Cosmic Ray Rates at the Fermilab Liquid Argon Test Facility

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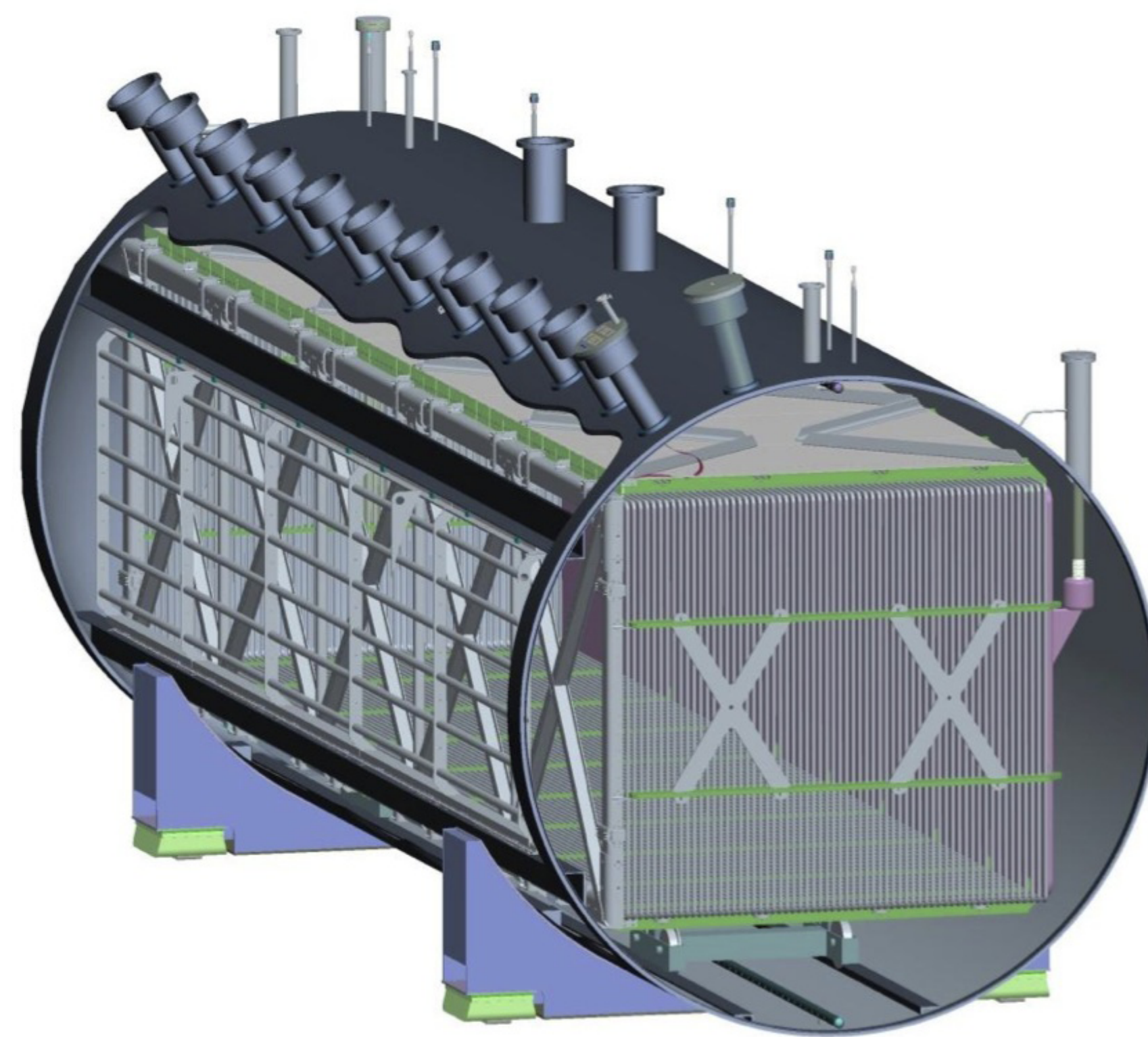New Mexico State University
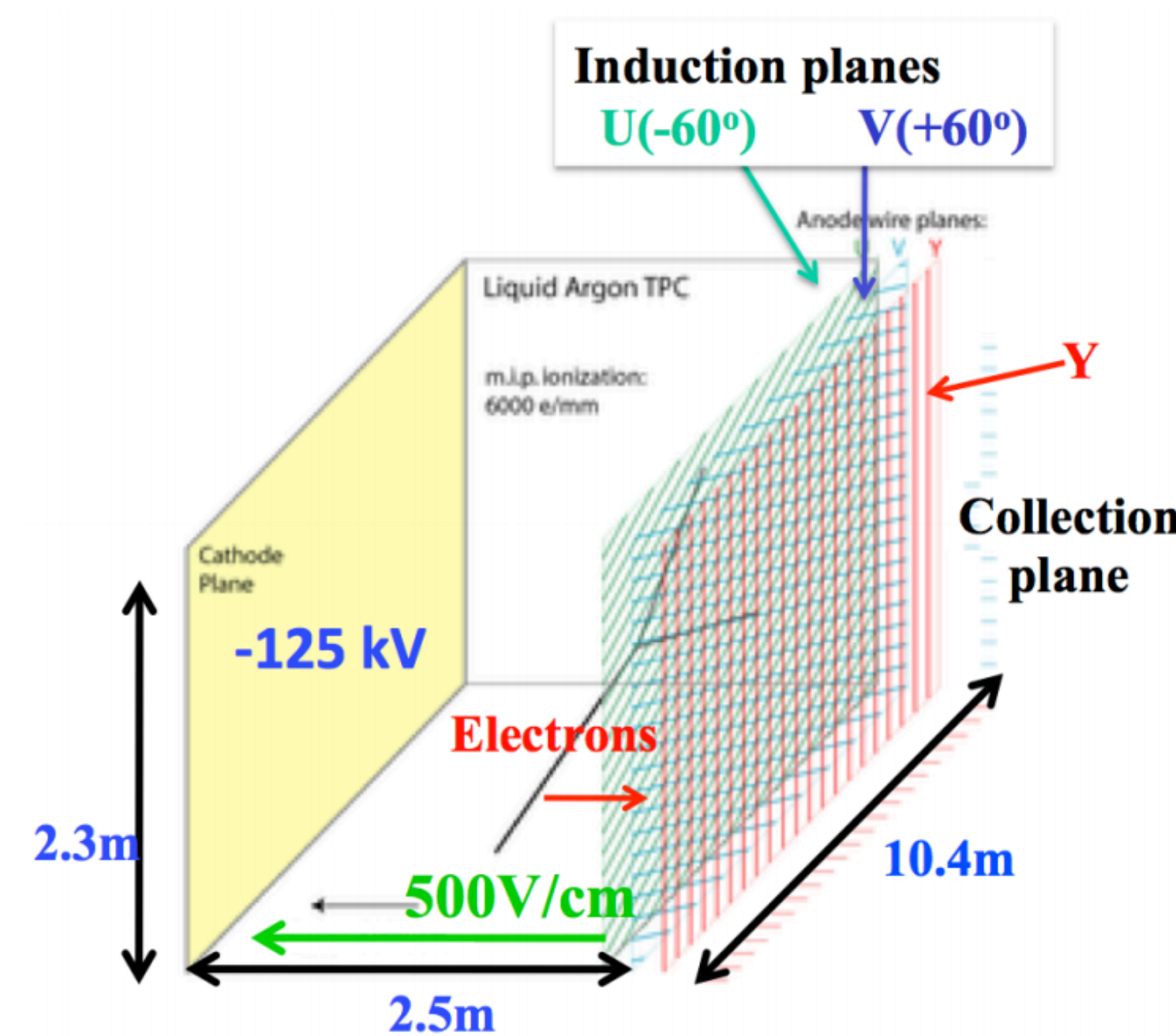for the MicroBooNE Collaboration

