DEEP UNDERGROUND NEUTRINO EXPERIMENT



DUNE Status

Ed Blucher LBNC Meeting Fermilab, 19 February 2018



Topics

- Collaboration news
- Collaboration management
- LBNC Recommendations
- Milestones
- Far Detector Strategy and Consortia
- Near Detector Status
- Summary



The DUNE Collaboration

As of today: 60 % non-US 1061 collaborators from 175 institutions in 31 nations

Armenia, Brazil, Bulgaria, Canada, CERN, Chile, China, Colombia, Czech Republic, Spain, Finland, France, Greece, India, Iran, Italy, Japan, Madagascar, Mexico, Netherlands, Paraguay, Peru, Poland, Romania, Russia, South Korea, Sweden, Switzerland, Turkey, UK, Ukraine, USA



DUNE is still growing: dN/dt > 100 collaborators/year! Ultimate size: 1500?





- The Collaboration is functioning very well.
- Record attendance of 275 at January 2018 Collaboration Meeting at CERN







Remarkable progress on ProtoDUNEs



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International Progress

- Europe:
 - UK: \$88M commitment to LBNF/DUNE/PIP-II
 - France: Journée DUNE (four weeks ago)
 - Participation from IN2P3 and CEA
 - Portugal: likely to join in near future
- Latin Americas:
 - DUNE presentation at OAS Ministers of S & T
 - Meetings with FA representatives: Colombia, Mexico, Peru
- Asia:
 - India (encouraging signs) and Japan (continued discussions)
- Near Detector:
 - Continued interest from Italy, Germany, Russia

Positive signs, but need to establish commitments



Leadership changes since last LBNC

- Beam Interface Group
 - Laura Fields and Zarko Pavlovic
- TDR Editors
 - Sam Zeller and Tim Bolton
- Co-spokesperson election underway. New cospokesperson term will start April 1.



DUNE Collaboration Management

- Many moving parts...
 - ProtoDUNEs
 - Detector Consortia
 - Physics
 - National level and plans for funding
 - Technical Design Reports

- We have well-defined management structures

- Collaboration governance
- DUNE management plan
- Currently updating structures to manage TDR decisions and construction phase
 - Evolution of collaboration organization to match current tasks (e.g., far detector consortia)
 - Aiming for greater collaboration representation and buy-in in decision making





Motivation for new exec. board

- Increase collaboration engagement/buy-in into decision making
 - We will have some difficult decisions ahead of the TDR
 - Collaboration leaders (consortia, physics, computing) need to be part of process
- Improved communication
 - Get leaders of all main DUNE activities in the "same room" on a regular basis
- Clearer/more-transparent decision making
 - All collaboration decisions flow through Executive Board
 - Implies more formal reporting from Technical and Resource boards
- More formal management
 - We will soon be executing a \$100M+ construction project with multiple international partners; need to sharpen overall collaboration management, move away from "ad hoc"

Not just a change to EC membership, but a change in management model

Proposed Management Structure





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Proposed Management Structure



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Advisory Group

A small advisory group (IB chair, rep. of Young DUNE, ~4-6 elected members) will meet monthly with the co-spokespersons.







Path forward on EB

- Institutional Board agreed in principle to this structure on Feb. 16.
- We will now draft proposal for modified governance document and management plan
- We hope to have new structure in place by ~May 2018



LBNC Recommendations

- DUNE continues to track and act on LBNC recommendations
- Current status of LBNC recommendations for DUNE:
 - 124 closed
 - 5 in progress
- Open recommendations:
 - 2 management
 - 2 physics
 - 1 protoDUNE-SP (DAQ)

Open and recently closed items will be addressed in plenary talks.



