nEXO and the SLAC HEP program

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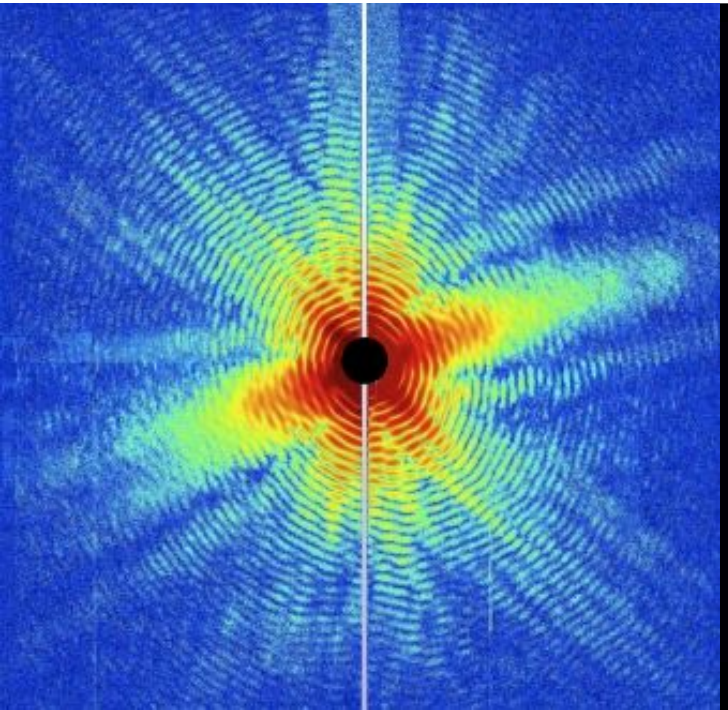
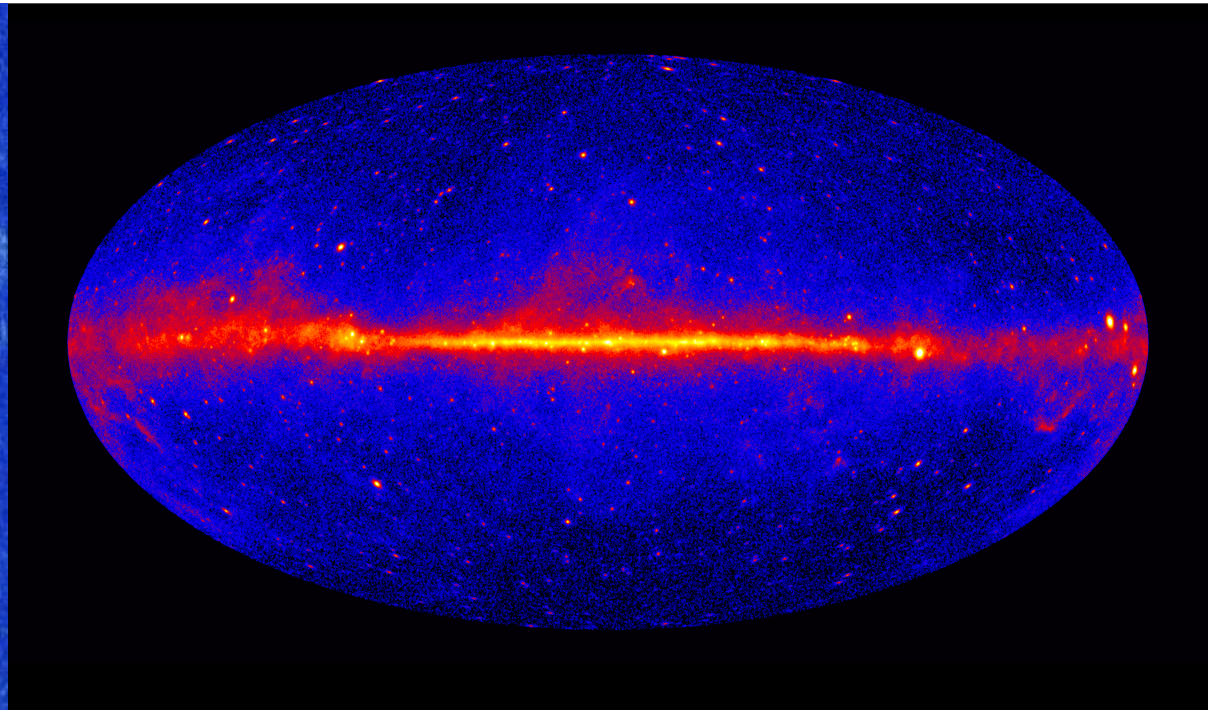
U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

