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<sup>b</sup>  
UNIVERSITÄT  
BERN

AEC  
ALBERT EINSTEIN CENTER  
FOR FUNDAMENTAL PHYSICS

LABORATORIUM FÜR HOCHENERGIEPHYSIK  
**LHEP**  
UNIVERSITÄT BERN



# ProtoDUNE-ND: Containment Studies

ArgonCube Fortnightly Call  
April 25th, 2019

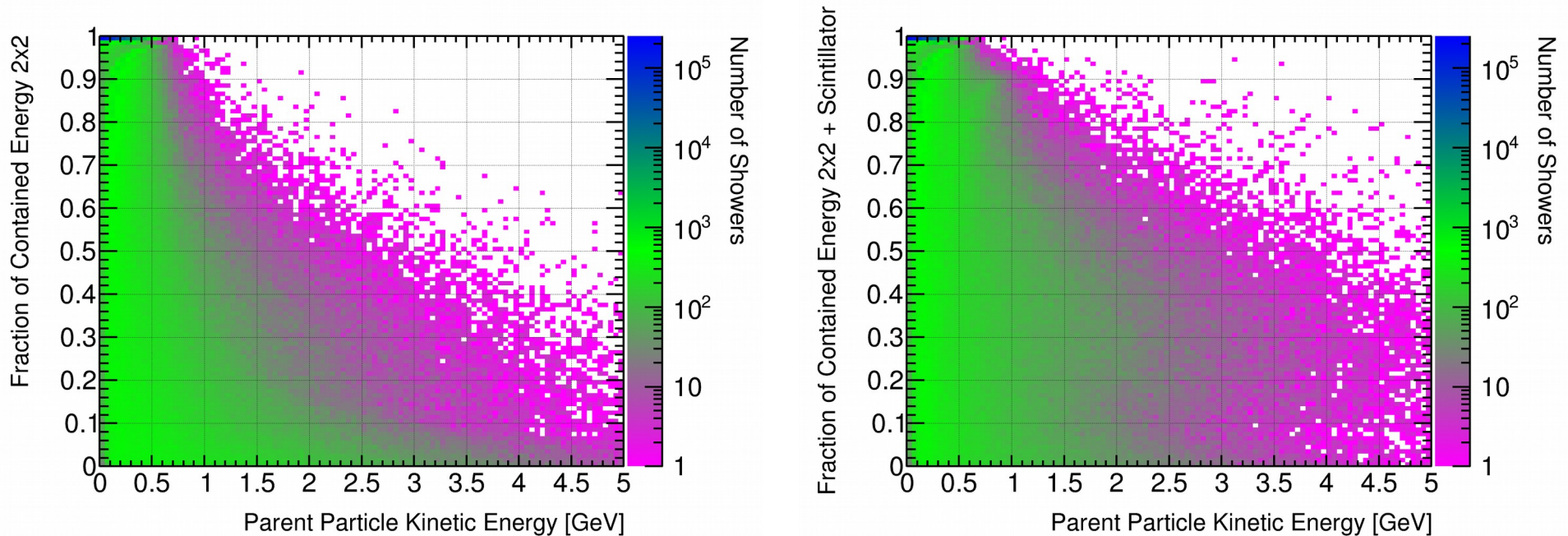
Patrick Koller ([patrick.koller@lhep.unibe.ch](mailto:patrick.koller@lhep.unibe.ch))

# Updates

- Total energy containment of the event
- Implemented gap between 2x2 and downstream tracker
- Implemented fiducial volume for nu vertices:
  - 30 cm from each side (~2 radiation lengths of LAr)
  - **not applied** to proton-induced tracks/showers

