

**u<sup>b</sup>**

---

**UNIVERSITÄT  
BERN**

**AEC**  
ALBERT EINSTEIN CENTER  
FOR FUNDAMENTAL PHYSICS

LABORATORIUM FÜR HOCHENERGIEPHYSIK  
**LHEP**  
UNIVERSITÄT BERN



# ProtoDUNE-ND Detector Physics Studies

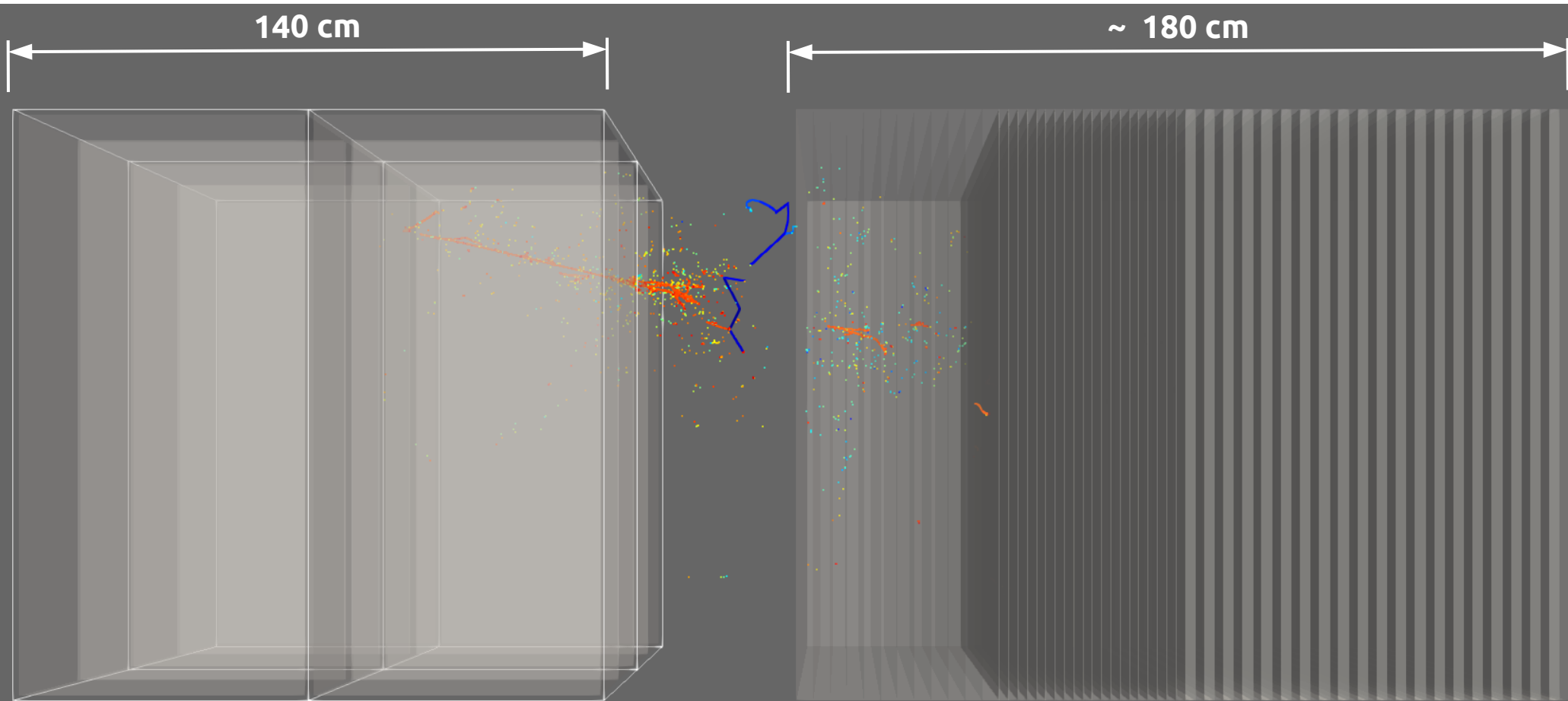
Biweekly ArgonCube Meeting – January 16, 2019

