

# NOvA Experimental Operation Plan

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28 October 2014





# NOvA Experiment

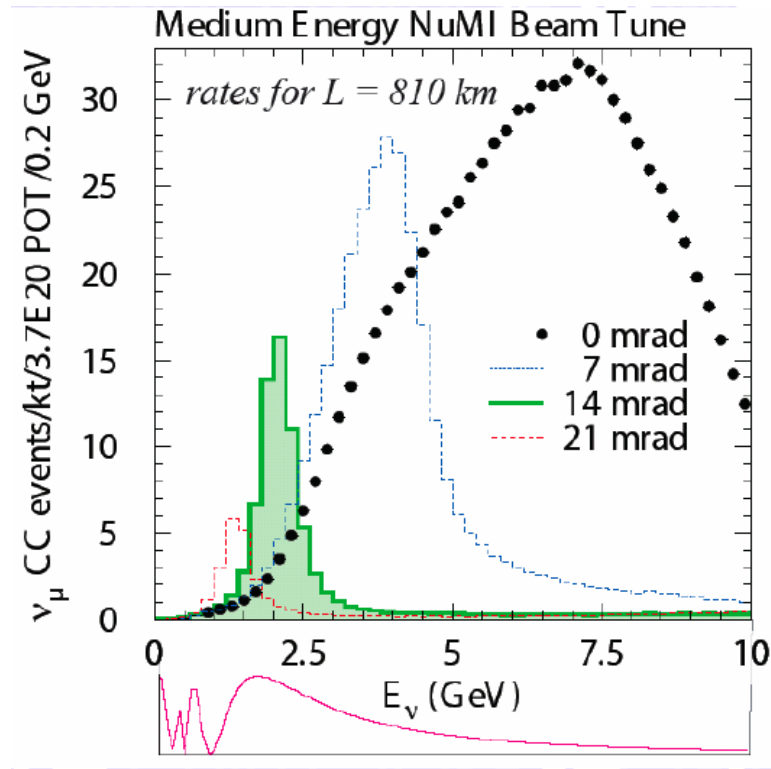
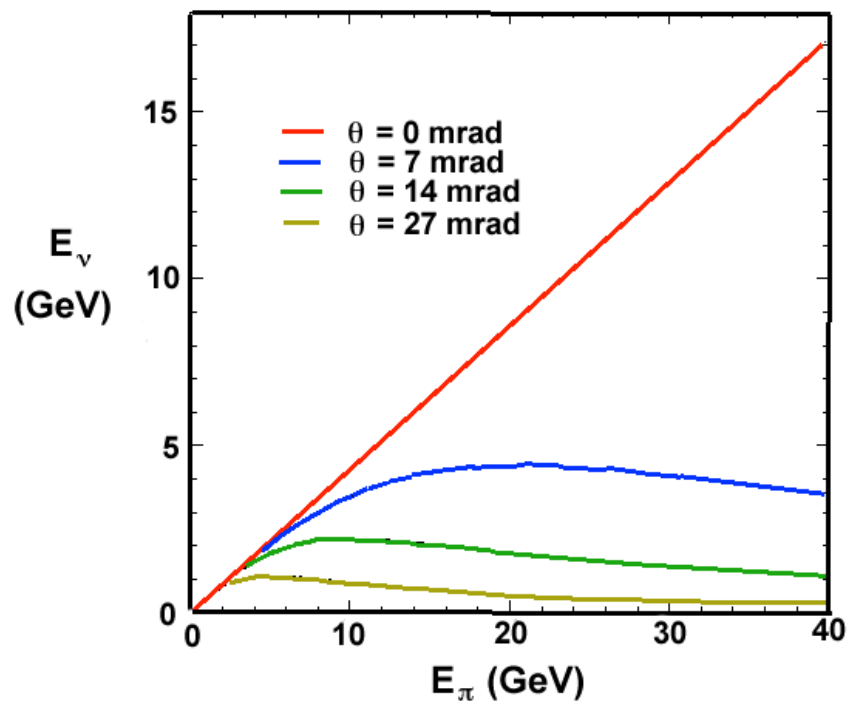


810 km baseline  
14kt “totally active” far detector  
300 t near detector  
14 m off-axis



# Off-Axis Beam

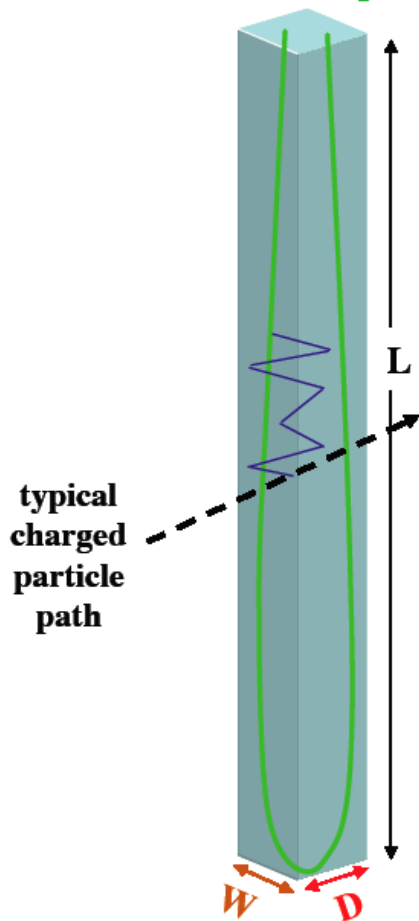
- More flux and less background from neutral current events.





# Basic NOvA Detector Element

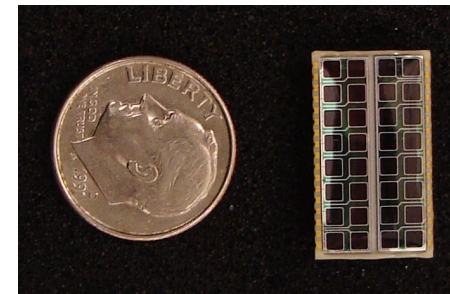
To 1 APD pixel



Liquid scintillator in a 4 cm wide, 6 cm deep, 15.7 m long, highly reflective PVC cell.

Light is collected in a U-shaped 0.7 mm wavelength-shifting fiber, both ends of which terminate in a pixel of a 32-pixel avalanche photodiode (APD).

The APD has peak quantum efficiency of 85%. It is run at a gain of 100. It is cooled to  $-15^{\circ}\text{C}$  to reduce noise.



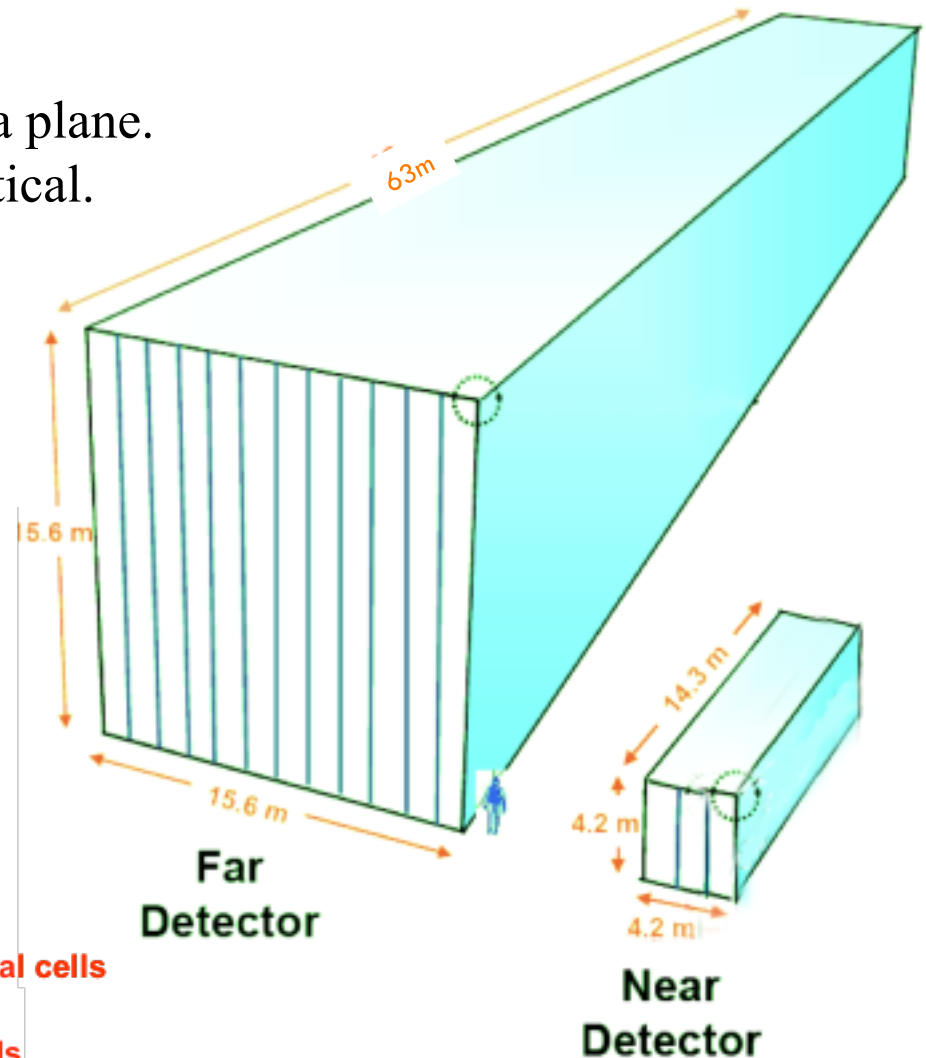
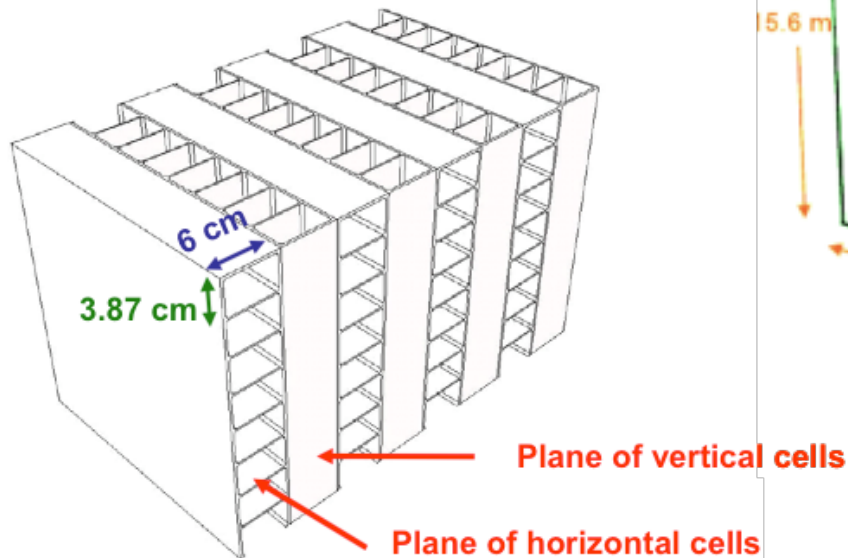