# Shower Containment Study: Protons

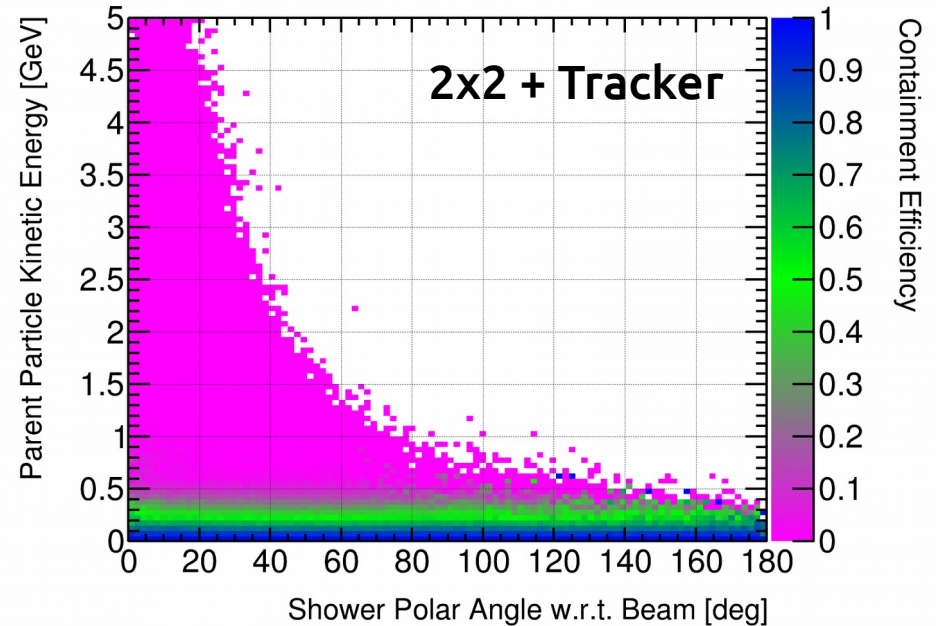
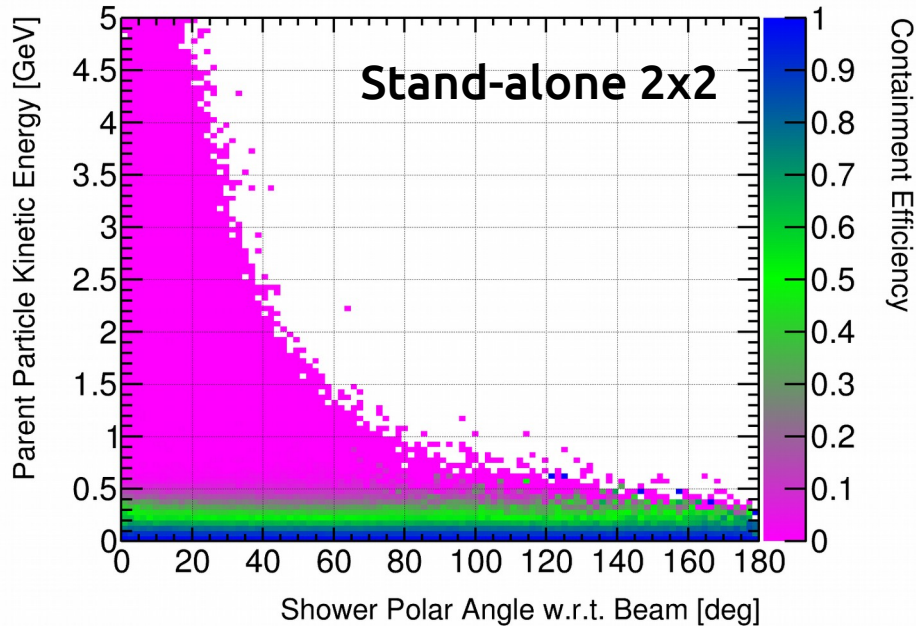
Proton-induced tracks/showers:



If more than 90% of **kinetic energy** is deposited within the 2x2 active volume, it is classed as contained.

