MITPC

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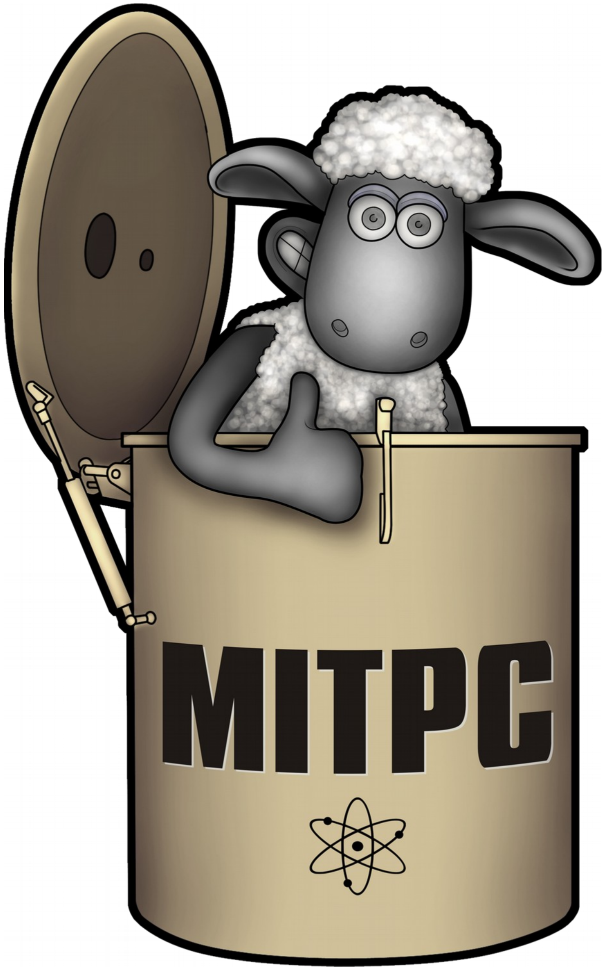
06/08/15



Outline

- What is MITPC and why do we care?
- How does MITPC work?
- Results from MITPC so far:
  - Little MITPC
  - Big MITPC
  - Neutron Rate vs Rainfall
- Next Steps

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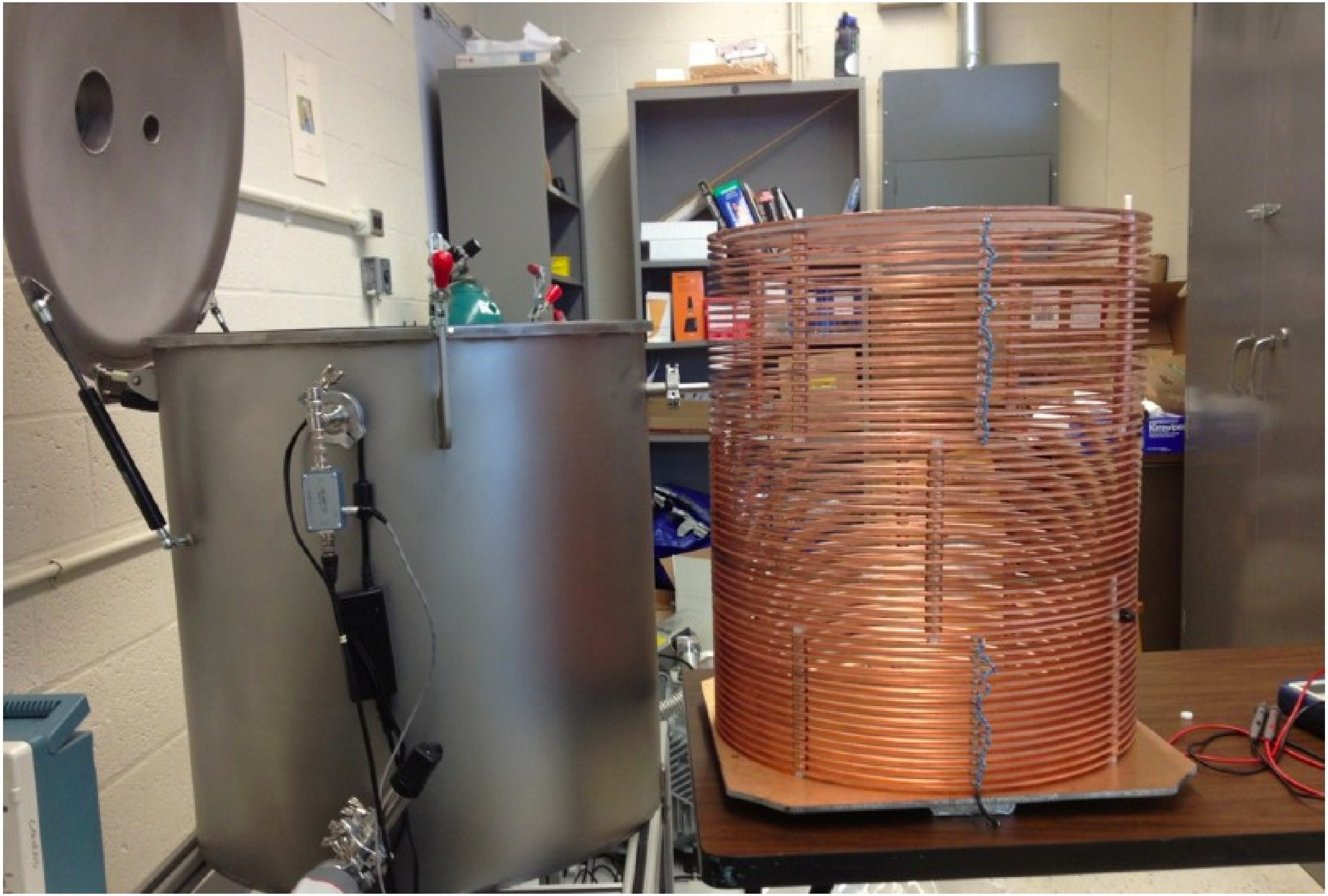
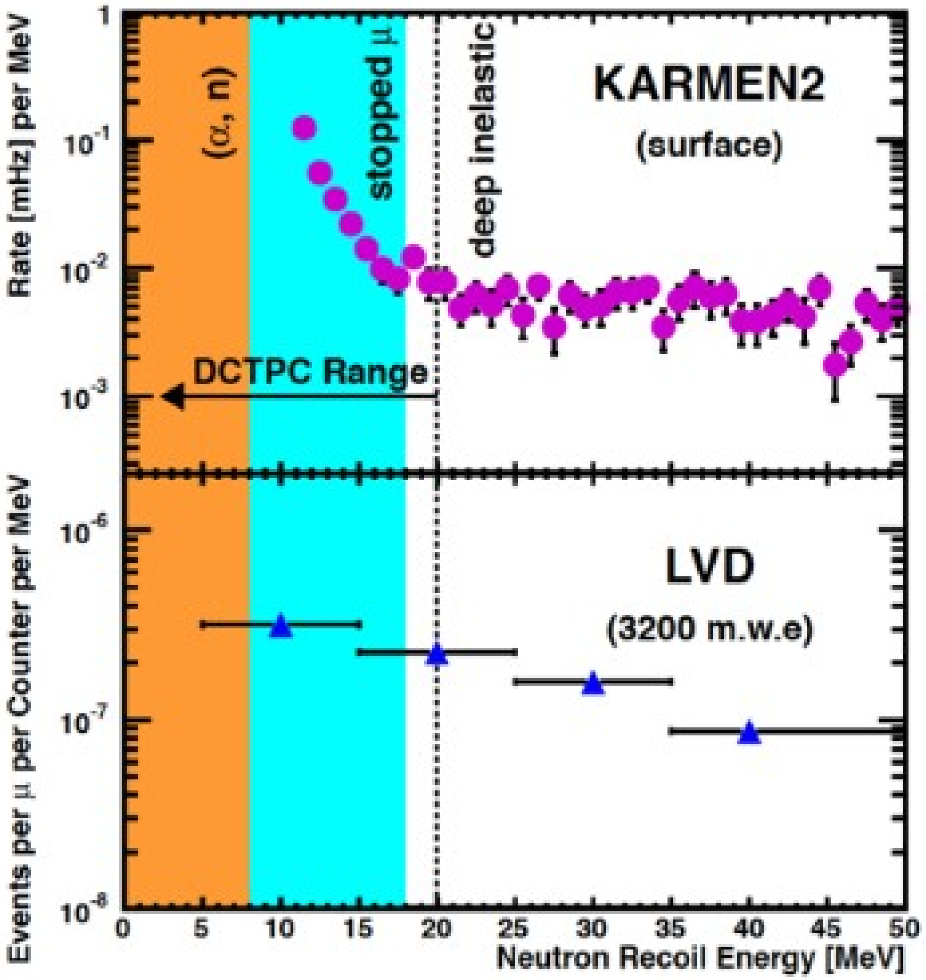
What is MITPC?