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µBooNE

Fermilab

Liquid Argon TPC

To study neutrino oscillations and cross sections at the Fermilab Booster Neutrino Beam


1.6 ms maximum drift time
Estimated muon flux through TPC: 4-8 kHz
Expect ~20-40 µ's during 3 "readout frames"

Induction planes
U(-60º)   V(+60º)

Anode wire planes:
Liquid Argon TPC
m.i.p. ionization:
6000 e/mm

Y

Collection plane

Cathode Plane
-125 kV

Electrons

2.3m

500V/cm

2.5m

10.4m

More accurate determination is needed:
Monte Carlo simulations
validated by measurements

Cosmic Ray Detector at LArTF

BC-408 scintillator, Philips XP2262B PMTs
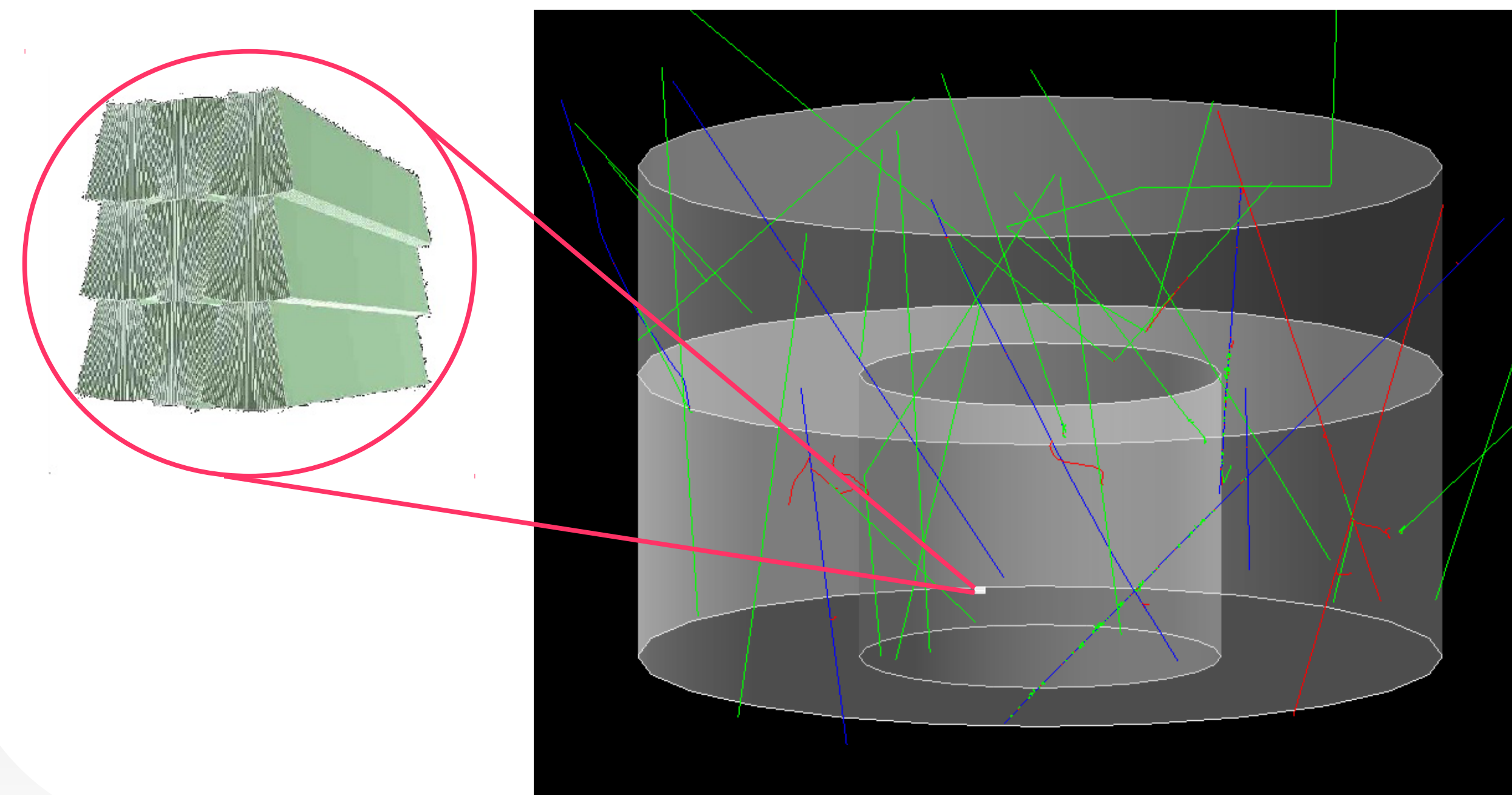CAMAC DAQ, Wiener CC-USB Controller

