



Operated by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

Synergies & complementarity among laboratories

13th Pisa meeting on Advanced Detectors

Steve Geer

Fermilab

May 26, 2015

In the U.S. we have clearly defined marching orders



Building for Discovery

Strategic Plan for U.S. Particle Physics in the Global Context

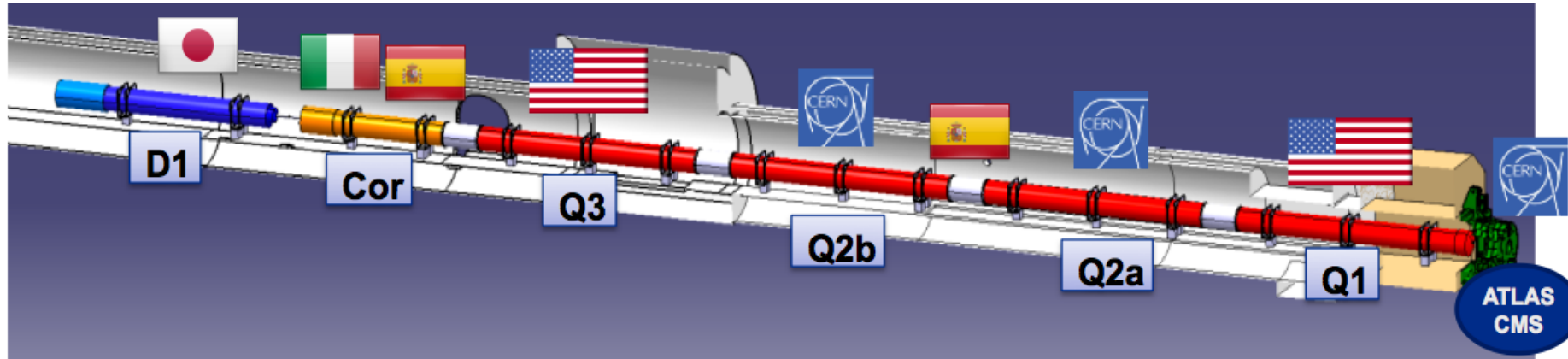
P5 plan in a nutshell

- Continue our commitment and leading roles in the LHC
- Build a neutrino program that will attract the world community
- Continue leading efforts in dark matter, cosmic surveys & CMB
- Invest in the accelerator and detector technologies that we will need in the future

It is a feature of this plan that the major components reinforce each other, and that it is in the global context

Continue our commitment and leading roles in the LHC

“The LHC upgrades constitute our highest-priority near-term large project.”



- Fermilab, BNL, LBNL & SLAC all working on HL-LHC accelerator upgrades
 - part of a larger **international** network of labs (good example of synergy & complementarity)
- Fermilab also hosts US-CMS
 - FNAL involved in extensive detector repairs & improvements during shutdown

Support for U.S. CMS is very visible within the laboratory ...



Build a neutrino program that will attract the world community

- The global community has identified long-baseline neutrino physics as a frontier of high priority and rich opportunity
 - CERN/European Strategy, US/P5, Japan/T2K-HK



The planets are aligned for a (phased) 40 kT liquid argon TPC far detector, 1300 km from Fermilab

- U.S. is enthusiastic about hosting
- Relies on combination of international will, talent, and resources
- South Dakota legislature just appropriated another \$4M, & Ross shaft rehab proceeding with two 12 hour shifts/day to be done by 2017 for excavation start.

