



# MicroBooNE Radon Doping and Precision Energy Measurements

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# MicroBooNE and DUNE

- **MicroBooNE**

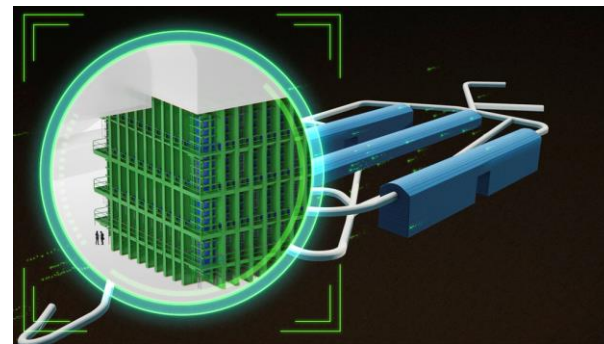
- 40 feet long, 170-ton Liquid-Argon Time Projection Chamber (LArTPC) located on the booster neutrino beamline
- Well understood and very precise MeV scale detector
- Taking data 2015-2020



An image of the MicroBooNE LArTPC detector.

- **DUNE**

- **D**eep **U**nderground **N**eutrino **E**xperiment
- Two detectors: one at Fermilab located at the long baseline neutrino facility (LBNF) along the world's most intense neutrino beam and one at Sanford Lab
- Sanford will have four LArTPC detector modules, totalling 70,000 tons of liquid argon, the near detector will also be made of LArTPCs



A rendering of the planned underground detectors at Sanford Lab.

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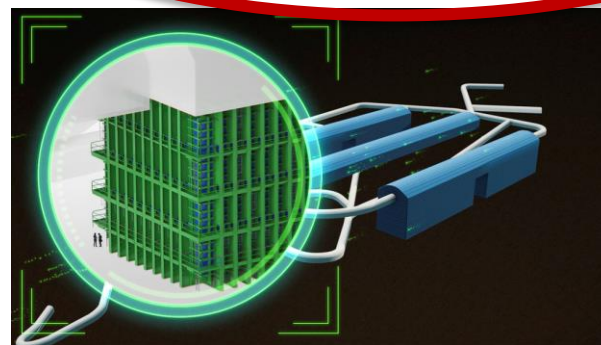
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An image of the MicroBooNE LArTPC detector.

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# MicroBooNE and DUNE

- **MicroBooNE**

- 40 feet long, 170-ton Liquid Argon Time Projection Chamber (LArTPC) located on beamline

- We are preparing for the next phase of the experiment
- Taking data on neutrino oscillations

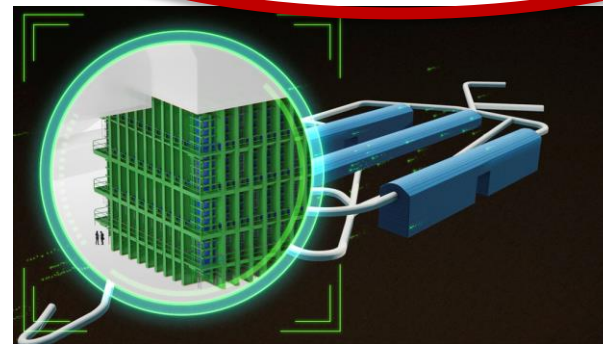
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We can use MicroBooNE for R&D of DUNE. Can DUNE be the next MeV scale detector?



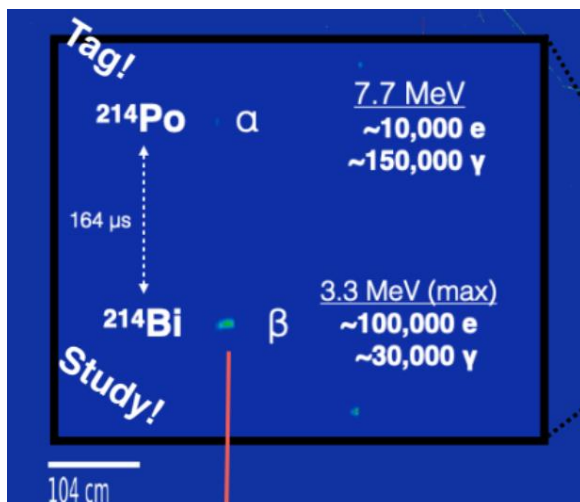
An image of the MicroBooNE LArTPC detector.



