

DUNE Trigger



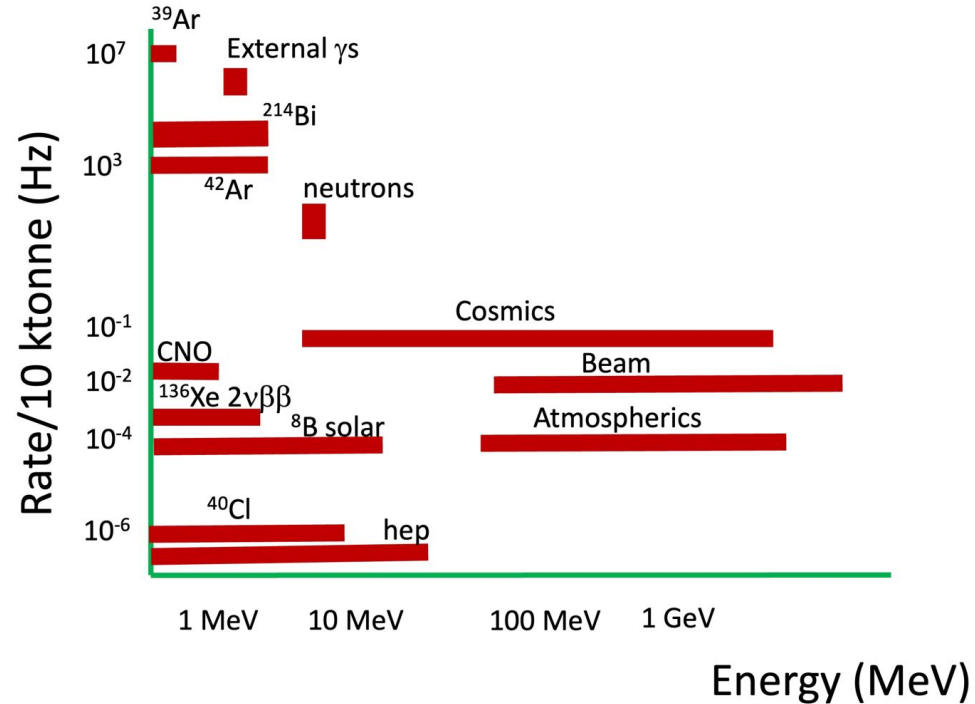
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Plenary outline:

- ❖ **Challenges for TDAQ in Deep Underground Neutrino Detectors**
 - **DUNE requirements**
 - **Backgrounds**
 - **Inclusivity and simplicity**
- ❖ **How the environment / detector segmentation guided TDAQ design**
 - **TP/TA/TC/MLT/TD structure and hierarchy**
- ❖ **Introduction to the Data Selection / Physics Performance team, Tuesday general meetings, Monday technical trigger meetings**
- ❖ **Existing trigger algorithms & their use at NP04.**
 - **Exclusivity because detectors are on surface**
- ❖ **New simulation software**
- ❖ **Example studies using simulation (...that we need to do before January)**
- ❖ **Conclusions, reminder to join & talk with DS before developing new algos, perhaps example studies/new algos we actually want.**

Challenges for TDAQ in Underground Detectors

- **Difference between the Underground and Surface**
 - ◆ Very low HighE (inc cosmic) rates. Opposite on surface.
 - ◆ High LowE rates (mostly Argon). Same on surface, but the number of hits per event far higher for HighE
- **In DUNE FD we can define HighE as > 10MeV.**
 - ◆ On many other LBL experiments, HighE means > 1GeV!
- **DUNE detector fragmentation, high volume of data**
- **Data volume vs. threshold and assumptions**
- **1-3 slides**



TDAQ purpose & design

→ TDAQ purpose to save interesting physics

- ◆ The trigger is not analysis
- ◆ NOT to tag events with PIDs/exact event/interaction type!
- ◆ Event reconstruction, PID tagging etc. is the task for reconstruction.
- ◆ Probably need a whole slide on that.

→ How detector fragmentation & raw hit rates guided TDAQ design

- ◆ Hits found on CPUs, possibly 4 APAs/CRPs per machine -> tested on NP02 which is SURFACE. Make a strong argument that we don't need fancy AI on FPGAs for hit-finding.
- ◆ Description of TAs per APA/CRP (maybe plane), TC for whole module, TDs sending requests to write the data.

→ Current plans for TA/TC making: TAs produced even from few hits (so very low energy), TCs looking for integral across.

→ Differential and integral efficiency curves (Rivera & Last, or updates)

→ Probably a few slides here.

Supernova triggers and data paths

- Requirements
- Burst trigger vs. “event” triggers
- “Nominal” trigger path (events > 10 MeV visible energy or so)
 - ◆ Good for fast pointing
- Burst trigger and 100 s storage
 - ◆ Good for longer (hours) timescale low E physics
- TP stream
 - ◆ Good for medium-timescale low E physics
- Performance
 - ◆ This might need some new work with the simulation
 - ◆ Might also want to talk about PDS

Data Selection & Physics Performance team

- This definitely requires a dedicated slide at least.
- Introduce our weekly Tuesday general & Monday technical meetings.
- Give links to slack channels, indico, zoom, repositories, our emails, everything short of giving our home address.
- Tell people that if they want their work to be actually included in DUNE, they **HAVE TO** present at the DS/PP meeting.
 - ◆ And the earlier in study/development they start the better. TDAQ is unique and complex, we don't want people do spend months/years/money developing something just for us to tell them "not needed/already taken care of/will not work in our TDAQ system" etc.