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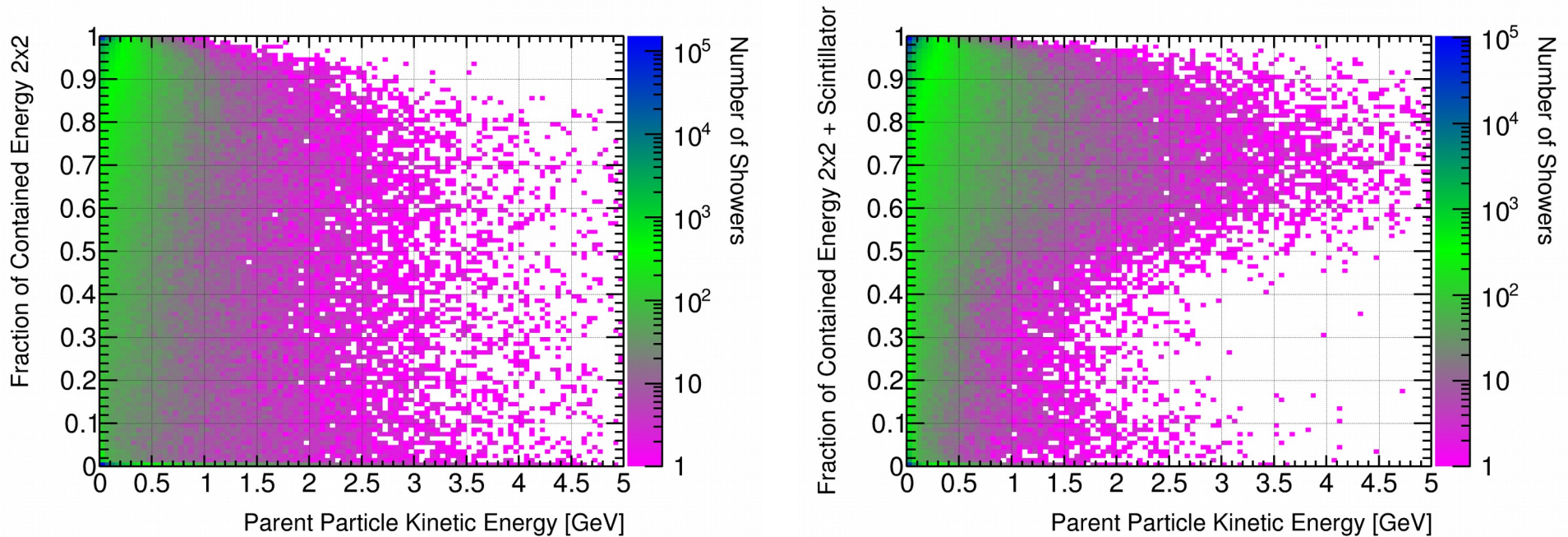
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# Shower Containment Study: **EM Showers**