The SLAC Mission

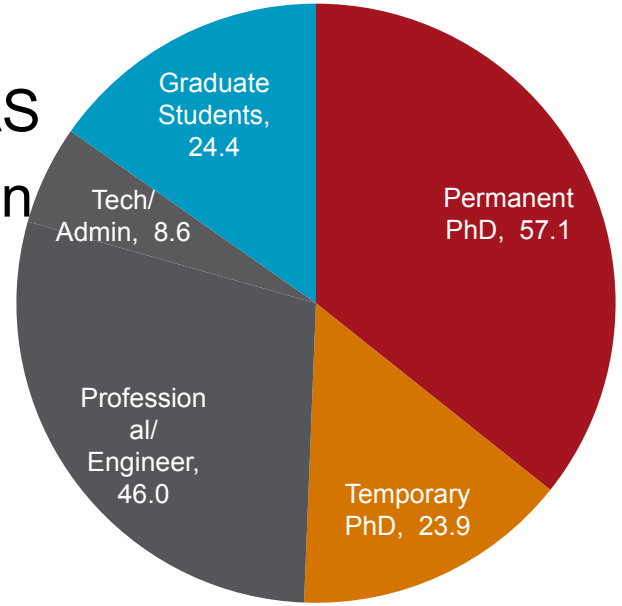
- Grow into the premier Photon Science Laboratory
  - Build and operate world leading facilities
  - Perform world leading science at these facilities
- Maintain our position as the premier accelerator laboratory
- Excel in strategic programs in particle physics, particle astrophysics and cosmology





PPA at a glance

- Energy frontier:
  - ☑ Exploring TeV-scale physics with ATLAS
  - ☑ Positioning community for future Lepton Collider
- Cosmic frontier:
  - ☑ Dark energy with DES and LSST
  - ☑ Dark matter with SuperCDMS, Fermi GST, CTA
- Intensity frontier:
  - ☑ Nature of the neutrino with EXO
  - ☑ Neutrino oscillations & CP violation with LBNE
  - ☑ Dark sector searches for heavy photons

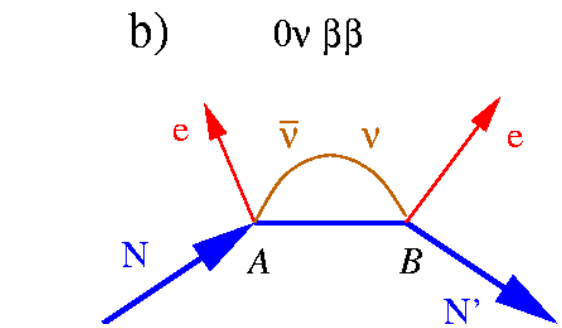


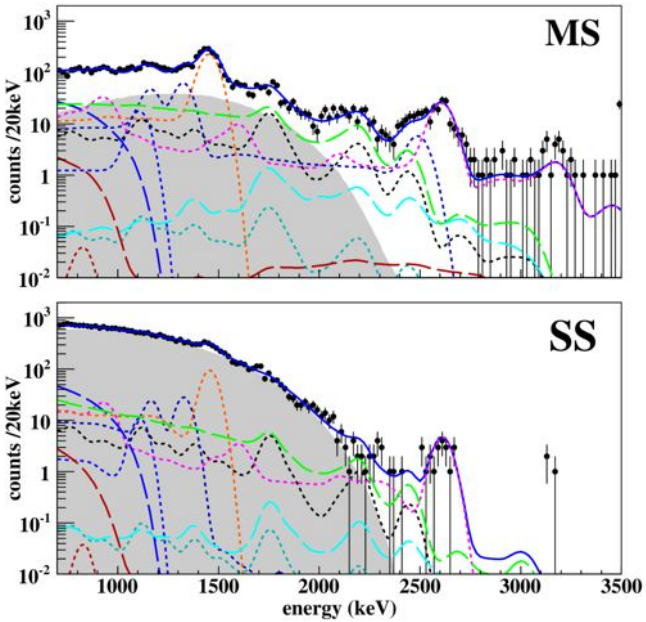
FY13: 160 FTE total
[FY11: 176 FTEs total]

