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Computational Science Working Group Pre-meeting 1

Oli Gutsche and Gabe Perdue
2017/April/12

Charge to the group

- Draft a list of possible long-term lab goals related to the topic of the working group (computation).
- Outline any input and/or additional work that would be required to prioritize each goal (for example, results from a running experiment, etc.).
- Provide a rough summary of any upgrades to the accelerator complex or lab facilities required to accomplish these goals.
 - This charge is quite broad!
 - "Computation" means a lot of things. There are "obvious" topics (do we have the ability to analyze the data our experiments are collecting), but also subtle ones (what sort of new technologies should we explore and how do we balance R&D versus operations, etc.).

- MI-LB neutrinos**
- MINOS+, MINERvA, NOvA
- Booster-SB neutrinos**
- uBooNE, SBND, ICARUS
 - FNAL Recycler-muons**
 - g-2
- LHC beams: Run 2**
- CMS

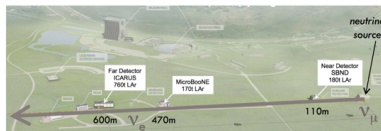
2020-2025

- ...
- Recycler-muons**
- Mu2e
- LHC Run 3 (phase 1 upgrade)**
- ...

2025-...

- Long Baseline Neutrino Facility (LBNF)**
- DUNE
 - LHC Run4 (HL-LHC)**
- ...

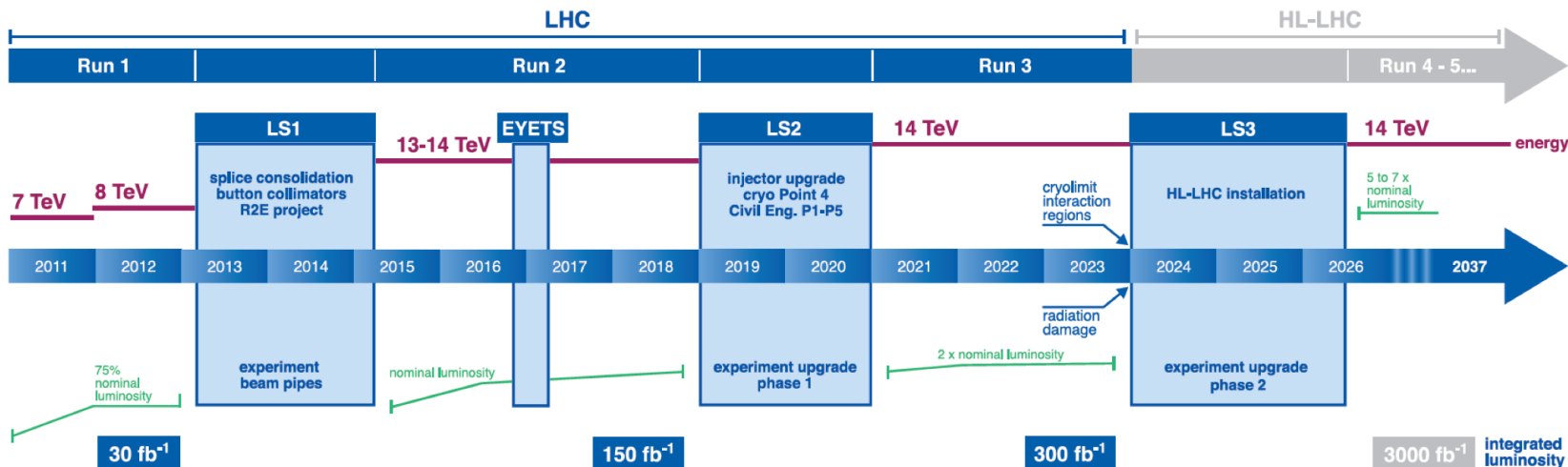
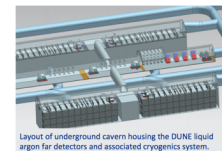
(N3) Establish the short-baseline neutrino program



- 2015: - PAC endorsement of SBN program
- start of μ BooNE & conventional facility construction
- 2016: - begin SBND detector construction
- complete ICARUS refurbishment
- 2017: - SBN conventional facilities complete
- deliver ICARUS to Fermilab
- 2018: start of SBN physics program

