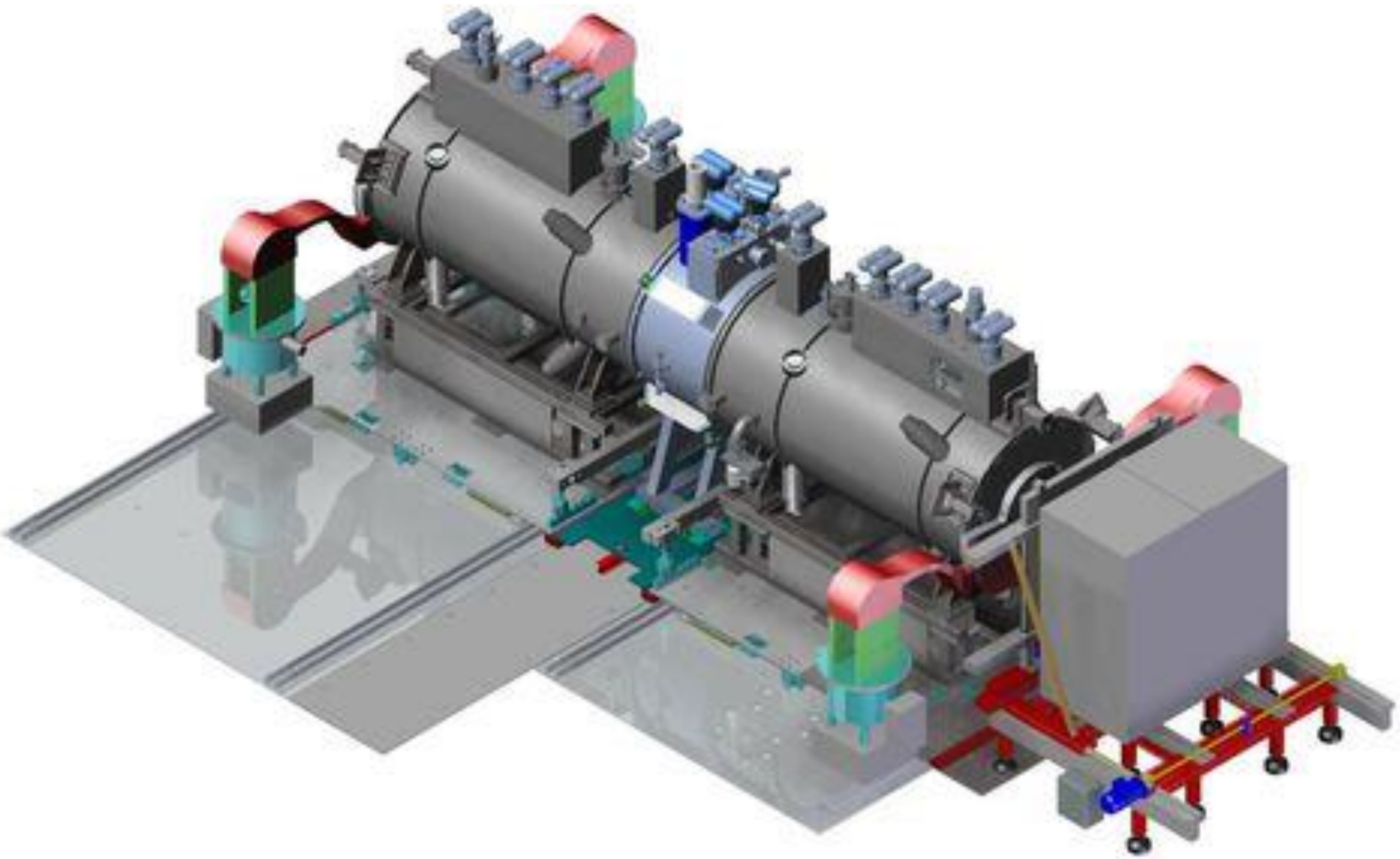

Monte Carlo Simulation of Reverse Emittance Exchange in MICE

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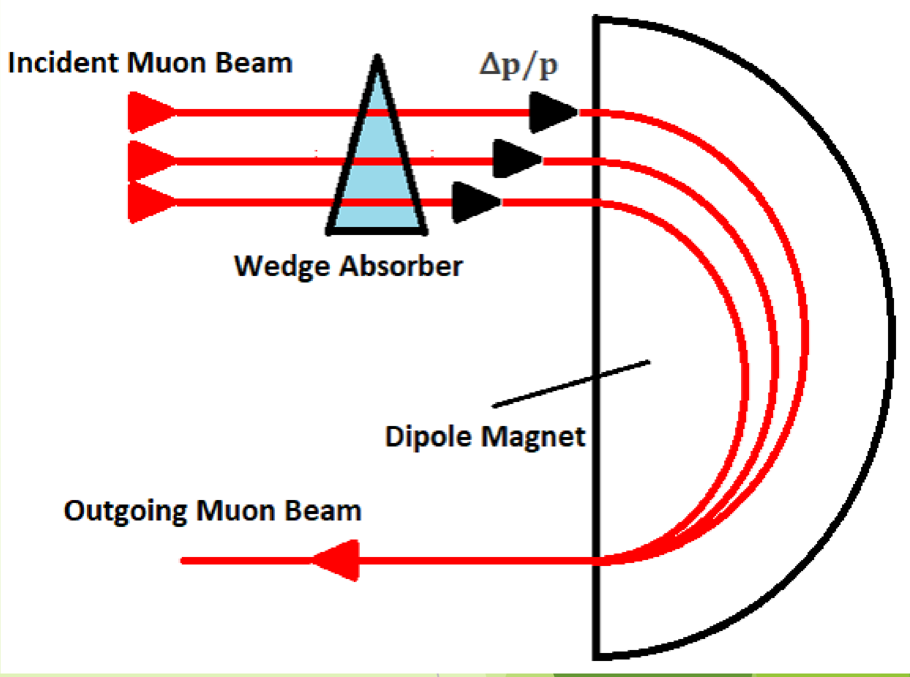
On behalf of the MICE Collaboration

Reverse Emittance Exchange

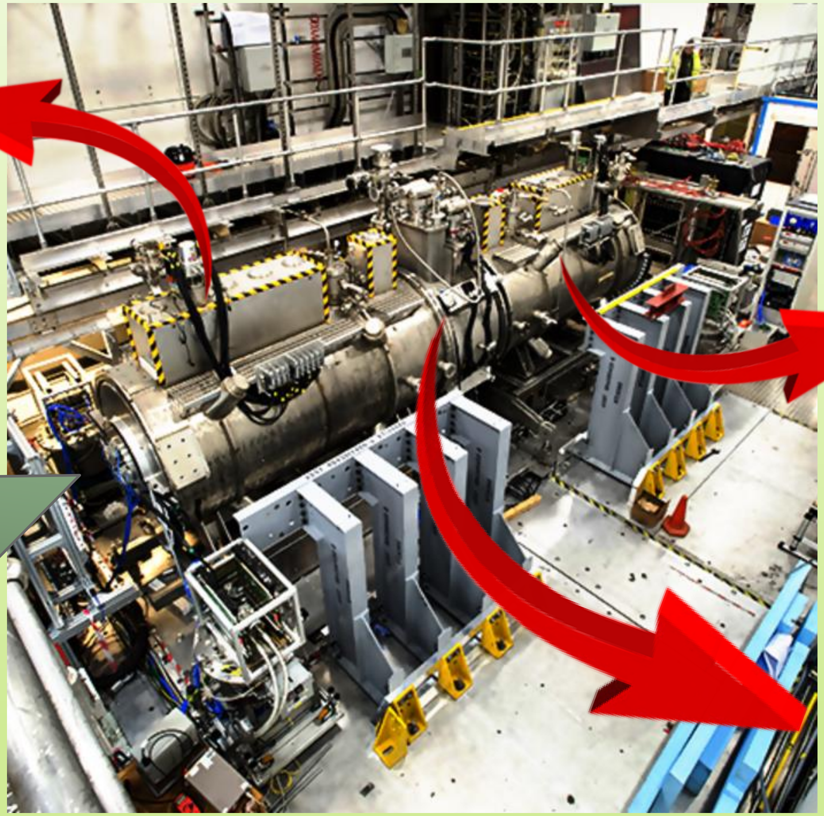


- When produced, muons occupy large phase-space volume (their spread in position-momentum space) or conversely the beam has a low phase-space density
- To create high intensity low-emittance beams requires cooling - Ionization cooling only viable process on a shorter timescale than muon lifetime
- Ionization Cooling – muons passed through an absorber material (losing momentum) and then an RF cavity (restoring longitudinal momentum)

- Emittance Exchange allows manipulation of transverse and longitudinal phase-spaces
- In Reverse Emittance Exchange, the beam is passed through a wedge (e.g. lower right picture) creating a position-momentum correlation, and then through a dipole magnet.
- The resulting beam has a higher transverse phase-space density and lower longitudinal phase-space density
- Repeated manipulation of the beam along with repeated transverse ionization cooling increases the phase-space density of the beam allowing for the creation of a beam of the desired intensity

Muon Ionization Cooling Experiment (MICE)

Measure muon position and momentum upstream



Beam

Measure muon position and momentum downstream

Cool the muon beam using LiH, LH_2, or polyethylene wedge absorbers

Monte Carlo Simulation of Phase-Space Density Change

- Liouville => Phase-Space density for a distribution of particles remains constant (unless acted upon by a dissipative force)
- Measure x, y, z, p_x, p_y and p_z upstream and downstream (i.e. before and after wedge)
- Calculate phase-space density of the beam

- No Absorber – Conservation of 6D density
- Wedge – Longitudinal density has been reduced

- Some biases still need to be taken account of e.g. transmission losses

- 6D density conservation in No Absorber case shows this analysis will be able to quantify the cooling performance of the wedge
- Future => Apply to MICE data