The Purpose of MITPC

- Background for WIMPs, neutrinoless double beta decay, solar neutrinos, coherent neutrinos...
- R&D overlap with direct-dark-matter-detecting DMTPC
- Nuclear non-proliferation and neutron dosimetry in general
- Cheap, mobile, scalable, duplicable, low-E threshold, directional, high resolution, high efficiency neutron detector

Motivating MITPC

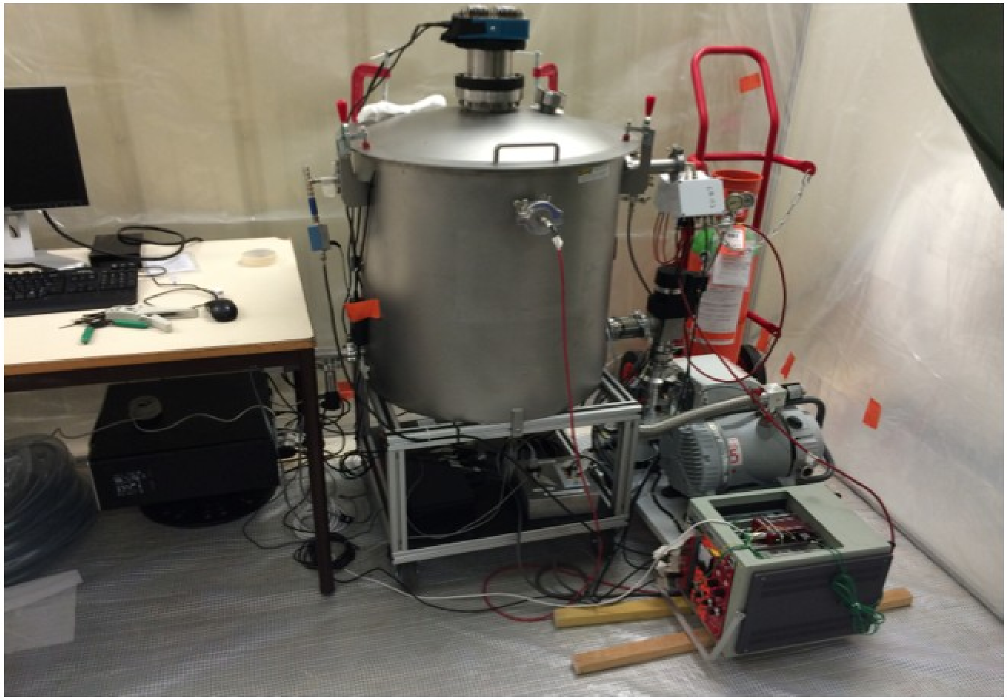


- There are surprisingly few measurements of fast neutron interactions as a function of depth
- Measurements as a function of energy and depth are needed
- Initially MITPC will make measurement at 115 mwe and 300 mwe.

What is MITPC?

Little MITPC

- 2.8 L
- 0.2 – 10 MeV nuclear recoil
- 4 months of data at Double Chooz far hall
- Now at MIT for R&D



Big MITPC

- 60 L
- 0.3 – 20 MeV nuclear recoil
- 7 months of data at Double Chooz near hall
- 6 months data at far hall and on its way to FNAL

