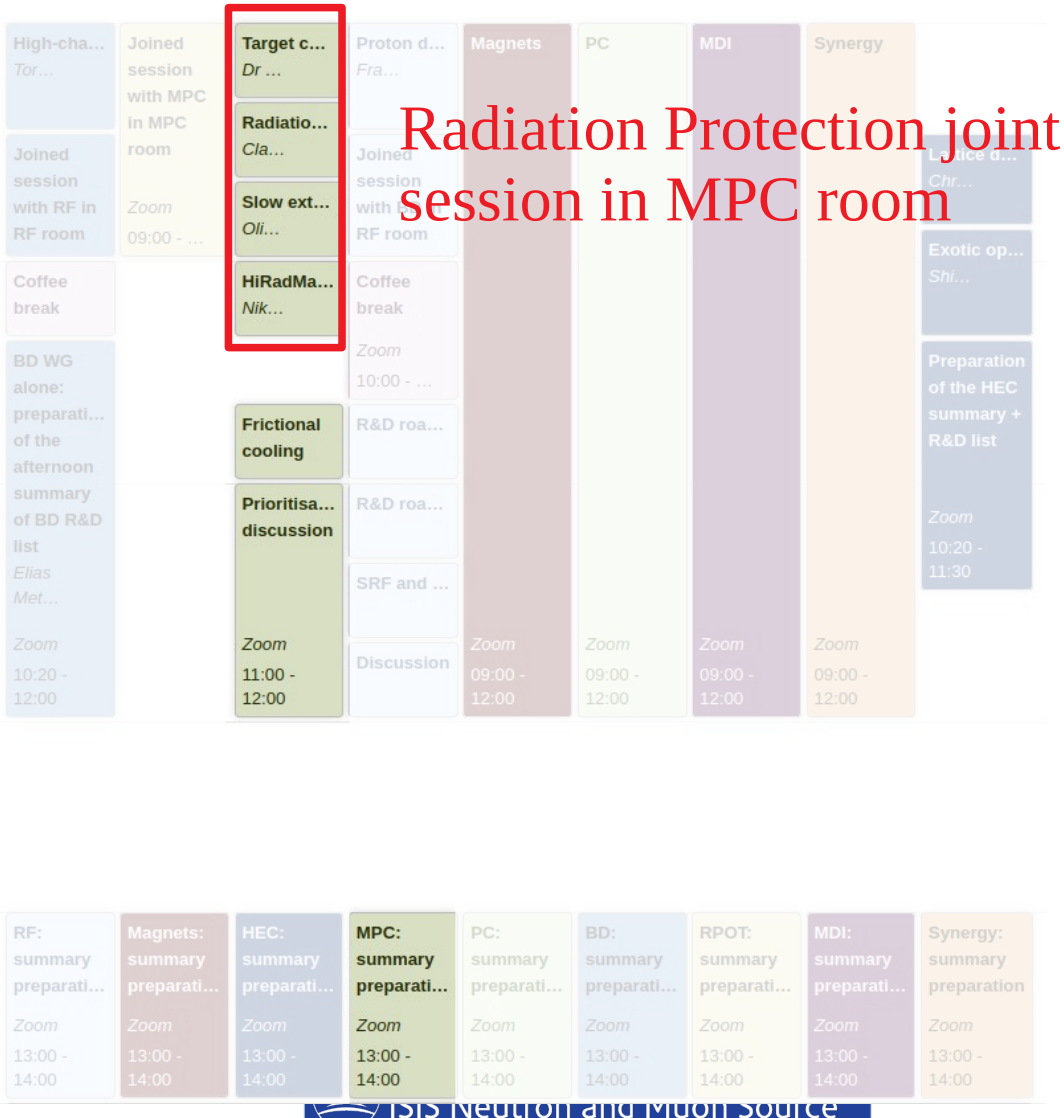


Agenda (Thursday)

RF joint session in RF room

Magnets joint session in MPC Room

Agenda (Friday)



Integration issues

- Potential issues pertaining to the whole system
  - Transmission and matching
  - Quench Protection System
  - Charge separation
  - Codes

Transmission and Matching

- Final cooling paper:

with absorber material. This includes energy loss, straggling, multiple scattering, and muon decays.