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

# The ProtoDUNE-ND Concept

- ArgonCube 2x2 Demonstrator on-axis in the NuMI medium energy neutrino beam
- MINOS-ND hall, upstream of the current MINERvA location
- Possibility to include test modules for other DUNE ND components
- ProtoDUNE-ND detector physics studies will inform the final DUNE ND design choices and help developing reconstruction tools
- Pairing 2x2 (and other ND components) with a downstream scintillator tracker enables a test of the ability to track muons and fast neutrons from a slow LAr detector into a fast-response detector

# ArgonCube 2x2 Demonstrator + Scintillator

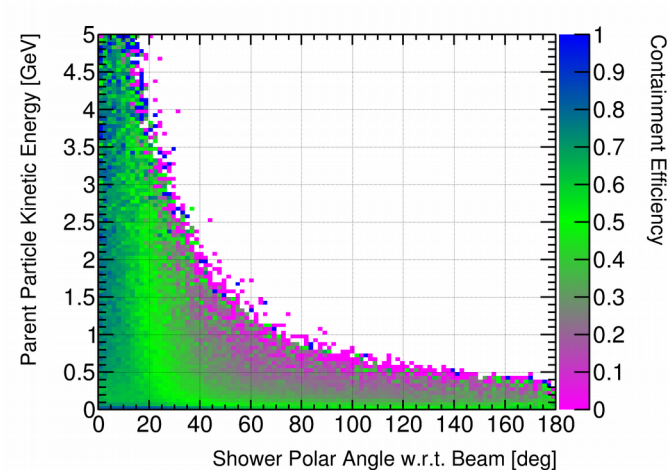
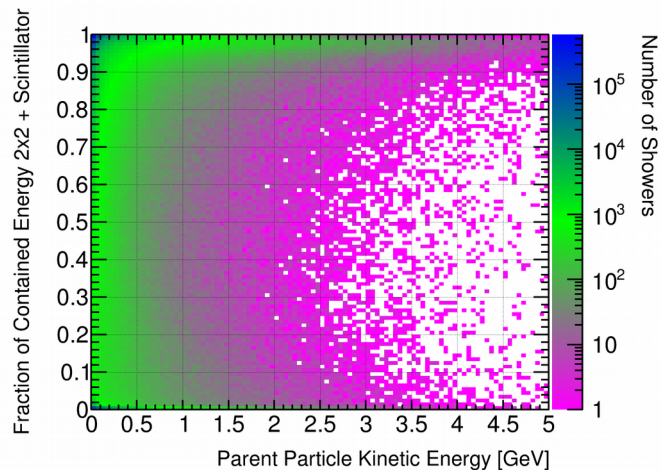
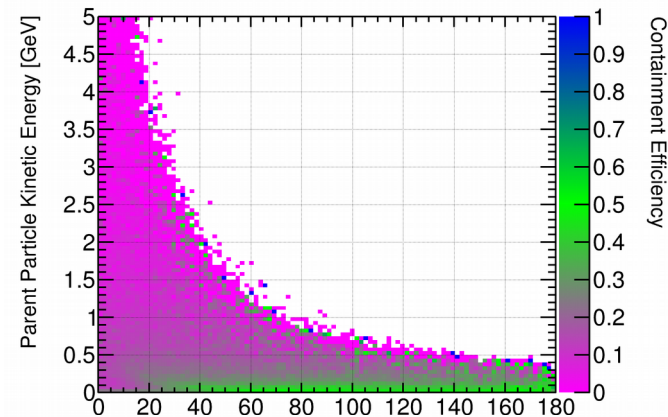
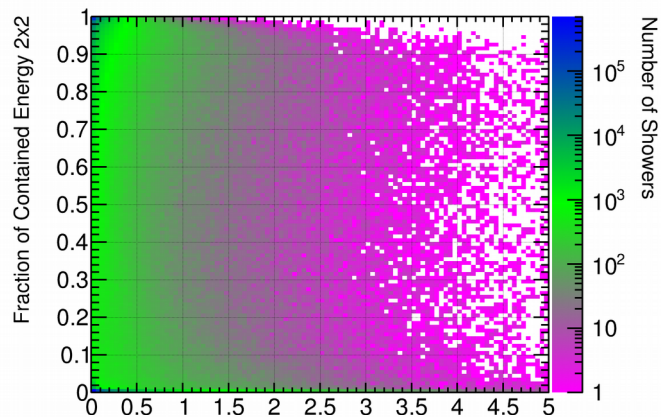