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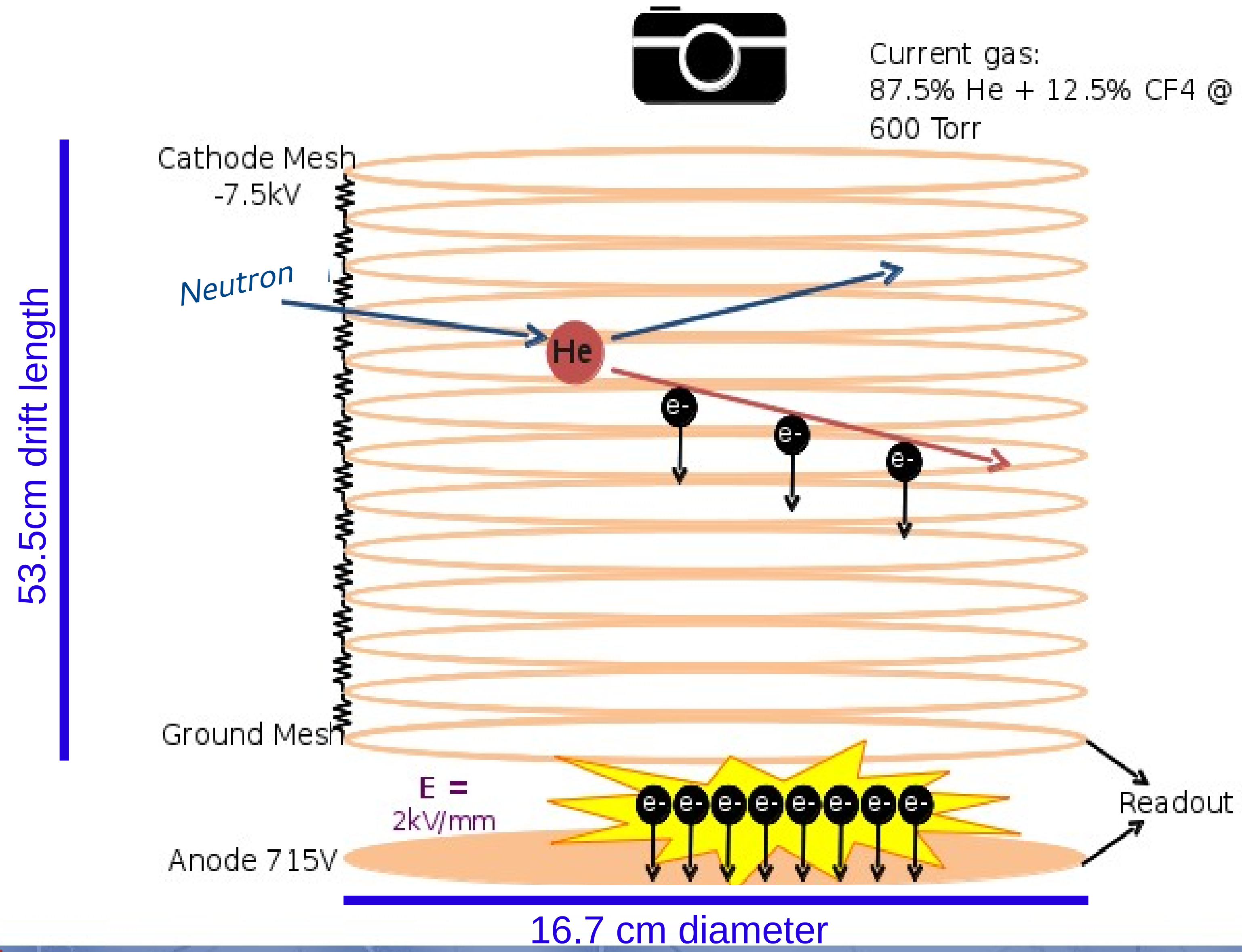
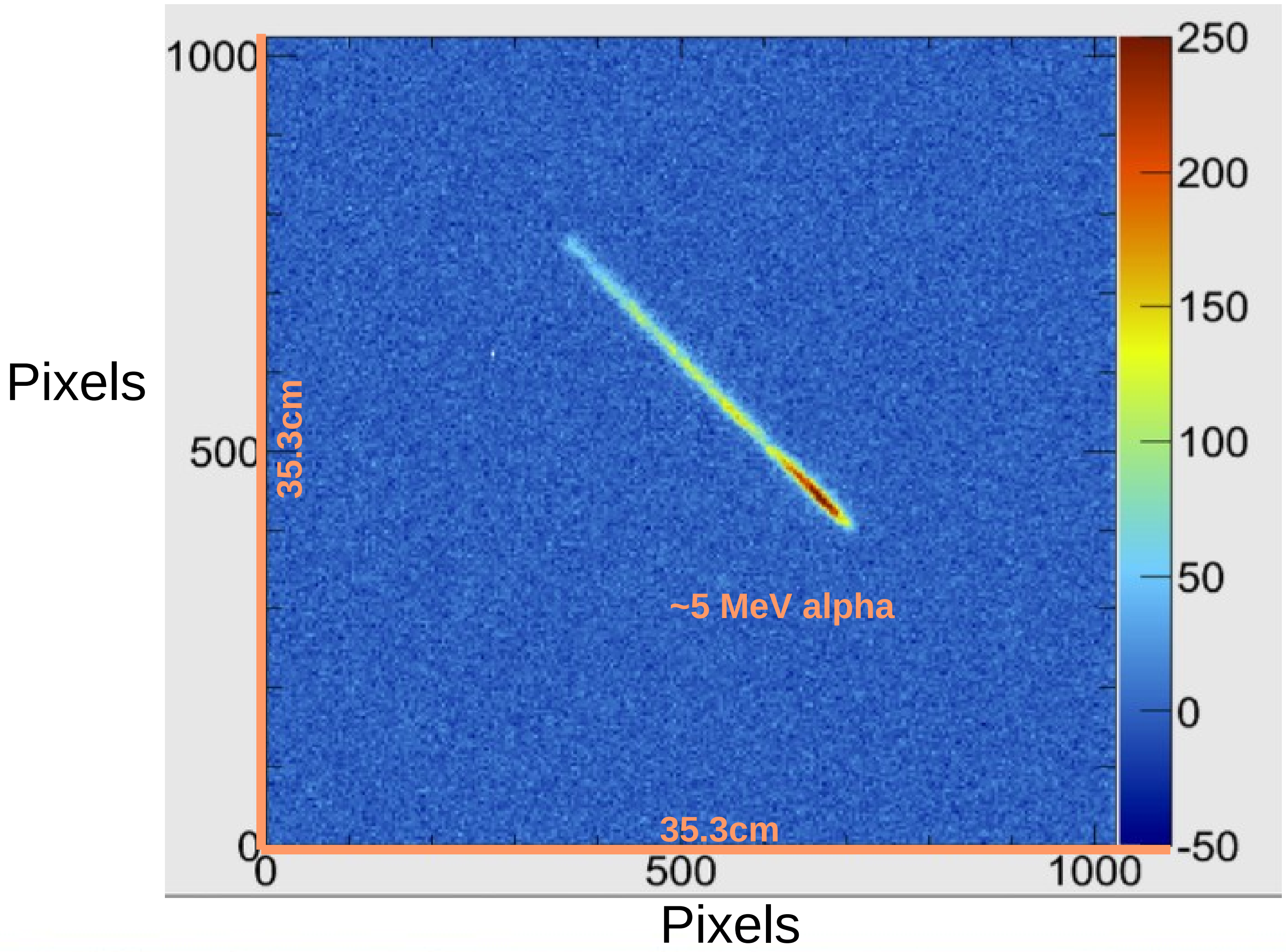
How MITPC Reads Events