Open "Management" Recommendations

- Lessons learned: A formal process to aggregate the lessons learned from previous detector prototypes, commissioning and operation of relevant LAr TPCs into the DUNE/LBNF design should be developed. The LBNC would like to hear a presentation at its next meeting on any cross-cutting system design issues that emerge from lessons learned, over and above the existing calibration task force.
 - As part of the close out for the construction and installation phases for the ProtoDUNE detectors, we will require all project and subsystem managers to contribute to a lessons-learned document detailing issues encountered. We would expect to have a draft document in place by the time of the next LBNC review in May.
- At our next meeting, the LBNC would like to hear a proposed mechanism for documenting the flow down from physics to technical requirements in DUNE, as well as how this will be addressed in the TDR and demonstrated with the protoDUNE test plan.
 - Technical Proposals will include the documented flow down and this will be presented a the May LBNC meeting.

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Recently Closed "Management" Recommendations

- A report on the calibration issues, including implications for the cryostat, should be presented at the next LBNC meeting.
 - Since the last LBNC meeting, responsibility for developing calibration plans has been transferred from the APA consortium to the Calibration Task Force, which sits within the DUNE physics organization. The leaders of this task force (Kendall Mahn (MSU) and Sowjanya Gollapinni (UTK)) have worked closely with Technical Coordination to define a set of dedicated penetrations for the top of the cryostat that will provide sufficient coverage for the various calibration systems under consideration. With these now in place and agreed upon, the task force will continue to work on physics-based studies with the goal of defining an optimized, comprehensive calibration plan for the far detector.
 - Technical proposal will have a dedicated section outlining calibration strategy for far detector

Collaboration Process Timeline

Finalize Calibration Penetrations

Collate and document existing information gathered by the TF so far

Seek Feedback (key questions/ concerns) from collaboration

Responses and strategy to be reviewed by TB , Physics Coordination & Collaboration

Demonstrate arguments & perform studies as needed for TDR

Complete! (Dec 2017)

Collaboration meeting Jan 2018

March 2018 Calibration Workshop (agree on a strategy for TP)

> Technical Proposal May 2018

Move Calibration into consortium June 2018

TDR Spring 2019



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Calibration Feedthroughs: Multipurpose ports







Pos.	Diameter [mm]	Quantity	Description
1	Ø250	100	Support
2	Ø250	75	Cable
3	Ø250	4	High voltage
4	Ø250	21	Instrumentation
5	Ø800	4	Manholes

Laser FTs (Magenta & Green) every 14 m or so. 10 m laser range demonstrated in MicroBooNE.



Milestones

- Continue to refine collaboration milestones
- Currently include milestones for:
 - protoDUNEs
 - Far detector
 - Near Detector
 - Management
 - TP/TDR
 - Reviews
- Tiered structure (1 4). Tier 1 is a major deliverable
- Consortium milestones, to be presented at this review, will be incorporated into full milestone list shortly.



Recently Completed Milestones

Target Date	Milestone	Туре	Tier	Original date	Complete
Oct-17	LBNC Meeting	LBNC	3	Oct-17	Oct-17
Nov-17	Update of DUNE management plan - consortia/appointments	Management	3	Oct-17	Nov-17
Nov-17	TP/TDR Editors appointed/agreed	TDR	3	Dec-17	Dec-17
Nov-17	Consortia plans developed for RRB	RRB	1	Nov-17	Nov-17
Nov-17	Document criteria/physics processes for ND tracker choice	ND	3	Nov-17	Nov-17
Nov-17	Document criteria for comparison of magnet options	ND	3	Nov-17	Nov-17
Nov-17	Determine physics analysis results needed for detector TDR	Physics	3	Nov-17	Dec-17
Nov-17	RRB Meeting	RRB	3	Nov-17	Nov-17
Dec-17	Update of strategy document	Management	2	May-17	
Feb-18	Plans for Technical Coordination finalised	Management	2	Nov-17	
Dec-17	CRP Consortium membership finalized	FD	3	Jun-17	
Feb-18	Report on cost implications/technical risks of Solenoid option	ND	3	Dec-17	
Dec-17	Definition of the decision-making process for the first two FD modules	FD	2	Dec-17	
Dec-17	CRP Consortium Leadership in place	Management	3	Jul-17	Jan-18
Dec-17	Update of DUNE management plan - Technical Coordination	Management	1	Dec-17	
Dec-17	Complete table of contents for TP and TDR	TDR	3	Dec-17	18-Jan
Dec-17	Criteria for decision on baseline on single-chip solution documented	SP-FD (Elec)	2	Dec-17	9-Feb
Dec-17	Single-Phase TPC Electronics consortium milestones defined	SP-FD (Elec)	3	Dec-17	18-Jan
Dec-17	Calibration moved from APA consortium to TF	Calibration	3	Dec-17	Dec-17
Dec-17	Penetration layout under change control	Calibration	3	Dec-17	Dec-17
Jan-18	Assessment of required plots for TDR; define strategy for delivering any mi	Physics	3	Jan-18	Jan-18
Jan-18	New APB rules ready	Management	3	Jan-18	
Jan-18	Management proposal for new EC presented to IB	Management	2	Jan-18	18-Jan
Jan-18	Status report on ND tracker studies - define next steps	ND	3	Jan-18	30-Jan
Jan-18	Recommendation on whether to purse PRISM concept	ND	2	Jan-18	1/30/18
Mar-18	Report on scientific arguments for magnet to EC	ND	3	Jan-18	

• Some delays related to dual phase



Milestones: 7-month look ahead

• Only high-level (tier 1 and 2) milestones shown

Target Date	Milestone	Туре	Tier	Original date
Feb-18	Decision on installation of beam plug	PD-SP	2	Feb-18
Mar-18	Decision on ND Magnet	ND	2	Feb-18
🗪 Apr-18	All components of protoDUNE-SP at CERN	PD-SP	2	Dec-17
\Rightarrow Aug-18	All components of protoDUNE-DP at CERN	PD-DP	2	Dec-17
Mar-18	Co-spokesperson elected - former term ends 31 March	Management	2	Mar-18
Apr-18	Feedback from TB and Physics coordination goes to EC for comment	Calibration	2	Apr-18
Apr-18	New Co-Spokesperson term begins	Management	2	Apr-18
Apr-18	Update of management plan - Executive Committee	Management	2	Apr-18
Apr-18	Complete TP Draft	TDR	2	Apr-18
Apr-18	Decision on PRISM concept	ND	2	Apr-18
Apr-18	Decision on 3-D scintillator	ND	2	Apr-18
Apr-18	Decision on ND Tracker technology	ND	2	Apr-18
May-18	EC approves "Calibration Strategy" in TP	Calibration	1	May-18
May-18	Decision on the conceptual design of the near detector systems	ND	1	Dec-17
May-18	Move to new Executive Committee structure	Management	1	May-18
May-18	Final version of TP delivered to LBNC	TDR	1	May-18
Jun-18	Calibration systems moved to consortium structure	Calibration	2	Jun-18
Jun-18	Start of ND EoI process	ND	2	Jan-18
Jun-18	Completion of protoDUNE-DP	PD-DP	1	Jun-18
Jun-18	Completion of protoDUNE-SP	PD-SP	1	Jun-18
Jul-18	ProtoDUNE-DP commissioned	PD-DP	1	Jul-18
Jul-18	ProtoDUNE-SP commissioned	PD-SP	1	Jul-18
Jul-18	LBNC Review of TP for first two FD modules	Review	1	Jul-18
Aug-18	Start of charged-particle test beam operation at CERN : PD-SP	PD-SP	1	Aug-18
Aug-18	Start of charged-particle test beam operation at CERN : PD-DP	PD-SP	1	Aug-18



Far Detector Strategy

- Four chambers hosting four independent 10-kt FD modules

- Flexibility for staging & evolution of LAr-TPC technology design
 - Assume four "identical" cryostats: 15.1 (W) x 14.0 (H) x 62 (L) m³
 - Do not expect that the four 10-kt modules will be identical

• DUNE is pursuing two LAr-TPC technologies

- Single-Phase
 - Technology is mature, e.g., ICARUS, MicroBooNE
- Dual-Phase
 - Lower technical readiness
 - A number of potential advantages & challenges
- DUNE is committed to deploying both technologies
- Decisions/Staging will depend on:
 - Results from ProtoDUNEs and funding/interests



Existing FD Planning Strategy

- Agreed by EC
- Assumes success of both protoDUNE detectors
 - Success is defined in dune-doc-2765

• For planning purposes:

- "we are assuming that the first far detector module will be single-phase and the second will be dual-phase"
- "This planning strategy is not intended to prejudice the actual technology decision in late 2018/early 2019, which will be based on the full knowledge at that time and the availability of funding."
- i.e., plan so that all options can be on the table



Strategy for TDR: 2 + 1 + 1

Full detector requires 4 FD modules: "2 + 1 + 1 model"

- Reflects current expectations of what might be reasonable from funding perspective at time of TDR in 2019
 - 2 Single-phase FD modules, one of which will be the first module
 - 1 Dual-phase FD module
 - 1 [As yet] uncovered "Opportunity" FD module

• For TDR in 2019

- Seeking approval of (at least) two FD modules
- Requires technical readiness and funding model

Consortia are key to constructing money-matrix for funding of DUNE

- Consortia need to be actively engaged with funding agencies





Timeline

Assumed timeline for DUNE (and LBNF) reviews

- May 2018: Technical Proposal for DUNE (+costs, responsibilities)
- Jan/Feb 2019: RRB for to provide funding status
- April 2019: LBNF and DUNE internal/external TDR reviews
- July 2019: LBNC review of TDRs
 Review of international DUNE construction project
- Sept 2019: **RRB** to confirm **funding** status for construction validation of **international** funding model
- October 2019: DOE CD-2 Review of LBNF/DUNE & "CD-3" review for far site and two far detector modules
- August 2020: DOE "CD-3" for near facilities and near detector
- In less than eighteen months
 - Need technical designs and understanding of funding model



Success depends on consortia

Excellent Consortia Leadership

Single-Phase

- APA: Stefan Söldner-Rembold (Manchester)
- Photon Detection System: Ettore Segreto (Campinas)
- TPC Electronics: Dave Christian (FNAL)
- Dual-Phase
 - CRP (Interim): Dominique Duchesneau (LAPP)
 - Photon Detection System: Ines Gil Botella (CIEMAT)
 - TPC Electronics: Dario Autiero (IPNL)
- Joint
 - HV System: Francesco Pietropaolo (CERN)
 - DAQ: Dave Newbold (Bristol)
 - Slow Controls/Instrumentation: Sowjanya Gollapinni (Tennessee)







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Consortia Progress

- Far Detector consortia are only 6 months old, but are working extremely well
- A vast amount of progress (see talks at this meeting)
 - WBS (i.e., scope of activities)
 - Planning milestones (to be incorporated into overall DUNE milestones)
 - Provisional picture of responsibilities
 - TDR preparations
 - Draft strategy documents for activities leading up to TDR
 - See full project documentation at <u>https://web.fnal.gov/collaboration/DUNE/DUNE%20Project/_layouts/15/st</u> <u>art.aspx#/SitePages/DUNE%20Project%20Office.aspx</u>

Next steps...

- Technical Proposal (May 2018) and TDR (April 2019)



Near Detector Progress

- Following plan described at previous LBNC (DUNE-doc-5841)
 - Drafted by Co-spokes, in consultation with Alfons and Kam-Biu, approved by EC
 - Includes concrete milestones to address outstanding questions and prepare for decision
- Near Detector Concept Study continues to make excellent progress, but a number of key decisions remain
 - Agreed to extend the process to May 2018
 - Latest date compatible with ND CDR and Near Site CF



ND Decisions to Date

- Agreed (from June WS recommendations endorsed by Exec Com)
 - LAr-TPC + a magnetized Multi-Purpose Tracker
 - LAr-TPC should not be magnetized
 - Near Detector hall should be 50% larger than CD-1R
 - Near Detector at 575m unless cost benefits of moving closer are identified by LBNF