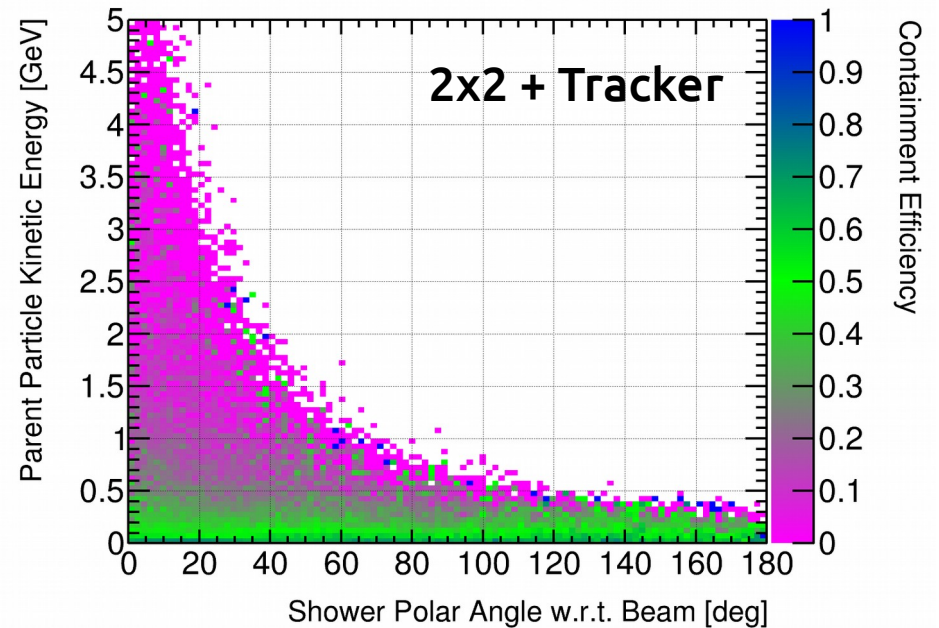
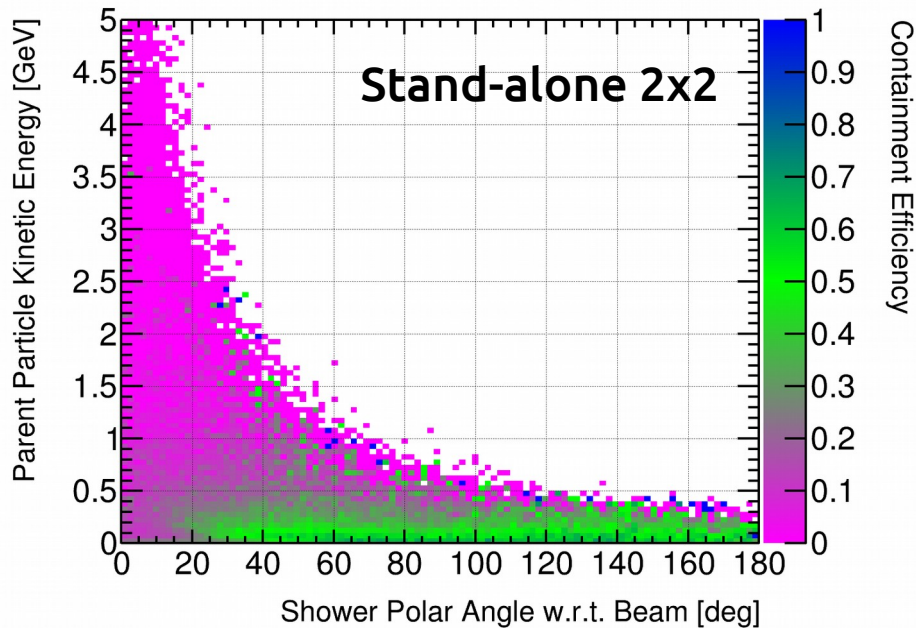
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