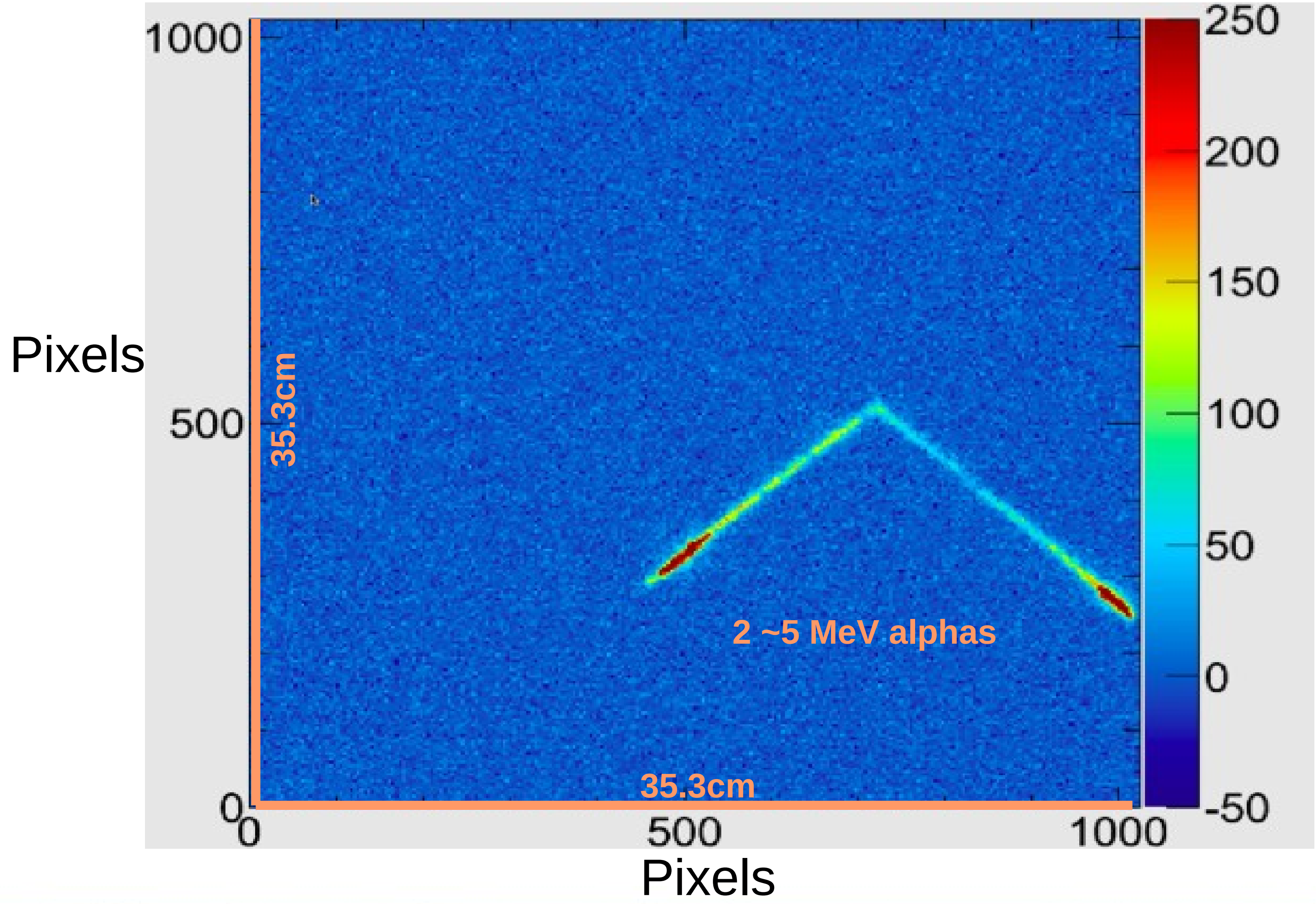


Alpha Event

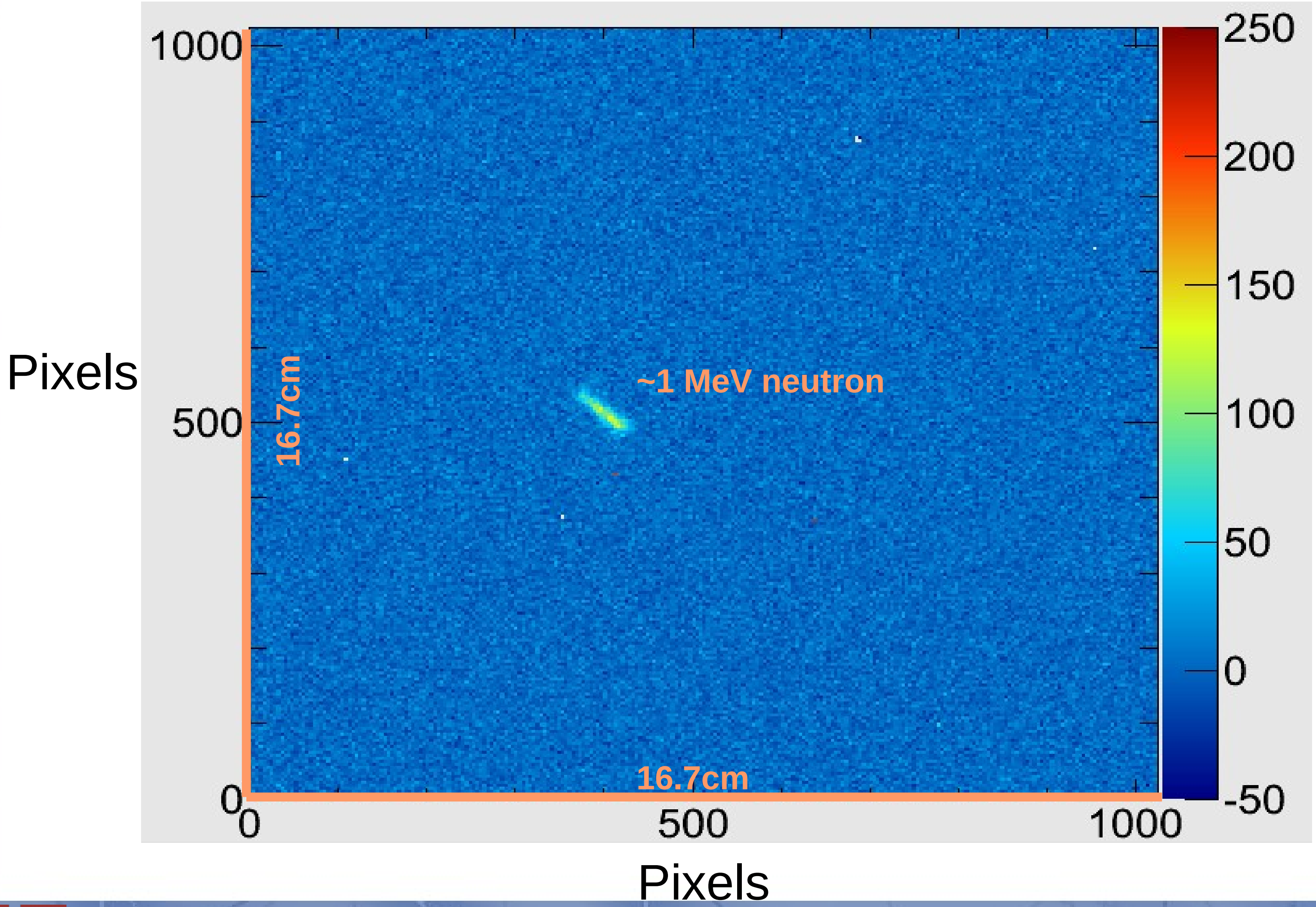


Pixels
1000
500
0
0
500
1000
35.3cm
35.3cm
~5 MeV alpha
250
200
150
100
50
0
-50
Pixels