DUNE

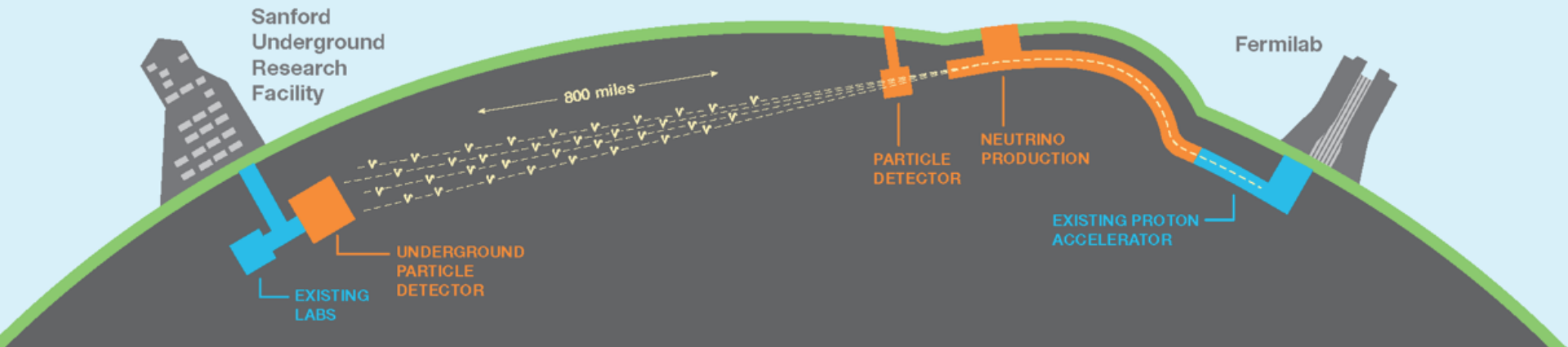
- Deep Underground Neutrino Experiment
 - A growing global science collaboration
 - 720 members
 - 142 institutions
 - 24 countries