# Containment: EM – Showers

2x2 only

Containment:  
90% of parent particles kinetic  
energy contained

2x2 + Scintillator

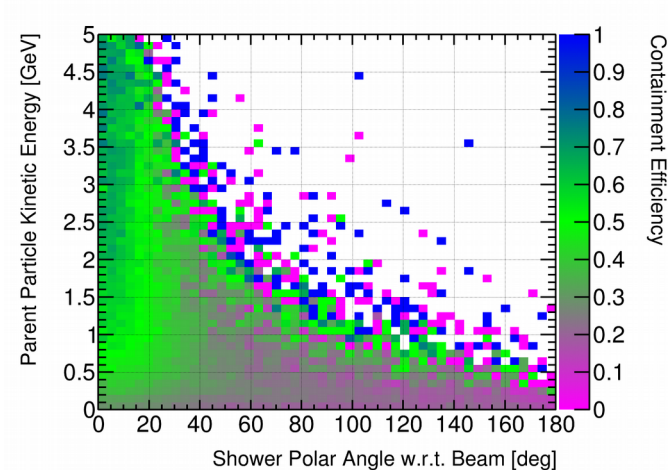
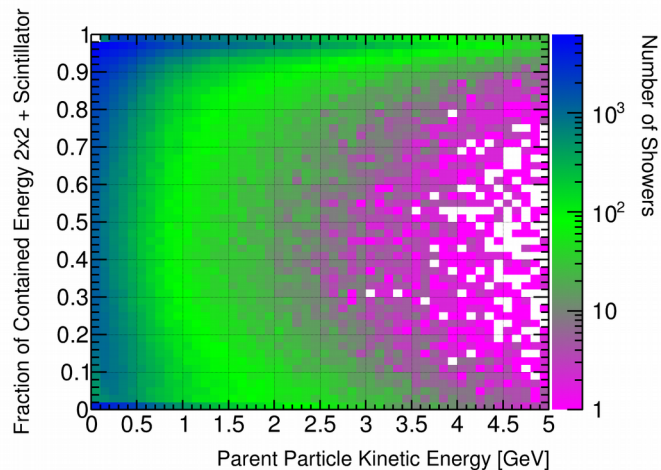
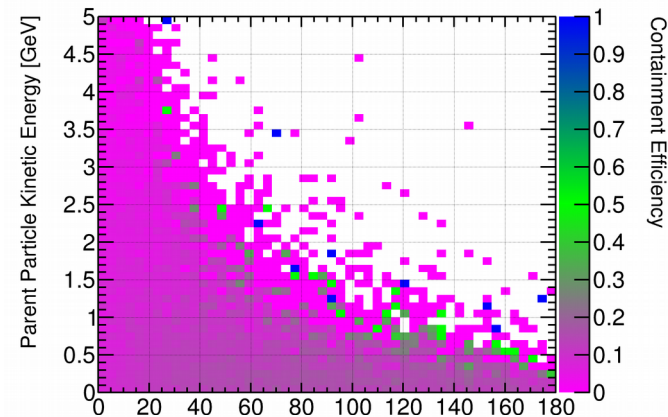
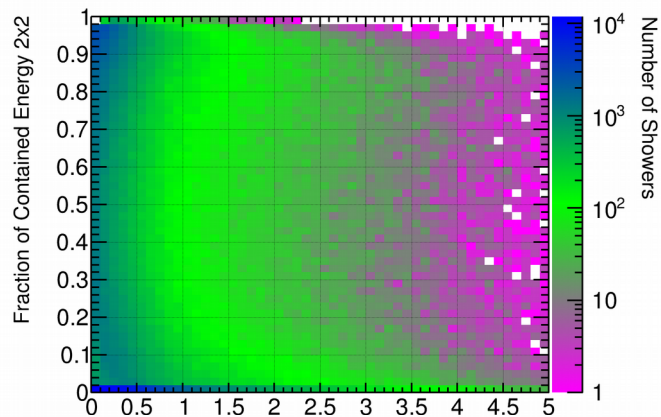