# NOvA Detectors

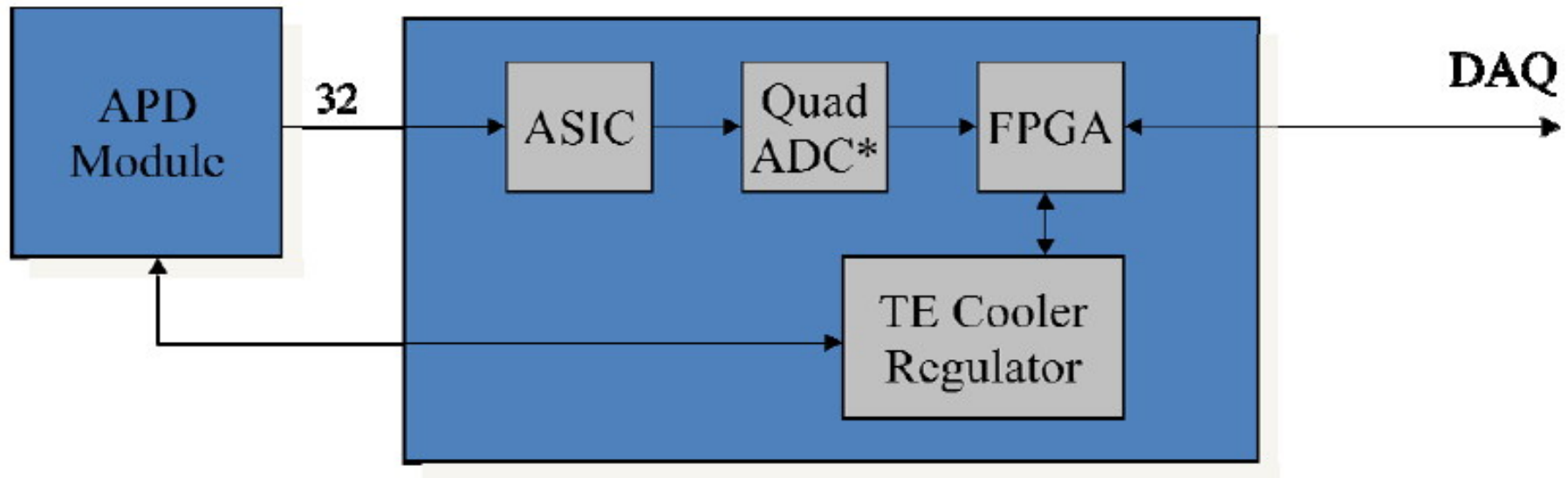
12 extrusion 32-cell modules make up a plane.  
The planes alternate horizontal and vertical.

The Far Detector has 896 planes, each  
about 0.2 radiation lengths.





# Front-End Board (FEB)

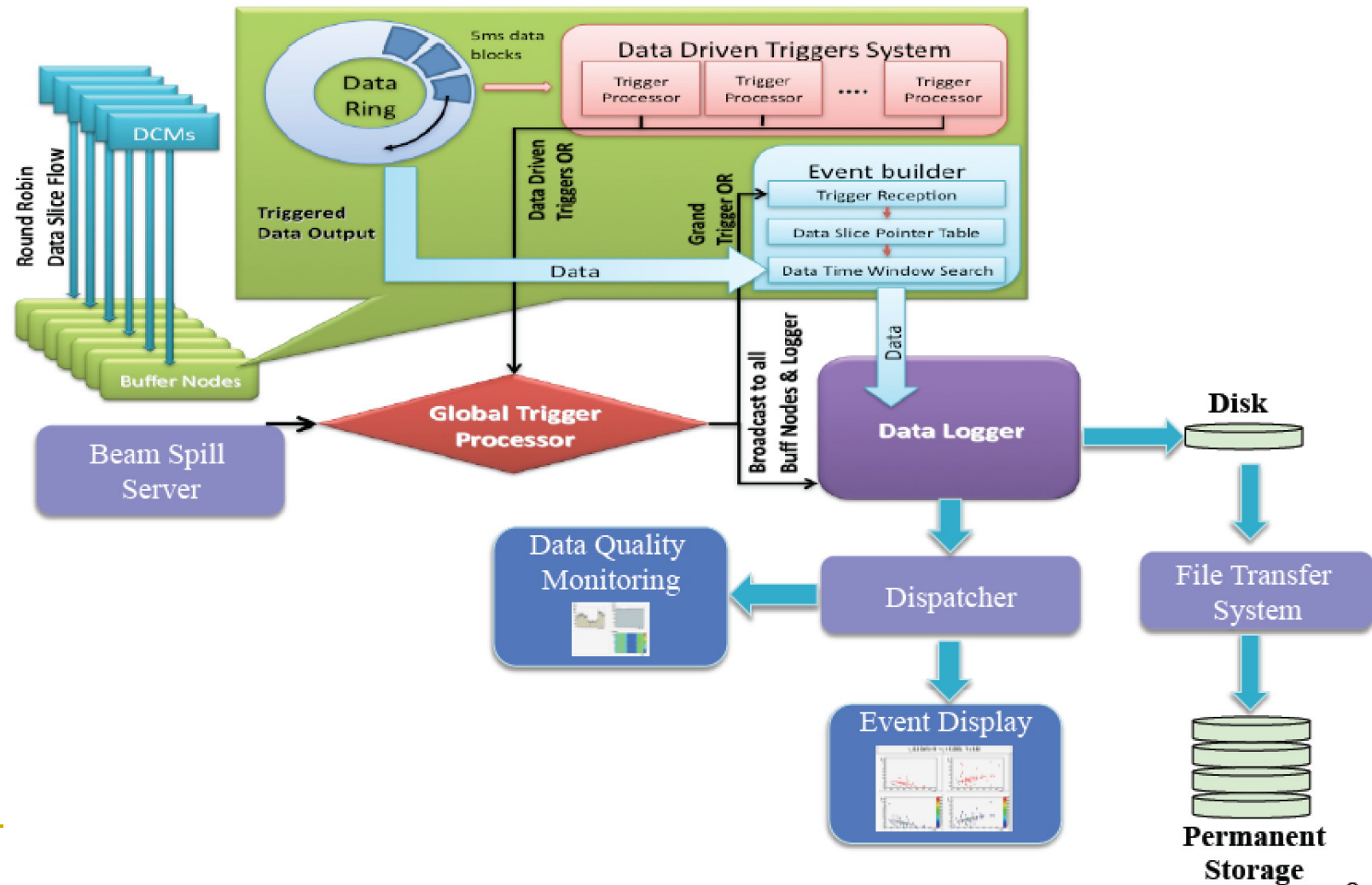


The ASIC amplifies and shapes the signal.  
The ADC digitizes it at 2MHz (FD) and 8MHz (ND).  
The FPGA outputs the highest pulse height and the 3 preceding ones and a time stamp provided through a time distribution unit (TDU) via GPS.





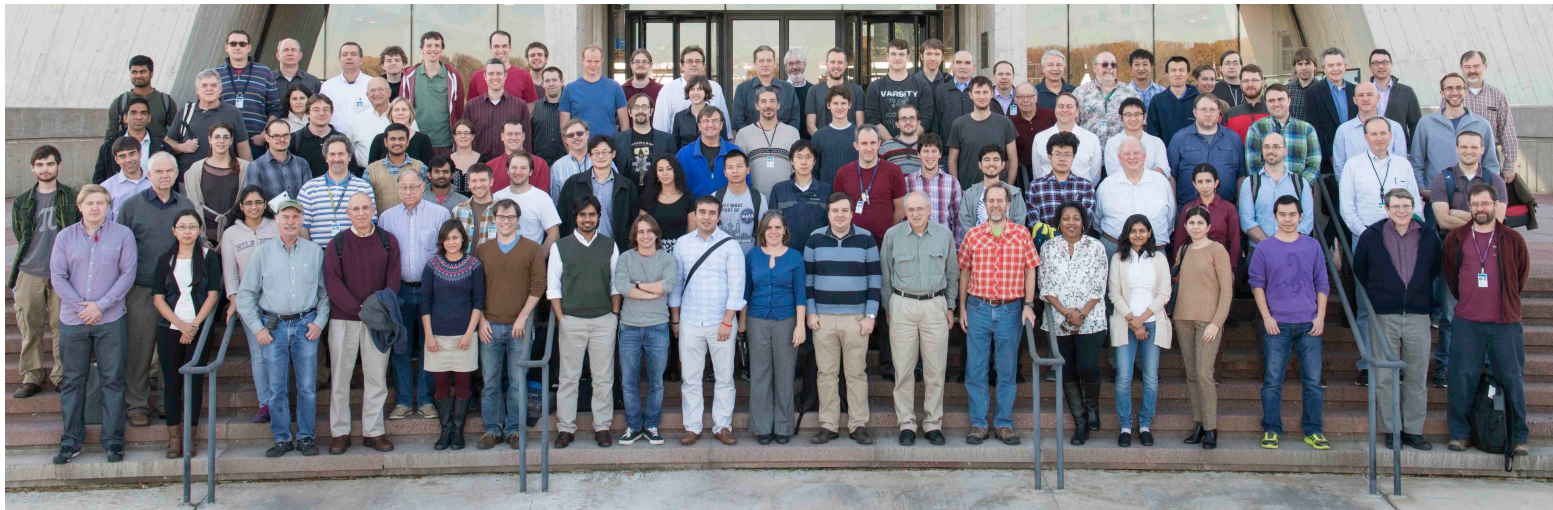
# DAQ System





# NOvA Collaboration

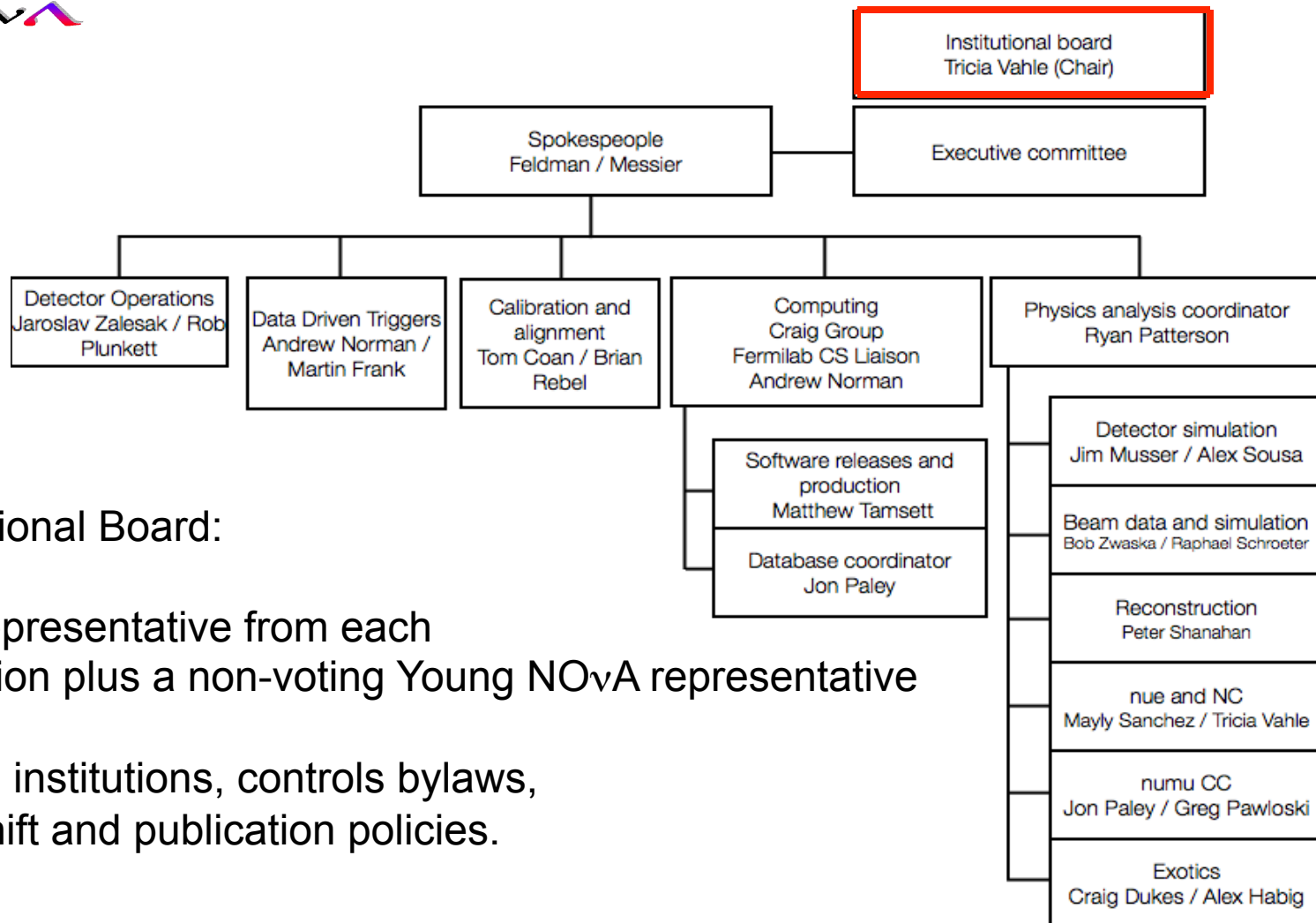
- 129 PhD physicists, including 35 from foreign countries
- 50 graduate students, including 13 from foreign countries
- 38 Institutions, including 17 from 6 foreign countries:
  - Brazil, Czech Republic, Greece, India, Russia, United Kingdom







# NOvA Organization



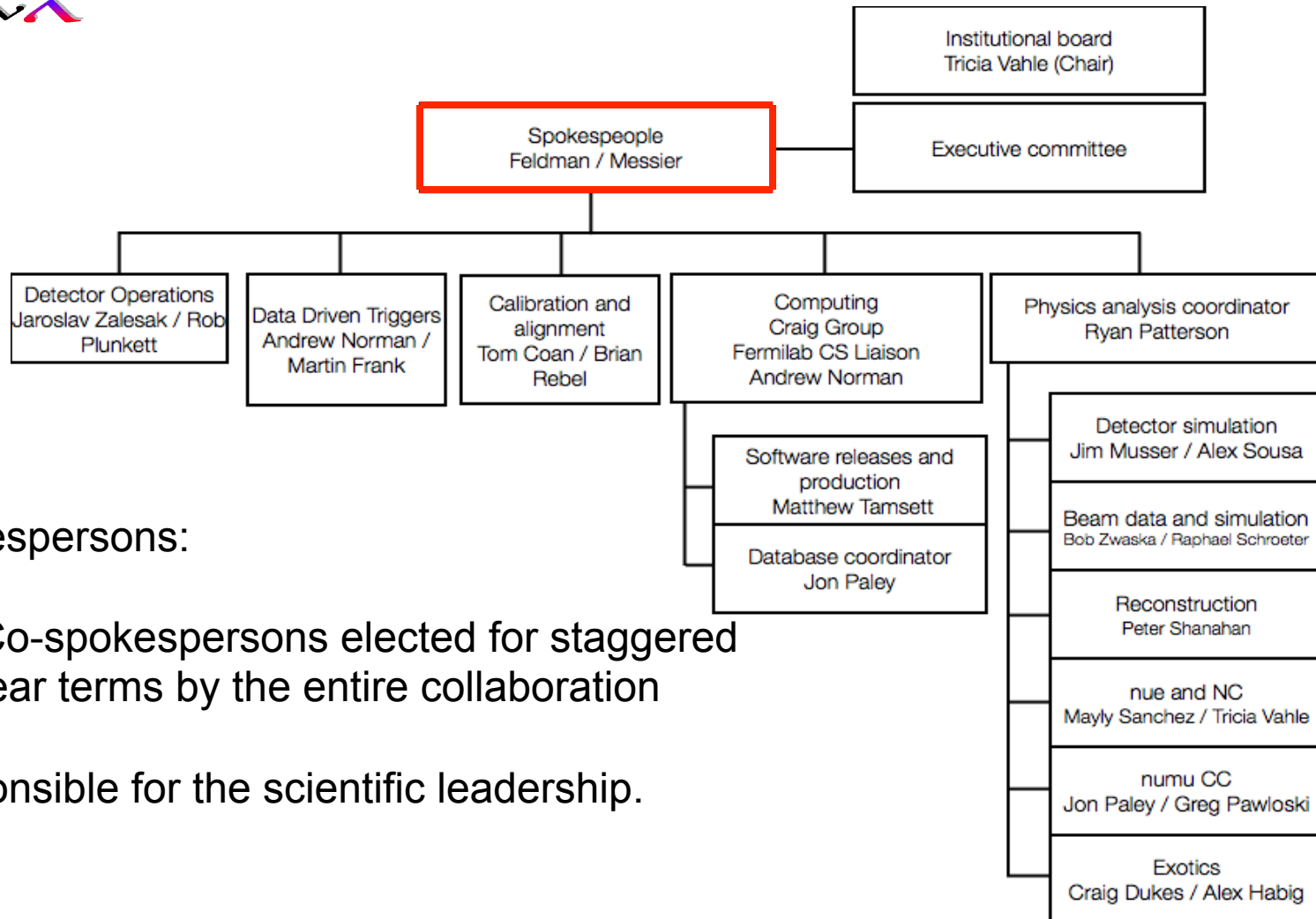
## Institutional Board:

One representative from each institution plus a non-voting Young NOvA representative

Admits institutions, controls bylaws, sets shift and publication policies.



# NOvA Organization



Spokespersons:

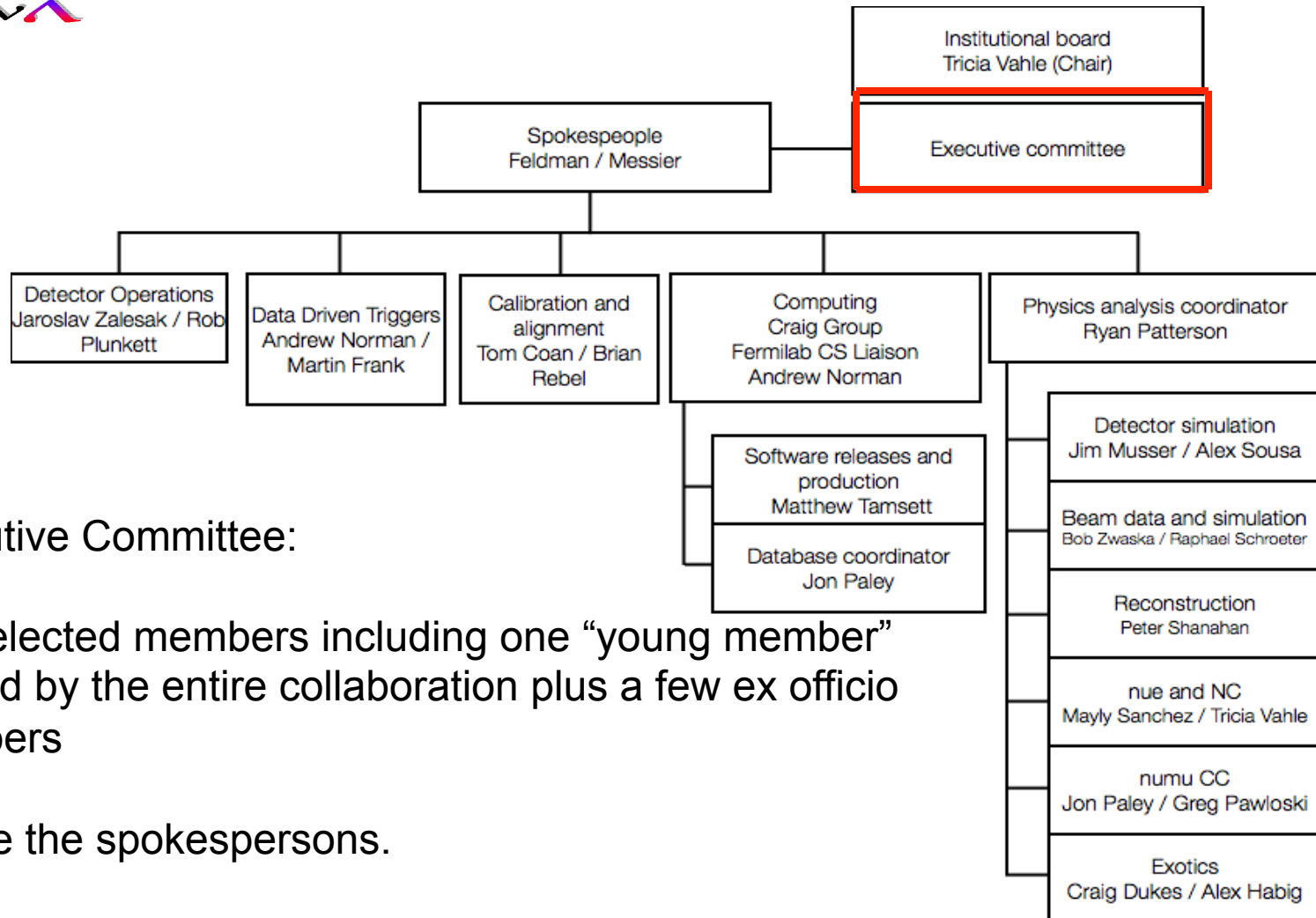
Two Co-spokespersons elected for staggered two year terms by the entire collaboration

