Discussions on designing a next-generation rare pion decay experiment

- We've seen lots of work so far with simulation, bench tests, and beam tests

- If we didn't know it then, we know it now: this is not an *easy* experiment; thus, will require attention to tiny details and non-intuitive measurement imperfections that lead to a systematic bias

- To guide us, we will need the Simulation Effort to really ramp up, thanking Patrick et al for building the framework. It's time to get many others involved, so please attend the Bootcamp if you might even think of contributing. (we will return to this point)

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Discussion Plan: 4 "themes" / timed

- Beam relate (7 min)

- ATAR related (7 min)

- Calo related (7 min)

- Photo nuclear .. Neutron production (7 min)

- Tracker, DAQ, Electronics related (5 min?)

- Already running late

Brief status of various thrusts (with apologizes)

- **<u>Beam:</u>** 1st tests; mixed results; but, it feels like a solution can be found with simulation effort and beamline configuration optimization

- Discussion: going forward
  - Who will model PiE5?
  - Can we add elements in existing space and, is that even worth the effort?
  - Might we consider PiE1 for Phase 0.5? We can start with a lower rate, preferring to have a better beam not distract from the detector tests

(allow 7 minutes)

Brief status of various thrusts (with apologizes)

- **<u>ATAR:</u>** Very active bench test program; sims of device developing; sims of "tracking" promising; practical decisions ahead to realize a multi-plane ATAR;

- Discussion: going forward
  - With micro studies of strip response dominating, can we devote time yet to more macroscopic issues that the Simulation framework requires?
    - E.g, flex cable thickness and layout; dead layers; E resolution; mechanical support; location of degrader; triggering and authentic 'tail trigger' software development.

(allow 7 minutes)

Brief status of various thrusts (with apologizes)

- **<u>Calo(s):</u>** Simulations driving work given costs and practical factors; bench tests with LYSO have begun; plans for LXe prototype made; in all cases, any prototype capable of meaningful response at 70 MeV will be expensive to have full containment and photo-nuclear response revealed.

- Discussion: going forward
  - What is actually needed for performance metrics (KPPs) here is probably the most important question we must answer because the cost of any Calo completely dominates the cost of PIONEER overall.
    - Energy resolution vs Pileup are 2 extremes for crystals vs LXe (among other differences)
    - Practical factors for LXe include review of needed windows and support that interfere with electron passage. Simulation programs need to have a better model here.

(allow 7 minutes)

Brief status of various thrusts (with apologizes)

- **<u>Photo-nuclear:</u>**
  - Measurement program
  - Simulations issues
  - Time constants ! Are these semi-prompt or very delayed?
  - What creates the scintillation light?
- Discussion: going forward
  - Important to fold into our Calo pileup and recon algorithms

(allow 7 minutes)

Brief status of various thrusts (with apologizes)

- **<u>Tracker</u>** Must get realistic model in GEANT and must establish efficiency and spatial resolution to address the pileup

- **<u>Electronics / DAQ</u>** When do you need to know the channel count and other parameters for the system?

- Discussion: