

# NEUTRINO PHYSICS FRONTIER

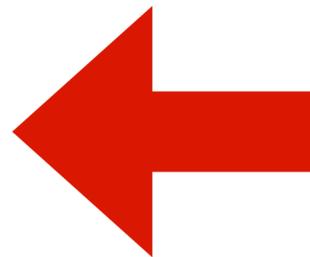
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*Mayly Sanchez and Josh Klein, Ana Machado, Dave Schmitz , Raimund Strauss  
(Instrumentation / Neutrino Physics Frontiers liaisons)*

# NEUTRINO PHYSICS FRONTIER

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- Conveners: Patrick Huber, Kate Scholberg, Elizabeth Worcester
- Neutrino Physics Frontier sub-groups:
  - NF01: Neutrino Oscillations
  - NF02: Sterile Neutrinos
  - NF03: BSM
  - NF04: Neutrinos from natural sources
  - NF05: Neutrino properties
  - NF06: Neutrino Interaction Cross Sections
  - NF07: Applications
  - NF08: Theory of Neutrino Physics
  - **NF09: Artificial Neutrino Sources**
  - **NF10: Neutrino Detectors**



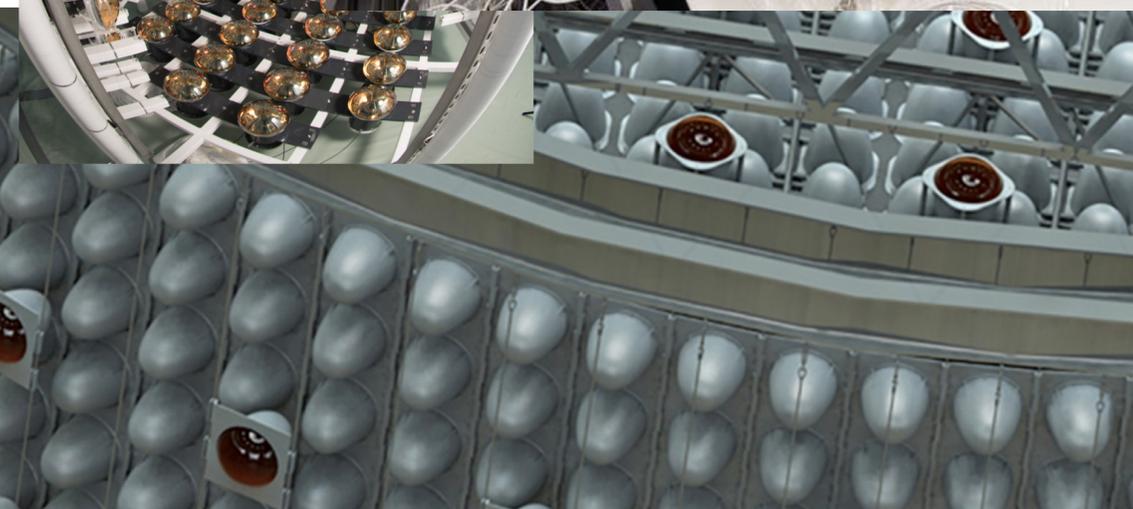
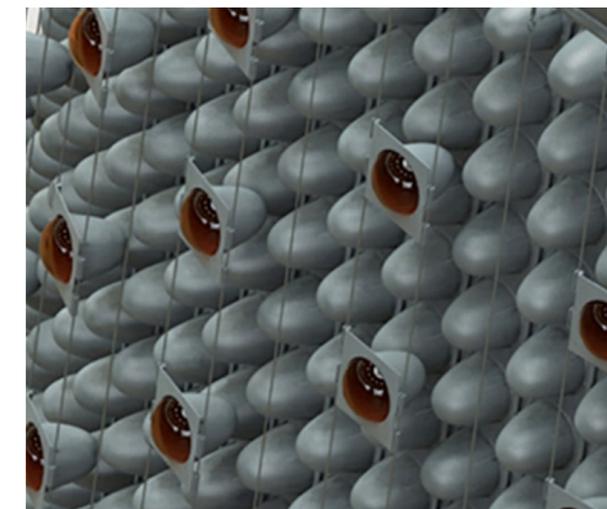
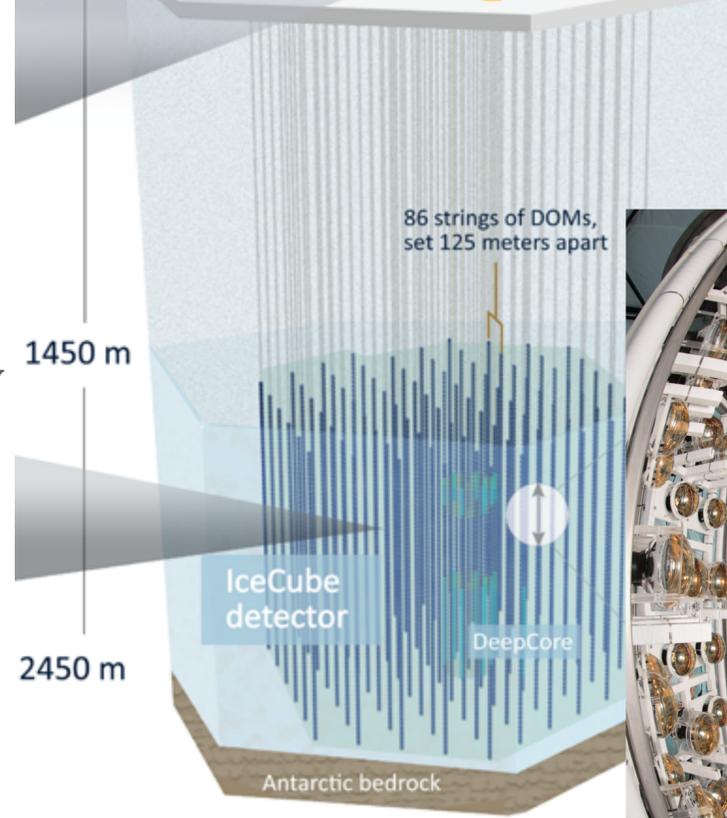
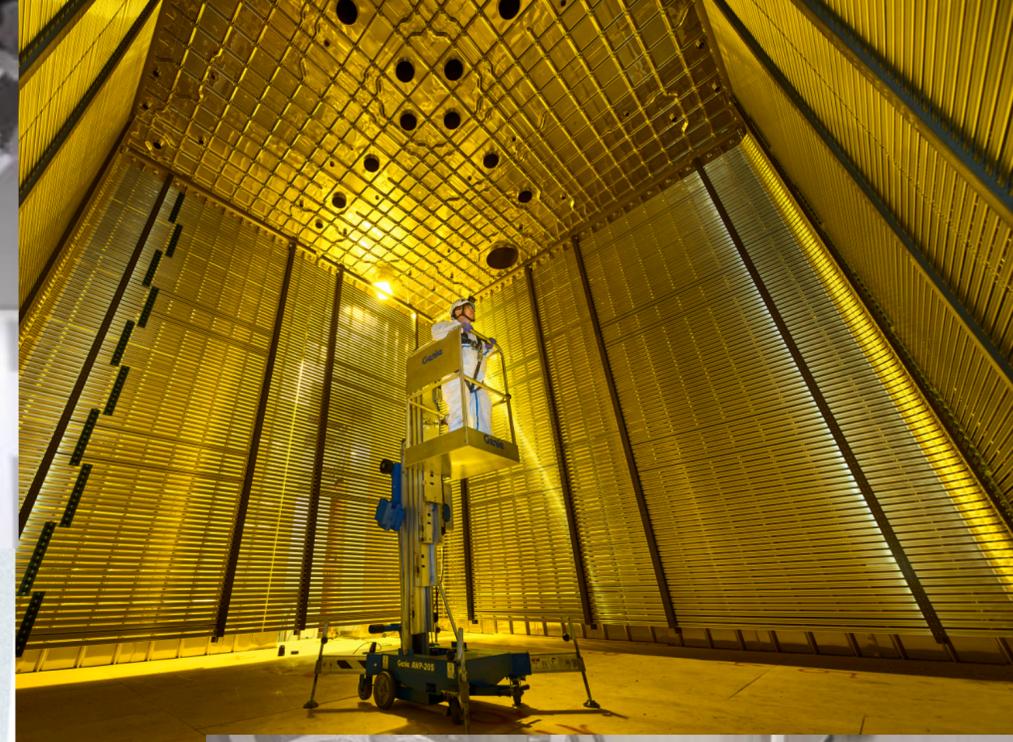
# NEUTRINO PHYSICS AND THE INSTRUMENTATION FRONTIER

