Neutrinos at Fermilab: 10 Year Outlook

It all culminates in DUNE, but how do we get there?

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Fermilab Neutrino Retreat

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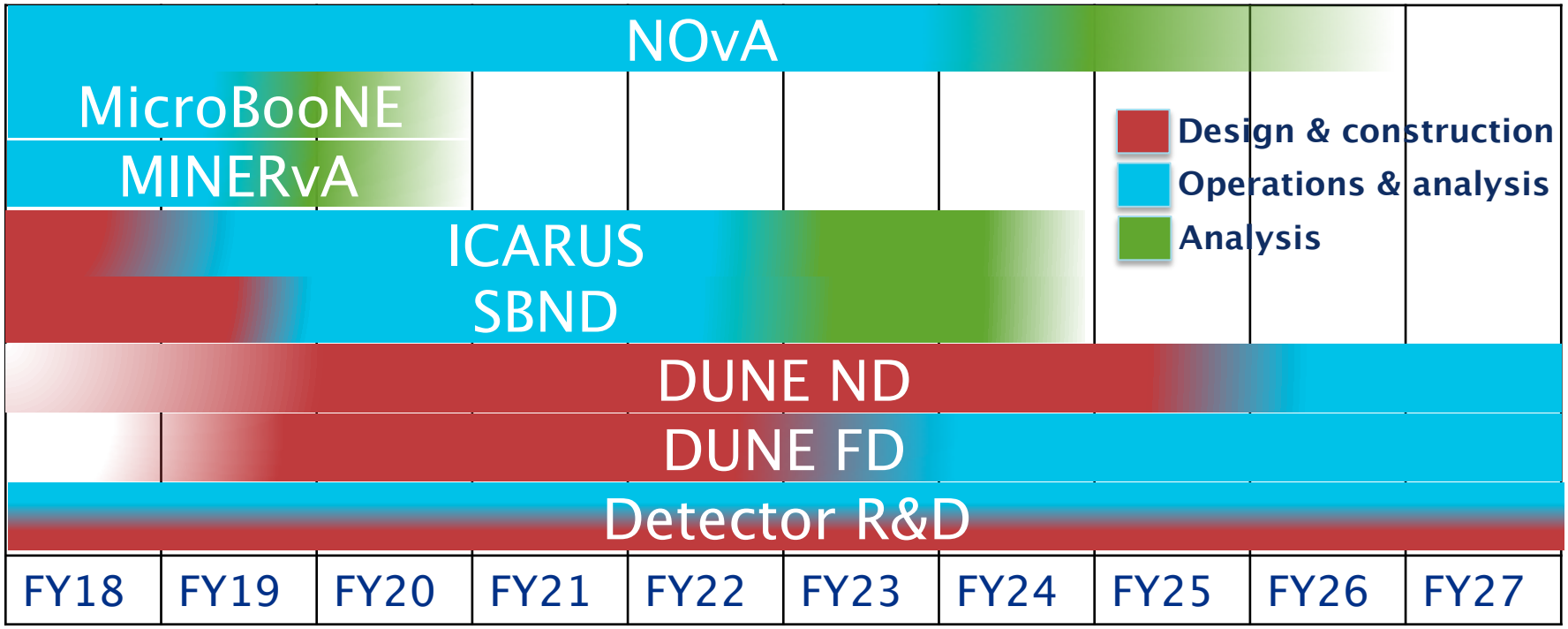
Overview

- Lay out the big picture of what the next 10 years will look like for neutrinos at Fermilab
- Many things are determined, but a number of issues remain to be decided
- Start with the experiments we are/will be running as this largely drives how we are organized
- Examine various subgroups and how their work evolves over the next 10 years
- Go through a set of areas where more thought and decisions are needed.
- You can use these and Sam's slides as raw material to consider when answering your breakout session questions