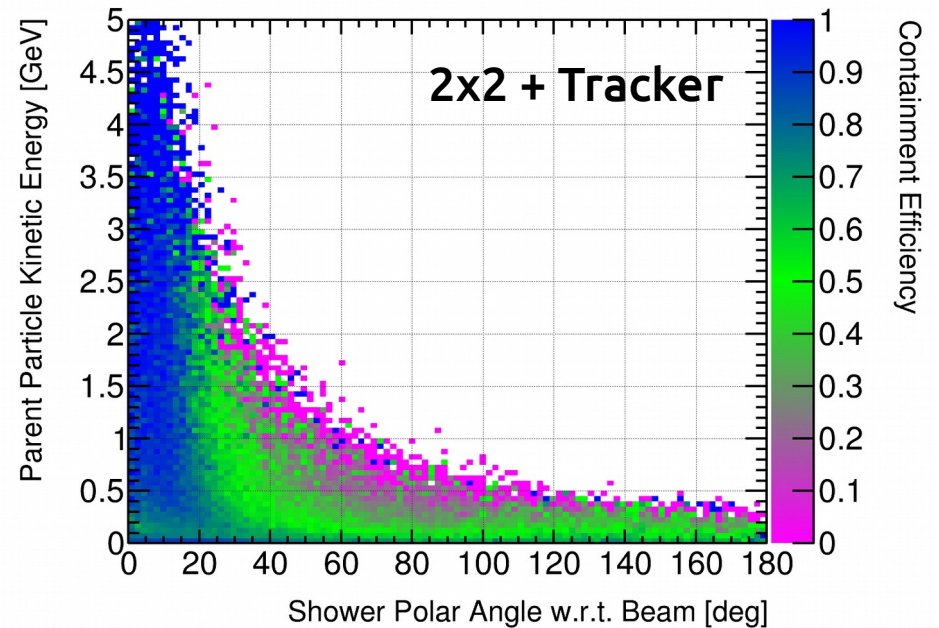
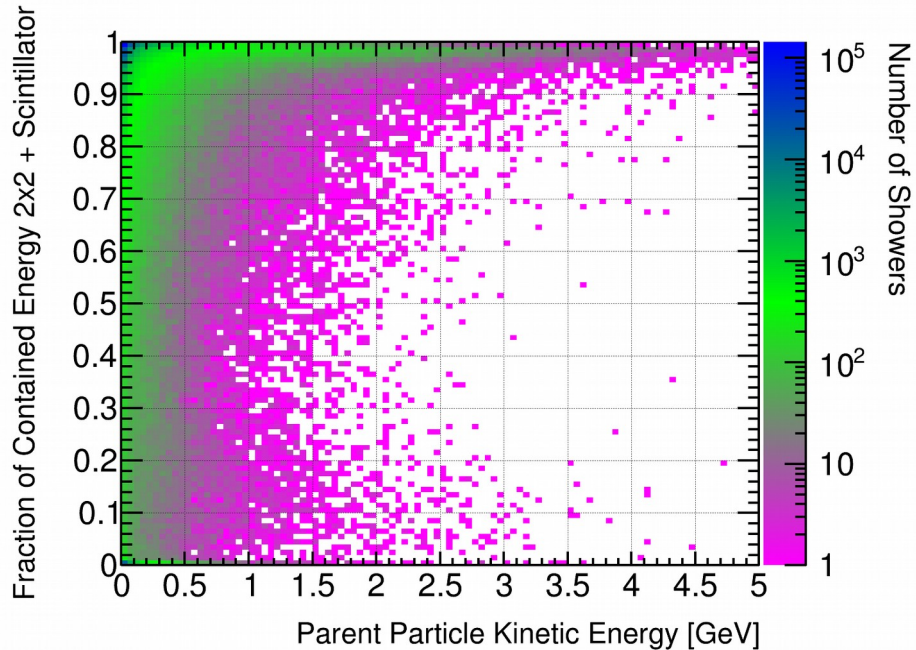
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