(N4) Establish the long-baseline neutrino program

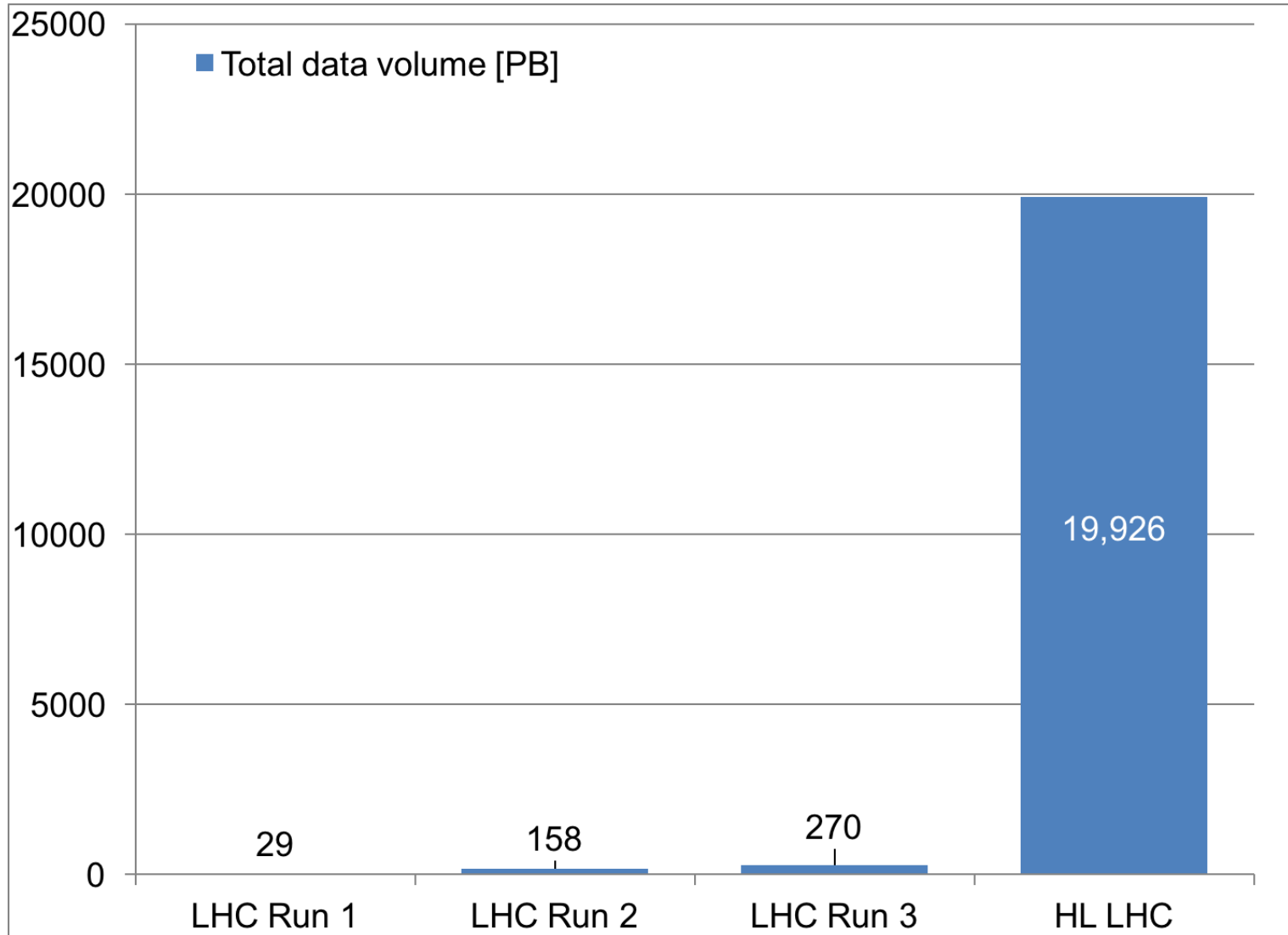
- 2017: - begin cavern excavation at SURF
- 2018: - complete single and dual phase CERN prototypes
- construct neutrino beam embankment at Fermilab
- 2019: - first 10 kton cavern ready
- 2022: - 4x10 kton caverns ready
- 2024: - first 10 kton detector module installed and filled with LAr
- 2025: - neutrino beamline complete
- 2027: - full 40 ktons of detector installed and filled with LAr



		FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26
LBNF/PIP II	LBNF/PIP II SANFORD							DUNE	DUNE	DUNE	DUNE	DUNE
	NuMI	MINOS+	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN		
		MINERvA	MINERvA	MINERvA	MINERvA	MINERvA	MINERvA	MINERvA				
		NOvA	NOvA	NOvA	NOvA	NOvA	NOvA	NOvA				
BNB	μ BooNE	μ BooNE	μ BooNE	μ BooNE	μ BooNE	μ BooNE	μ BooNE					OPEN
	ICARUS	ICARUS	ICARUS	ICARUS	ICARUS	ICARUS	ICARUS	ICARUS				OPEN
	SBND	SBND	SBND	SBND	SBND	SBND	SBND					OPEN
Muon Campus	g-2	g-2	g-2	g-2								
	Mu2e	Mu2e	Mu2e	Mu2e	Mu2e	Mu2e	Mu2e	Mu2e	Mu2e	Mu2e		Mu2e
SY 120	MT	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF		FTBF
	MC	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF	FTBF		FTBF
	NM4	SeaQuest	SeaQuest	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN		OPEN

■ Summer shutdown ■ Construction / commissioning ■ Run ■ Extended running possible

It is all about data! Nothing else matters...



General points

- Computing is enabling science - our science cannot be done without MASSIVE scale computing anymore.
 - In the future, data volumes will grow exponentially, making this even more concrete.
- Because of this, investment in computing, technologies, and computing hardware is crucial.
 - Fermilab has not always been at the forefront of investment in computing hardware.
- To do our science, we will need to push the envelope in ways that require new hardware and new technologies.
- In this working group, we want to operate within the framework of these points to answer the following questions:
 - What computing do we need to do what is already on our schedule?
 - What computing can we do to enable new science and entirely new scientific programs? In other words, are there experiments that can only be made possible with certain computing technologies as a premise?

Thrusts

- Thrust 1: data access
 - Data and compute are both distributed and not necessarily co-located. How do we manage this?
 - How do we handle paradigms like those required by machine learning where training data access is very different from analysis (ntuple) data access.
- Thrust 2: scientific software
 - Moore's Law is dead. Panic. How do we adjust to a massively parallel world?
 - We need to rethink how we do algorithms. Do we have to have deterministic algorithms? What matters in the end for us is that we understand our *systematic uncertainties*.
- Thrust 3: security and collaboration
 - We must work together with many people across administrative boundaries. How do we do that conveniently, efficiently, and securely?

What we want from you

- For the future, it is not anymore feasible to ask "do what I am doing right now, but faster."
 - There is deep expertise in computing that is not necessarily attached to experiments in a scientific role.
 - User perspectives can be short-sighted at times.
 - We need common solutions that cover more than one endeavor - this is a core competency of the lab that we need to leverage effectively.
- We need your ideas! - Nothing is off limits!
- We want realistic, unrealistic, ... everything. Don't be shy.
- We are going to organize some talks about topics to spark ideas and conversation and you can provide feedback during the pre-meetings or send us written ideas (please, not longer than 1/2 page).