Rough Experiment Timeline

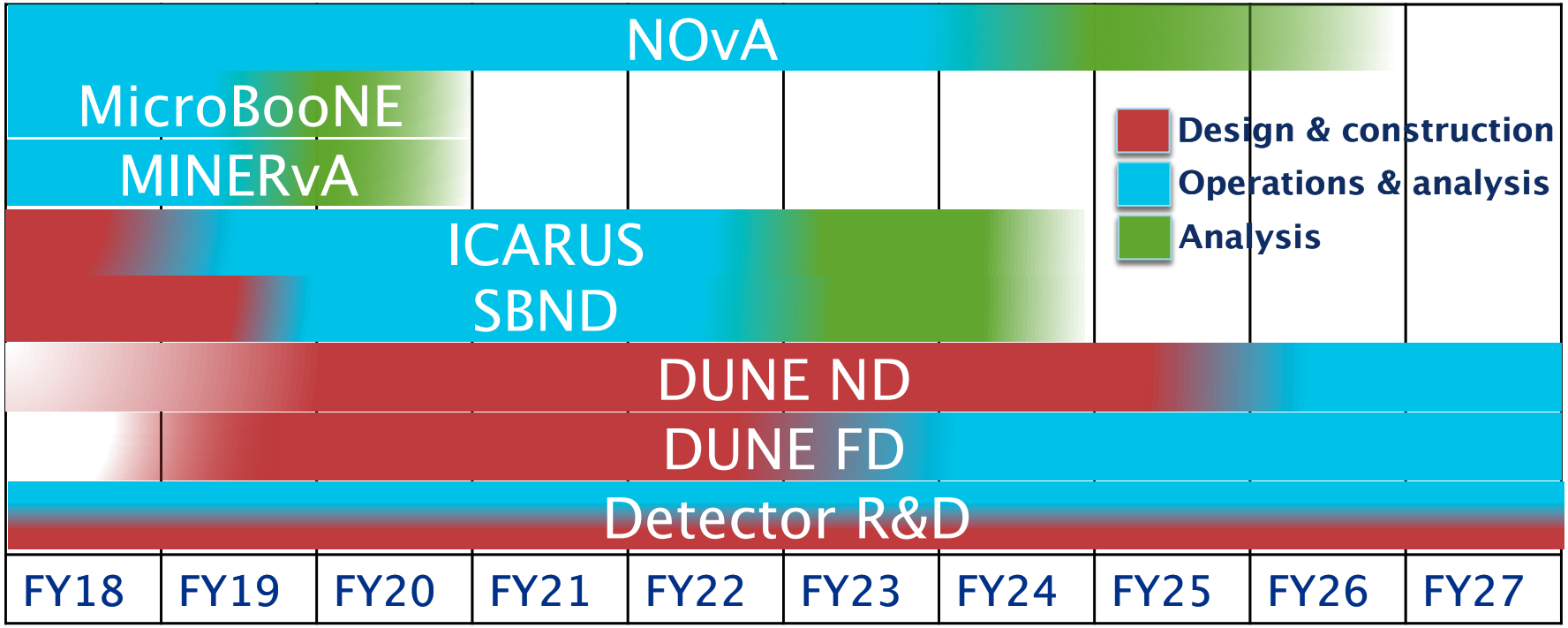


- Only considering large experiments that drive how we are organized
- Testbeam, PAB, ANNIE all folded into Detector R&D
- The beginning and termination times are deliberately vague
- It all culminates in DUNE

R&D Facilities

- **We'll be running and expanding the capabilities of PAB for the foreseeable future**
- **We need to be getting out of PC4 at some point in the next few years**
  - Too costly to make it an acceptable lab space
  - Hopefully move PC4 capabilities to space in the Integrated Engineering Research Center (IERC)
- **Does LArTF have a use beyond MicroBooNE running?**
- **We probably need better facilities for TPC electronics testing**
  - What and where?
- **What about facilitating non-LAr R&D?**
  - We support ANNIE – should we do more?
- **We have a number of testbeam efforts taking up the MCenter beamline for the next couple of years**
  - LArIAT -> LArPix (or PIxLAr!?)
  - NOvA testbeam experiment under construction
  - What about hadro-production experiments (culminating in LBNF spectrometer?)
  - What further testbeam work is needed for DUNE (beyond what the ProtoDUNEs will deliver)?
- **What further R&D is need for DUNE?**