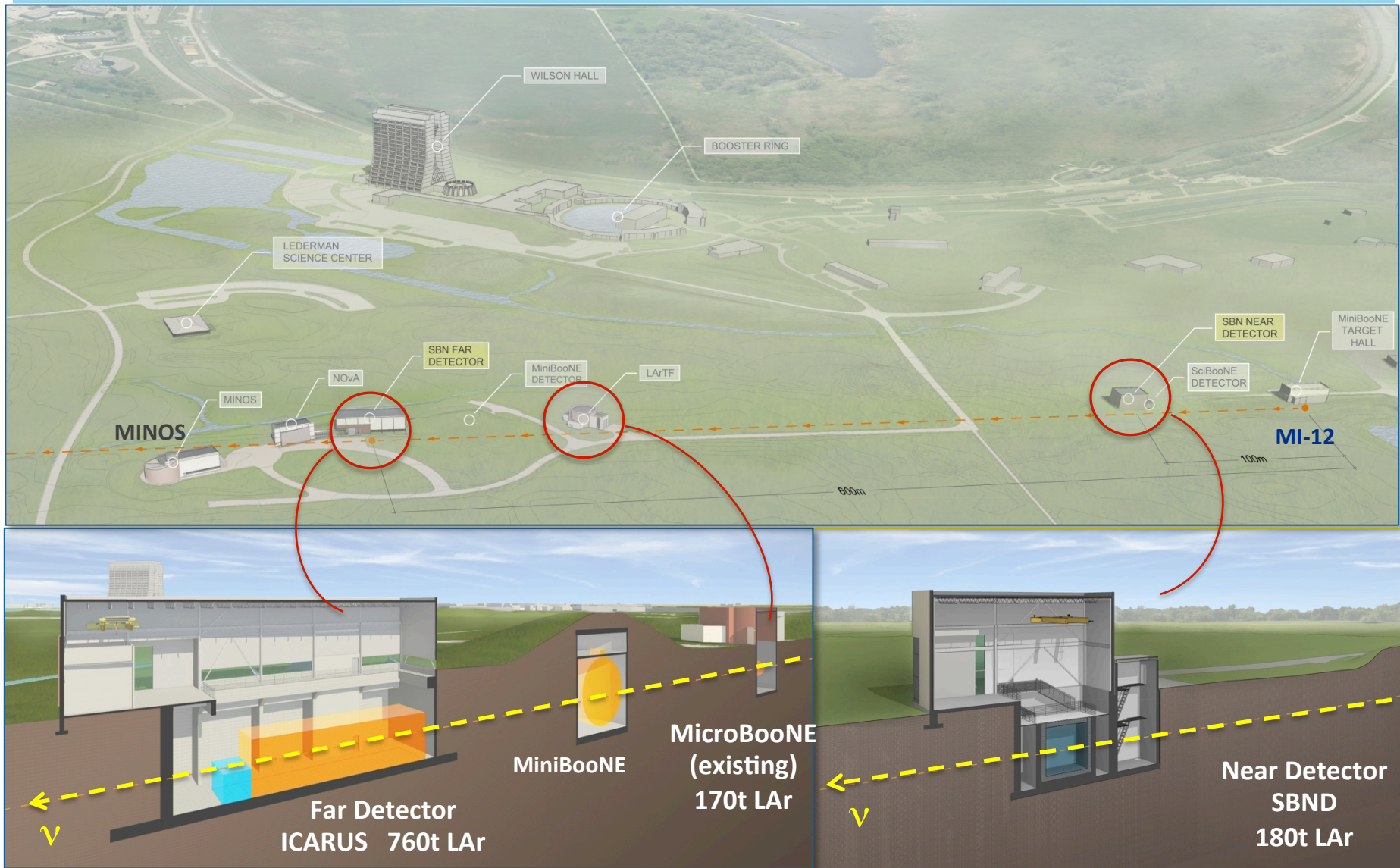
Spokesperson:
André Rubbia
ETH



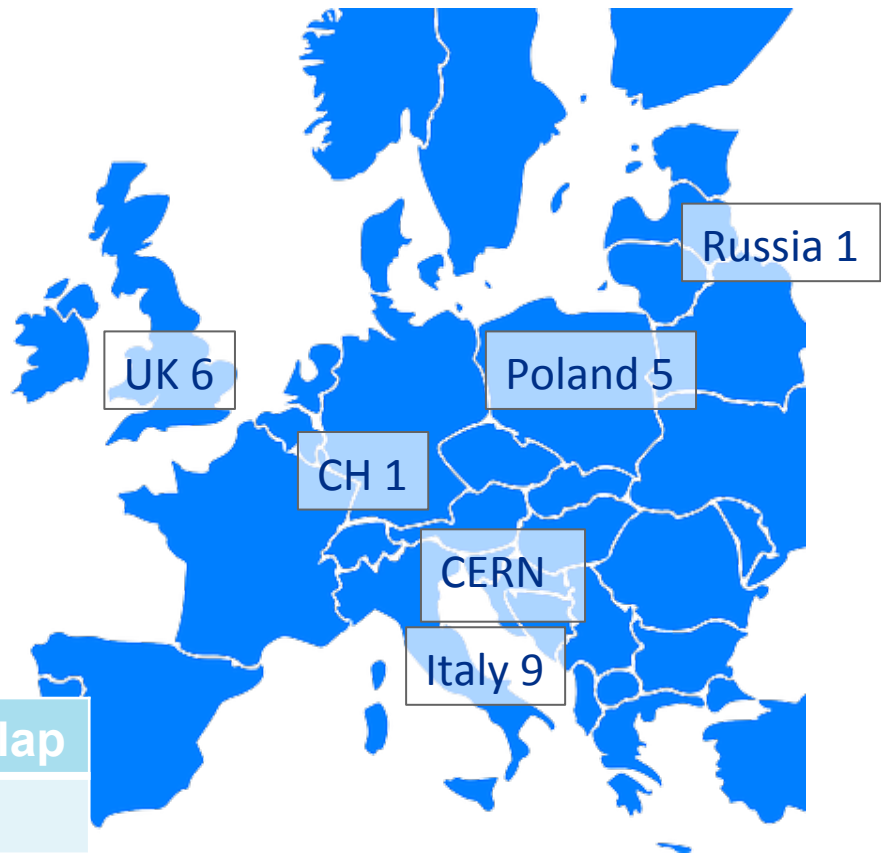
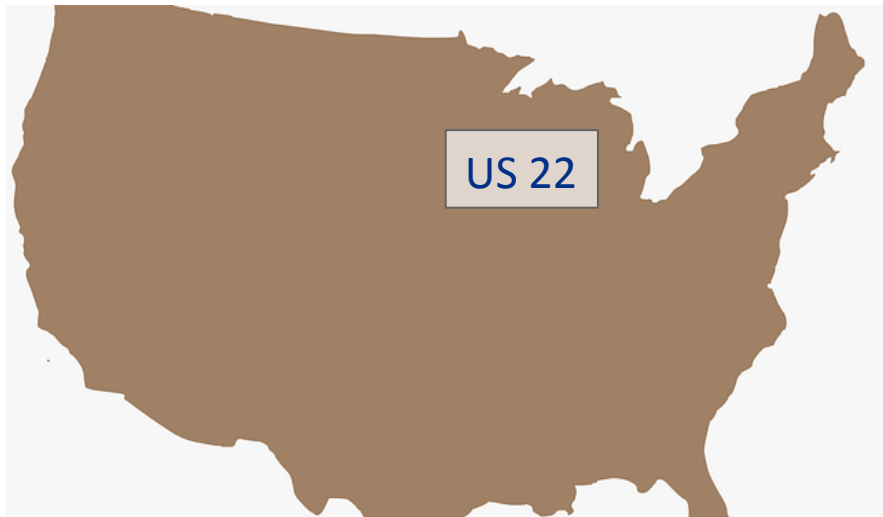
Spokesperson:
Mark Thomson
Cambridge