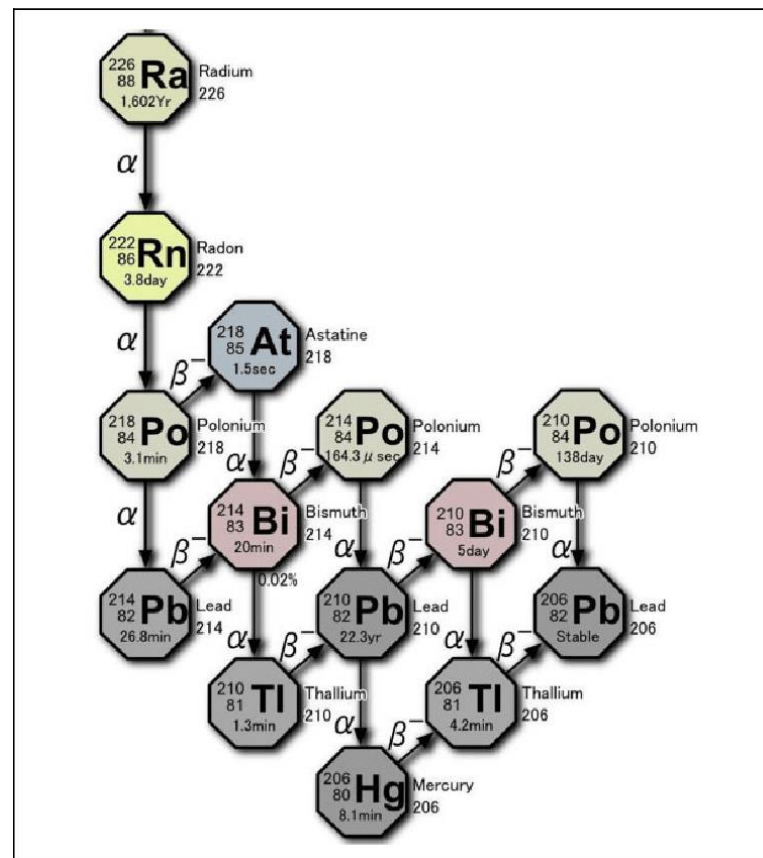
A rendering of the planned underground detectors at Sanford Lab.

# Radon Doping and Precision

- What do we want to test?
  - How precisely we can measure energies in a LArTPC
  - Radon-222 doping allows us to examine the detector's MeV scale response
    - We are interested in the Bi-214 and Po-214 which produce a taggable signal due to the Po-214 half-life
    - Known energies, will be used as a “standard candle”



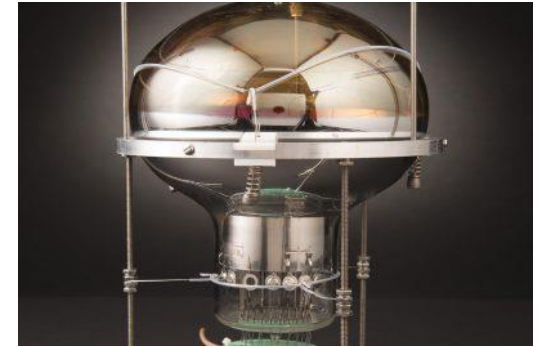
Here is the desired signature we wish to observe and study.



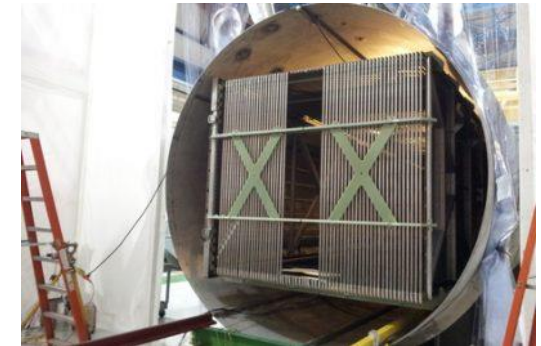
The decay chain for radium 226, which includes the radon 222 decay.

# My Project – Data Taking

- Aid in the data taking that will start in a week or so
  - I will be the first to look at the data
  - Joseph Zennamo's Project
- We are expecting about 550 events per second
- Goals for this part of the project
  - Learn more about MicroBooNE, understand the details of how it works and how it collects/records data
  - Produce the energy spectrum we hope to compare to simulations, how precise is it
  - Learn more in general about data acquisition
    - And the coding techniques that go along with it