Physicists



- Full slate of experiments
- Designing, operating, and analyzing something at any given moment
- Don't see a need for a large increase in the number of neutrino experimentalists employed by Fermilab
  - Other neutrino related areas have bigger needs (see later in talk)
  - Do need a big increase in number of neutrino postdocs

Neutrino Physics Scope

- **The focus is currently on what's needed for LBNF/DUNE success**

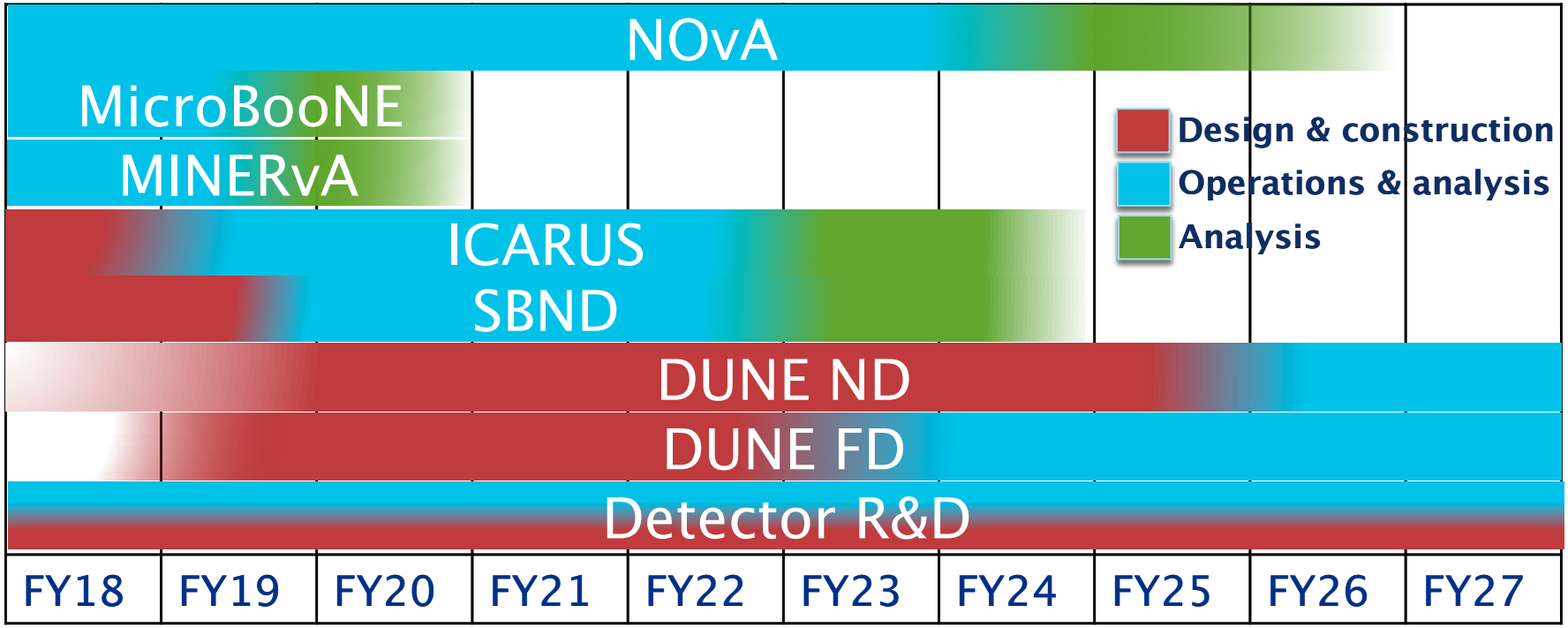
- **Decided to focus on few areas of the DUNE physics menu…**
  - Membership in 5 far detector construction consortia
  - Near detector
  - Electron neutrino analysis