In this simulations we used a Gaussian input beam with normalized transverse emittance $\epsilon_\perp$ of 300 μm-rad and longitudinal emittance ϵ_L of 1.5 mm. The initial momentum distribution was generated with an average longitudinal momentum of 135.0 MeV/c. Tracking was performed using an initial sample of 10^7 particles matched and injected into the first ionization cooling stage.

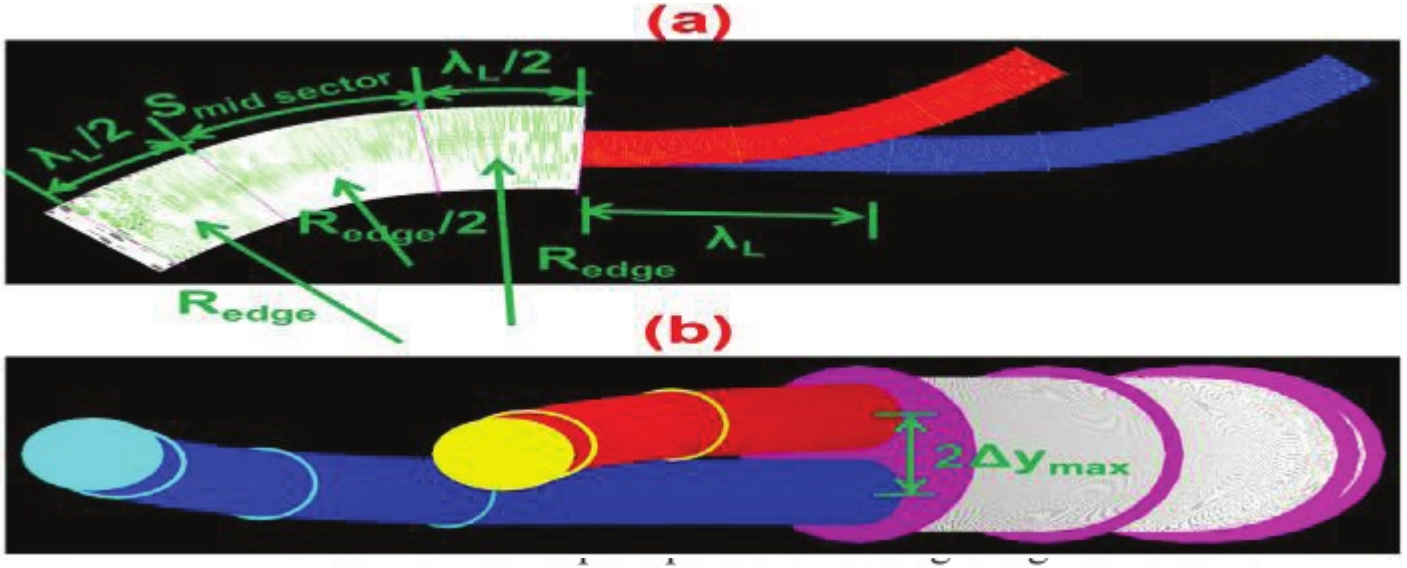
- What about rectilinear, bunch merge, etc?
  - How good is matching between different lattices
- Start-to-end simulation is desirable

Quench protection system

- Solenoid lattice – from target to end of cooling – is coupled
  - Fringe field of adjacent magnets overlaps
- Is it possible to make a QPS that does not quench the entire system?
  - Do we need to make an optics solution?

Charge separation

- Charge separation



charge of the muon, but a charge separator had not been designed. The tight time constraint forbade the design of a realistic charge separator, so a study was performed to emulate the effects of a simplified charge separator on muons exiting the front end of a muon collider. The output of the study provides particle distributions that the competing designs will use as input into their cooling channels.

Codes

- Two codes in common use
  - ICOOL (BNL)
  - G4Beamline (Muons, Inc / Fermilab)
- For collective effects, Warp
- They do everything we want – at the moment
- As time goes by, we will want new features
  - Deal with novel physics issues
  - Add in new beam elements, as required
- Need to ensure that we maintain the capability