Responsible for the scientific leadership.





# NOvA Organization



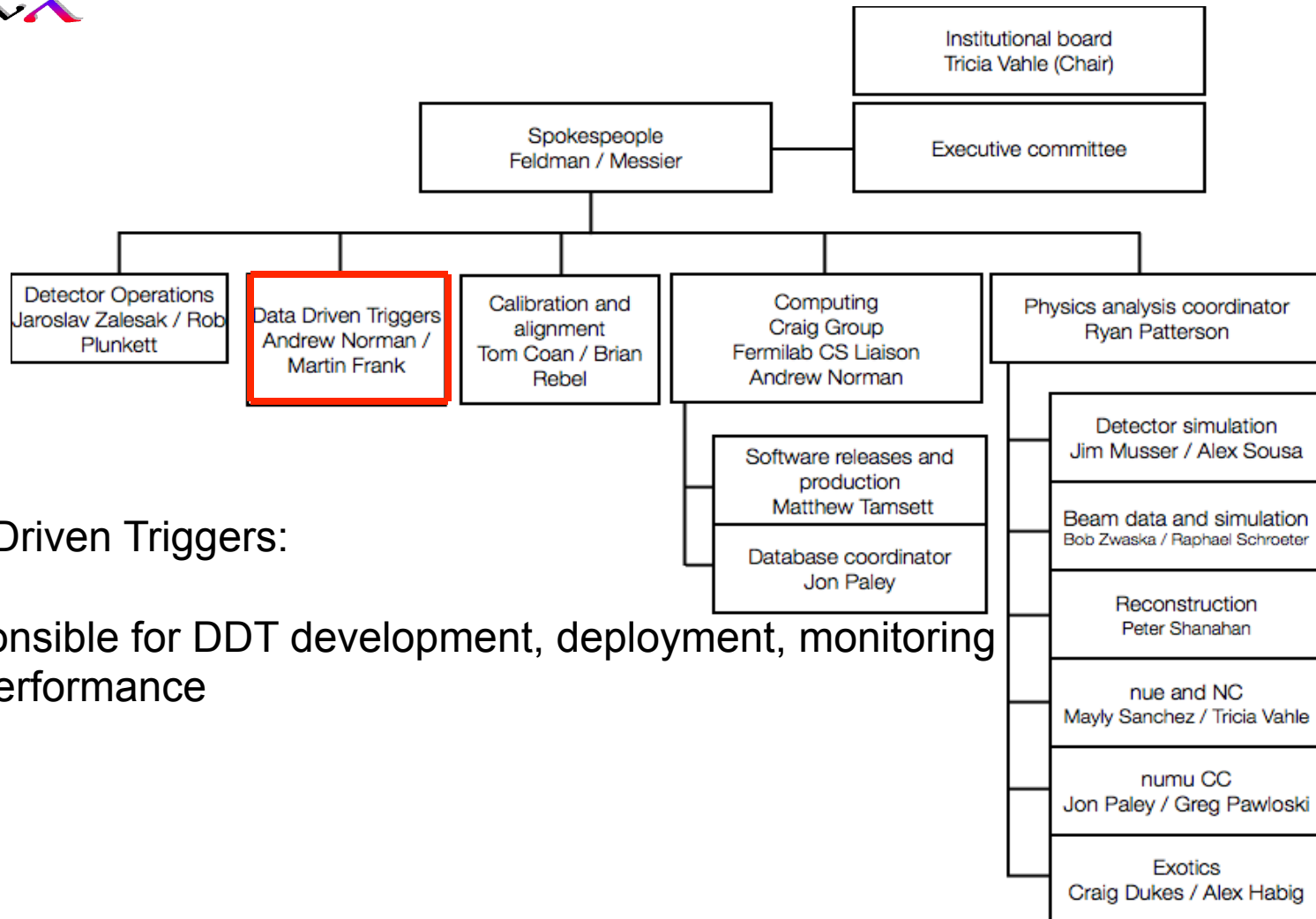
## Executive Committee:

Nine elected members including one “young member” elected by the entire collaboration plus a few ex officio members

Advise the spokespersons.



# NOvA Organization

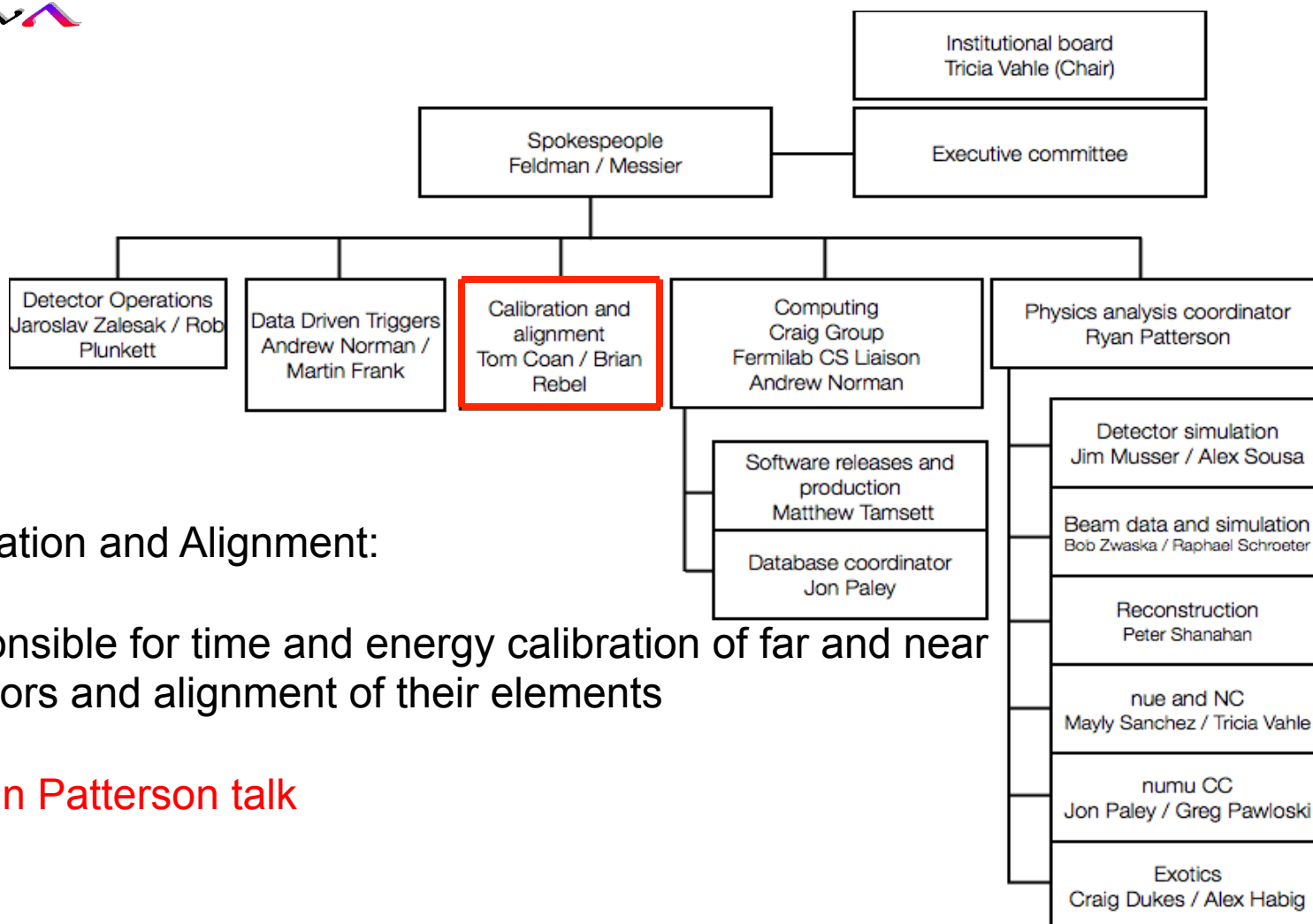


Data-Driven Triggers:

Responsible for DDT development, deployment, monitoring and performance



# NOvA Organization



Calibration and Alignment:

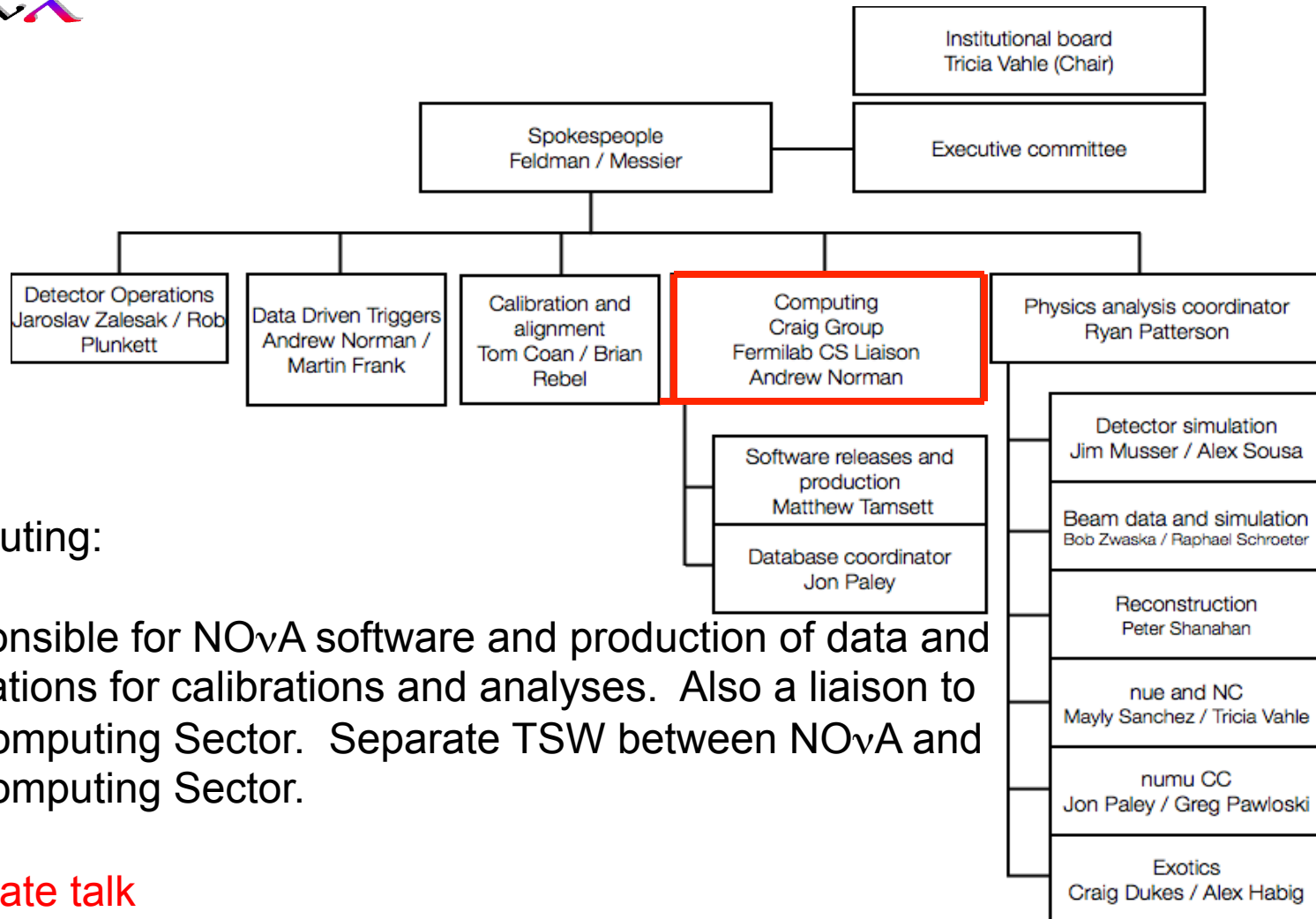
Responsible for time and energy calibration of far and near detectors and alignment of their elements

More in Patterson talk





# NOvA Organization



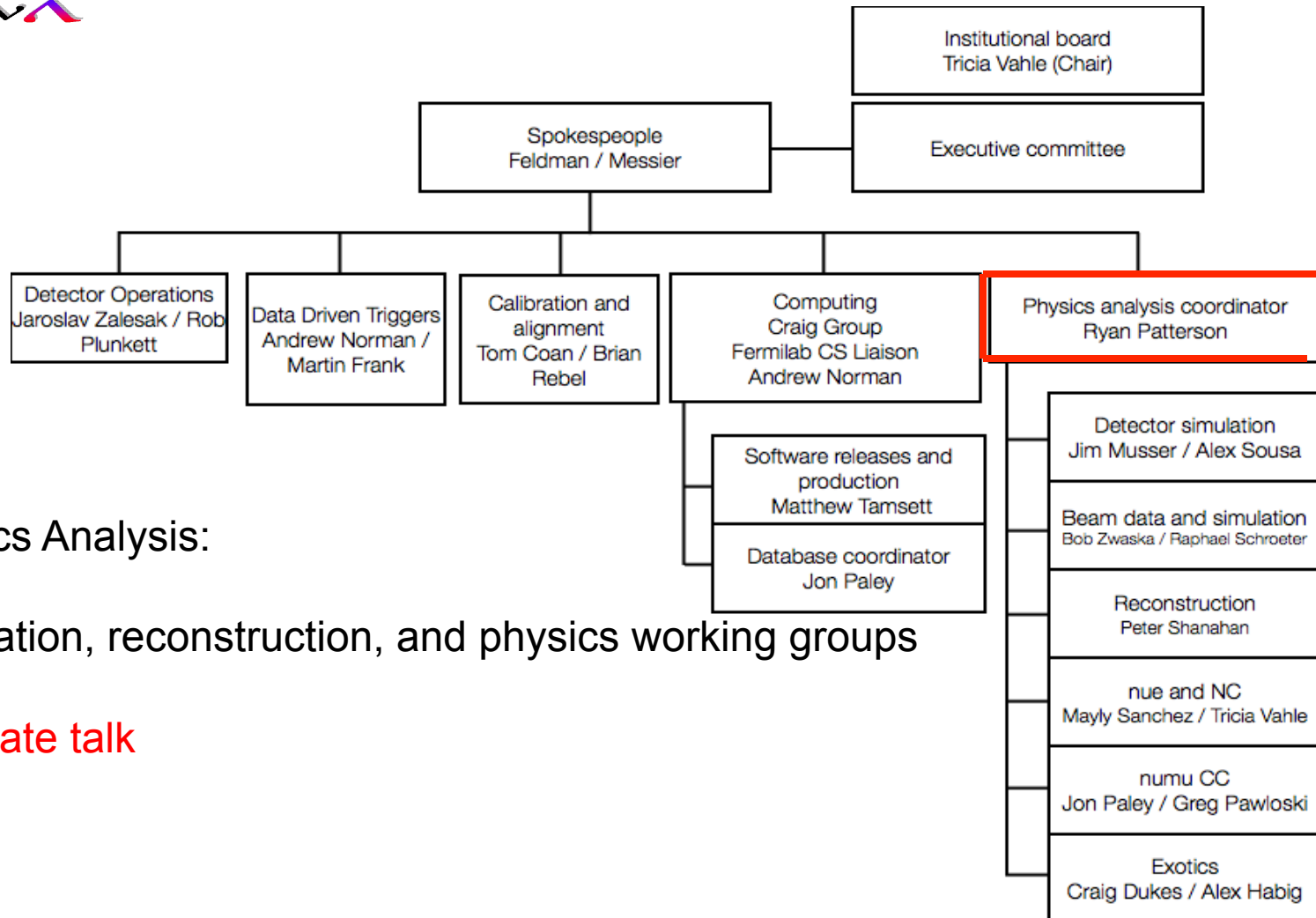
## Computing:

Responsible for NOvA software and production of data and simulations for calibrations and analyses. Also a liaison to the Computing Sector. Separate TSW between NOvA and the Computing Sector.

Separate talk



# NOvA Organization



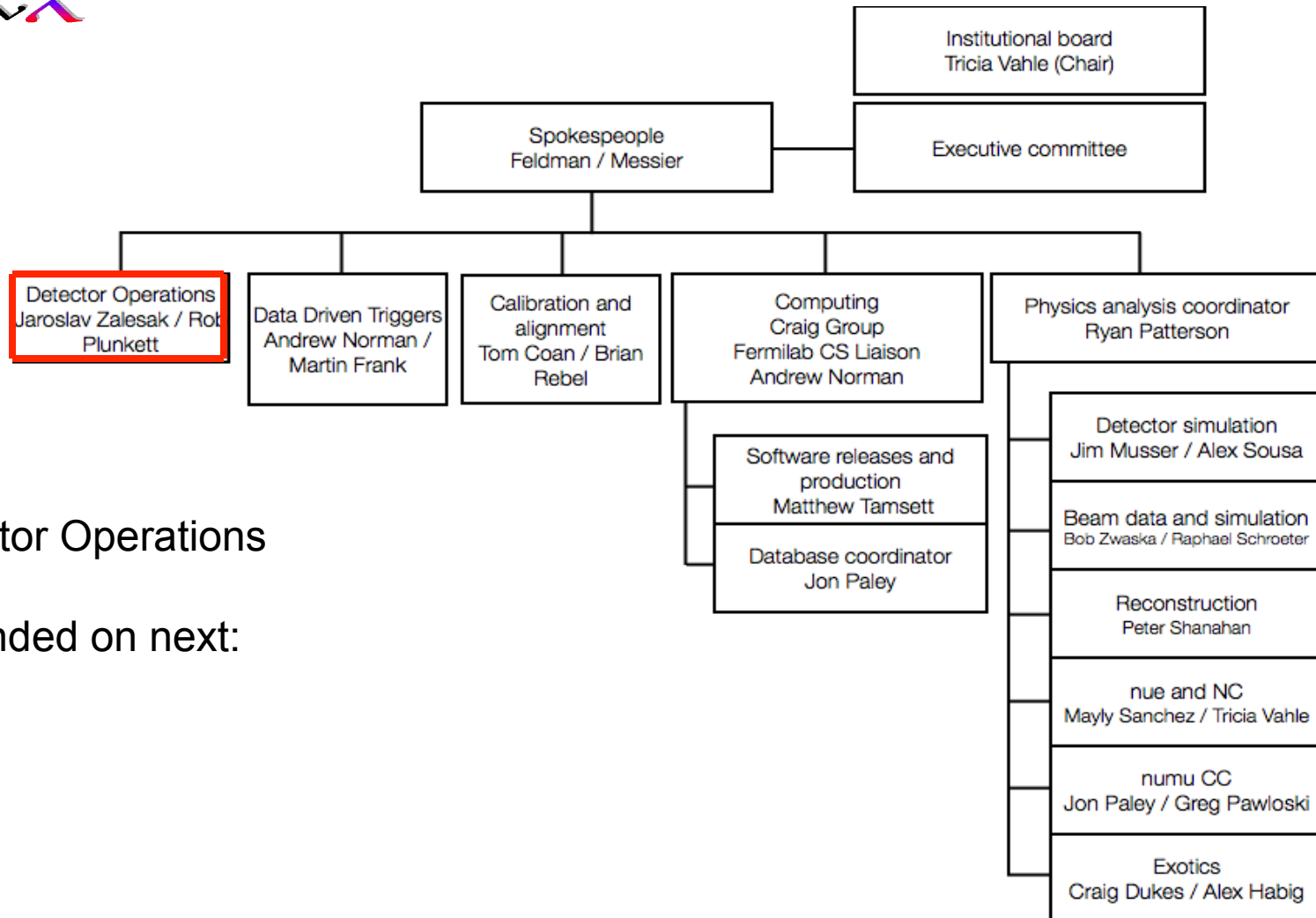
Physics Analysis:

Simulation, reconstruction, and physics working groups

Separate talk



# NOvA Organization



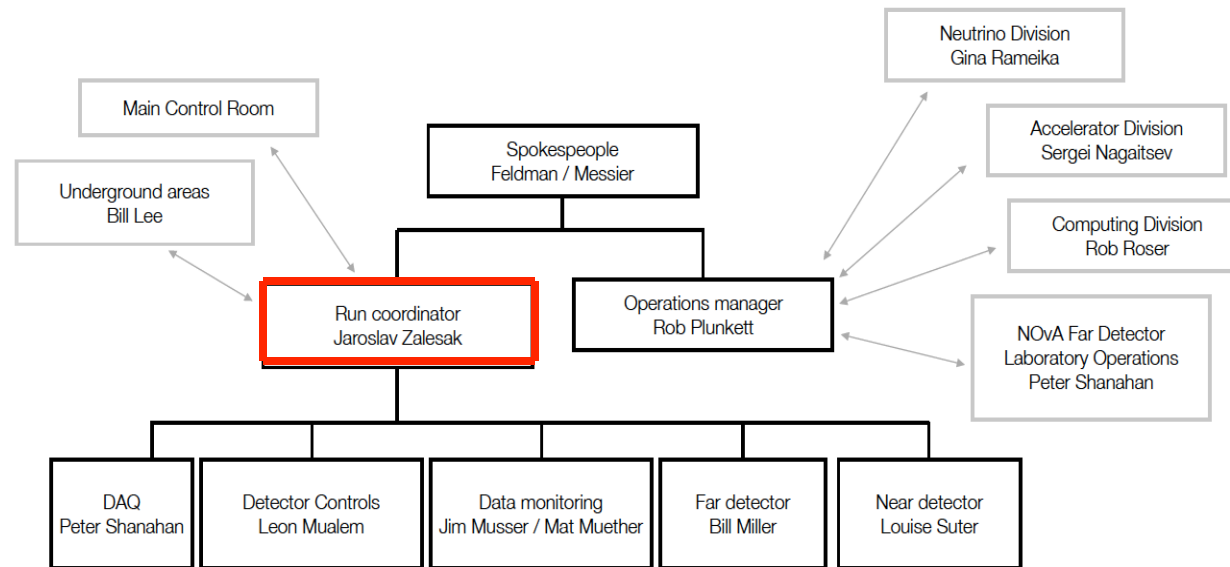
Detector Operations

Expanded on next:





# Detector Operations

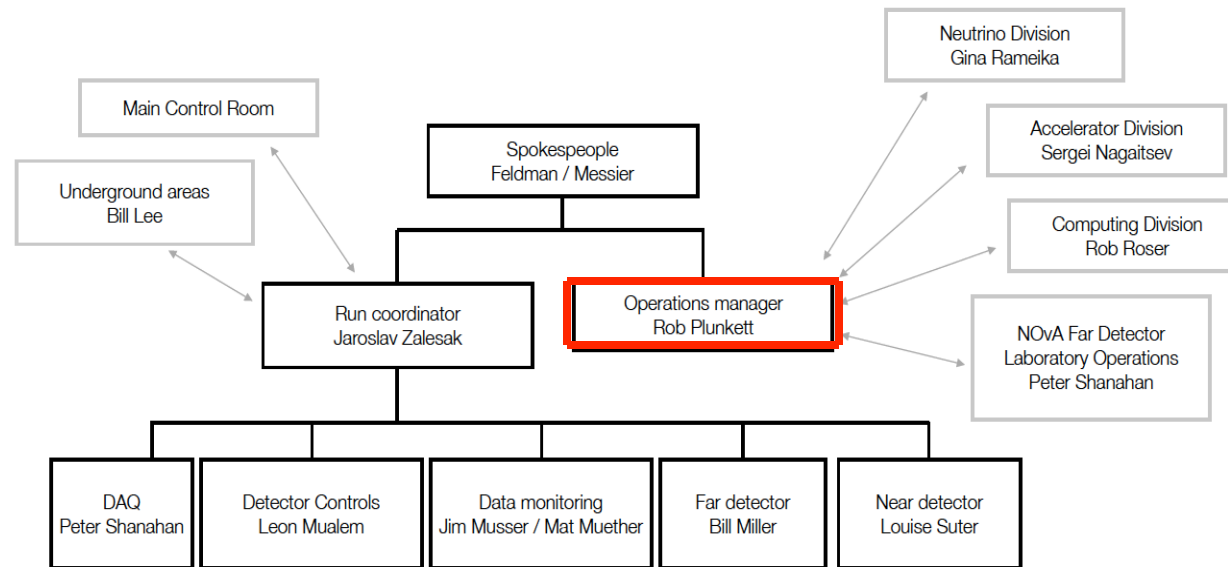


## Run Coordinator:

Responsible for optimizing the near and far detector to meet the physics goals of the experiment. Directs and decides the priority and scheduling of detector systems development and maintenance. Responsible for scheduling shifts, maintaining shift procedures, and maintaining the on-call expert list. Primary contact between the experiment and the MCR and the Underground Areas Group. Reports at the AEMs.



# Detector Operations

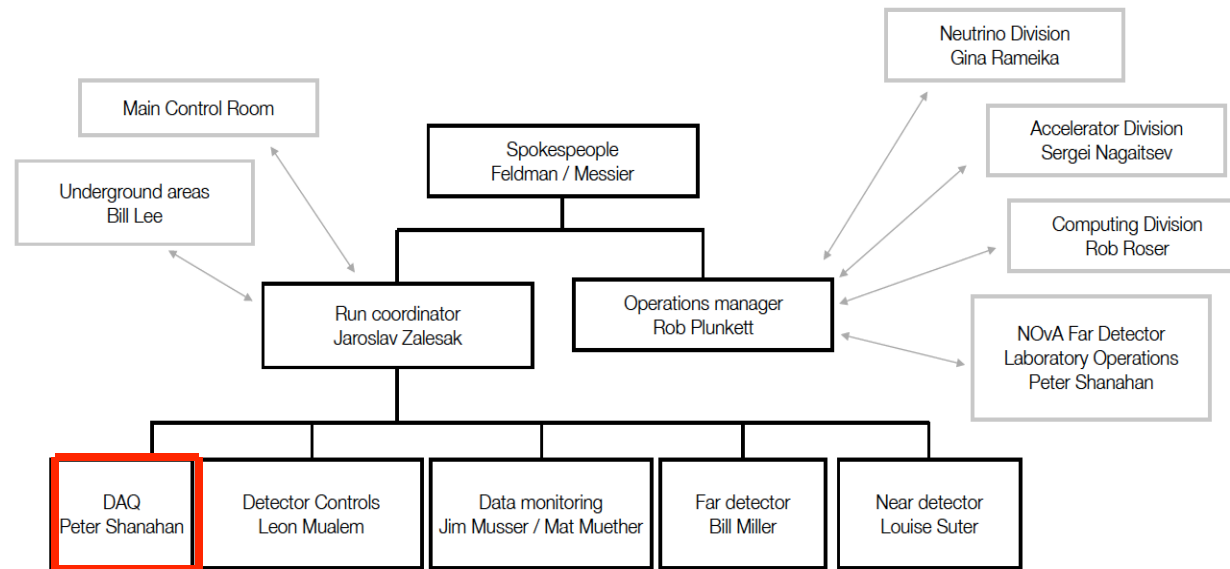


## Operations Manager:

Responsible for oversight of NOvA operations and assists the Run Coordinator in long-term operations planning. Liaison with Fermilab support groups and Far Detector Laboratory. Maintains agreements between NOvA and university and Fermilab support groups and writes operations budget requests in consultation with the Run Coordinator and the spokespersons.



# Detector Operations



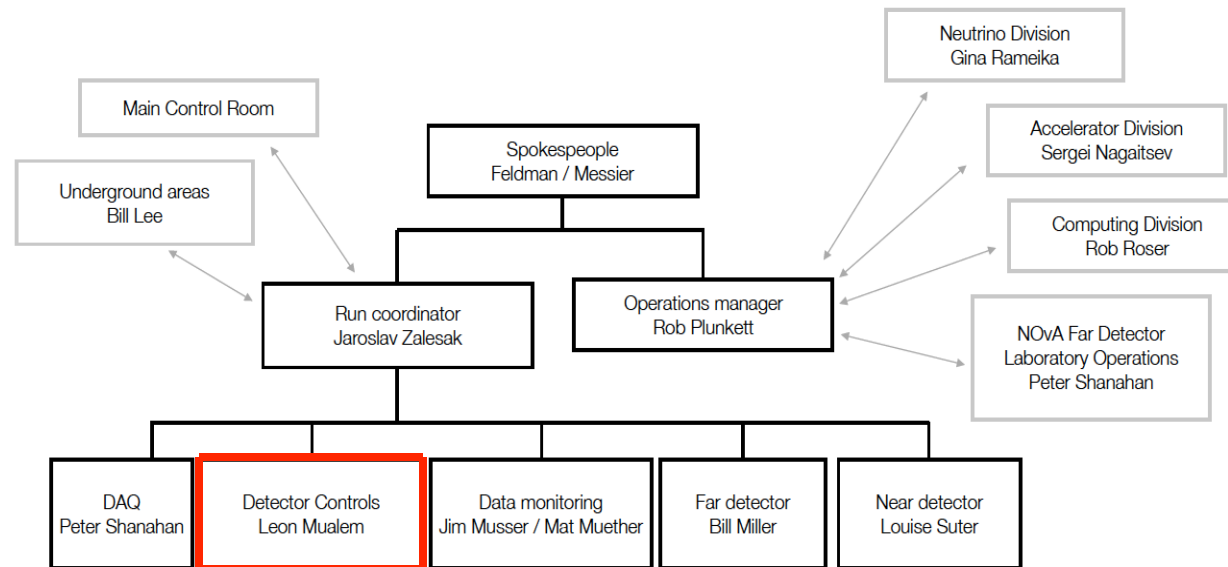
DAQ Working Group:

Responsible for the development, maintenance, and online support of the data acquisition system.