Fermilab and Neutrinos at Short-Baselines



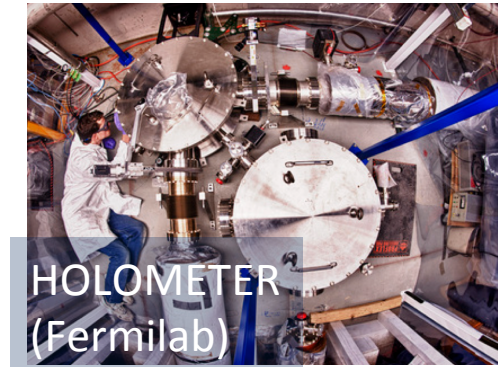
Fermilab and Neutrinos at Short-Baselines



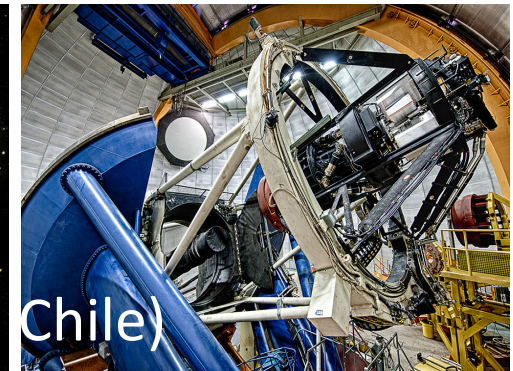
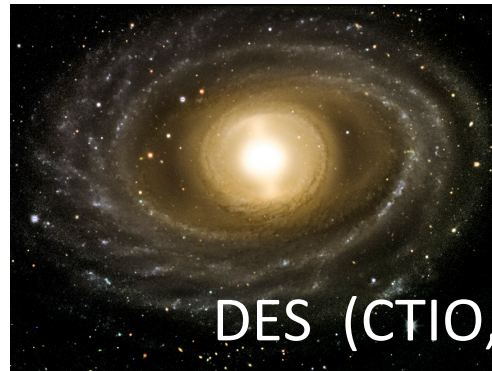
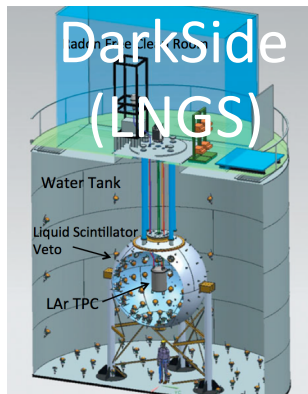
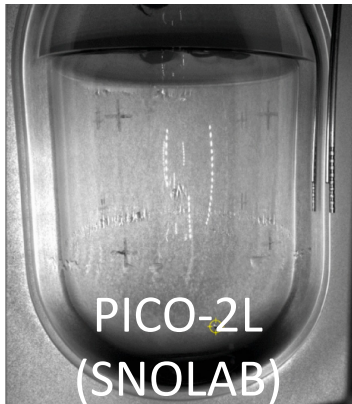
Collaboration	Authors	Overlap
ICARUS-WA104	57	} 6 } 59
SBND	108	
MicroBooNE	118	
All SBN (excl overlaps)	218	