What we are going to do with all of this

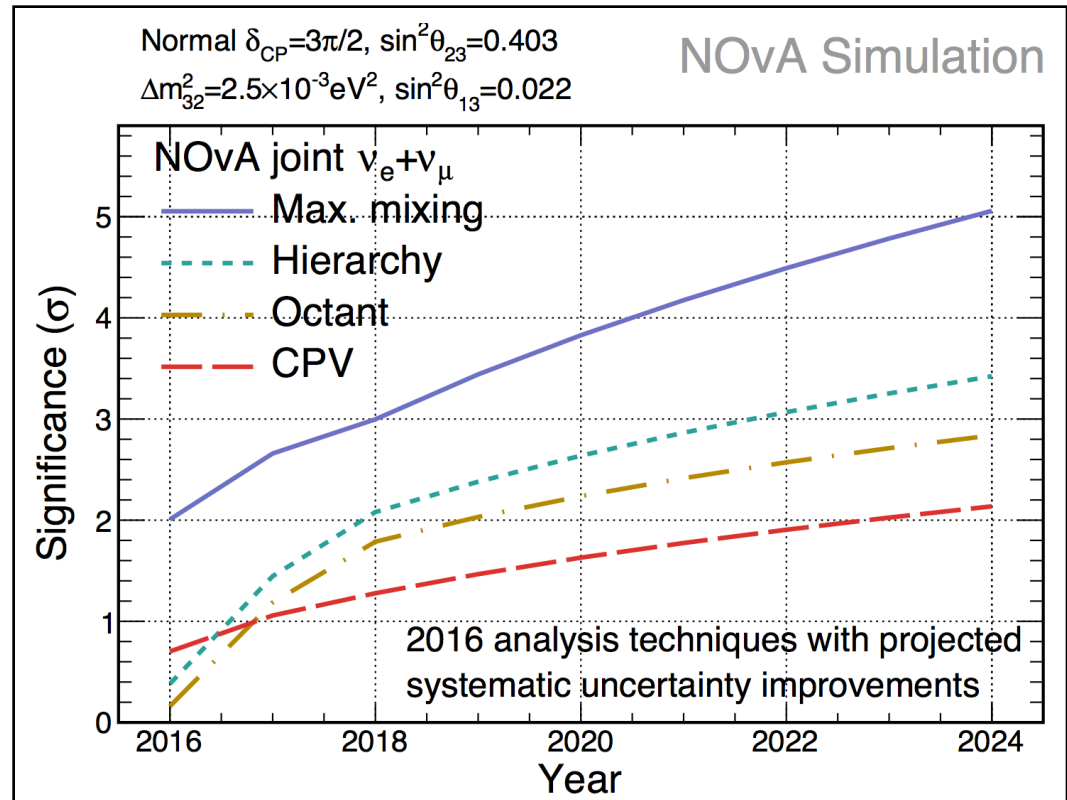
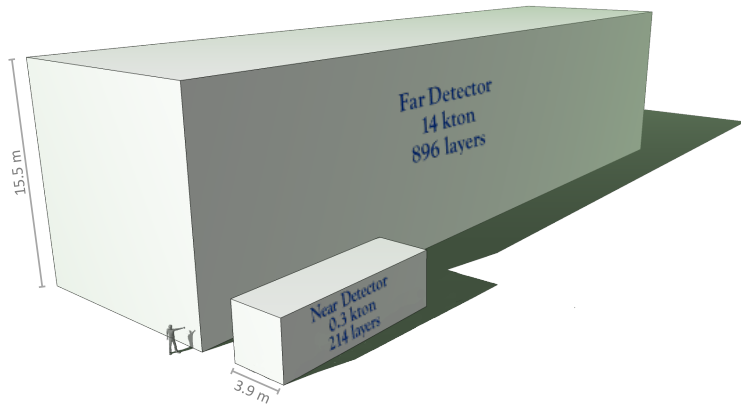
- We are going to prepare a talk for the retreat.
- The retreat schedule is a series of plenary presentations from the various working groups. Each presentation is scheduled to be 15 minutes with 10 minutes for discussion.
- Synthesis and prioritization are not possible on this timescale and are not generally appropriate for the retreat.
- Instead, we will emphasize the general points made here (we need feedback on these as well) and we will provide a summary of your ideas.
 - This will be raw material in the future to define Fermilab's position in the community wide process leading to the next Snowmass + P5.
 - It would be nice if we did have a set of points that were items that "we **HAVE** to do - these are not just nice things to have, they are requirements."