Main Outstanding Issues

- 1) Analysis Magnet: KLOE solenoid or new-build dipole?
- 2) MPT tracker technology: Straw Tube Tracker or HPTPC?
- 3) Use of 3-D Scintillator as an active target: yes/no
- 4) PRISM concept: yes/no. (1/18: Continue to pursue)
- Have a plan to address each of these questions



ND Decisions to Date

- **Agreed** (from June WS recommendations endorsed by Exec Com)
 - LAr-TPC + a magnetized Multi-Purpose Tracker
 - LAr-TPC should not be magnetized
 - Near Detector hall should be 50% larger than CD-1R
 - Near Detector at 575m unless cost benefits of moving closer are identified by LBNF



ND Milestones

	Target Date	Milestone	Type 📲	Tie 🔻	Original date	Complete
	Jan-17	Launch of expressions of interest in ND Concept Study	ND	2	Jan-17	Feb-17
	Mar-17	ND Concept Study workshop	ND	2	Mar-17	Mar-17
	May-17	Define two/three ND concept options for further study	ND	2	May-17	May-17
	Jun-17	ND Concept Study workshop	ND	2	Jun-17	Jun-17
	Nov-17	ND Concept Study workshop (CERN)	ND	4	Nov-17	Nov-17
	Nov-17	Document criteria/physics processes for ND tracker choice	ND	3	Nov-17	Nov-17
	Nov-17	Document programme of studies to demonstrate physics benefits of 3D-Sc	ND	4	Nov-17	Nov-17
	Nov-17	Document layout for PRISM concept and studies to demonstrate case	ND	4	Nov-17	Nov-17
	Nov-17	Document criteria for comparison of magnet options	ND	3	Nov-17	Nov-17
	Feb-18	Report on cost implications/technical risks of Solenoid option	ND	3	Dec-17	
	Jan-18	Status report on ND tracker studies - define next steps	ND	3	Jan-18	Jan-18
	Jan-18	Recommendation on whether to purse PRISM concept	ND	2	Jan-18	Jan-18
Mar-18	Jan-18	Report on scientific arguments for magnet to EC	ND	3	Jan-18	
Mar-18	Feb 18	Decision on ND Magnet	ND	2	Feb-18	
	Mar-18	Report on comparison of tracker options and recommendation	ND	3	Mar-18	
	Mar-18	Report on benefits of PRISM concept and recommendation	ND	3	Mar-18	
	Mar-18	Report on benefits of 3-D scintillater as part of MPT and recommendation	ND	3	Mar-18	
	Mar-18	ND Concept Study workshop	ND	4	Mar-18	
	Apr-18	Decision on PRISM concept	ND	2	Apr-18	
	Apr-18	Decision on 3-D scintillator	ND	2	Apr-18	
	Apr-18	Decision on ND Tracker technology	ND	2	Apr-18	
	May-18	Decision on the conceptual design of the near detector systems	ND	1	Dec-17	
	Jun-18	Start of ND Eol process	ND	2	Jan-18	
	May-19	CDR for Near Detector	ND	1	Sep-18	
	Aug-19	Review of Near Detector CDR	ND	1	Aug-19	
	Apr-20	TDR for Near Detector	ND	1	Apr-20	
	Jun-20	LBNC Review of Near Detector TDR	ND	1	Jun-20	
	Aug-20	CD-3 and LBNC Reviews for near site and Near Detector	ND	1	Aug-20	



Summary

- 2017 was a very good year for DUNE
 - Amazing CERN NP & ProtoDUNE progress
 - Consortia driving far detector activities
 - Funding progress (UK, US)
 - Increased interest from other funding agencies
- 2018 will be a critical year for DUNE
 - Complete, commission, and take data with protoDUNEs
 - Complete technical proposals for far detector and continue work on TDR
 - Decide on and develop near detector concept. Begin work on CDR
 - Need further progress on funding

The coming months will continue to be extremely challenging and exciting!