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- Conveners: Patrick Huber, Kate Scholberg, Elizabeth Worcester
  - Neutrino Physics Frontier sub-groups:
    - NF01: Neutrino Oscillations
    - NF02: Sterile Neutrinos
    - NF03: BSM
    - NF04: Neutrinos from natural sources
    - NF05: Neutrino properties
    - NF06: Neutrino Interaction Cross Sections
    - NF07: Applications
    - NF08: Theory of Neutrino Physics
    - **NF09: Artificial Neutrino Sources**
    - **NF10: Neutrino Detectors**
  - Conveners: Phil Barbeau, Petra Merkel, Jinlong Zhang
  - Instrumentation Frontier sub-groups:
    - **IF1: Quantum Sensors**
    - **IF2: Photon Detectors**
    - **IF3: Solid State Detectors and Tracking**
    - **IF4: Trigger and DAQ**
    - **IF5: Micro Pattern Gas Detectors**
    - **IF6: Calorimetry**
    - **IF7: Electronics/ASICs**
    - **IF8: Noble Elements**
    - **IF9: Cross Cutting and Systems Integration**
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# NEUTRINO DETECTORS

- ▶ Neutrino Detectors come in many flavors:
  - ▶ Liquid Argon TPCs (wires/pixels/phases) and other TPCs
  - ▶ Water/Ice Cherenkov detectors
  - ▶ Liquid scintillation detectors: Water-based or hybrid scintillation/Cherenkov
  - ▶ Solid-state detectors
  - ▶ Segmented detectors
  - ▶ Plastic and Inorganic scintillator detectors
  - ▶ Cryogenic (mK) detectors
  - ▶ Bolometric detectors
  - ▶ etc...



# NEUTRINO DETECTORS

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- Example of enabling instrumentation technologies:
  - (IF01) New quantum sensors
  - (IF02) New photon sensors (new PMTs, SiPMs, LAPPDs etc.)
  - (IF02) New photon collection approaches (ARAPUCAs, dichroicons, etc.)
  - (IF06) New materials (water-based liquid scintillator, LiquidO, etc.)
  - (IF08) Noble Elements light and/or charge
  - (IF02/IF07) Fast Timing photosensors and electronics
  - (IF06/IF??) New purification techniques and new loading techniques (Gd, Te, Li, etc.)

and much more... (insert your cool new idea here)

# BRAINSTORMING A MATRIX...

Enabling Technologies	Detector Applications	Experiments	Neutrino Physics	Other applications
New photon sensors	LS, WC, LAr,LXe	DUNE, SBN,Theia, Jinping, nEXO, CUPID	LBL oscillations, Sterile, Solar, SN, Onbb	Medical imaging
Arapuca	LArTPCs, LAr scintillators, LXe scintillators	DUNE-FD, protoDUNE, SBND, LARIAT (Possibilities : DarkSide, DRIFT, LAGO SWIGO)	LBL oscillations, sterile, neutrino interactions	Cosmic rays, dark matter, medical imaging, solar
Dichroicons	WC detectors, LS detectors, segmented scintillators	ANNIE, WATCHMAN, Theia	Low E solar, Onbb, LBL,reactor antinu	Solar panels, medical imaging
New liquids	WbLS, slow fluors, cloudy scintillators	Jinping, JUNO, SNO+, Theia,K-Z,LiquidO	Solar, LBL,Onbb	...
Charge Pixels	LAr Tracking	DUNE-ND,DUNE-FD, SBN	LBL oscillations, SN neutrinos, sterile, neutrinoÂ	...
Low threshold (~eV)	Solid state detectors Cryogenic (mK) detectors	NEWS-G, RICOCHET, NUCLEUS, MINER, CONNIE, nuGEN, CONUS	CEvNS	Non-proliferation, X-ray spectroscopy
New purification techniques	Liq. Noble detectors, LS detectors, WbLS detectors, bolometers,	DUNE, SBN, nEXO, HK, SNO+, Theia, LEGEND, CUPID	Everything?	Low Bkd Counting
Isotopic loading	Neutron detection (Gd), CC interactions (Li), Onbb (Te,Xe)	S-K,HK,Theia,K-Z, SNO+,WATCHMAN	DSNB,solar, reactor antinu,SN Bursts, Onbb	...
More to come...				

# INTERFACE OF NEUTRINO PHYSICS AND INSTRUMENTATION FRONTIERS

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- The Neutrino Physics Frontier (in particular the NF10 subgroup) will cover the application of enabling technologies in the context of physics capabilities. Including those that are not obviously covered by the Instrumentation subgroups. Also it will cover integration of technologies for neutrino detection.
- The Instrumentation Frontier aims to cover detector technologies and R&D for future experiments including those in neutrino physics.
- At the interface we hope to advertise technological advances being driven by neutrino physics and contribute to cross-cutting discussion of these technologies.
- Plans for a joint workshop are being worked on. Stay tuned for the announcement!
- Input on new ideas, what might be missing and the discussions on the interface are welcome.

*When submitting your LOI do not forget to tag both the physics and the instrumentation R&D!*

**THOUGHTS/COMMENTS?**