DUNE DAQ Consortium Meeting: Technical organization and status

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“Milestones”

1. Janurary 2018: Consolidate architecture options into (ideally a single) technical design(s)
2. End of Spring 2018: Technical Proposal
3. Fall 2019: Technical Design Report

In this talk, I will focus on **near term**: Now thru January 2018

Goal: Preferred, realizable technical design

How to get there: 1. Technical design(s)

- **Now thru end of October:** Review system requirements, architecture options, hardware solutions, associated costs and risks
  - We expect collaborators with ideas (old and new) on architecture solutions will give presentations at meetings
  - Must consider solutions from the perspective of both SP and DP (at least for backend DAQ)

- **DAQ Workshop (Oct. 30-31):** Gather architecture solutions and corresponding information provided by working groups (see slide 5):
  - **By the end of workshop we should have a clear idea on preferred and realizable technical design**
  - Anticipated funding matrix and costs will be taken into consideration
  - DAQ simulations studies will be taken into consideration

How to get there: 1. Technical design(s)

- **November through January:** Refine technical design, and carry out additional needed DAQ simulation studies to substantiate technical design assumptions
  - Working Groups should provide list of specific questions to address with the help of the DAQ simulations team, per architecture solution. Most critical questions first.
  - DUNE Physics Week (Nov. 14-17) is a great opportunity for reinforcing DAQ simulation efforts

How to get there: 1. Technical design(s)
In practice: What can consortium members do?

- **Consortium Institutes mapping on Working Groups** (based on one-to-one institutional discussions with Dave/myself)
- Working group leaders define task lists and initiate efforts:
  - **Performance/Architecture:** set parameters of system and identify/ specify each data flow scheme under consideration. Clear, complete documentation is a requirement.
  - **Data Selection:** define timing and trigger requirements, timing distribution scheme, trigger strategy
  - **Hardware:** (No hardware design—yet.) looking at hardware options (processing/fpga and computing technologies, data links) for proposed data flow schemes, specifications (extrapolated in time), costing, defining interfaces
  - **Backend:** computing and software aspects; what daq framework, server costs, surface vs. underground?
  - **Infrastructure:** define (conservatively) power, network, cooling, physical space (hardware & server) needs at SURF

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(At least preliminary) findings will be reported at DAQ Workshop

How to get there: 1. Technical design(s)
In practice: What can consortium members do?

- Working Groups are encouraged to **leverage past experience** (MicroBooNE, 35ton, DP prototypes, …) as much as possible, e.g. on CPU needs, infrastructure practicalities, commissioning needs, …

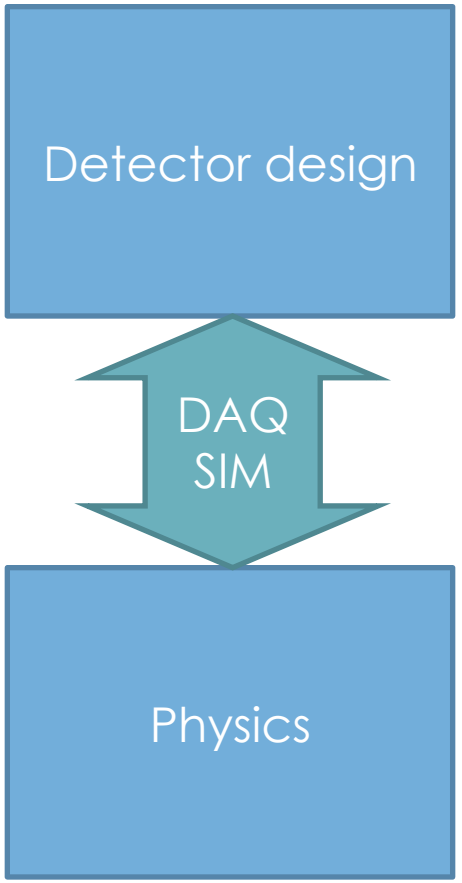
DAQ Simulations: Ongoing efforts and plans

DAQ simulations aim to:

- Inform the DAQ design (buffering, networking, storage, processing) on:
  - Anticipated data rates (incl. noise)
  - Anticipated trigger rates (incl. fake)

- Understand design decisions' impact on physics sensitivity
  - Charge collection efficiency
  - Trigger efficiency

By construction, must work closely with both DAQ Consortium and Physics Groups



DAQ Simulations: Ongoing efforts and plans

Planned **DAQ Simulations Report**

Report **draft outline**:

1. Expected **TPC data rates for continuous readout**, for different data reduction schemes:
   1. Radiologicals only
   2. Noise only
   3. Radiologicals plus noise (this combination is nominal; and is expected to dominate data rate, compared to physics events)

   Simulation needs: For both SP and DP:

   – Noise simulations (not just default white noise, but also noise features such as those in MicroBooNE); efforts ongoing for SP but welcome help!

   – Radiological simulations; efforts ongoing for SP but welcome help!

DAQ Simulations: Ongoing efforts and plans

Planned **DAQ Simulations Report**

Report **draft outline**:

2. Expected **TPC "event size"** (amount of data to be saved/built subsequent to a trigger decision), for different data reduction schemes:
   - Single-interaction event
   - Multi-interaction event (for the case of SN, can last up to 10's of seconds)

   Need to work on "event definitions". Limit to drift size? Suggestions welcome!

   Simulation needs: For both SP and DP:
   - A library of off-beam rare events (highest priority for DAQ) is available.
   - Coordinate with physics groups on updated simulations

DAQ Simulations: Ongoing efforts and plans

Planned **DAQ Simulations Report**

Report **draft outline**:

3. Expected **TPC signal collection efficiency**, for different data reduction schemes:

- Quantify in terms of recovered ionization charge arriving at wires
- Low-level quantity that provides some insight on energy resolution; higher level studies (E resolution, vertex resolution) can be performed with lower priority; anticipate help from physics groups
- Need help with this! No-one actively looking at this currently; samples can be provided.

DAQ Simulations: Ongoing efforts and plans

Planned **DAQ Simulations Report**
Report **draft outline**:

4. Expected **TPC event trigger rates**:
   - Dedicated, serious effort on quantifying SN trigger efficiency
     - fraction of single-interactions of SN neutrinos that pass if trigger is defined as single-interaction trigger
     - Fraction of SN core collapse ~10-sec-events that pass if trigger is defined as multi-interaction trigger
   - Consider also resulting false trigger rates from noise/radiologicals
   - For algorithm development:
     - Consider trigger algorithm application on both lossy data and full waveforms; is there significant performance difference?
     - Consider trigger algorithm application over long and short timescales

DAQ Simulations: Ongoing efforts and plans

Planned **DAQ Simulations Report**

Report **draft outline**:

5-8. **Similar studies for PD readout system** (maybe longer term timescale? Addendum to report)

9. (longer term; addendum to report) What can we gain from **combining PD and TPC**?

DAQ Simulations: Urgent needs

- Need a dedicated effort on **DP DAQ simulations**
  - Could leverage existing data from past prototypes (what is available?)
  - New charge collection simulations
  - Work with real data once available from protoDUNE (but would like to not wait that long!)

  - Interested individuals please reach out to georgia@nevis.columbia.edu ASAP

Closing Remarks

- The DUNE Far Detector DAQ design represents one of the most challenging technical aspects of the experiment!

- Many people are willing to take this on!
  This consortium: collection of enthusiastic, experienced, skilled individuals!

- Let's get to work!

Reminder: Important upcoming events

- **DAQ Workshop, Oct. 30-31 at Columbia U.**; expect institutional reps. to attend (look out for email in the next 1-2 days with further details). Aim:
  - Discuss (a narrow list of) architecture options and inputs from other working groups (on hardware technology/cost surveys, physics requirements, timing requirements, infrastructure practicalities, …)
  - Gather information necessary to put together a real design option by ~January 2018

- **DUNE Physics Week, Nov. 14-17 at Fermilab**; organizing DAQ Simulations efforts during that week together with SNB/LE group