Plastic Scintillators   PMTs   PMT Bases
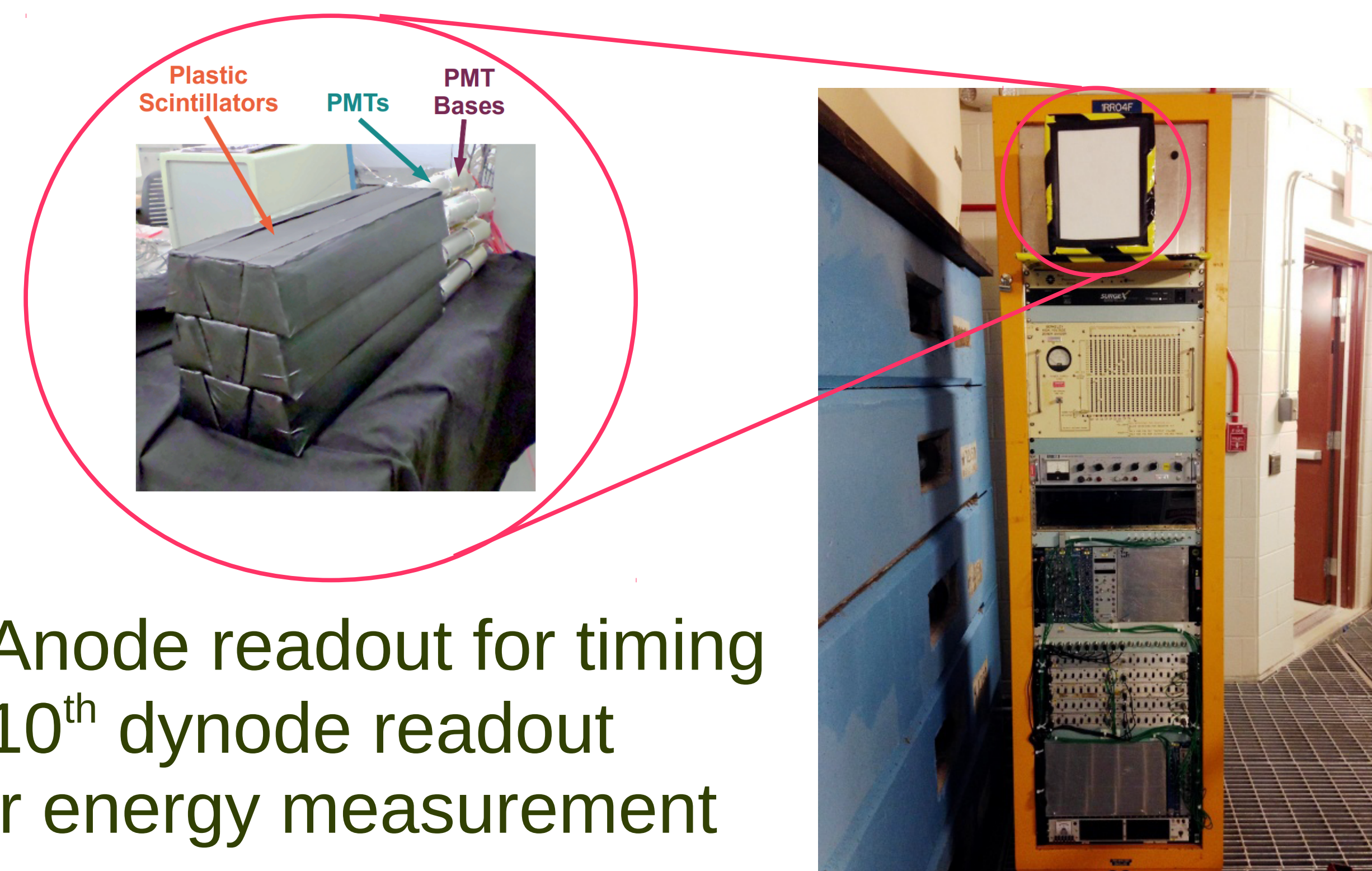
• Anode readout for timing
• 10th dynode readout
for energy measurement