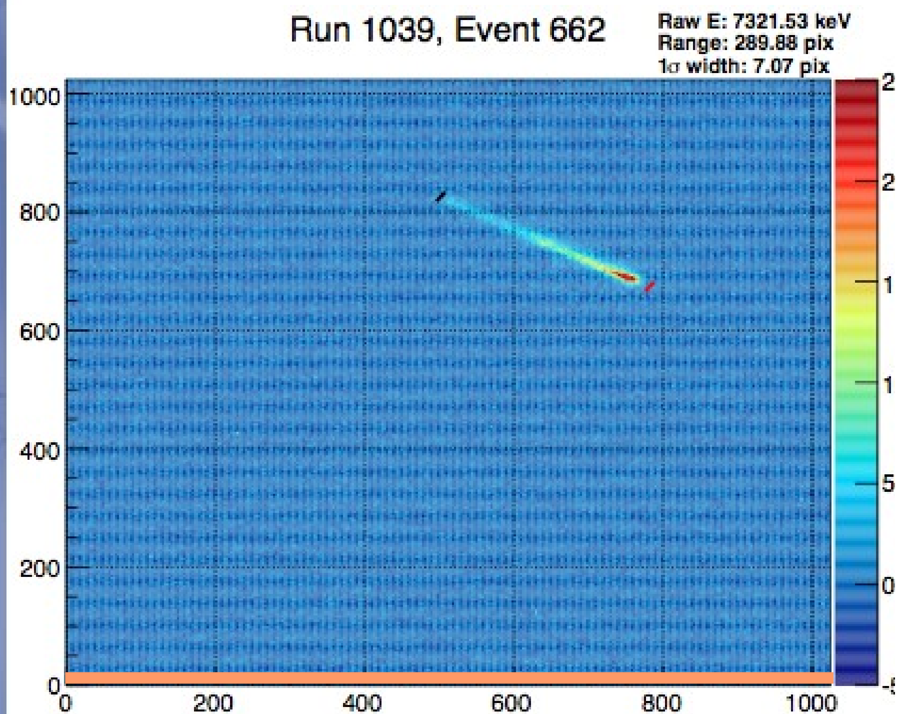
Double Alpha Event



Neutron Event

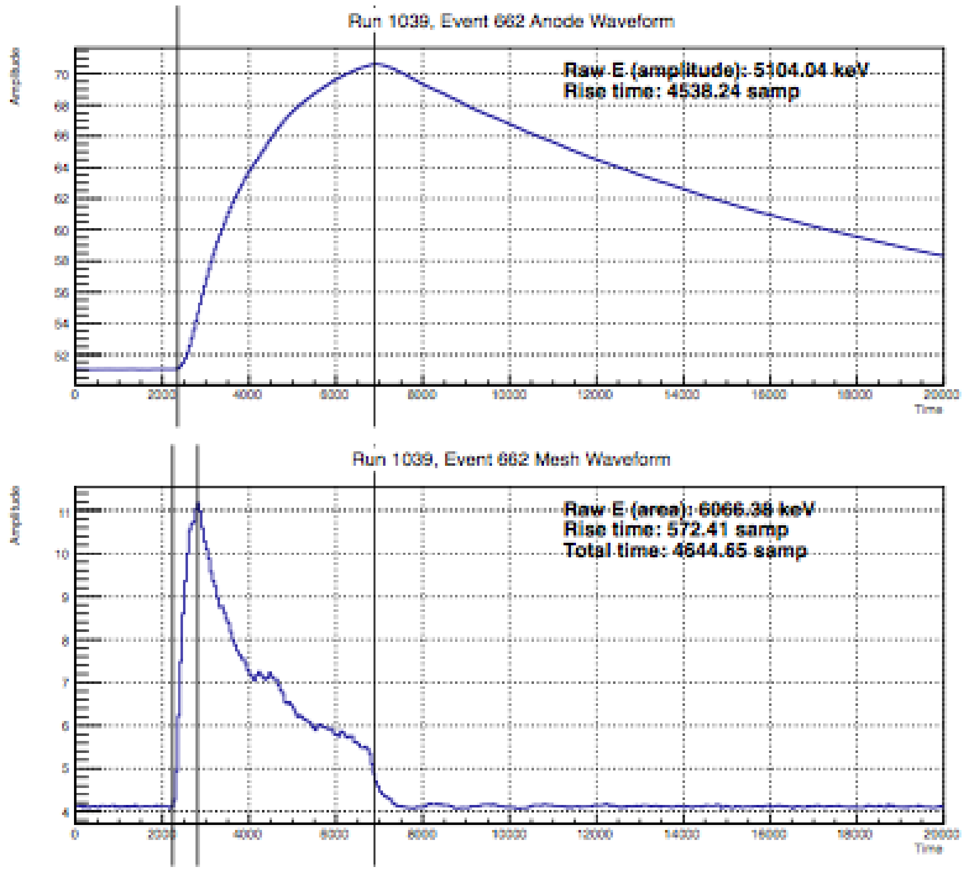


Event Readout of an Alpha



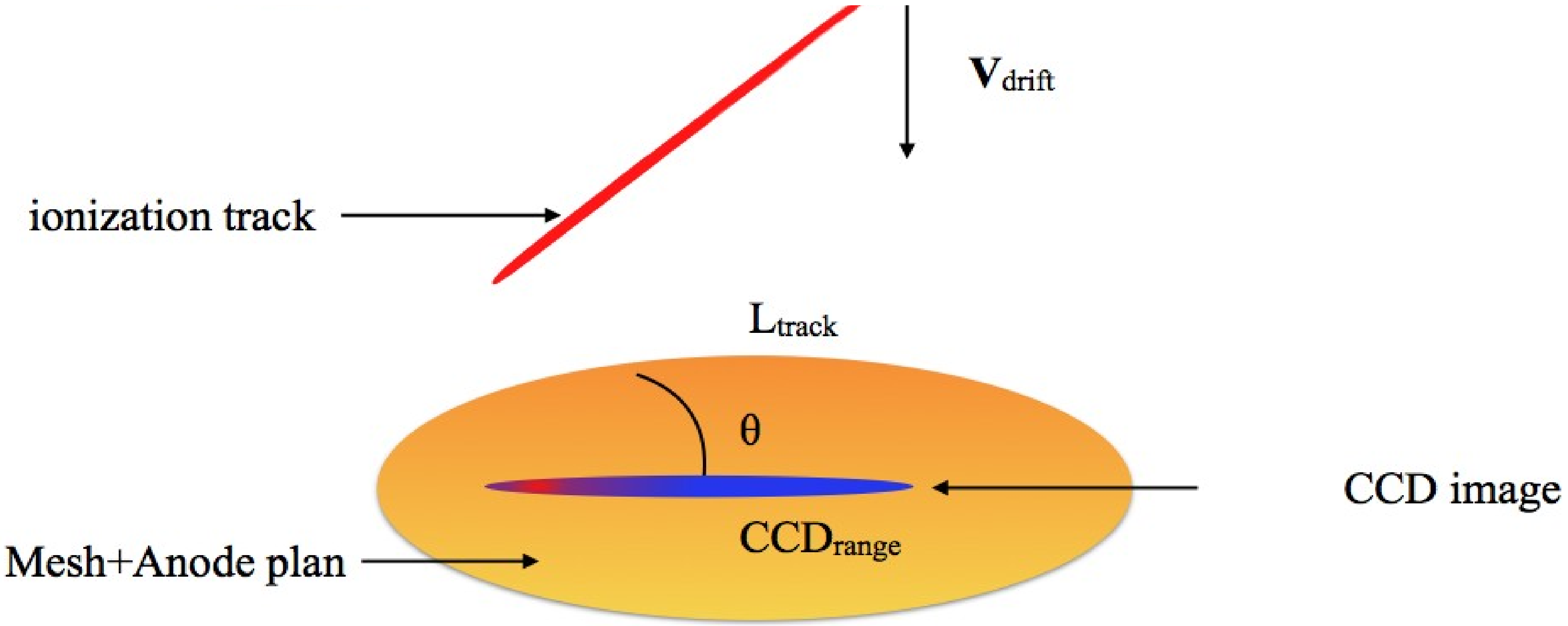
35.3 cm

CCD readout



Waveform readouts: anode (top); mesh (bottom)

