

NF10: Photon-based Neutrino Detectors

Welcome!

Today's Goals:

- *Begin* community discussion on different approaches and needs
- Take a reasonably broad perspective relevant to ν detection
- Focus on enabling technologies and ideas, not sensitivities
- Discussion, not formal presentations

Q: Should there be a Whitepaper?

Relevant Letters of Intent

- NF10 had about 160 total including cross-references
- 49 of these fall into “Photon Detector” Category
- Some of these are sensitivity studies for detectors that already exist, are under construction, or that have TDRs
- Remaining LOIs fall into categories we will discuss today
- +things (suprising...) that never became LOIs

Today's Topics

- Cherenkov/scintillation separation
- New isotopic loading ideas and new target media
- New photon sensors and collectors and needs
- New readout, trigger, DAQ approaches and needs
- Needs for simulation and analysis
- Critical R&D facilities
- “Novel” detector ideas

Panel

- Steve Biller, Oxford
- Doug Cowen, Penn State
- Julieta Gruszko, UNC
- Tanner Kaptanoglu, LBNL
- Ben Land, U Penn
- Ana Amelia Machado, UNICAMP
- Juan Pedro Ochoa-Ricoux, UC Irvine
- Gabriel Orebi Gann, Berkeley
- Mayly Sanchez, Iowa State
- Bob Svoboda, UC Davis
- Minfang Yeh, BNL

Question 1

How do various methods of Cherenkov/Scintillation separation compare? What are the advantages and disadvantages of each?

- “lean” cocktails (e.g., WbLS, LAB, etc.) [NF081,NF098,NF133...]
- Slow fluors [NF015,NF060]
- Spectral sorting (“dichroicons”) [NF095,IF023,NF066]
- Filters/Red sensitive photon sensors
- Fast timing [NF071,NF133]
- Wavelength shifters (e.g., TPB in LAr for scintillation)
- Combinations...

Question 2

What are the most critical and interesting isotopic loading ideas, and what are interesting new developments in various new target media?

- Gd loading [NF097,NF128,NF034]
- Tellurium [NF059,NF013,NF083,NF125]
- Nanoparticles/quantum dots [NF159]
- ^6Li (for neutrons and PSD) [NF149,NF117]
- ^7Li (as a CC neutrino target)
- Perovskites (as wavelength-shifters)
- Xe doping (as a wavelength shifter in LAr)
- Xe doping (as a $\beta\beta$ isotope)
- Narrow-band wavelength shifters

Question 3

What are the most critical readout instrumentation, trigger, and DAQ issues for future detectors? (channel costs, "wet" or cold electronics, data volume, etc.?)

- Wet-end encapsulation [NF100]
- Analog Processing [IF052]
- Power-over-fiber
- “Digital” SiPMs
- Fast digitization?
- Machine learning-based triggers?
- AI shifters...?

Question 4

What are the highest priority simulation and analysis needs, and what are the options?

- RAT-PAC [CompF097]
- *Chroma* ray-tracer [CompF045]
- *Opticks* ray-tracer
- WCSim
- Machine Learning/AI approaches
- Reconstruction?

Question 5

What are the most interesting developments in photon sensors and collectors? What is needed?

- LAPPDs [NF178,NF133]
- MPPCs/SiPMs [NF035,NF159]
- Dichroicons [NF095,IF023,NF066]
- ARAPUCAs [NF123]
- Fast, large-area PMTs (e.g., R14688)
- HQE PMTs
- Charge/light pixels
- Red-sensitive PMTs (e.g., R6594)
- Nanowires
- ...?

Question 6

What are the critical R&D paths and facilities for next-generation photon-based experiments?

- CHESS [NF071]
- NuDOT [NF159]
- ANNIE [NF133]
- NEO/AIT [NF096]
- CERN Neutrino Platform/WCTE [IF151]
- CERN Neutrino Platform/WbLS-Testdetektor

Question 7

What novel detector ideas are out there?

- LiquidO [NF030]
- SLIPS [NF014]
- Theia [NF081]
- TRINITY [CF202]
- ICECUBE-2 [IF144]
- Pacific Ocean Neutrino Detector [NF020]
- JUNO-TAO [NF035]
- LArSCD (“liquid argon scintillation and Cherenkov detector”)