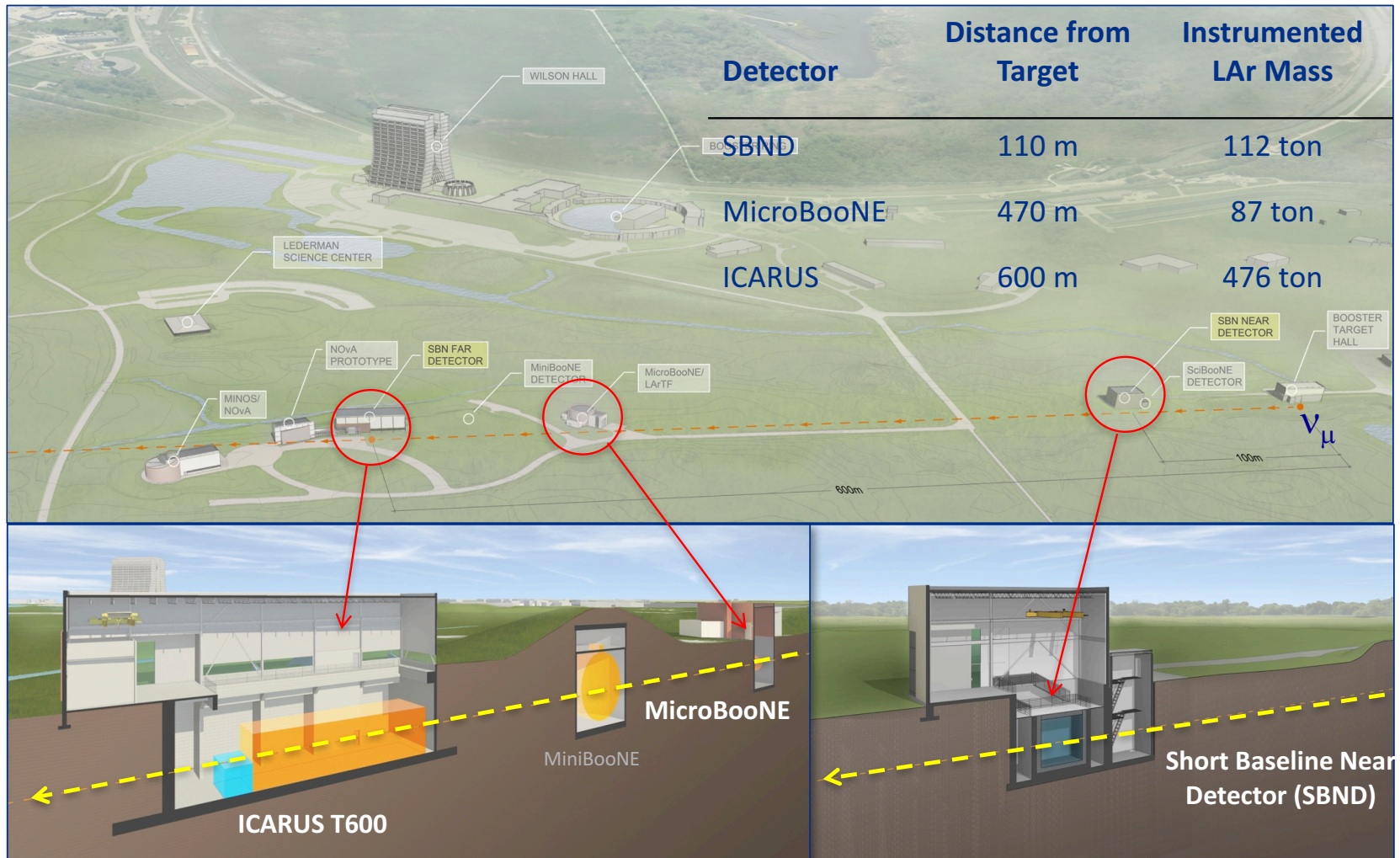
Back-up

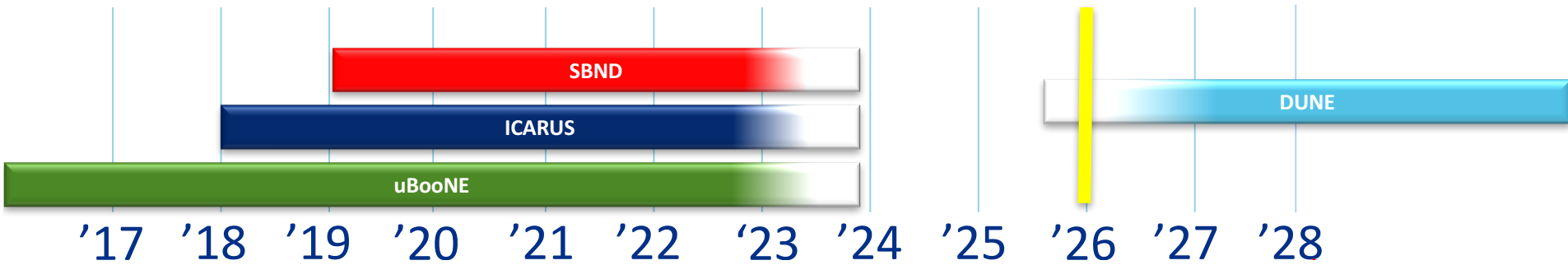


Experiments



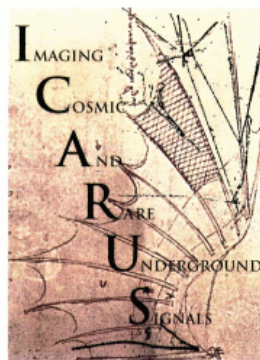
SBN Program: Three LAr TPC Detectors





2015

