

Multiple Scattering Measurements in MICE

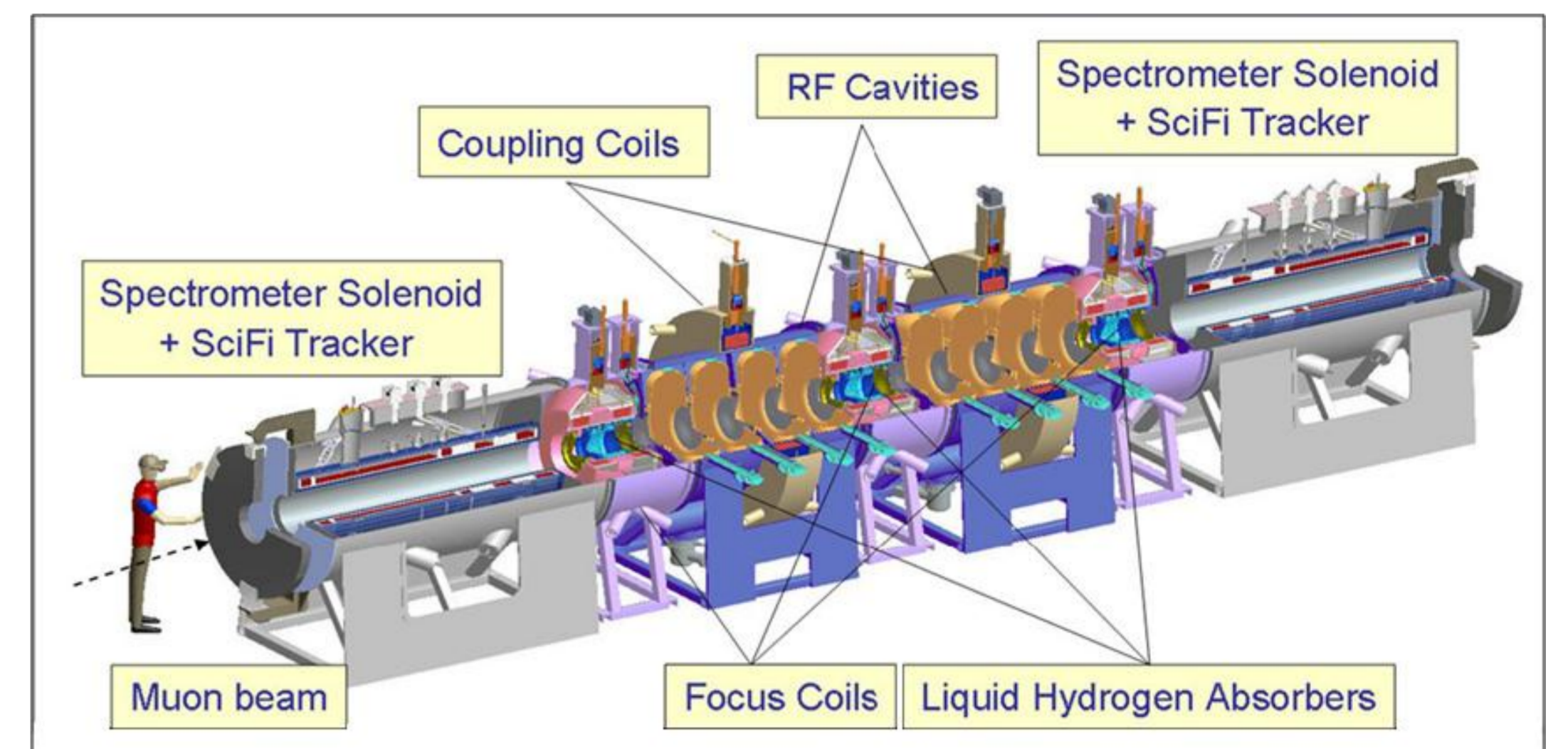
The international Muon Ionization Cooling Experiment (MICE)

MICE is the **first experimental test of ionization cooling**, under construction at the Rutherford Appleton Laboratory (UK).

Three 35 cm long liquid hydrogen absorbers reduce the total momentum by 11 MeV/c each – providing **cooling**. Cooling is the reduction of beam volume (emittance) in phase space.