29%:48%:23%
EPP, KIPAC, & theory

Nature of the neutrino with the EXO program

- Fundamental physics question
  - » Is the neutrino Majorana or Dirac?
  - » Is Lepton Number conserved?
  - » Crucial to origins of neutrino mass
- EXO-200 operating at WIPP
  - » Published results for $2\nu\beta\beta$ decay and limit on $0\nu\beta\beta$ decay
  - » Substantial further improvement anticipated with additional running
  - » Leading entry in this field, DOE HEP/NP supported
  - » Demonstrated powerful technique that is a scalable foundation for a next generation experiment



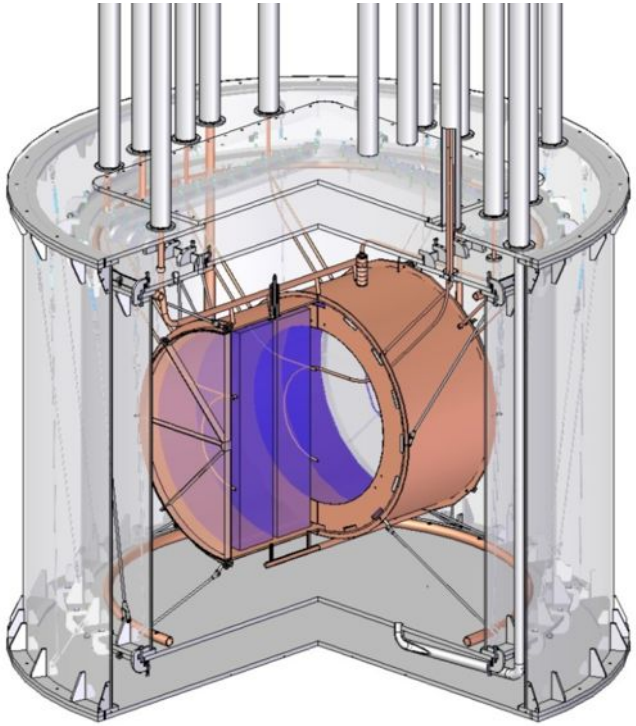


$T_{1/2}$ $0\nu\beta\beta$ > 1.6×10^{25} yr (90% CL)

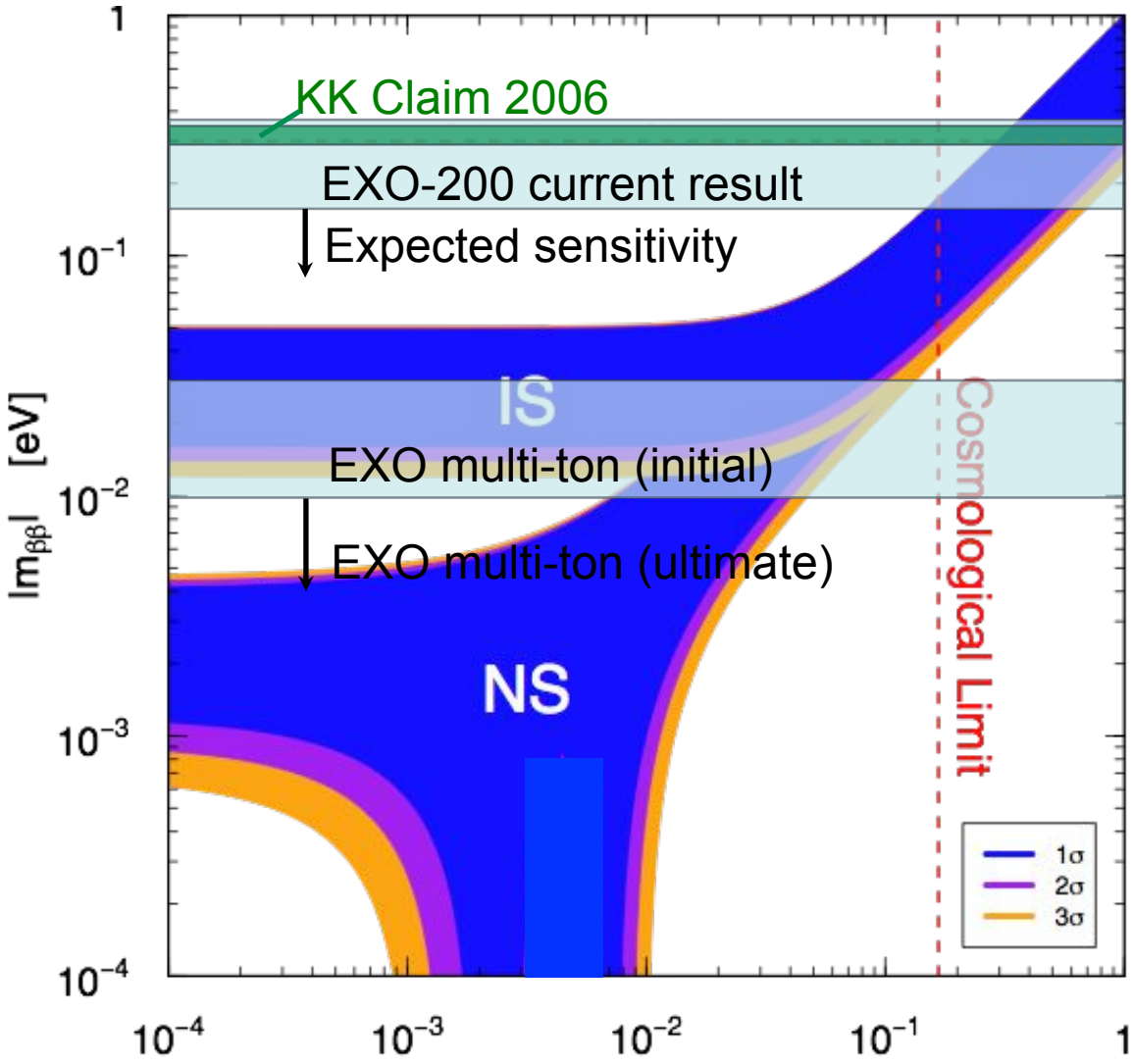
Developing plans for next generation experiment nEXO

