

First Look at Cosmic Ray Tagging (CRT) Track Reconstruction at ICARUS

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Introduction and Motivation

- ICARUS¹ (based on Liquid Argon Time Projection Chamber(LArTPC)) is on the surface at Fermilab exposed to huge cosmic activity. Cosmics are primary background for several physics analysis.
- 4 π coverage of the detector with Cosmic Ray Tagger² (CRT) to tag the cosmic muons and remove them to identify neutrino interaction.
- The CRT's are plastic scintillators read out by silicon photomultipliers and digitized by CAEN Front End Boards. CRT is fully installed and taking data in the ICARUS detector hall.
- CRT has three sub systems, top, side and bottom and able to tag more than 95% cosmic muons.
- We can use the CRT to analyze dirt muons produced by neutrino interactions in the materials around the ICARUS building.
- CRT tracks provide both position and angle information for particles which cross the CRT volume. Matching TPC track with CRT tracks can provide high purity samples for detector calibrations.

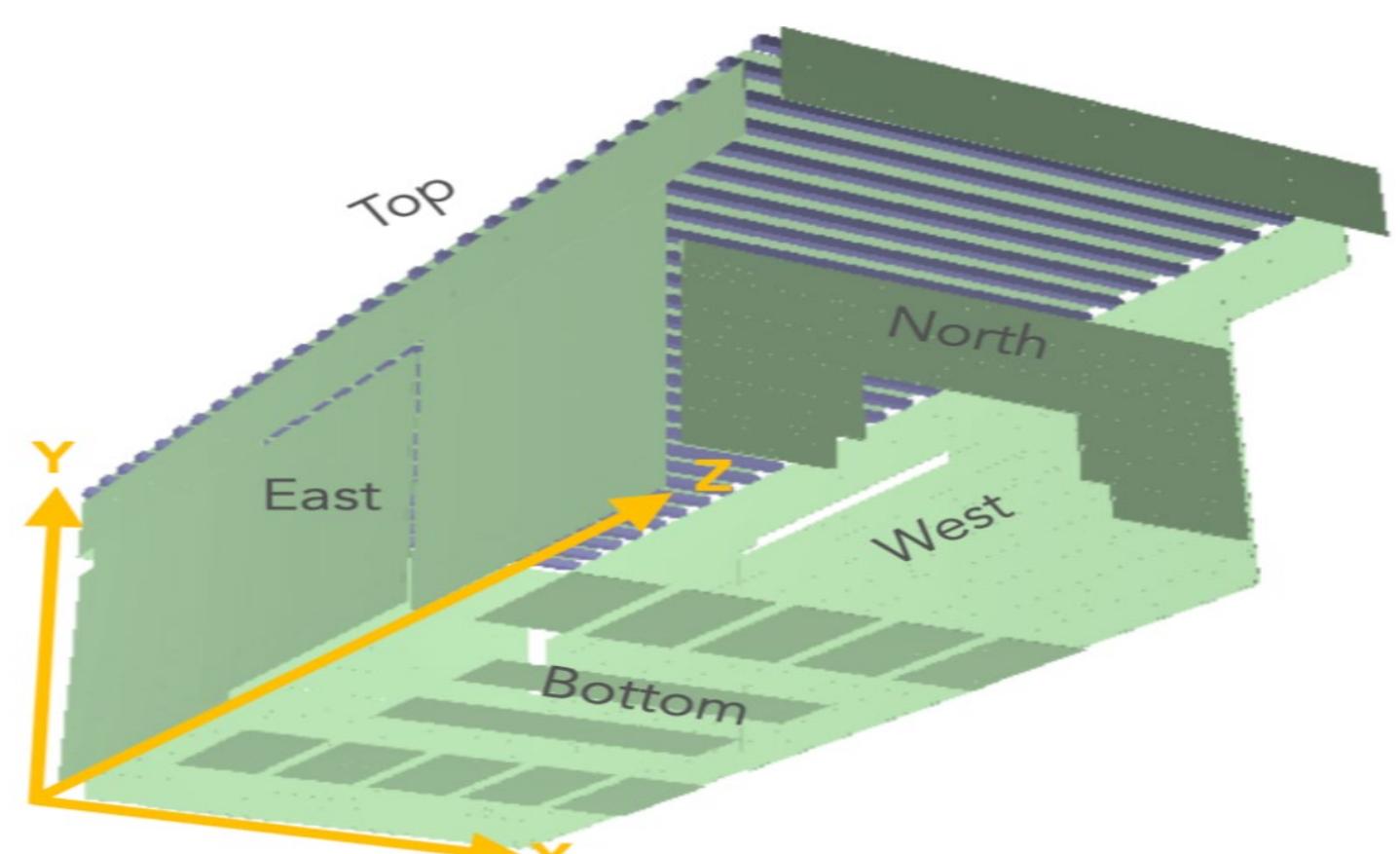


Figure 1: CRT Geometry with Coordinates

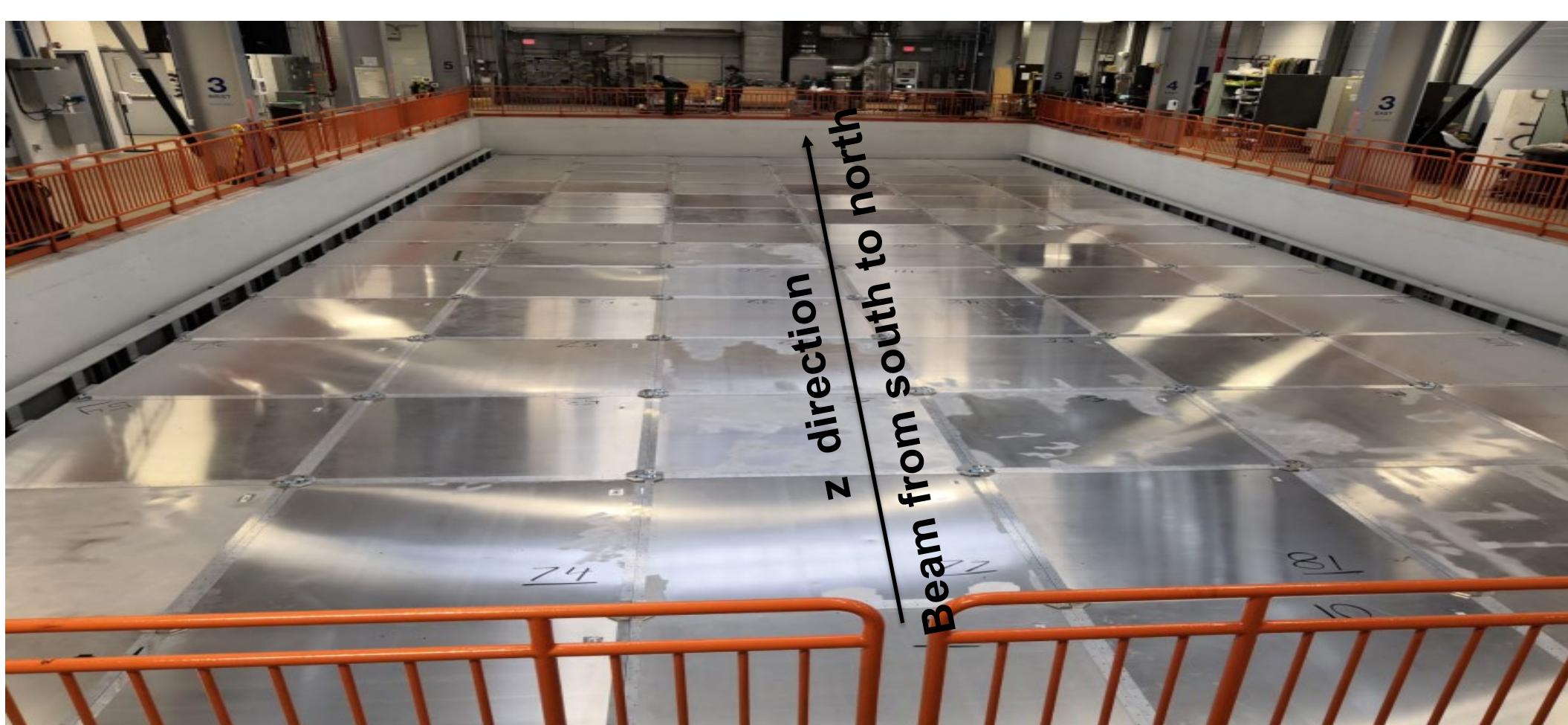
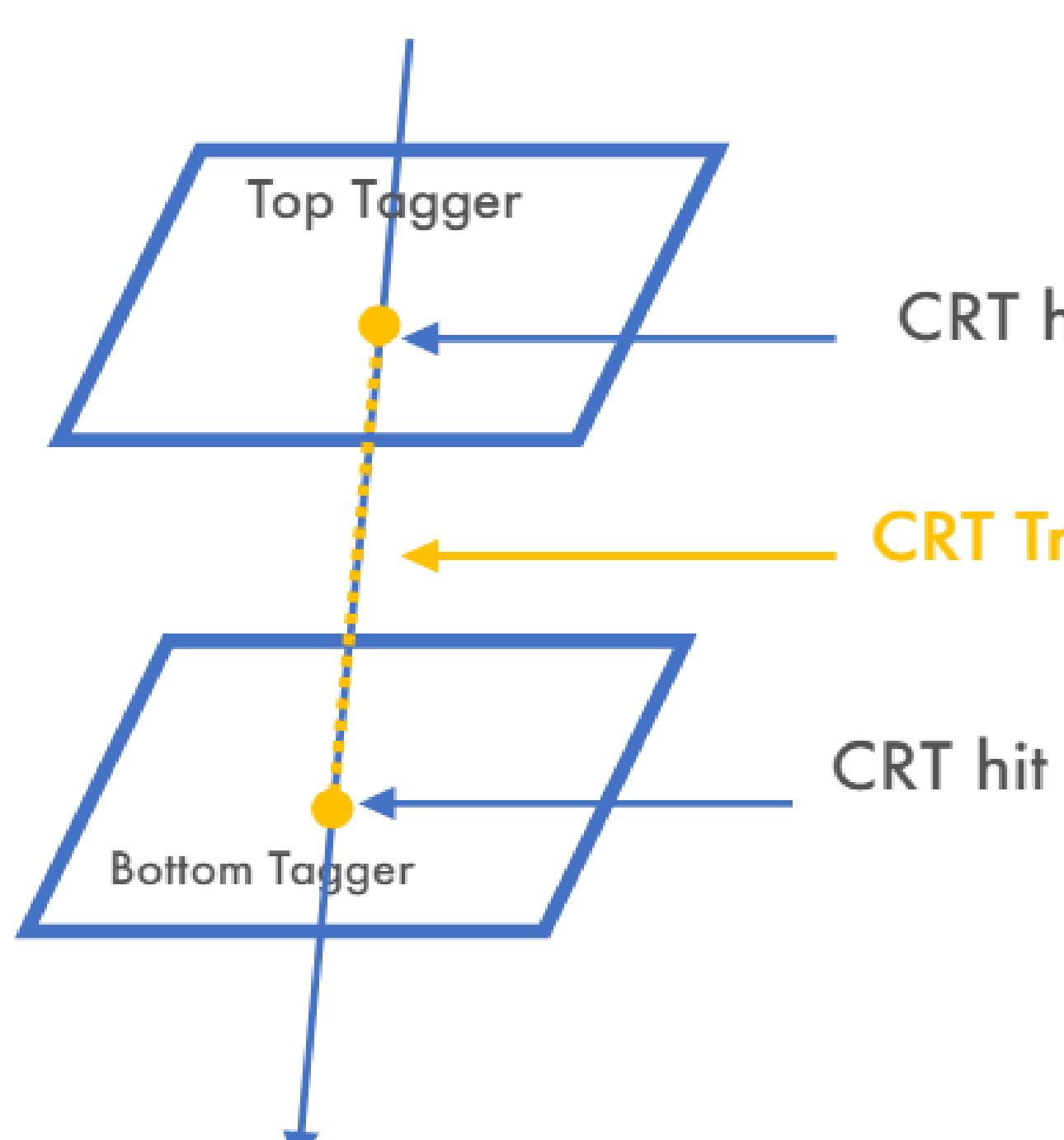