Measure rates for different combinations
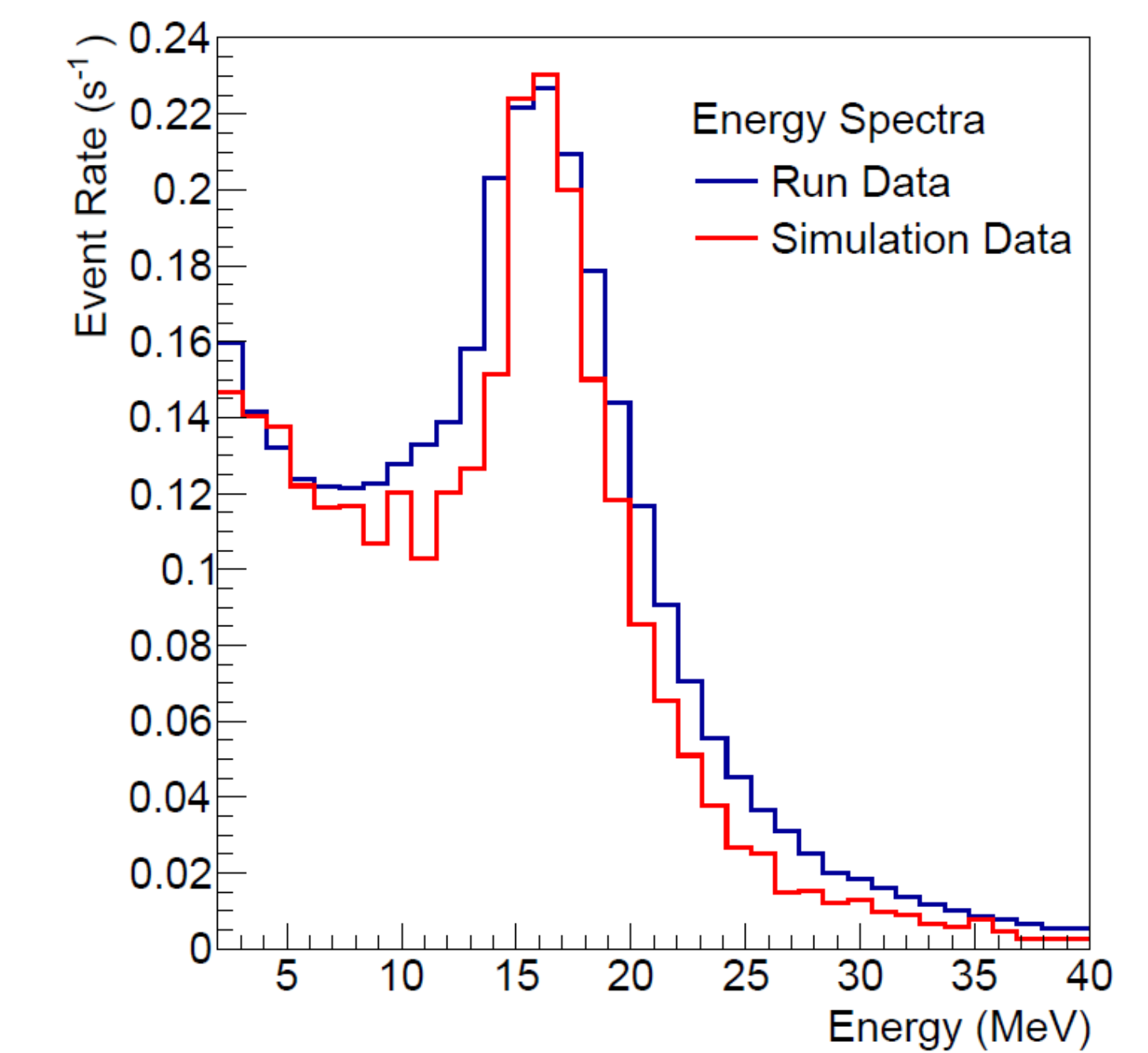