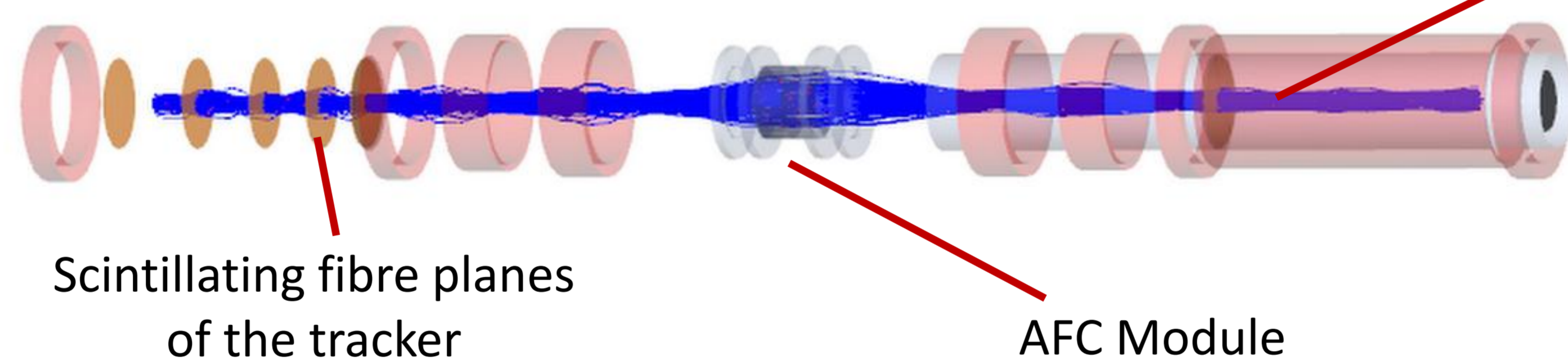


Energy loss → Multiple Scattering → Re-accelerate!



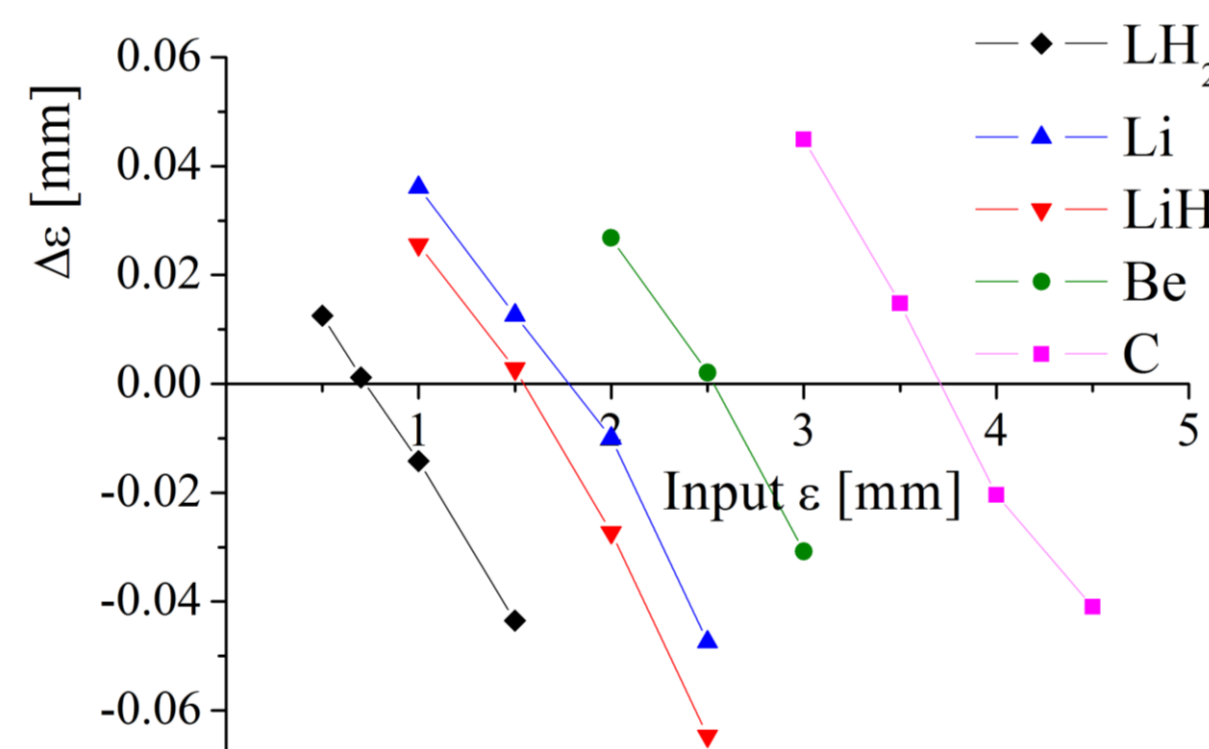
Re-accelerate using **201 MHz RF cavities** at high gradients.