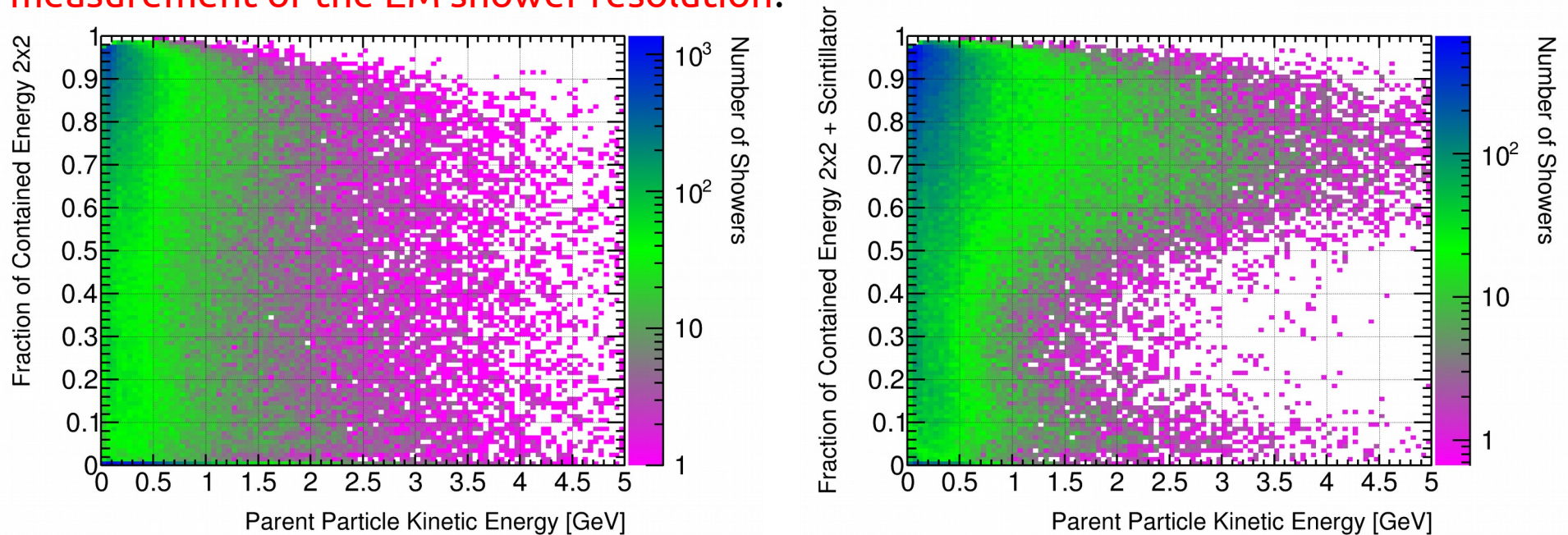
EM showers using geometry (gap between 2x2 and tracker ignored):