Fermilab and the Cosmic Frontier

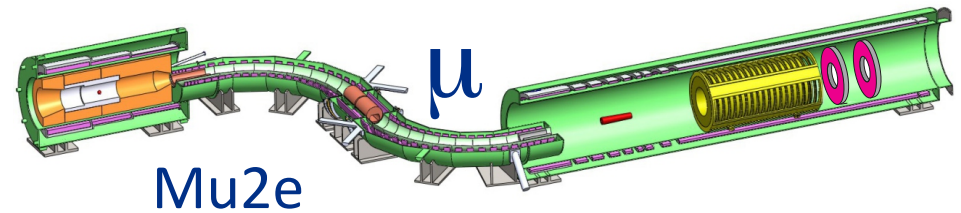
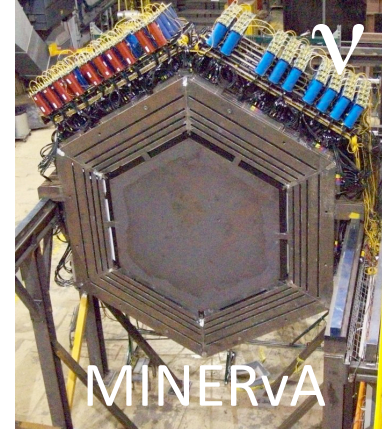
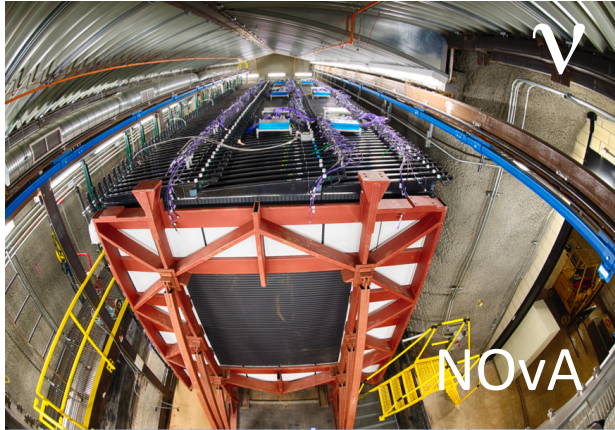
P5 Driver	Experiments
Dark Matter	G1: SuperCDMS Soudan, COUPP/PICO, Darkside, DAMIC G2: SuperCDMS SNOLAB, LZ, ADMX G3: R&D towards advanced WIMP and Axion experiments
Dark Energy	DES, DESI, LSST
CMB	SPT-3G, CMB-S4
Exploring the Unknown	Holometer, Pierre Auger
Detector R&D	R&D on new techniques for particle astrophysics experiments
Astrophysics Theory	Strong coupling with particle astrophysics experiments



Tremendous overlap between particle physics
& cosmic frontier detector technologies



Also at Fermilab



synergies with
nuclear physics

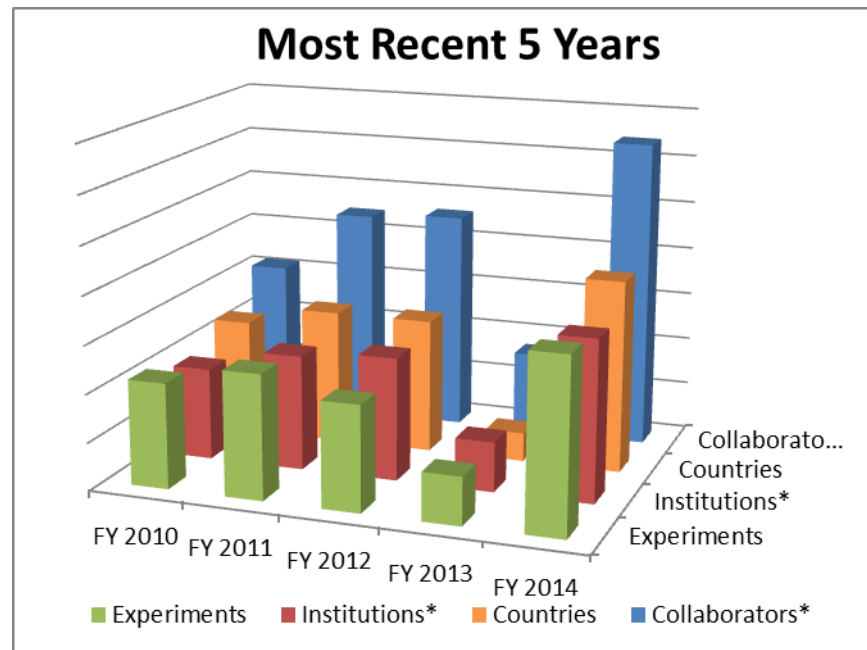
Fermilab testbeam program serves a broad community

Test	Description
T1015	Dual Realout Calorimetry
T1018	Spacordian
T1031	ATLAS Tile Electronics Test
T1036	High Rate Pixel Detector for CMS Upgrade
T1037	FIYSUB
T1041	CMS Forward Calorimetry R&D
T1042	Muon g-2 Straw Tracker
T1044	sPHENIX Calorimetry Tests
T1048	PHENIX Fast TOF
T1049	ATLAS large scale Thin Gap Chambers
T1054	sPHENIX PreShower
T1056	ATLAS DBM Module Qualification
T1058	Secondary Emission Calorimeter
T958	FP420 Fast Timing Group
T979	Fast Timing Counters for PSEC
T989	DAMIC
T992	SLHC sensor tests
T994	JASMIN

