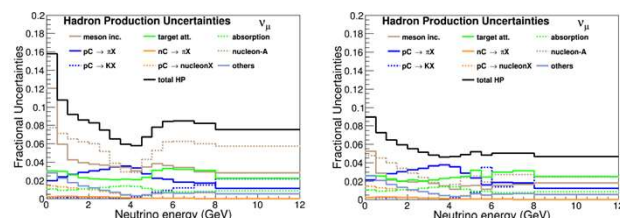


Truly EMPHATIC: Simulation Analysis & Testing of SSDs

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Introduction to the Neutrino Flux Problem

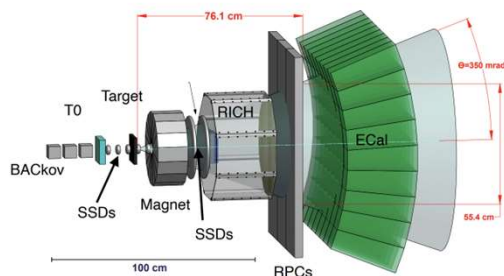
- Fermilab makes neutrinos by colliding a proton beam with a target, making a spray of particles via hadron production (HP) that will decay into neutrinos
- Neutrino flux uncertainties are dominated by HP in the target and horns, which have large uncertainties, especially at energies below 20 GeV



Left: Current hadron production uncertainties. Right: Reduced uncertainties with modest improvements in hadron production uncertainties, from 40% to 10%.

EMPHATIC!! About Hadron Production

- Table-top experiment, simple design optimized to measure HP for energies between 1-20 GeV
- Compact permanent magnet and silicon strip detectors used for momentum measurements, ring-imaging Cherenkov and time-of-flight detectors for particle identification

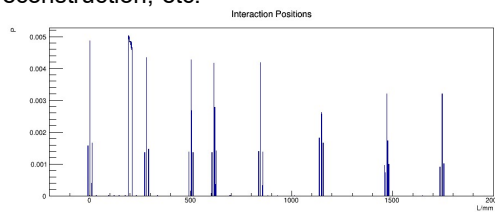


EMPHATIC spectrometer design.

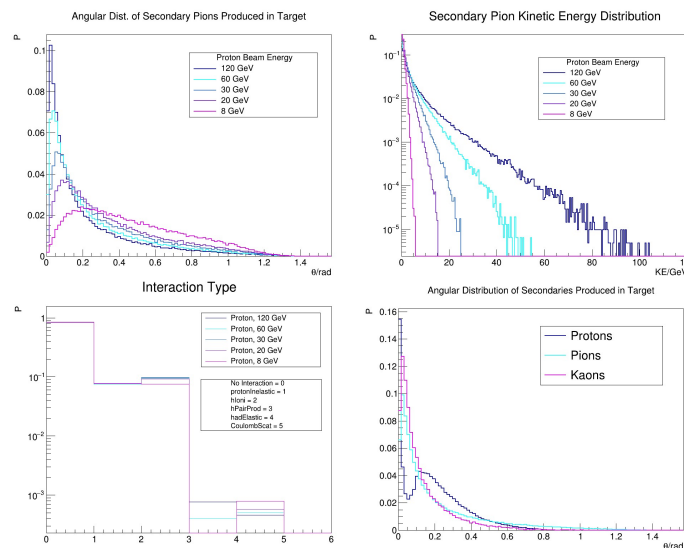


Simulating in GEANT4

- I added simulation “truth” information to EMPHATIC’s analysis framework, so we can ask specific questions about the experiment’s capabilities
- We can predict interactions within the experiment, and soon estimate the efficiency of charged-particle reconstruction, etc.



Interaction positions of a 120 GeV proton beam through the spectrometer.



Simulation studies. UL: Angular distribution of Pions produced in the target for different beam energies. UR: Kinetic energy distribution of Pions produced. LL: Types of interactions. LR: Angular distribution of secondary particles produced.

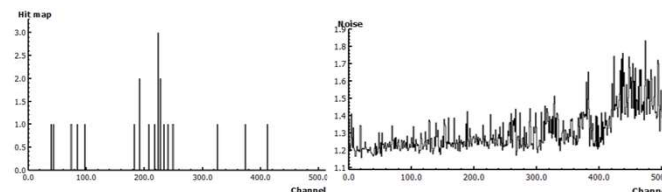
Acknowledgements

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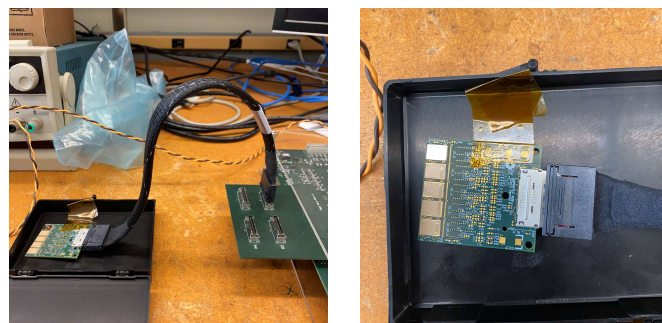
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Silicon Strip Detector Tests

- EMPHATIC plans to use an off-the-shelf data acquisition system from Alibava Systems for an upgrade to the silicon strip detectors used for tracking
- I have confirmed that the Vdaq system works, and we will begin testing the custom FNAL board soon



Software test of the Alivata SSD module. Left: Recorded hits by channel. Right: Noise measured by channel.



Left: EMPHATIC SSD chip connected to the motherboard. Right: Close-up of the SSD chip.

Conclusion

- EMPHATIC can now ask (and answer) questions about tracking/reconstruction efficiencies, and other physics potentials
- Progress on the new SSD chips can move forward now, with noise/pedestal measurements on their way