Figure 2: Top CRT installation

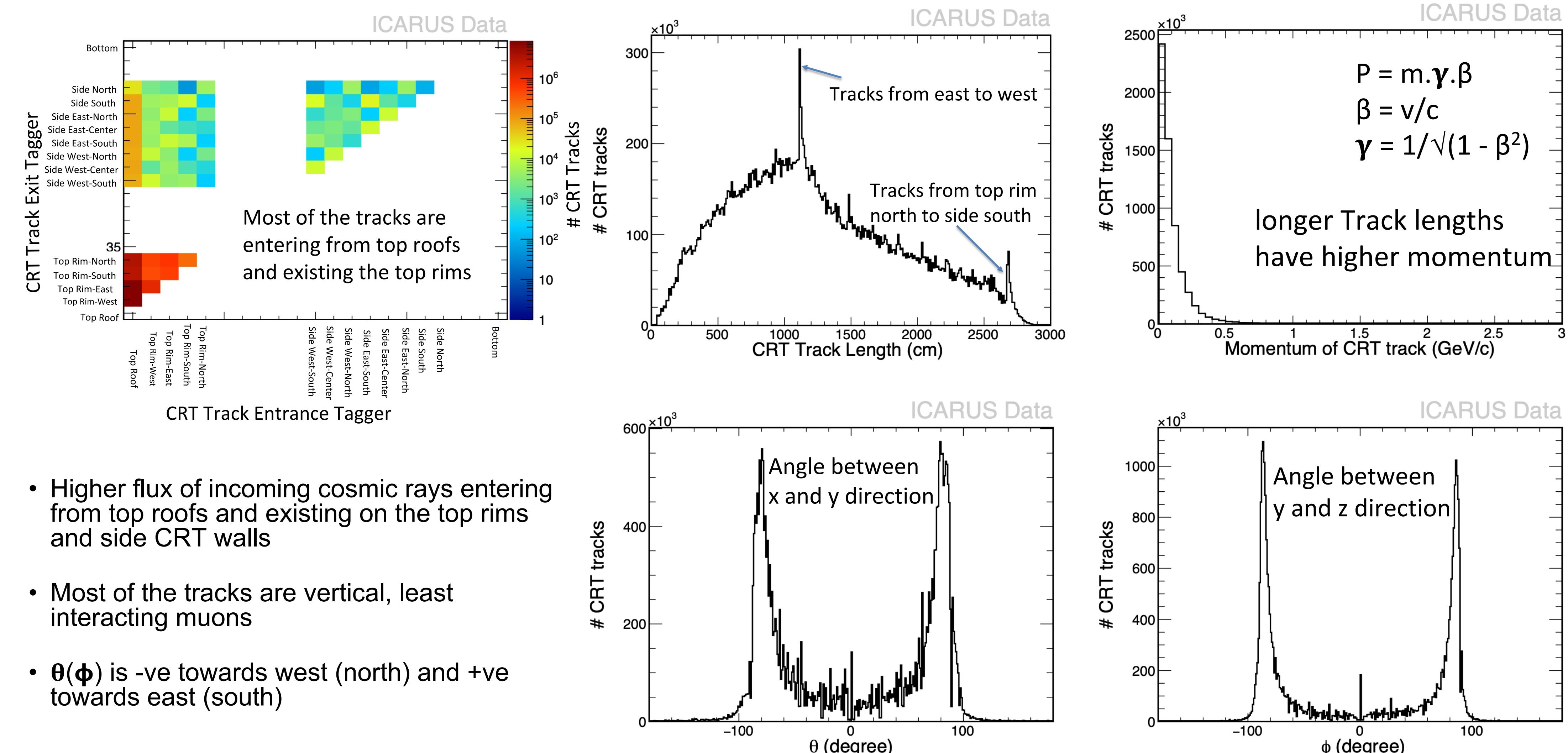
CRT Track Reconstruction Algorithm



- Acquire the CRT hit data from the latest run.
- Create t_0 collections for hits within 100 ns of each other. For each t_0 , sort hits by tagger.
- Take the average position and time of all the hits within 60 cm on a tagger.
- Loop over all unique pairs of average hits on different taggers. Draw an infinite track between the 2 hits.
- Do not create tracks with already used hits.

Figure 3: CRT track reconstruction

CRT Track Properties



Summary and Future Work

- Understanding the various properties of cosmic tracks using CRT track.
- First experience on learning and using CERN ROOT³ data analysis framework used for high energy physics.
- Quantify the amount track crossing the LArTPC which is tagged by the CRT.
- Use the CRT track to calibrate the ICARUS detector.
- Develop an algorithm to match CRT track - TPC track to reject cosmics.

References

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