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2018

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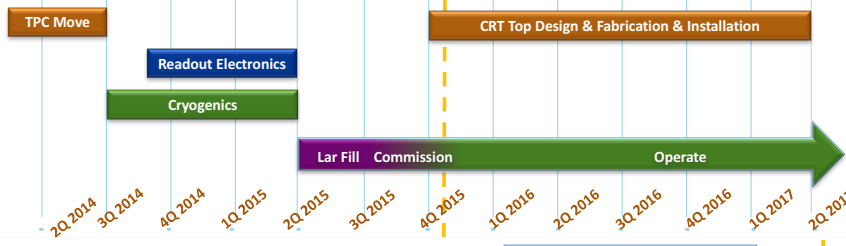
2019

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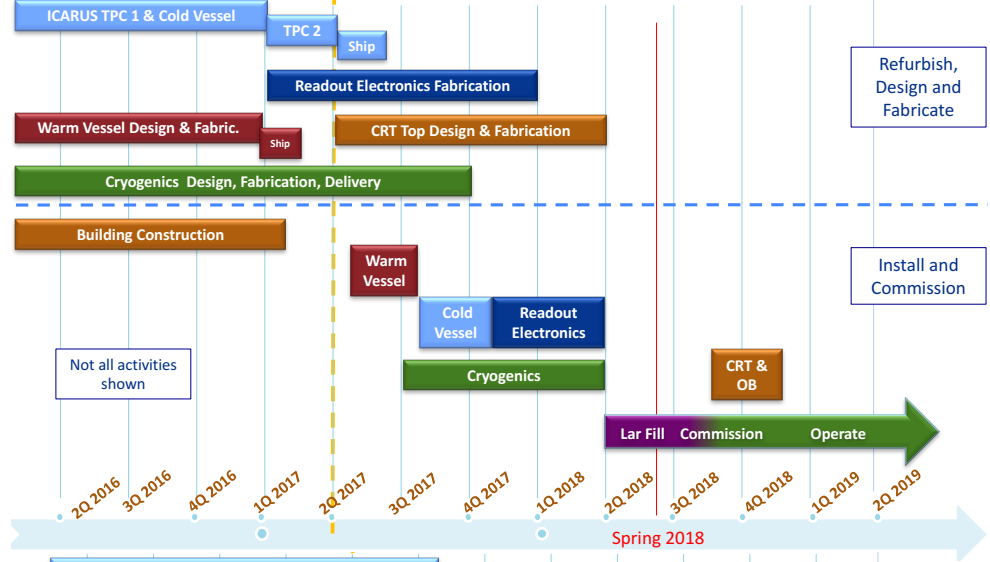


