Muon Production and Cooling R&D Prioritisation

C. T. Rogers
ISIS
Rutherford Appleton Laboratory

Cooling issues

- A number of issues raised during discussion
  - Some are opportunities to improve performance
  - Some are potential problems that have to be dealt with
- I will discuss the cooling/capture system
- Marco will discuss target and active handling area (incl. chicane)

Cooling issues

- Basic lattice parameters need work
  - No self consistent baseline exists
  - Final cooling system alternatives may have better performance
  - Charge separation system has only preliminary design
- Optimisation opportunities
  - Performance may improve with stronger magnets
  - Performance may improve with higher gradient RF
  - Performance may improve with lattice optimisation
  -
- Potential technical issues
  - Material physics processes may not be well understood
  - Collective effects may be detrimental to performance

Self-consistent baseline

- Significant performance uncertainty – no self-consistent baseline design
  - E.g. initial cooling and rectilinear mismatched
  - E.g. chicane (etc) not fully optimised
- Actions
  - Collection of existing lattice designs
  - Reoptimisation of individual elements in light of appropriate specification of interface points
  - End-to-end simulation
  - System reoptimisation
    - E.g. where do we finish rectilinear and start final cooling, etc

Final cooling

- A number of improvements over current final cooling have been suggested
  - PIC
  - More rectilinear
  - Potato slicer
  - Frictional cooling
  - Wedge
- Actions
  - Design work on alternatives
  - Down selection

Charge separation

- No well-defined design exists for charge separation system
  - Preliminary study only
- Actions
  - Design work required here

Lattice optimisation

- Lattice performance can be improved with more work
  - E.g. matching between rectilinear cells
  - E.g. looking at different momentum goals in final cooling
- Actions
  - Do lattice optimisation

Material physics

- Material physics effects not accurately modelled
  - E.g. energy straggling or multiple Coulomb scattering is not well-represented
- Actions
  - Literature review
  - Simulate using multiple codes
  - Simulation of sensitivity to energy straggling, etc
  - Measurement with beam

Magnetic field strength

- Magnetic field strength uncertainty leads to performance uncertainty
  - Could be able to push performance further (opportunity)
  - Could be we have over estimate of performance
- Actions
  - Better understanding from magnet team of limits
  - Reoptimisation of lattice design in light of magnet team suggestions

RF

- RF gradient uncertainty leads to performance uncertainty
  - Could be able to push performance further (opportunity)
  - Could be we have over estimate of performance
- Actions
  - Better understanding from RF team of limits
  - Reoptimisation of lattice design in light of RF team suggestions

Collective effects

- Various collective effects lead to performance degradation
  - E.g. space charge
  - E.g. beam loading
  - E.g. absorber heating
- Actions
  - Calculation of magnitude of different effects
  - Simulation of sections where the risk is highest
  - Reoptimisation as appropriate