Vertical Rate

Diagonal Rate
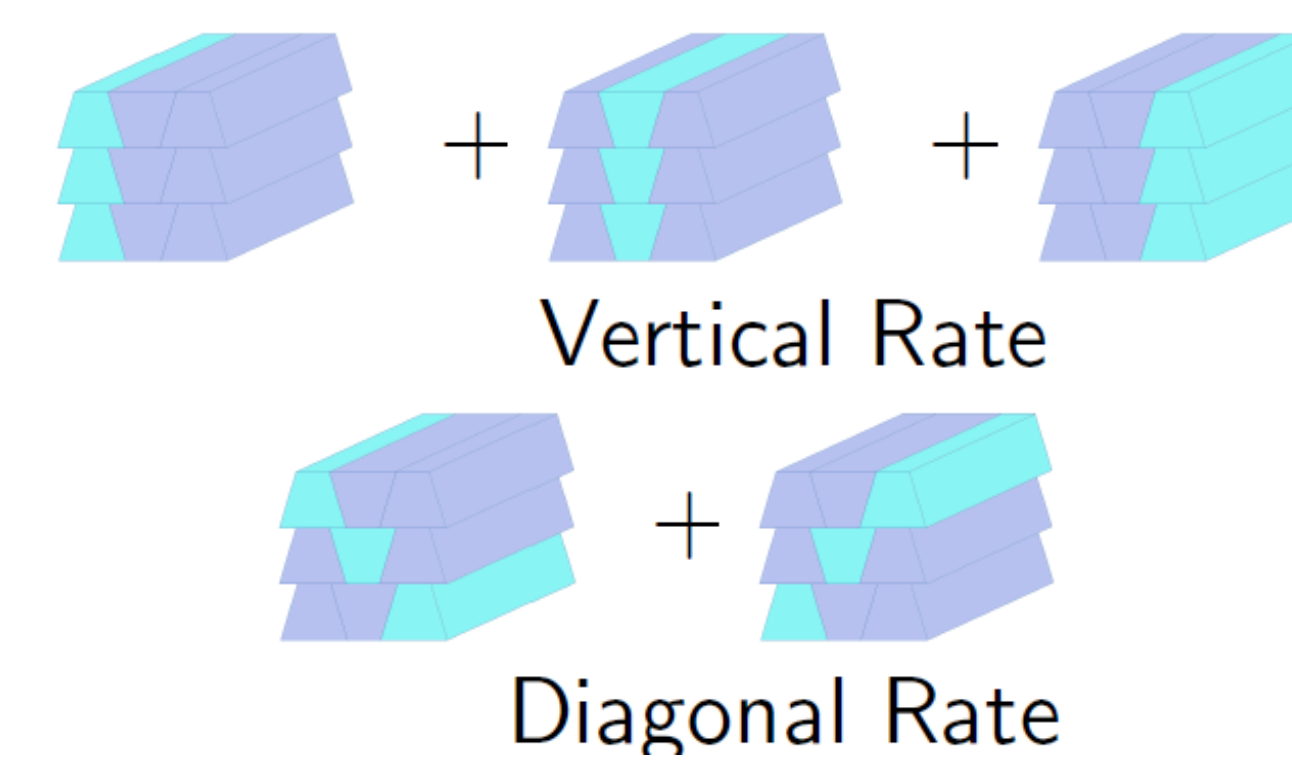
CRY/Geant4-Based Simulation