# Containment: Pi0 – Showers

2x2 only

Containment:  
90% of parent particles **total**  
energy contained

2x2 + Scintillator

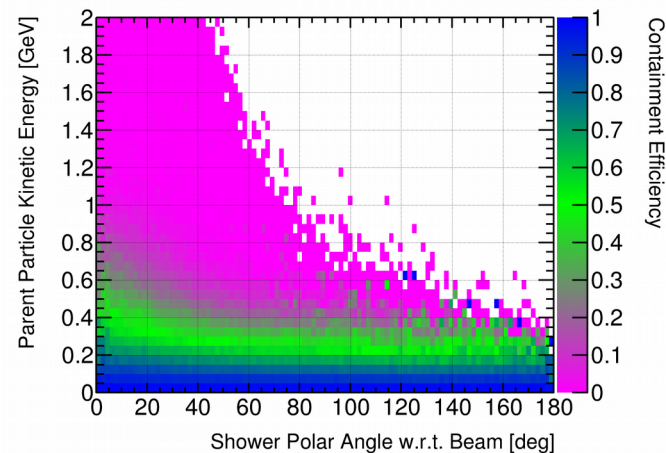
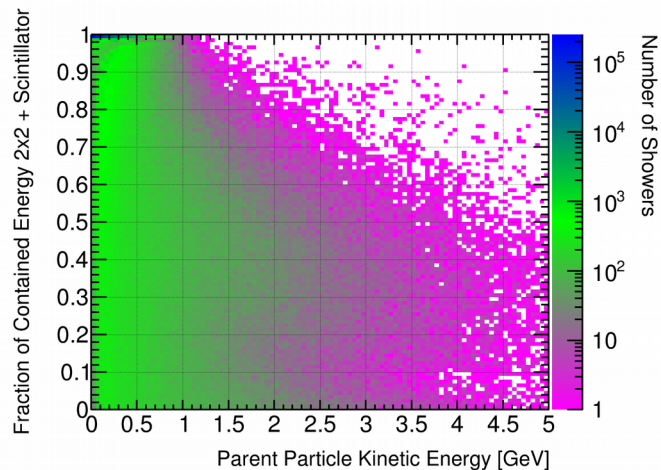
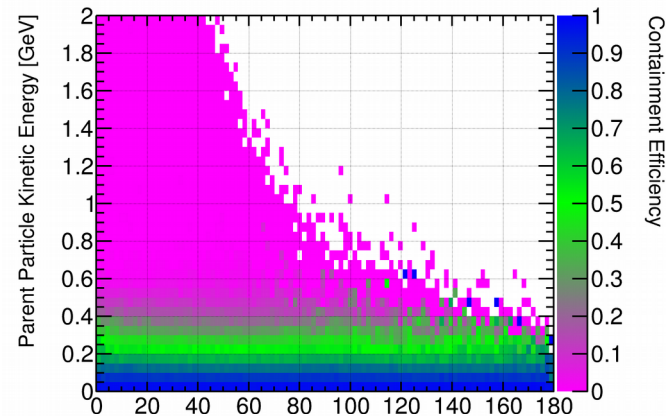
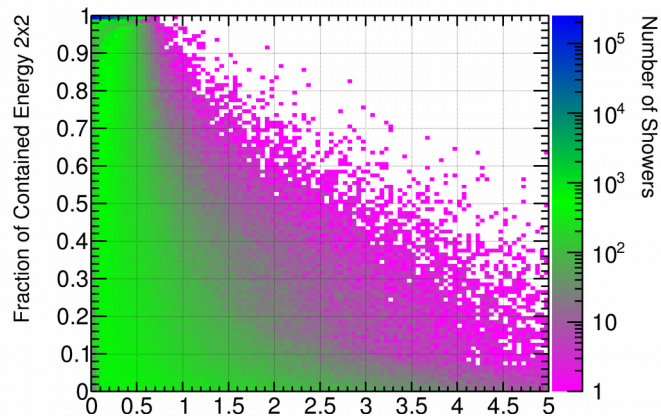


# Containment: Proton induced Showers

2x2 only

Containment:  
90% of parent particles kinetic  
energy contained

2x2 + Scintillator



# Fast Neutron induced Proton Recoils

- Event vertices in 2x2
- Tracker sees detached energy deposits induced by fast neutrons escaping ArgonCube 2x2
- ~ 15% only seen by the downstream tracker