# Detector Operations

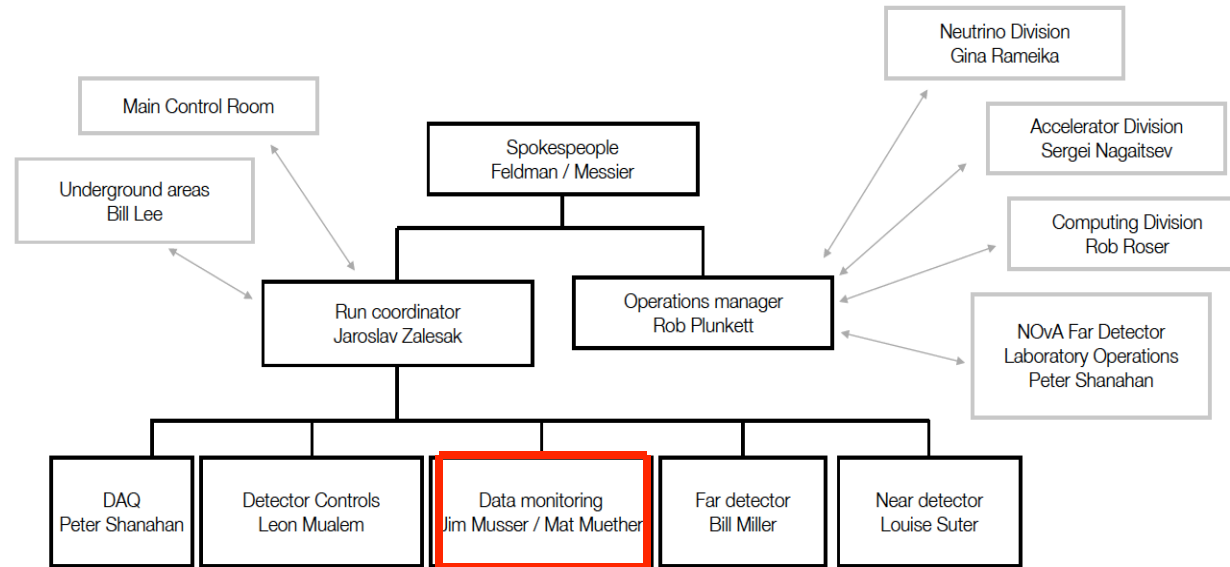


## DAQ Working Group:

Responsible for the development, maintenance, and online support of the detector controls hardware and software.



# Detector Operations



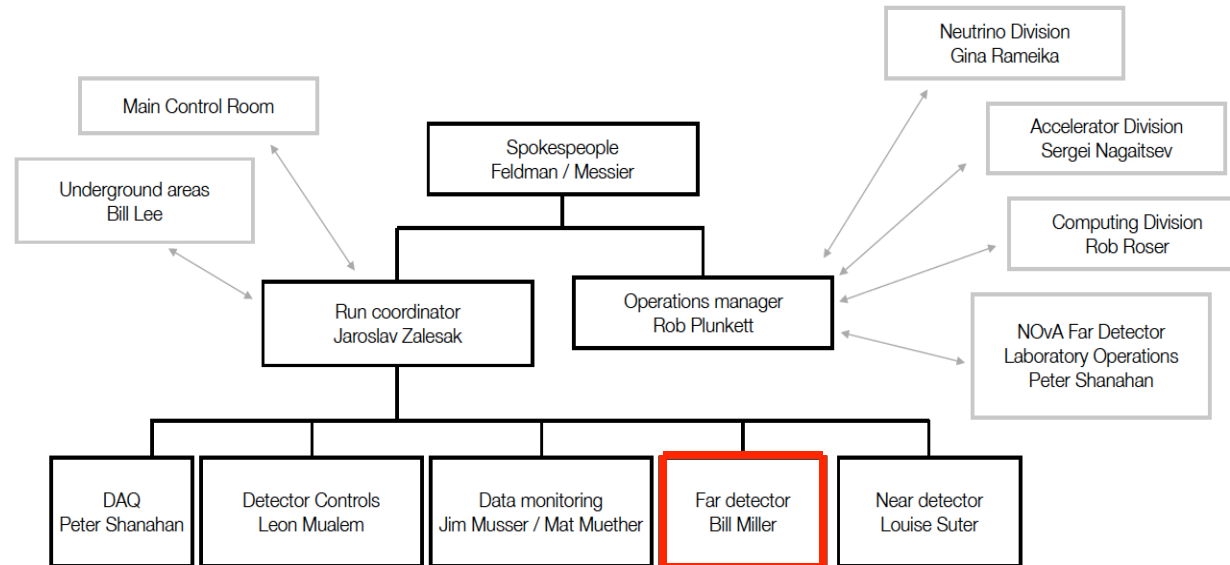
## Data Monitoring Group:

Responsible for the development, maintenance, and online support of tools to monitor data quality and for giving regular feedback on the performance of detector hardware.

**Separate Talk**



# Detector Operations



Far Detector Group:

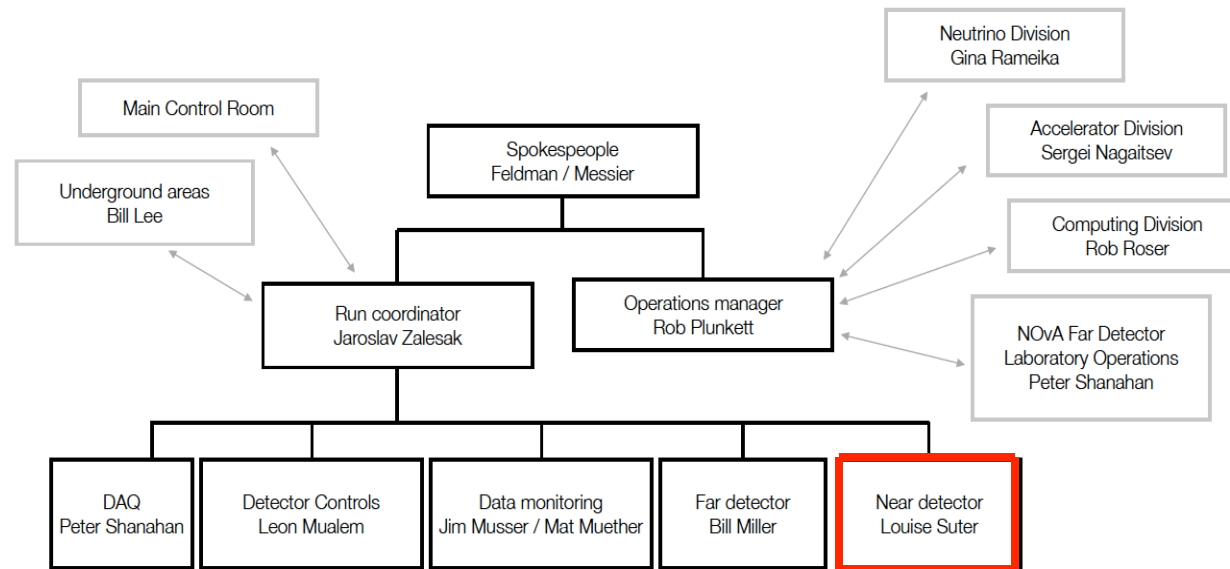
Responsible for executing maintenance and repair work scheduled by the Run Coordinator on the far detector.

Separate Talk





# Detector Operations



Near Detector Group:

Responsible for executing maintenance and repair work scheduled by the Run Coordinator on the near detector.