Use measurements to validate simulation
6×10^7 particles (41.4 s simulated time)

Data-Monte Carlo Comparison

Energy Spectra
— Run Data
— Simulation Data

Sample energy spectrum

	Detector Rate (s^{-1})	Simulation Rate (s^{-1})
Total Rate	10.21 ± 0.01	9.63 ± 0.04
Vertical Rate	2.73 ± 0.01	1.99 ± 0.02
Diagonal Rate	0.717 ± 0.003	0.87 ± 0.01

Errors are statistical only

Cosmic-muon rate from Monte Carlo:
3.72 ± 0.01 kHz (stat. error only)
~6 per 1.6-ms readout frame
(~18 muons/event)
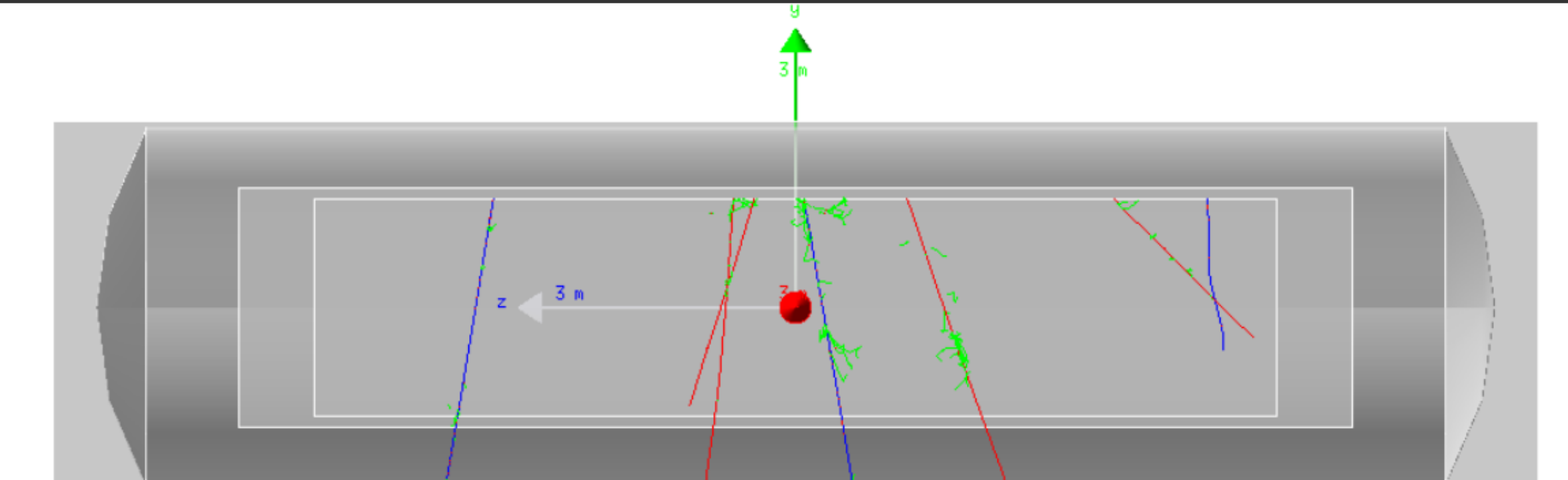
Agrees with independent determination
with "Mega-Mini" detector (Va Tech)
4.3 ± 0.7 kHz

Preliminary