Sterile ν Search

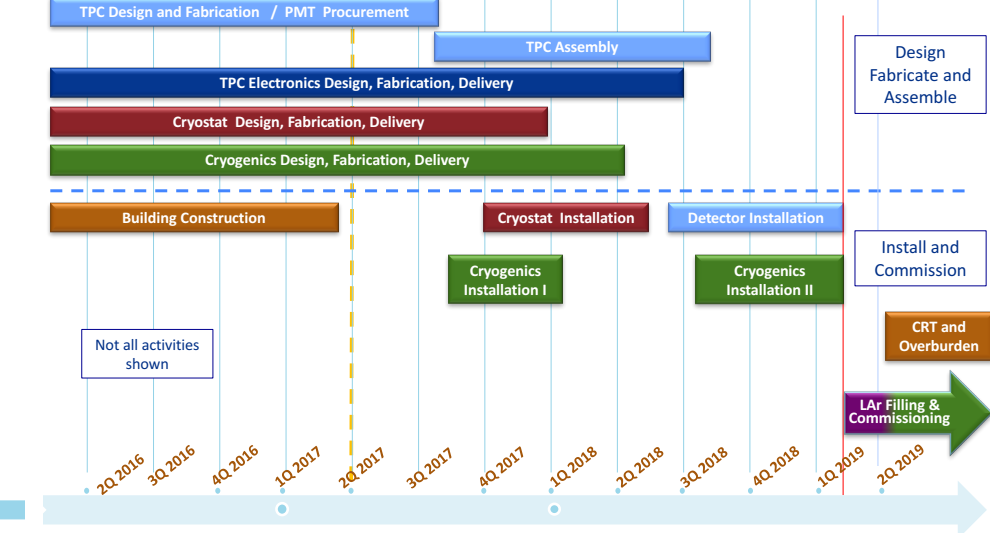
MicroBooNE



ICARUS

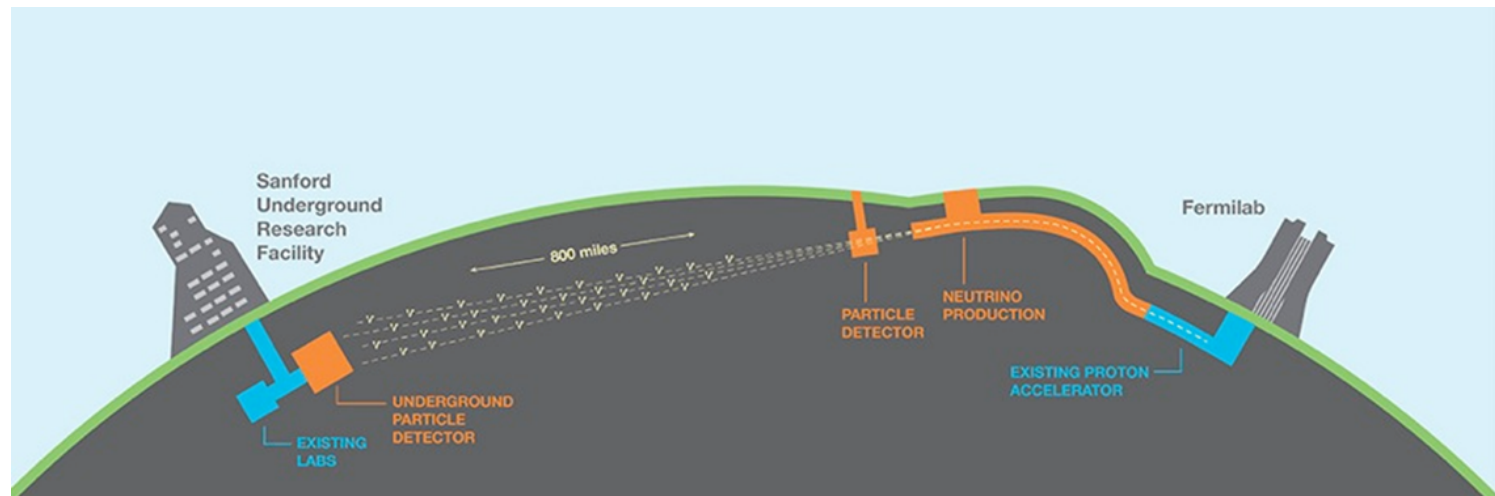


SBND



LBNF Facility and DUNE Experiment

- **LBNF: DOE project with support from non-DOE partners.** Provides facility infrastructure at two locations:
 - **Near site:** Fermilab, Batavia, IL - facilities to create neutrino beam
 - **Far site:** Sanford Underground Research Facility, Lead, SD - facilities to support DUNE detectors
- **DUNE: Deep Underground Neutrino Experiment - international collaboration**
 - A next generation experiment for **neutrino science, nucleon decay, and supernova physics.**
 - Near and far site detectors