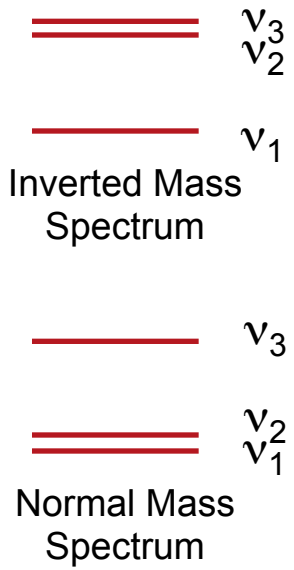
SLAC

- Concept for tonne-scale nEXO
  - » Working towards scaled up liquid TPC design, tagging as upgrade
  - » Physics goal: < 10 meV sensitivity
- R&D program needed to address scaling issues for known risk areas
  - » Cold electronics
  - » HV stability
  - » Photo-detection choice
  - » Simulation
  - » Pre-conceptual engineering and project development
- Three-year program aimed to a technology decision by end of 2015



Importance of 10 meV physics goal





Connections:
- Neutrino oscillations (LBNE) will determine hierarchy

Adapted from Bilenki, Giunti arXiv:1203.5250v1

SLAC support for EXO & nEXO

- Major role in most technical systems for EXO-200
  - » TPC, electronics, control & safety systems, Xenon systems, HFE systems, refrigeration systems, UPS, slow controls, DAQ software, offline/online data processing software
- Support for EXO-200 operations
  - » Providing Operations Manager, Chief Scientist, Technical Coordinator, and many Subsystem Managers
- Major role proposed in directed R&D addressing key technical risks for nEXO
  - » Providing Project Manager, Chief Scientist & key engineering leadership
- Working with EXO to define R&D and eventually nEXO project organization as a major part of our future program

Poised for the next steps

- SLAC currently has research and operations funding for EXO science and fractions of the technical team
  - » Very capable and experienced scientific and technical team has been assembled to build and operate EXO
- Successful DOE/HEP proposal for nEXO R&D funding will allow development of the future multi-tonne experiment
  - » $5M four-year DOE/HEP funding for simulation, cold electronics, HV testing, SiPM development, & pre-conceptual engineering
  - » Exploit optimally the expertise of the current team in developing an exciting science opportunity for HEP & NP
- DOE/NP steward for neutrinoless double-beta decay program
  - » Expect NSAC subpanel this fall as first step towards technology down select for next generation experiment
  - » nEXO is a leading contender for such an experiment