Existing trigger algorithms & PD2 tests

→ Explain some of the currently-existing algorithms

- ◆ And how they were written for coldboxes, that have very different specifications than FD, or even PD2s.
- ◆ ADCSimpleWindow: something more close to what we want for the FDs.
- ◆ TP performance

→ PD2 operations

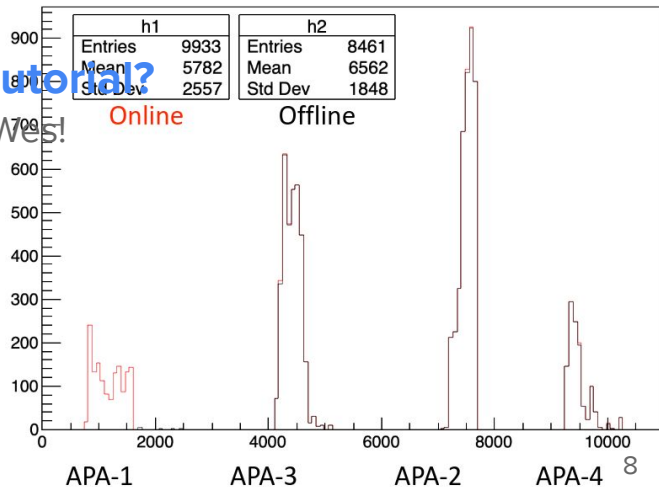
- ◆ No point of saving each cosmic: we wouldn't need trigger, just save all raw data. Too many cosmics.
- ◆ CentralTriggerBoard sending timing events from tertiary beam monitors.
- ◆ ADCSimpleWindow successfully used for monitoring anomalous hardware events, & used by BSM group to find the most high energy events.

→ Maybe compare this with what we might want for the FD?

→ 2-3 slides? Could go as high as 5.

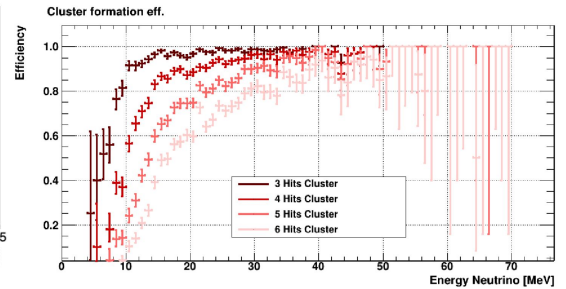
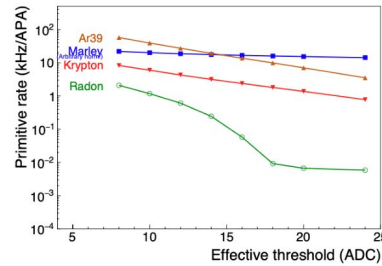
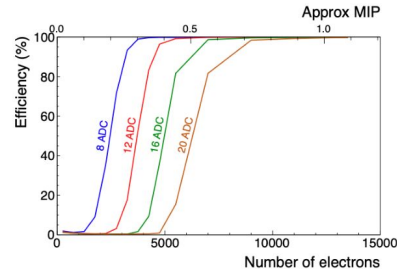
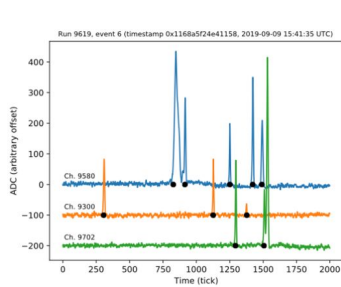
Trigger Simulation

- Talk about recent developments on TDAQ simulation in LArSoft
- Probably a slide on what's currently possible
 - ◆ So give it raw data file, reconstruct TPs.
 - ◆ Reconstruct TAs and TCs. Using trigger repository! Some validation plots.
 - ◆ Should be able to simulate some event in FD and see if trigger catches it with given algo.
- And maybe a slide what's not quite possible yet.
 - ◆ E.g. MLT logic not implemented, so no trigger decisions.
 - ◆ The simplest logic converts TC into TD in Trigger though, so it should be good enough for now!
 - ◆ Area for future development.
- Links to the documentation, git repositories, some tutorial?
- 3-5 slides?



Trigger Simulation: Case studies

- This still needs to happen. We should decide here, today, what studies we should do before January.
 - ◆ And allocate some person-power so it actually happens...
- Example: new efficiency studies:



- Supernova burst study:

Concluding slides

- **Conclude the desired workflow for any new development on the trigger (whether TP, triggering algorithms, Supernova triggers, further data filtering etc)**
 - ◆ Before start development, join the DS and present your ideas.
 - ◆ Use trigger simulation to study your ideas.
 - ◆ Give regular updates on your work at the DS meetings.
 - ◆ Join trigger technical meetings if you have technical issues / framework infrastructure issues you need help with.
- **And then the normal conclusions**
- **How about ND? How about DataFiltering?**
- **2 slides?**

- **In total, 15-30 slides? 25min + 5min?**