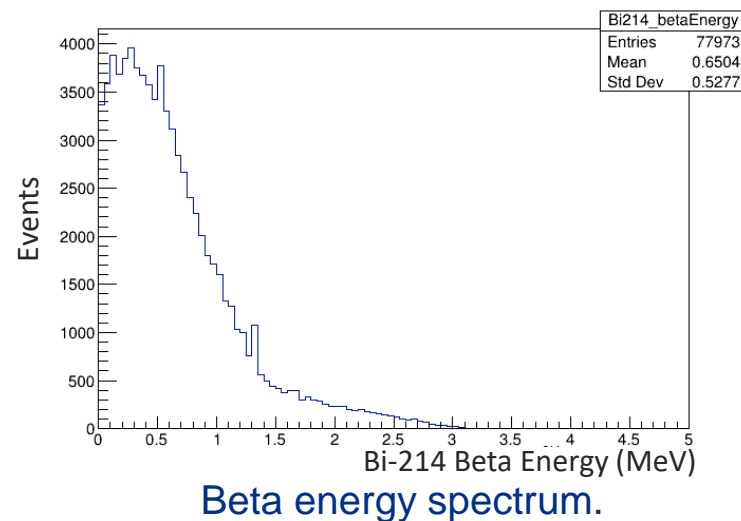
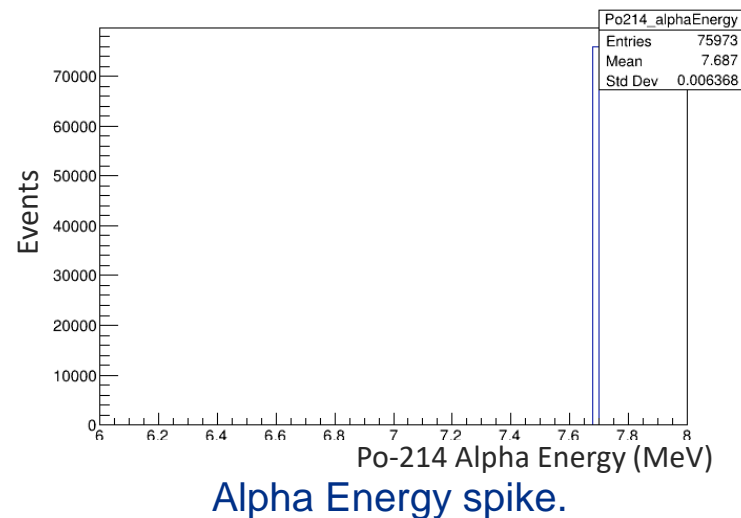
One of the photo-multiplier tubes (PMTs) installed in the LArTPC meant to detect light.



A picture of the time projection chamber.

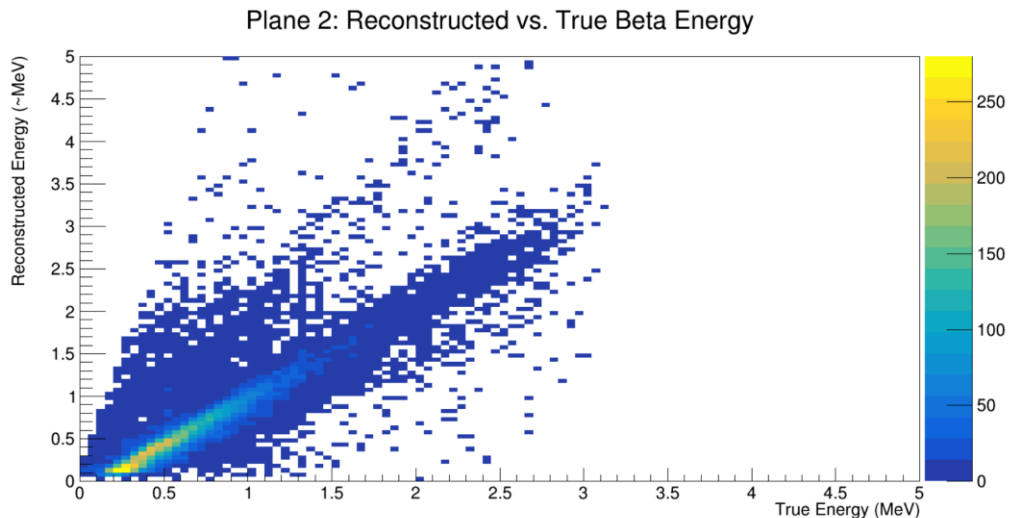
# My Project – Analysis and Precision Energy

- During or before data taking, I will work on simulations of what we expect to see from MicroBooNE
  - Precision
  - Expectations
  - Truth Spectrum
- After the data taking, I will aid in analyzing the data we get from the doping
  - What does the  $\beta$  spectrum look like?
  - What do we get for the  $\alpha$  energy?
  - What is the detector's precision?
- Goals
  - Learn more about fitting
  - Get back into coding/analysis



# Where am I now and what is next?

- For now
  - Got started on the computers and helped our new intern
  - Fit the  $\beta$  spectrum
  - Started looking at MicroBooNE simulation
- What is Next?
  - Look at the comparison of True vs Reconstructed energy
  - Develop cuts with Joseph and Fernanda
  - Try to look at our regions of best precision



The first  
comparison  
plot of  
Reconstructed  
vs. True





Thank You!