- 18 experiments
- 321 collaborators
- 84 institutions
- 20 countries

+

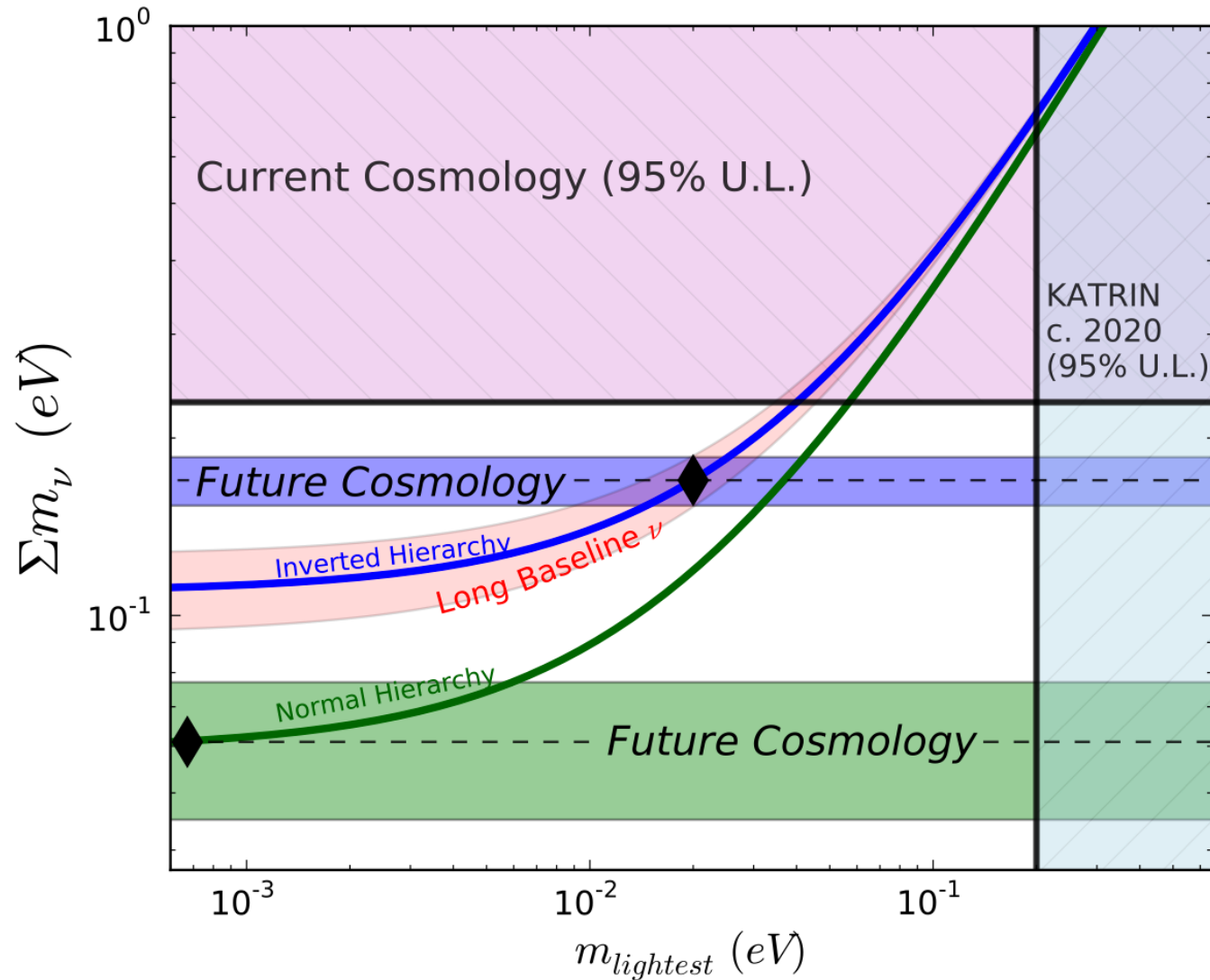
New beamline at
MCenter brought
into operation



Scientific Synergies

- Scientific frontiers are intertwined – a discovery in any one of them can affect thinking & expectations for all of them:
 - **Cosmic vs Neutrinos:** Increasingly precise constraints on relativistic degrees of freedom in the early universe c.f. increasingly precise & complete terrestrial neutrino measurements will test both the cosmological model & neutrino physics.
 - **Neutrinos/Muons vs LHC:** An unexpected discovery in flavor physics at either the LHC or at the Intensity Frontier would probably alter expectations & perhaps priorities for both intensity & energy frontiers.
 - **LHC vs Cosmic:** A discovery of new particle degrees of freedom at the LHC would impact our understanding of the early universe.
- There is also significant overlap between detector technologies & the associated R&D employed at all these scientific frontiers.

Scientific Synergies



On the timescale of DUNE & the CMB Stage-4 experiments, the combination of long-baseline neutrino + cosmological measurements is expected to either pin down the neutrino mass spectrum OR challenge the standard cosmology

Final remarks

- At Fermilab, we are excited by future prospects
 - Continue our commitment and leading roles in the LHC
 - Build a neutrino program that will attract the world community
 - Continue leading efforts in dark matter, cosmic surveys & CMB
 - Invest in the accelerator and detector technologies that we will need in the future

thankyou