- **Are Fermilab physicists striking the right balance between supporting the user community and pursuing their own research interests?**
  - An old problem for lab scientists

- **Does every Fermilab neutrino physicist have a transition plan for how they will move into DUNE (if they're not there already)?**

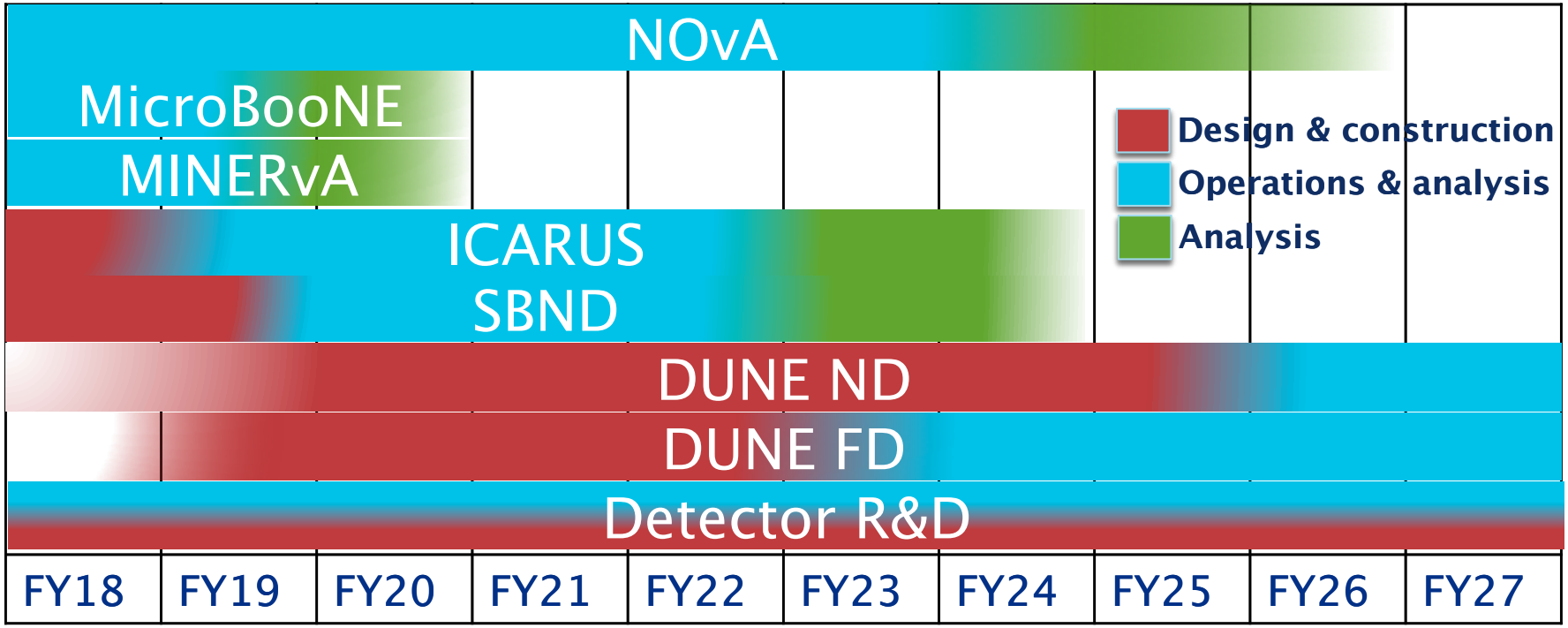
- **At the right time should we broaden experimental scope beyond accelerator neutrinos?**
  - double beta decay?
  - cosmological neutrinos?
  - …

Operations Support



- ELOs, technicians, engineers, DAQ experts, computing professionals
- R&D support is mostly PAB, PC4, and testbeam
- Need to strengthen ops support to carry out ICARUS and SBND in addition to the current program
- What will ops support for the DUNE FD look like