Energy Reconstruction from 3D Length

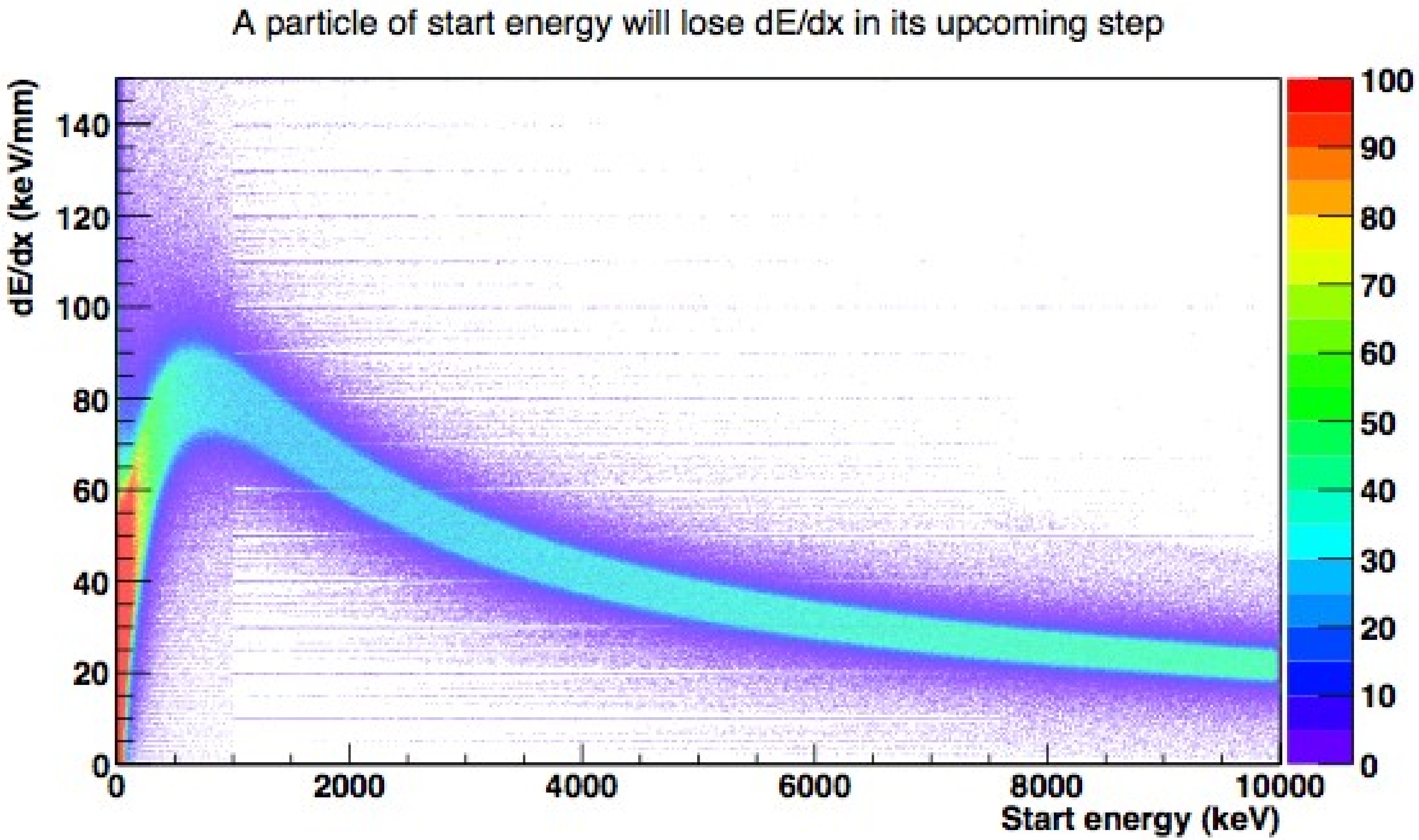


$$\tan\theta = \frac{T_{deposit} V_{drift}}{CCD_{range}}$$

$$L_{track} = \sqrt{CCD_{range}^2 + (T_{deposit} V_{drift})^2}$$

Use SRIM simulation to find energy from length

SRIM/TRIM Simulation



Alpha particles in 75 torr CF4, 525 torr 4He

www.srim.org

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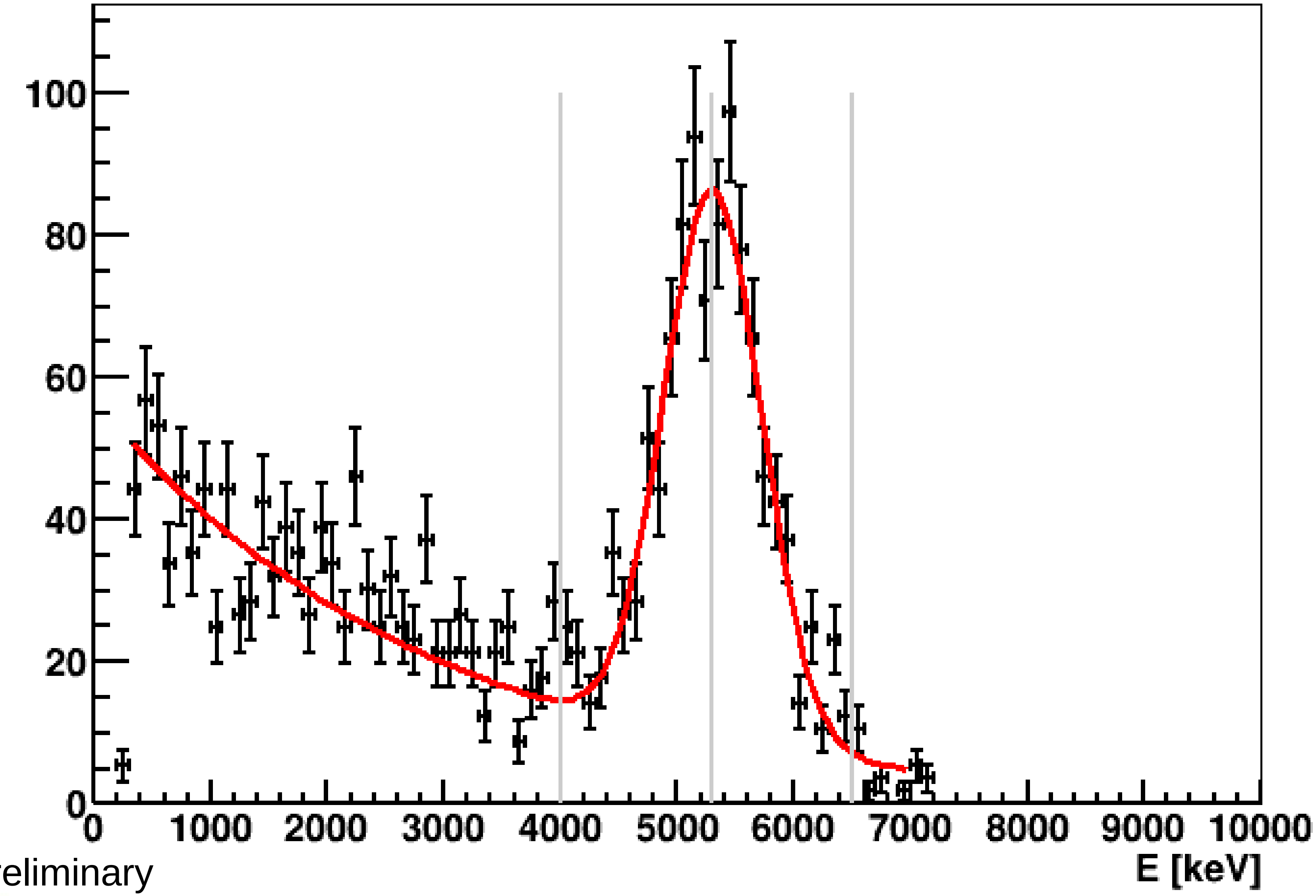
Results from Little MITPC