Step IV – starting in 2013

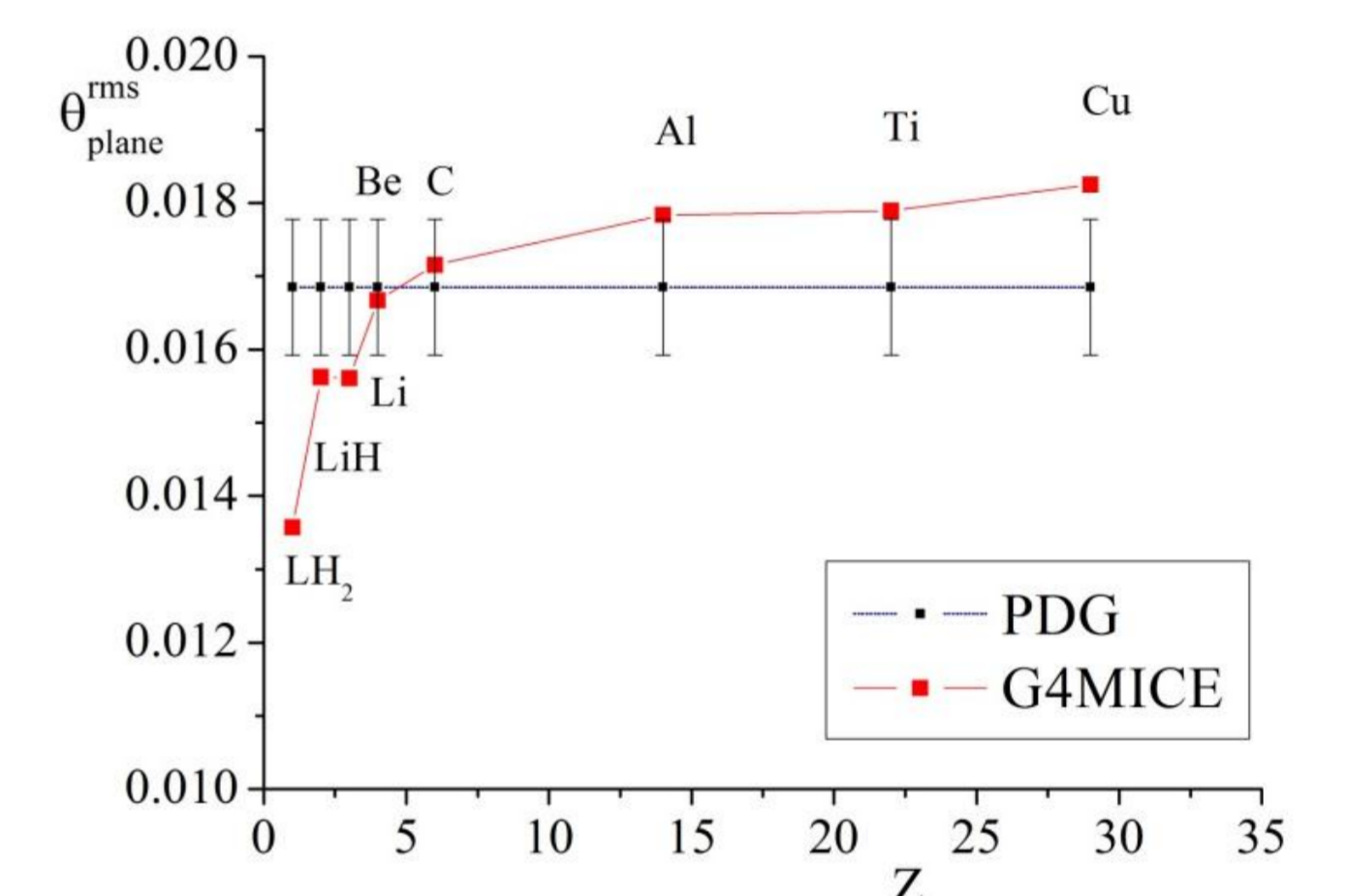


Scintillating fibre trackers measure the beam emittance before and after the cooling channel to an accuracy of 0.1%.