Cryo Engineers (Outside of LBNF/DUNE Project)



- Neutrino Division will be responsible for DUNE ND and FD cryo operations
- Need to connect ND cryo-engineers to DUNE FD design and build activities
- Need to ensure cryo-engineers and technicians get trained up on current and near future experiments

DUNE Operations

- **How will Fermilab operate the DUNE far detectors?**
  - What is Fermilab responsible for and what will South Dakota Science and Technology Authority (SDSTA) cover?
    - Fermilab covers detector operations and SDSTA does the “building management”?
  - How many people will need to be stationed in South Dakota and of which skill sets?
    - What will be the mix of cryo-engineers and cryo-technicians we will need in South Dakota?
    - What about DAQ and computing support on site
    - Who is responsible for computer networking?
  - What can the DUNE collaboration be relied upon to provide
    - Run 24/7 shifts at Fermilab as well as South Dakota?
    - What assumptions should be made about the DUNE collaboration’s ability to have subsystem experts on site?
  - Put together a plan that works for steady state operations once the Project is complete (late 2020’s)
    - Then work backwards to understand how to function when the Project is active
  - Seek inspiration from successful Soudan, Ash River, and SNOLab operations
  - Need to understand the staffing plan several years before the staff are needed on site.
- **DUNE Near Detector operations are expected to follow our current model for neutrino experiment operations onsite**

International Engagement

- **The DUNE experiment is international in ways that we have not experienced before at Fermilab**
  - International Scale – most of the 1000 scientists on DUNE are not from US institutions
  - International Structure – we want full partners not just users

- **We need to examine *all aspects* of the lab to ensure that we are optimally configured to be an effective and welcoming international host**

Office Space: 13th Floor

PROGRAM:

LBNF:
(16) PRIVATE OFFICES:
(9) WINDOW OFFICES
(6) ATRIUM OFFICES
(1) INTERNAL OFFICE
(10) WORKSTATIONS:
(9) 8 x 8 WORKSTATIONS WITH GUEST SEATING
(1) 6 x 8 WORKSTATION WITH GUEST SEATING

DUNE:
(12) PRIVATE OFFICES:
(7) WINDOW OFFICES
(5) ATRIUM OFFICES
(14) WORKSTATIONS:
(1) 8 x 8 WORKSTATION WITH GUEST SEATING
(2) 6 x 8 WORKSTATIONS
(11) 6 x 6 WORKSTATIONS
LOCKERS / WARDROBES IN OPEN OFFICE AREA

NEUTRINO:
(6) PRIVATE OFFICES:
(2) WINDOW OFFICES WITH CONNECTING 6-PERSON CONFERENCE ROOM
(4) INTERNAL OFFICES AT NORTH CROSSOVER
(2) WORKSTATIONS - 6 x 8 WITH GUEST SEATING
(4) FILE CABINETS IN OPEN OFFICE AREA

SHARED RESOURCES:
(1) INTERNAL OFFICE - WDRS

FUTURE:
(3) ATRIUM OFFICES
(2) INTERNAL OFFICES
(4) 6 x 8 WORKSTATIONS

CONFERENCE / COLLABORATION / HUDDLE AREAS:
(1) LARGE 32+ PERSON CONFERENCE ROOM
(4) 4-PERSON MEETING ROOMS
(1) 8-PERSON CONFERENCE ROOM
(3) 10-PERSON CONFERENCE ROOMS
(8) COLLABORATION AREAS AT ELEVATOR LOBBIES & WAITING AREAS
(2) LOUNGES BEHIND EACH ELEVATOR BANK WITH LAPTOP BAR AREA
(4) PHONE BOOTHS