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# Shower Containment Study: $\pi^0$ Showers

Attempt to reconstruct the invariant mass peak of the  $\pi^0$  from  $\pi^0 \rightarrow \gamma\gamma$  provides a **measurement of the EM shower resolution:**

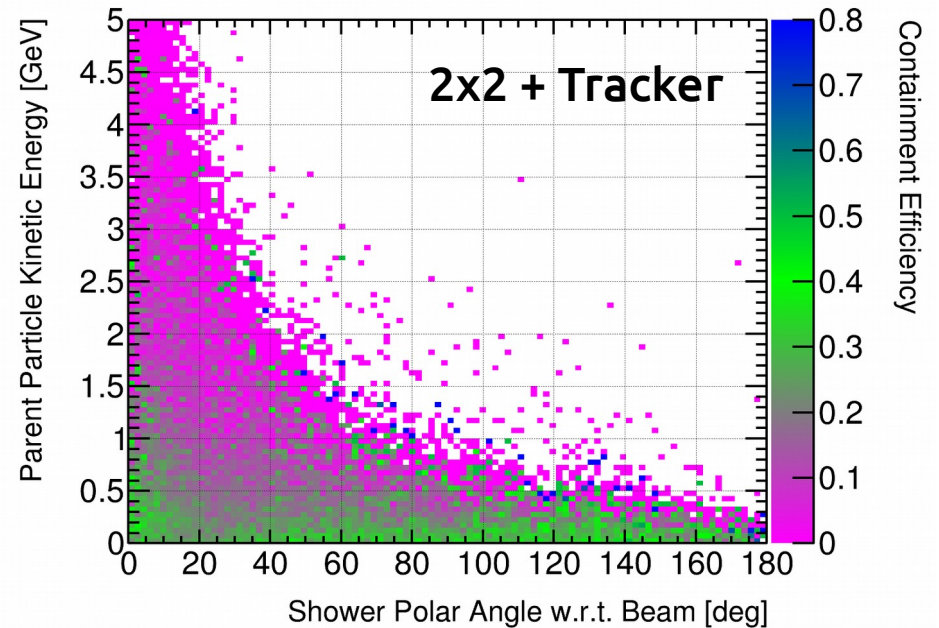
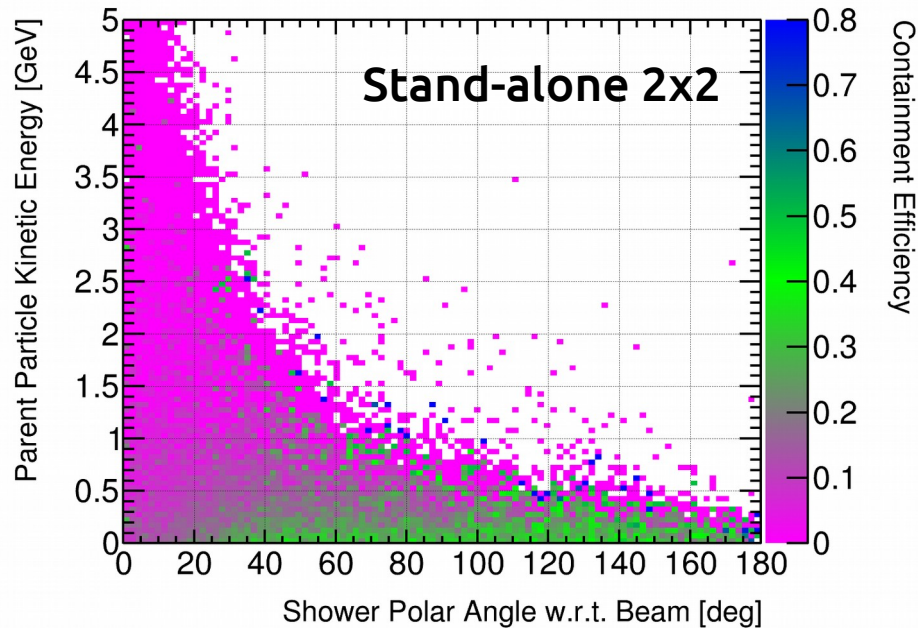