Can **study cooling** in various materials in G4MICE simulations, based on GEANT4.



Helical muon tracks through the MICE solenoidal magnetic fields



Predicted values using G4MICE differ from those using PDG multiple scattering formula.

Multiple Scattering Measurements

Can **directly measure multiple scattering** using the scintillating-fibre trackers in Step IV.

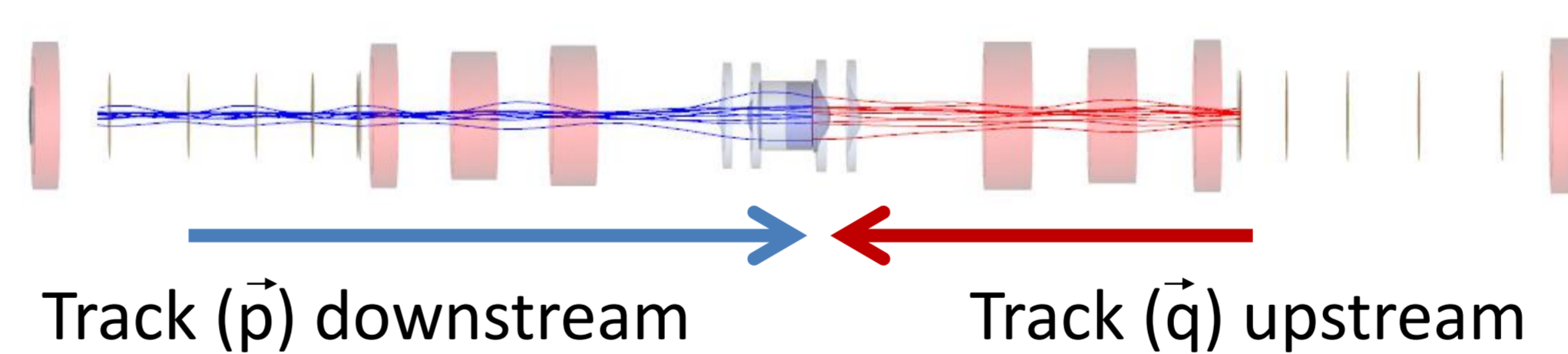
Muon hits recorded in each tracker. Apply a **Gaussian smear** to coordinates represent Tracker resolution.

Track particles from each tracker to downstream edge of absorber, in an empty channel, using G4MICE simulation code.

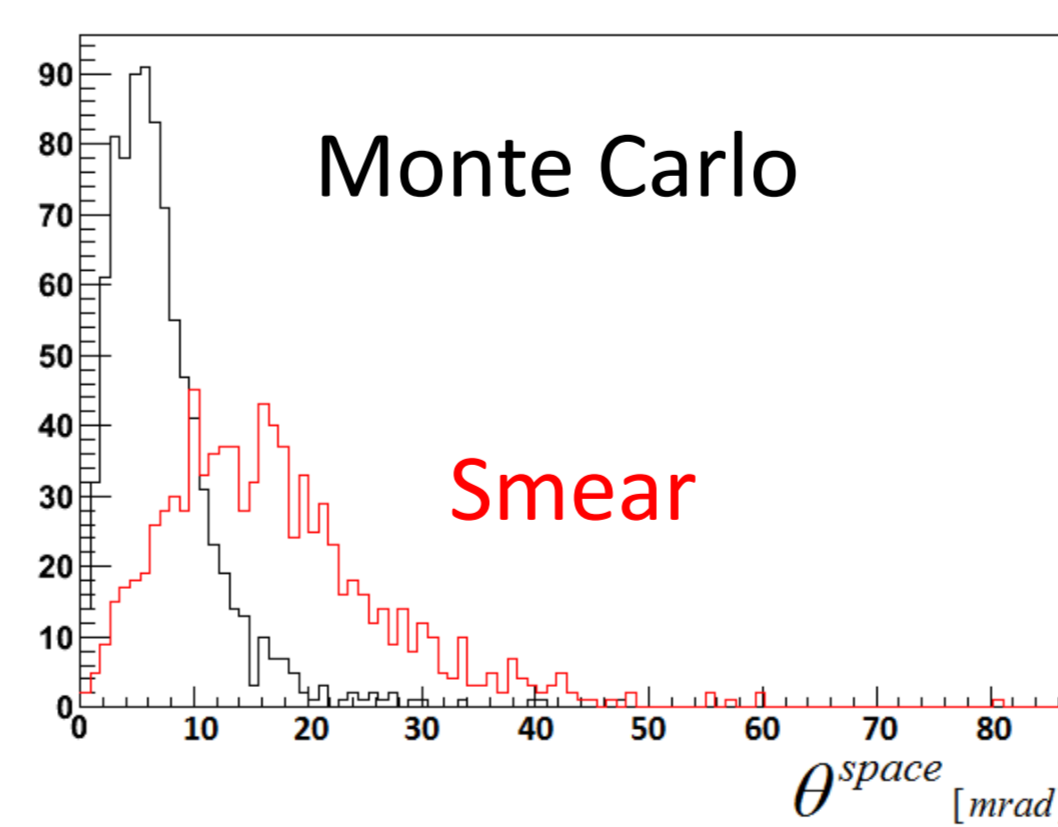
→ **Calc. angle** between the beams.