COFFEE / COPY:
(1) COFFEE AREA AT SOUTHEAST CROSSOVER
(1) COFFEE AREA AT NORTHWEST CROSSOVER
(1) PRINTER AREA IN WEST SIDE OPEN OFFICE
(1) COPIER AND (2) PRINTERS AT SOUTHEAST CROSSOVER
(1) COPIER/PRINTER ON WEST SIDE BEHIND ELEVATORS WITH MAIL SLOTS
(1) COPIER/PRINTER ON EAST SIDE BEHIND ELEVATORS WITH MAIL SLOTS

- Move in to 13th floor is expected in April (2018)

Fermilab

Office Space: 12th and 10th Floors

- **The move to the 13th floor will free up quite a bit of space on the 12th floor**

- **Plan to modestly reconfigure the 12th and 10th floors to better serve the neutrino community**
  - Relieve the cramped conditions
  - More and better visitor space
  - Better communal space
  - A committee chaired by Max Hronek and with representations from the experiments has made a set of suggestions
  - Work on a detailed plan should finish and be out for broad consultation by the end of January
  - Please feel free to approach Steve or Sam with your suggestions/concerns

- **Plan to keep Engineering at BEG and Technicians housed at PAB**

Personnel and Organization

- **Most of the lab's neutrino people are housed in Neutrino Division**

- **Vital pieces need to be housed in the other divisions**
  - Neutrino computing support and DAQ development need to be in Scientific Computing Division to leverage commonality with other efforts (esp. CMS)
  - Neutrino beamline support needs to be in Accelerator Division to work closely with other aspects of the accelerator complex

- **How do we ensure we work across Divisions seamlessly?**

- **We are proud of the diversity of our neutrino staff at Fermilab, but we need to do better.**
  - We need to work harder to generate diverse applicant pools
  - The hard work happens before the job ad closes (and much of it before the job ad is placed)
  - Diversification becomes easier once you gain a reputation for supporting a diverse working environment

Personnel and Organization

What further changes to the neutrino effort at Fermilab are needed?

- **TPC electrical group**
  - Noise mitigation in TPCs with wire readout is a serious issue
  - Experience with MicroBooNE and the scale of the task with DUNE suggests we should form a small group to focus on TPC electronics
  - Probably have a remit beyond just noise

- **Admin support**
  - The huge load from our fellowship and guest programs requires more support
  - The visitor load is ever increasing and requires more support

- **DAQ & computing support**
  - Stretched very thin right now – more professional support needed
  - What is the model for DUNE support?

- **Technician Support**
  - Staff of full complement of cry-technicians who will work closely with the LAr experiments

Personnel and Organization

What further changes to the neutrino effort at Fermilab are needed?

- **Neutrino theory**
  - Fermilab theory group is engaged with neutrinos
  - Neutrino Theory network formed and funded – administered by Fermilab
  - How to best couple HEP and nuclear theory efforts?

- **Simulation Support**
  - Need more effort on LArSoft
  - Need more effort on neutrino specific GEANT4 upgrades
  - Need to strengthen our neutrino beam simulation effort (hadro-production, horn field simulation,….)

- **Scientific Staffing**
  - Need more postdocs – currently 8 FTE, should be ~18 given size of scientific staff

Closing

- **We are the future of the lab**

- **We are establishing a reputation for excellence**
  - ICARUS detectors arrived this year and will soon be installed
  - SBND set to take us to the next level in LAr TPC design
  - MINERvA is cranking out physics at a high rate
  - MicroBooNE is blazing the trail for operating and analyzing large LAr TPCs
  - NOvA is world leading in long baseline oscillations
  - ProtoDUNEs are forging ahead
  - Fermilab people are vital to the current DUNE organization
  - Accelerator complex is delivering 700kW to NuMI as the new normal
  - Collecting, storing, and reconstructing unprecedented amounts of neutrino data
  - Forging new and important partnerships in neutrino theory (experiment/theory, NP/HEP, …)
  - Our R&D facilities are the best in the world for LAr TPC development
  - Well on the way to having the most diverse team in particle physics

- **We have a clear vision for the next decade**

- **Turning vision into reality will need all of us.**