If more than 90% of **total energy** is deposited within the 2x2 active volume, it is classed as contained.



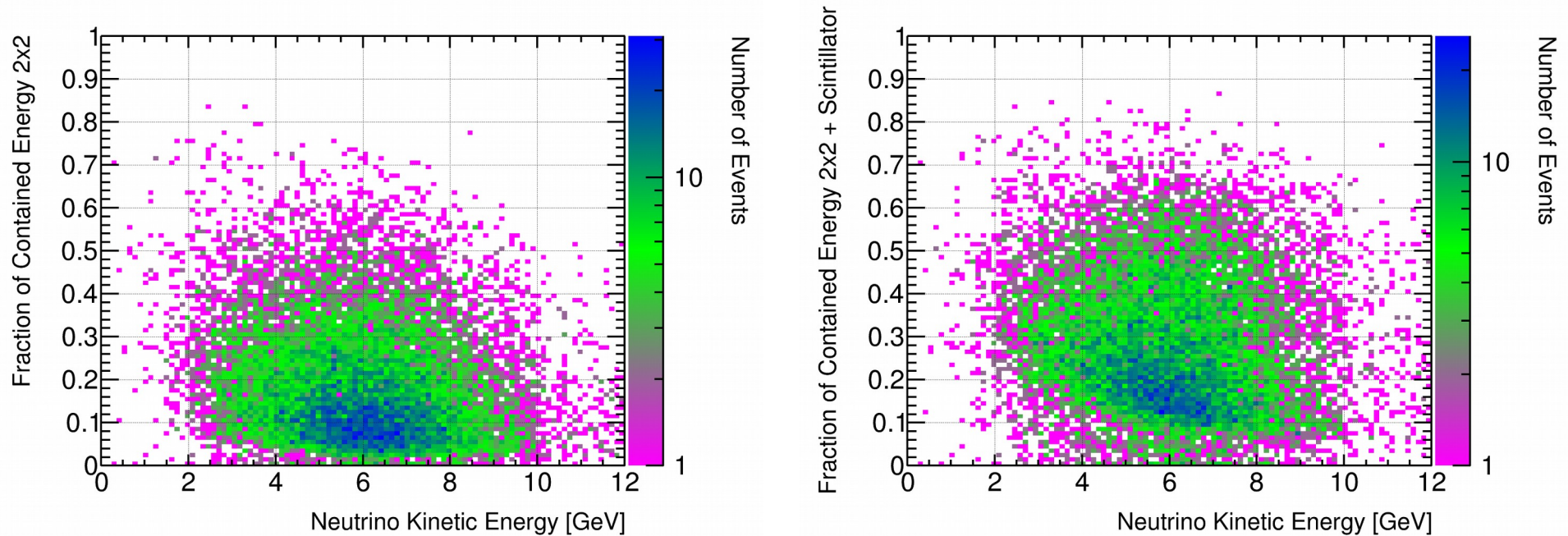
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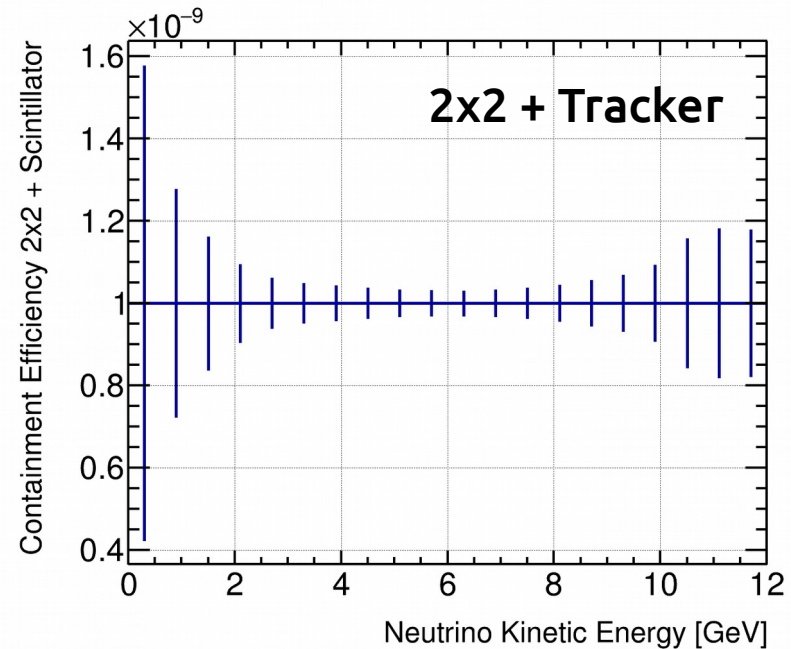
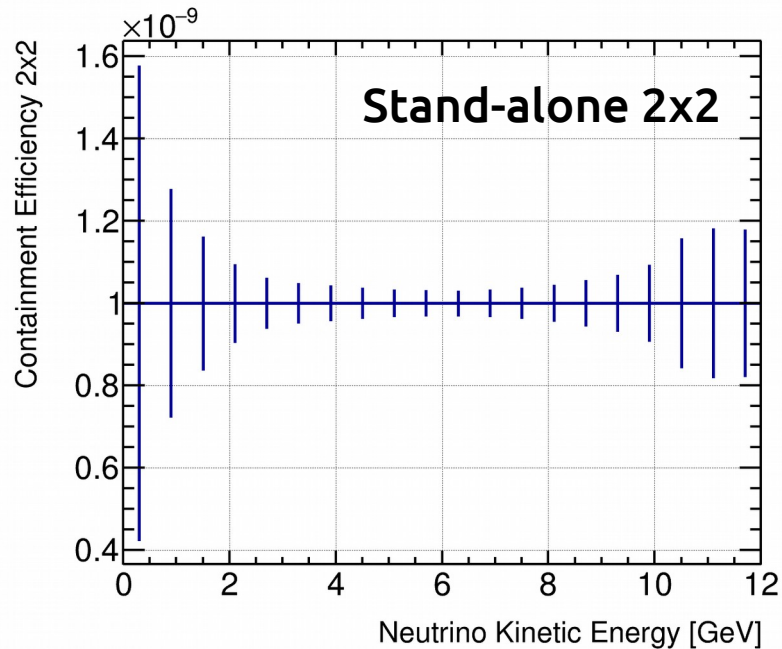
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# Shower Containment Study: Total Event



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