→ Angular offset gives the **multiple scattering angle**.

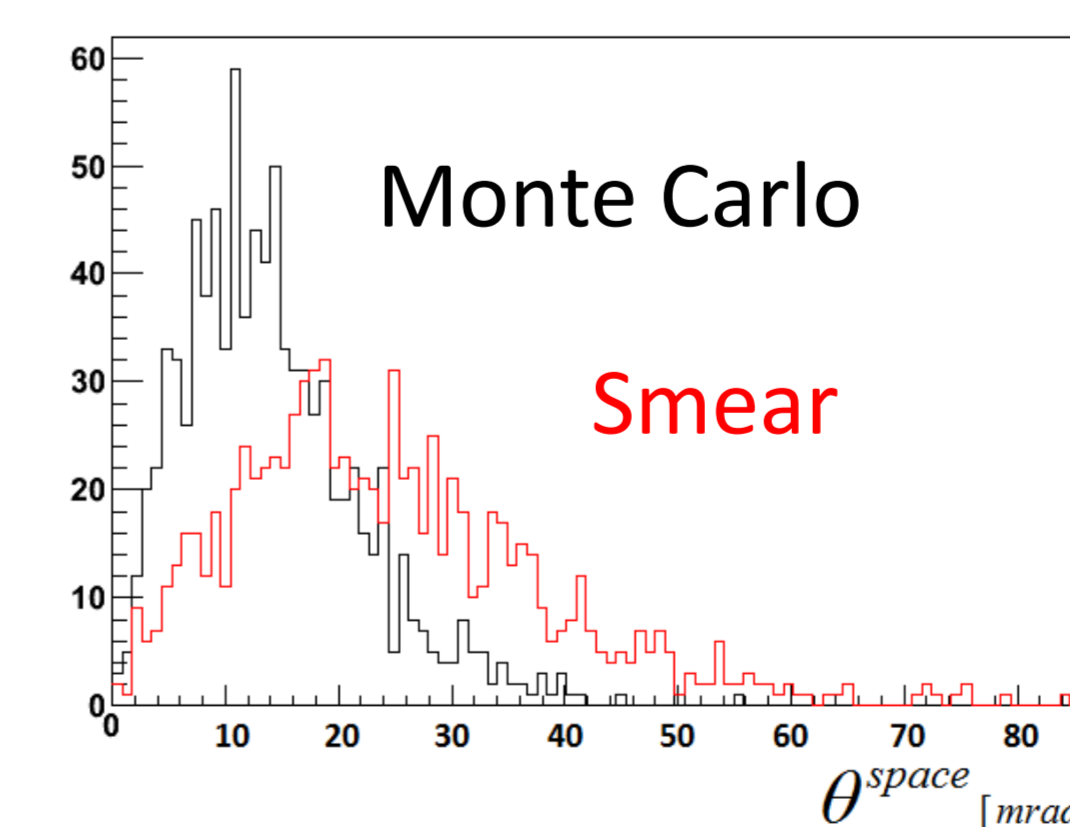
→ **Unfold the data** to removing smearing effects.



$$\cos \theta_{rms}^{space} = \frac{\vec{p} \cdot \vec{q}}{|\vec{p}| |\vec{q}|}$$



empty channel



35 cm LH₂ absorber

Step IV measurements can address the disagreement between G4MICE Monte Carlo & PDG theory



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