Preliminary

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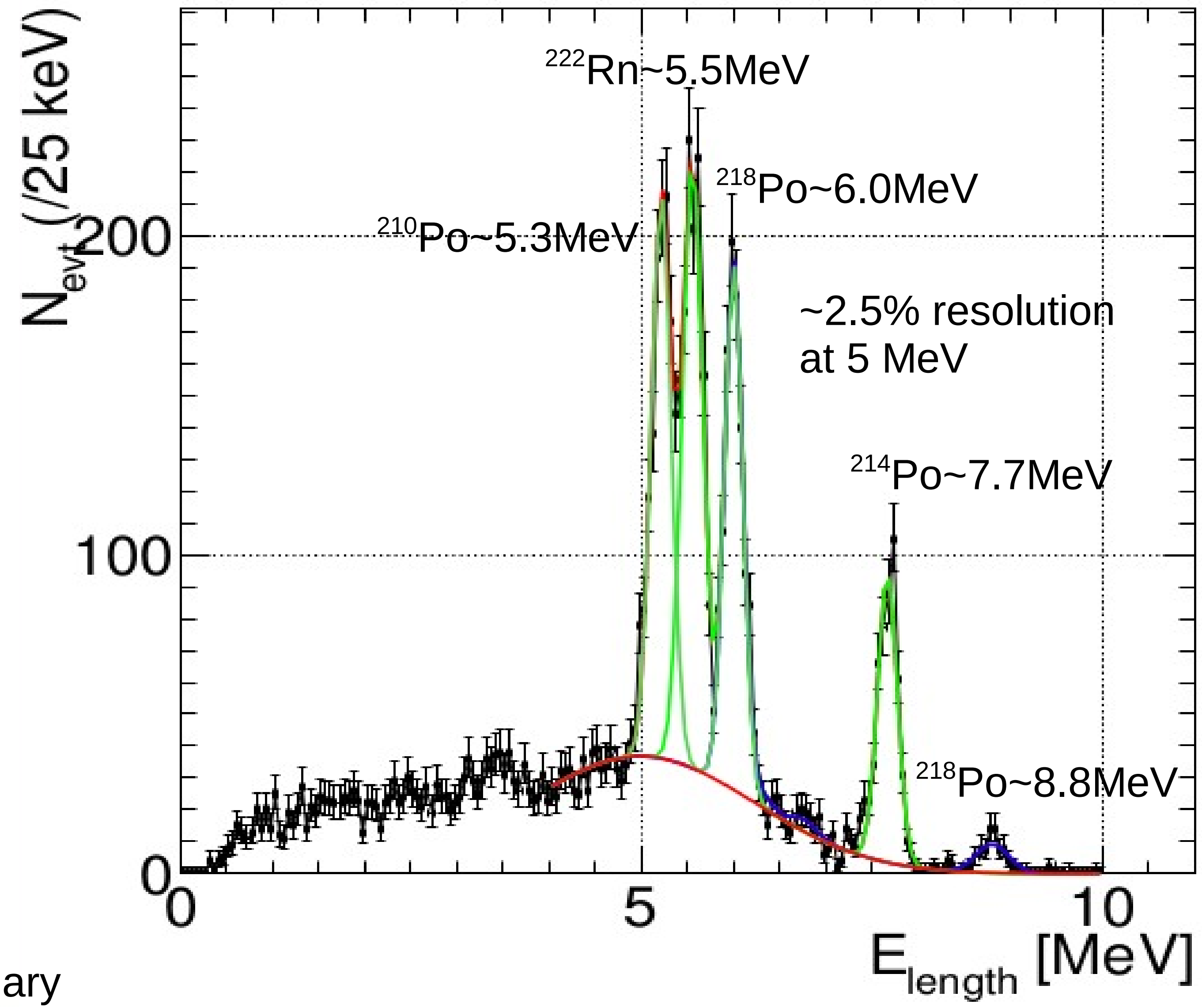
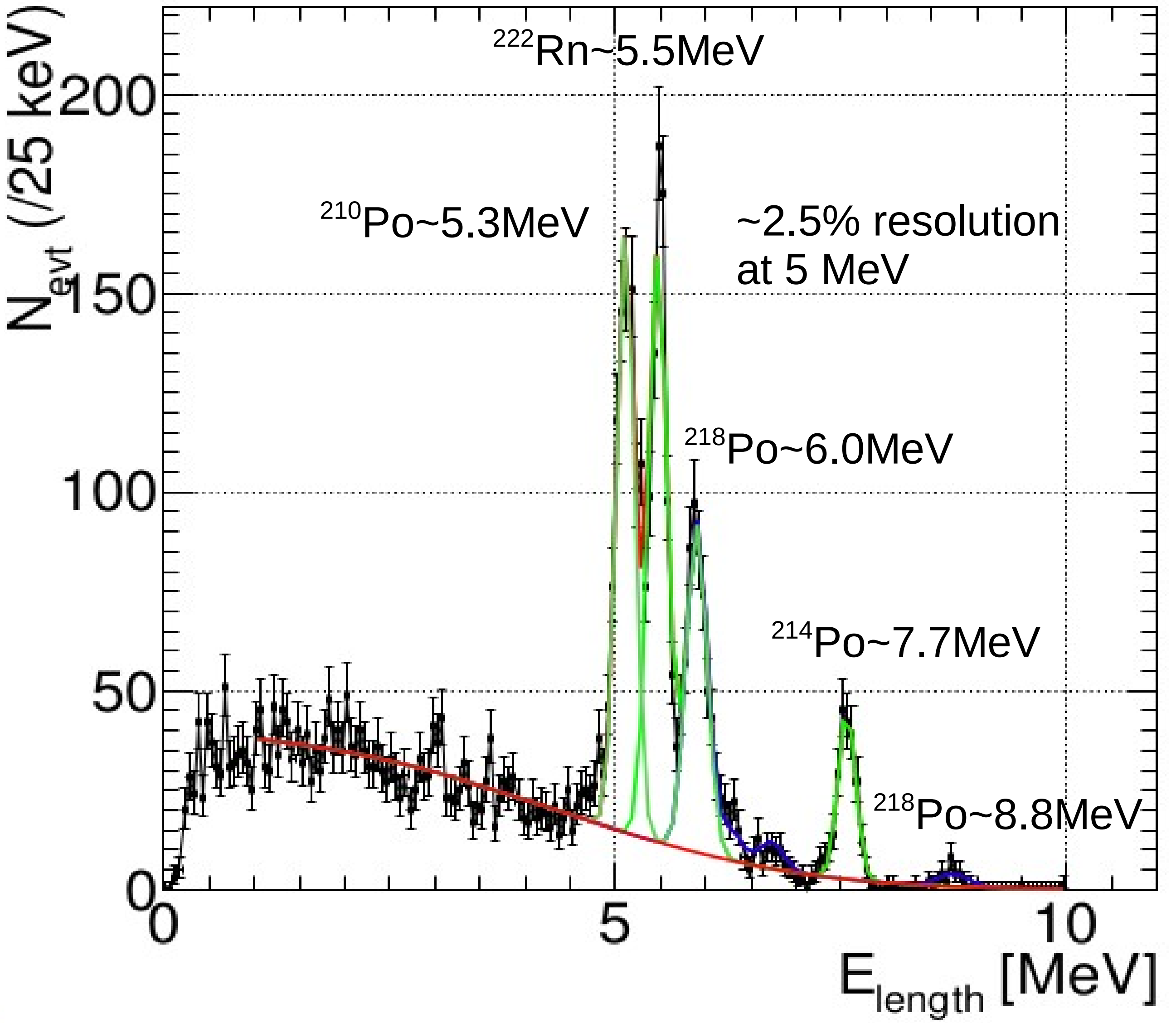
Big MITPC – Near Hall