Separate Talk

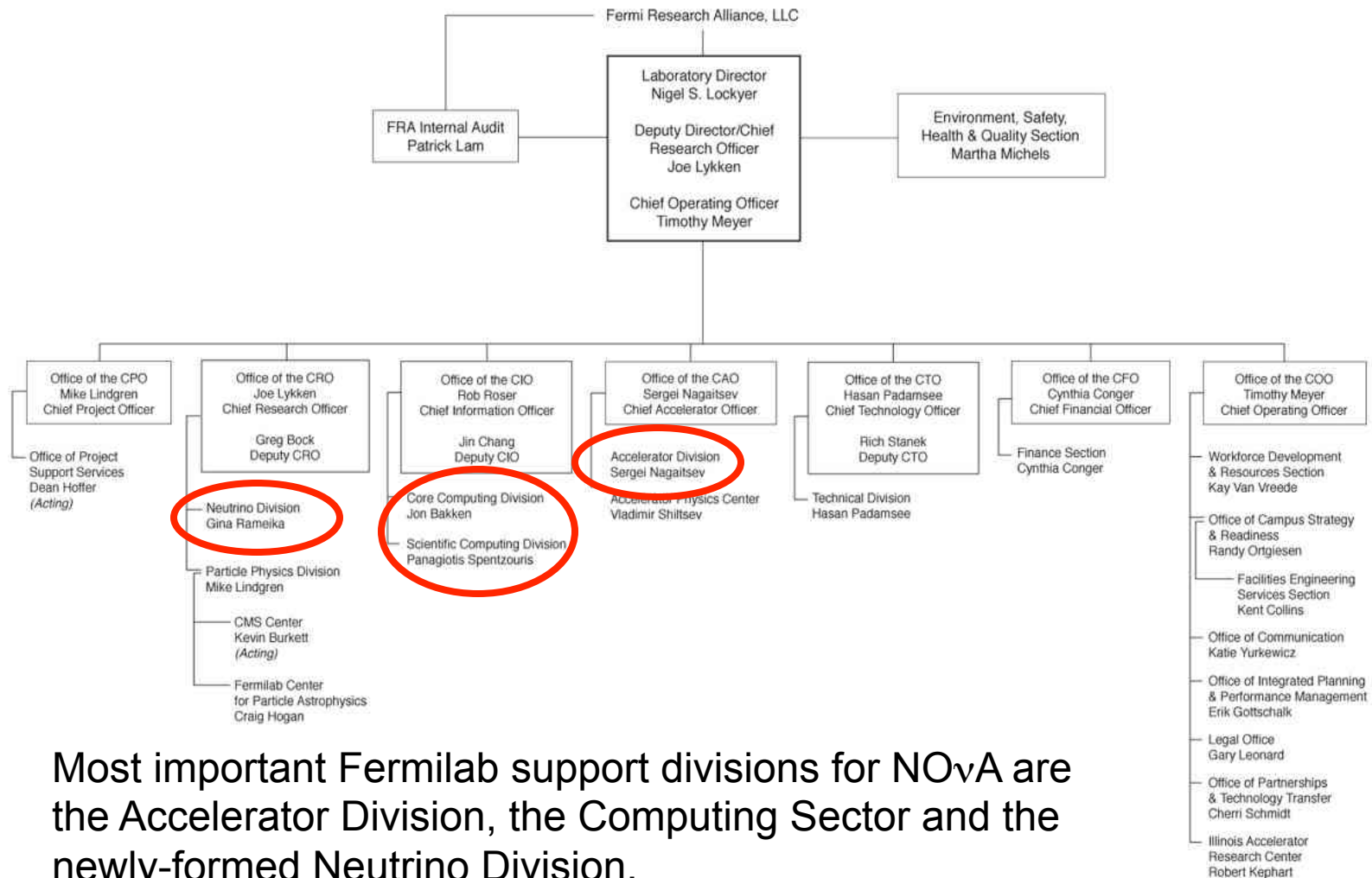


# Shifts

- Shifts are an institutional responsibility with shifts equally shared by all PhD physicists and graduate students.
  - Responsible for
    - Following the run plan set out by the Run Coordinator
    - See that the detectors are running properly
    - See that the data is of high quality, as determined from the online monitoring tools.
- Shifts run 24/7 whether the beam is on or off. Currently two shifters day and swing, one on night. Partial remote shifts will start soon. Shift policy will evolve with time.
- DAQ and DCS experts run on-call shifts.



# Fermilab Organization



Most important Fermilab support divisions for NOvA are the Accelerator Division, the Computing Sector and the newly-formed Neutrino Division.



# Accelerator Division

- The EOP has detailed listings of AD responsibilities. However, since the AD serves all experiments and the NuMI beamline is used by three experiments, the AD is reviewed elsewhere and is not terribly relevant to this NOvA review.
- The two most relevant AD issues for NOvA are
  - Adequate spare targets and horns – current status will be shown later.
  - The integrated number of protons on target.
    - A nominal “NOvA year” is  $6 \times 10^{20}$  POT
    - In FY15, we only expect to receive between 2 and  $3 \times 10^{20}$  POT, due to long shutdowns and awaiting the completion of Booster rf refurbishing.





# Computing Sector

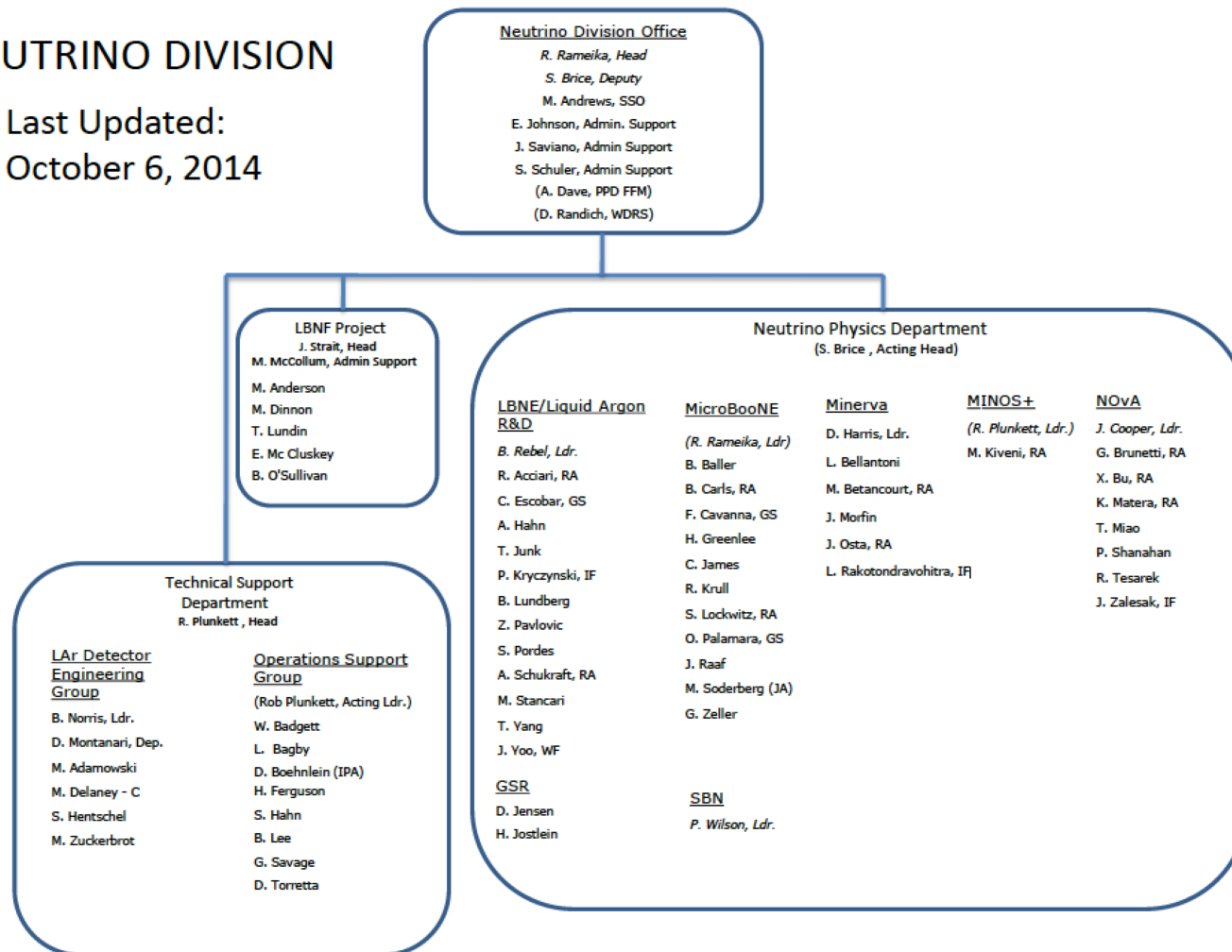
- The Fermilab Computing Sector supports the NO<sub>v</sub>A experiment computing through provision, maintenance, and support of common, and in some cases NO<sub>v</sub>A specific core and scientific services and software.
- Lists of services supported by CS are given in the EOP and more detail is provided in a separate NO<sub>v</sub>A-CS TSW.
- Computing will be covered in a separate talk.



# Neutrino Division Organization

## NEUTRINO DIVISION

Last Updated:  
October 6, 2014





# Neutrino Division Responsibilities

- ND provides an administrative organization for the Fermilab staff working on the NOvA experiment.
- It provides funds for the operation and maintenance needs of the NOvA detectors and those parts of the NuMI/NOvA facility for which it is the landlord.
- It provides funds for the operation and maintenance needs of the NOvA Far Detector Laboratory at Ash River, MN under an MOU with the University of Minnesota.
- It provides office space for resident and visiting NOvA collaborators.
- It is responsible for the maintenance and repair of the dry air and water cooling systems at the near detector.
- It has ES&H oversight responsibility for the near detector area.



## Responsibilities for Maintenance of NOvA Electronics

System	Responsibilities
High Voltage Supplies	Repair or replacement by Fermilab.
Low Voltage Supplies	Repair or replacement by Fermilab.
Power Distribution System	Repair and maintenance by University of Virginia
APDs	Testing and evaluation by Caltech
Thermal Electric Coolers (TEC)	Repair of controllers by Fermilab. Technical assistance by Indiana.
TEC Cooling System	Maintenance by Fermilab.
Front End Boards	Repair by Fermilab. Technical assistance and firmware by Harvard.
Data Concentrator Modules	Repair by Fermilab .
Timing Distribution Units	Repair by Fermilab. .
Detector Control System	Repair and maintenance by Fermilab. Technical assistance by Tennessee.
Data Acquisition System	Maintenance by CS with assistance from several collaborating institutions.



## Spares and Anticipated FY15 Purchases

Item	Spares	# used in NOvA	Anticipated purchases FY15	Comments
ND APDs	>2000	631		
FD APDs	300	10,752	750	
ND FEBs	70	631		~100 more can be repaired
FD FEBs	~1000	10,752		
TECCs	~1000	11,383		
TECs	1000	11,383	1000	
DCMs	31	182		
TDUs	15	31		
PDBs	6	182		
HV main frame	3	3		
HV controllers	2	3		
HV PS	5	13		
LV Chassis	7	61		
LV PS	6	61		
700 kW Targets	2	1	1	1 in 2016s
Horn 1	1	1		1 in 2016
Horn 2	1	1	1	1 in 2016





# FY15 Far Detector Budget

Item	Cost	Comments
Crew labor	\$705,484	9.75 FTE -> 7.75 FTE in Q2
Utilities	\$461,542	85% electricity
Other M&S	\$135,033	>30% for safety
26% Overhead	\$338,536	
Total	\$1,640,595	



## Requested ND FY15 Budget for NOvA

Item	Cost	Comments
Travel to Ash River	\$4,500	
Design of overburden	\$50,000	To FESS
ND dry gas and water cooling maintenance	\$47,000	
Purchase of 750 spare APDs	\$271,875	
Purchase of 500 spare TECs	\$5,190	
Repair of ND APDs	\$50,000	To Harvard
M&S for FD dry gas and water cooling maintenance	\$70,750	
FD computing upgrades	\$185,000	
FD spare scintillator storage	\$24,000	
Test beam preparation and operation	\$30,000	
Total	\$738,815	



# Common Fund

- NO<sub>v</sub>A will follow Fermilab policies once they have been established.



# Run Plan

- The first phase of NO $\nu$ A is defined as  $36 \times 10^{20}$  POT, nominally 6 years of running.
- Approximately half of this running will be with a neutrino-enhanced beam and one half with an antineutrino-enhanced beam, but the ratio will be optimized for maximum information, once we have some results.
- The first analysis is planned for early in CY15 with some FY15 data included.
- After the first analysis, we expect that we should be able to produce results 3 months after taking the data, or sooner.