Fermilab

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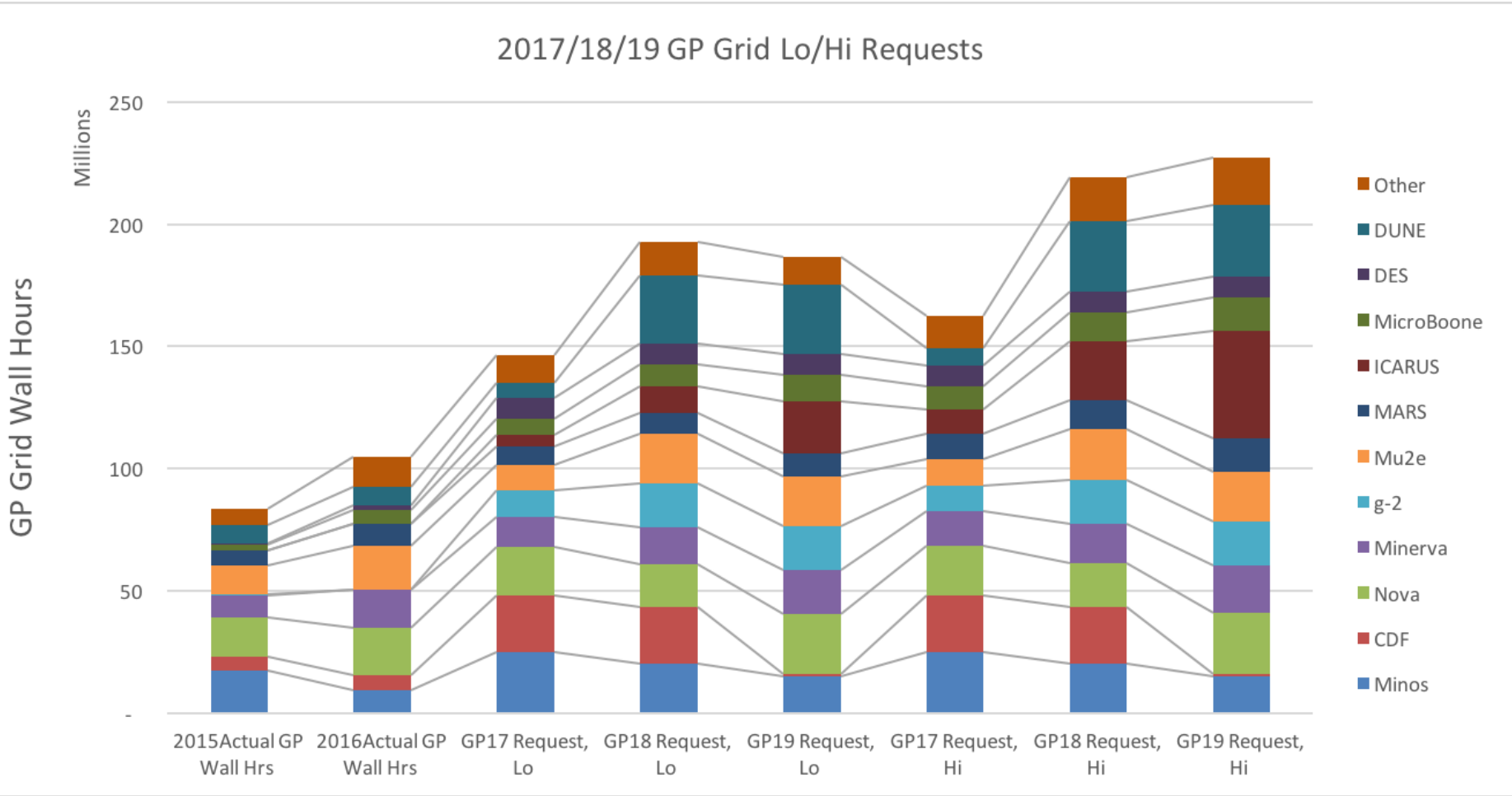
Slide courtesy of T. Yang

Fermilab



Are we ready?

Are our facilities ready?



What about new technologies? (GPUs, etc.)

Are our facilities ready?

Persistent dCache Current and Requests