Preliminary

Big MITPC – Far Hall



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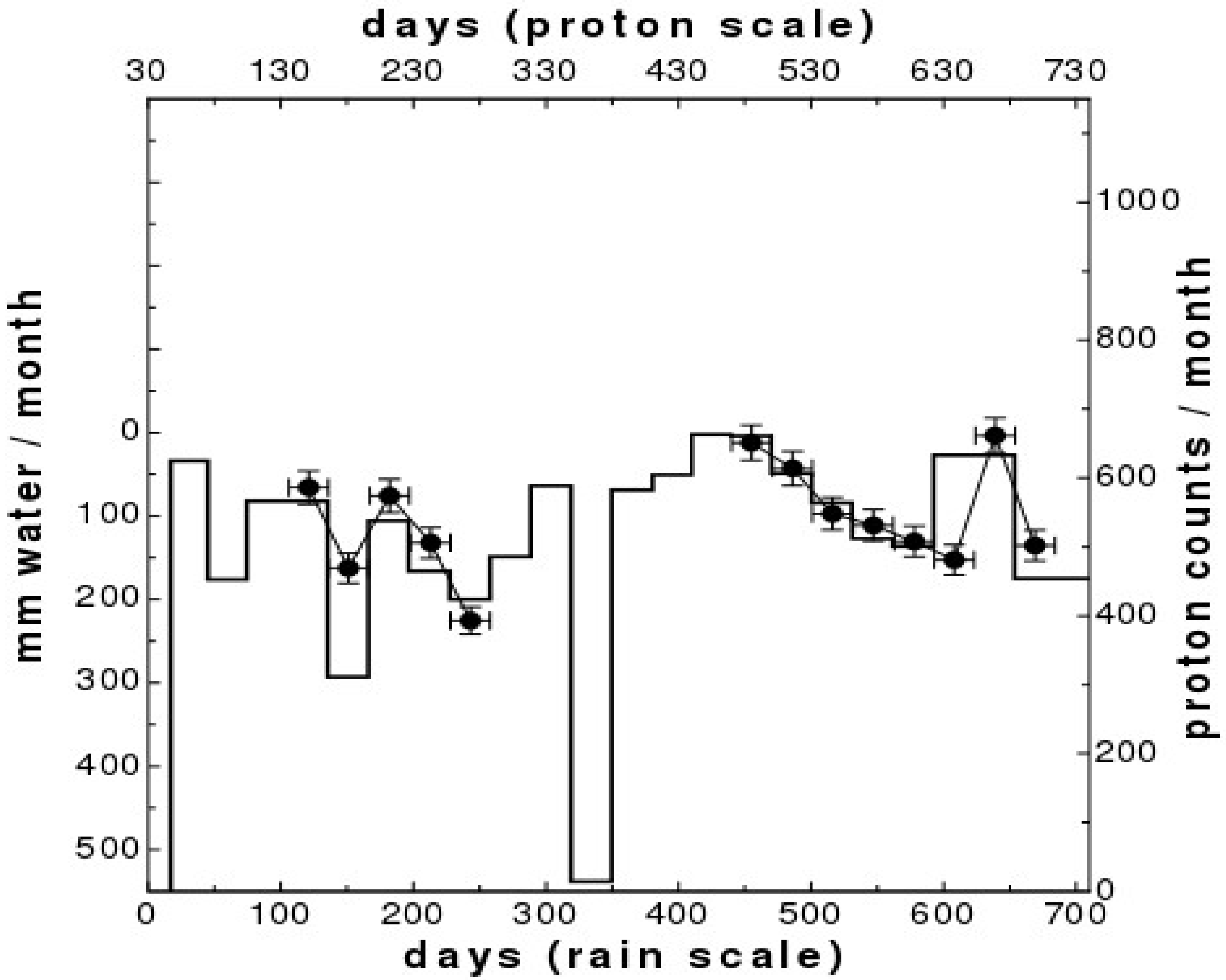
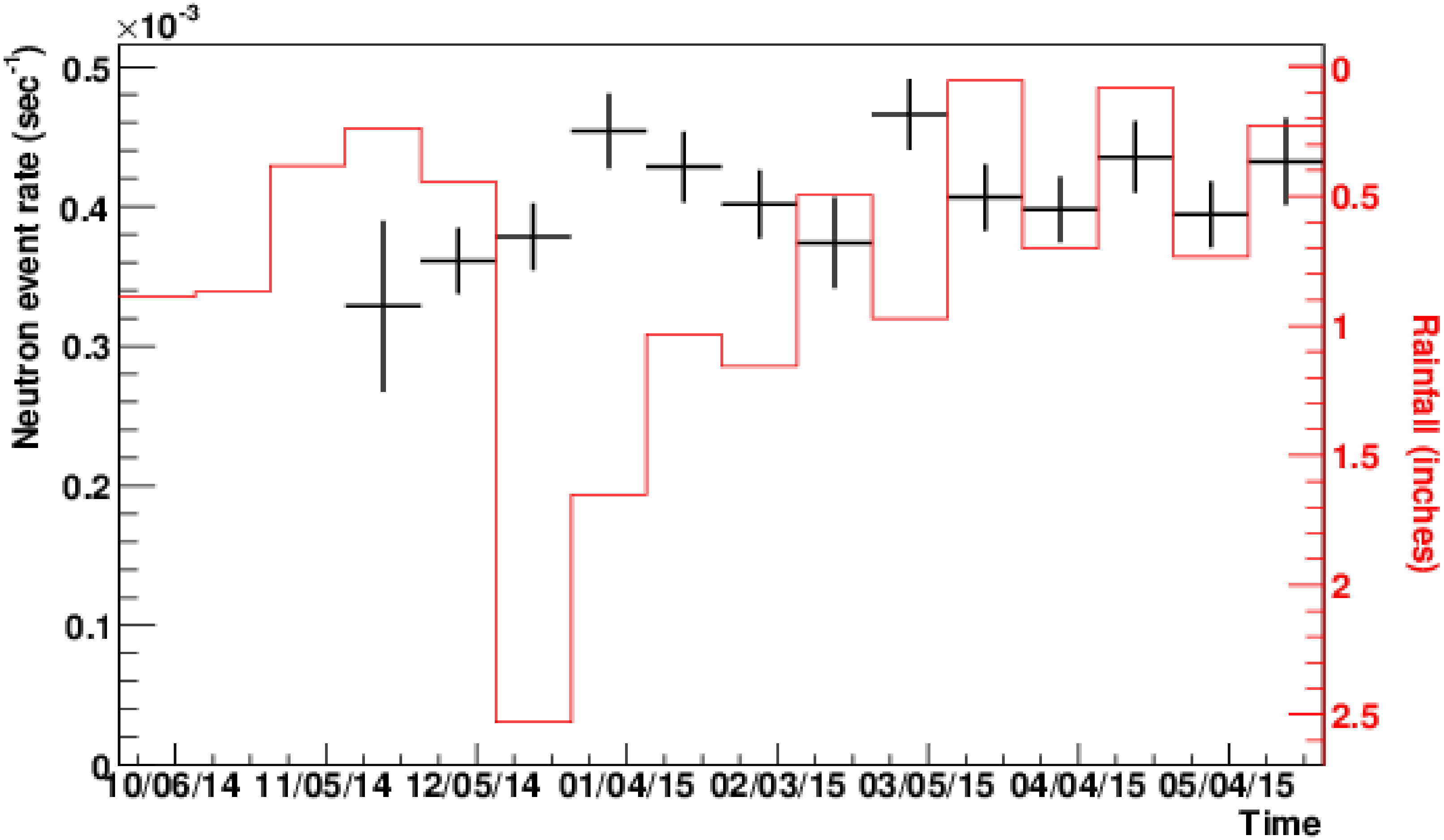
Motivation



- Previous results saw correlation between rainfall and neutron rate
- The neutron intensity is related to the moisture at the surface

A. Borio di Tigliole, et al. Europhys. Lett., 67 (6), 1045 (2004)

Neutron Rate vs Rainfall – Far Hall



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Next Steps

- MITPC @FNAL:
  - Neutron measurement obtained from MITPC will be helpful in multiple Fermilab experiments: MicroBooNE, SBND (formally known as LAr-1ND), and ANNIE
  - Allow us to tune the Monte-Carlo based simulations of neutron background
  - Installation of MITPC at Fermilab begins this summer
- Further analysis of rainfall vs neutron rate plots
- Publish paper
- Many other potential uses of MITPC in the future!

Thanks to MITPC Collaboration: Janet Conrad, Josh Spitz, Marjon Moulai, Adrien Houlier, Jaime Dawson.

Questions?