

IF08 Status and Plans

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IF08: Noble Element Topical Group Meeting

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Recap

- IF08 (Noble Elements) includes technology with Ar, Xe, He in any phase (gas, liquid, solid)
- We received 53 LOIs (19 with IF08 as primary)
- We organized several IF08 meetings to gather community inputs
 - If new ideas have emerged during the pause, please contact IF08 conveners to discuss where your idea will fit within our organization
- Before the pause, we proposed a plan to handle the inputs, leveraging the then-very-recent DOE Basic Research Needs (BRN) study activities
- It was agreed within the IF08 group to focus on *Executive Summaries* instead of White Papers

Topics

Topic 1

Topic 2

Key Concern / PRD	Subtopic	LOI	Title
Enhance and combine existing modalities to increase signal-to-noise and reconstruction fidelity			
	Pixels		
		IF2_IF8-	Multi-modal pixels for noble element time projection chambers
		IF7_IF8-	Q-Pix: kiloton-scale pixelated liquid noble TPCs
		IF7_IF8-	An R&D collaboration for scalable pixelated detector systems
	Charge Gain		
		CF1_CF1	Search for low mass WIMPs with spherical proportional counters
		IF8_IF0-	Electron multiplication in liquid argon TPC detectors for low energy rare event physics
		IF8_IF5-	Scintillating and quenched gas mixtures for HPGTPCs
	Low-threshold TPCs (electron counting)		
		IF8_IF0	R&D for low-threshold noble liquid detectors
		NF7_NF9	Noble liquids for the detection of CEvNS from artificial neutrino sources
	Increasing Light Collection		
		IF8_IF2	Cost-effective solution for increased light collection in noble-element detectors with metallic foils
		IF8_IF2	Wavelength-shifting reflector foils in liquid Argon neutrino detectors
		IF3_IF8-	COHERENT: Instrumentation development
		NF10_NI	Improving large LArTPC performance through the use of photo-ionizing dopants
Develop new modalities for signal detection			
	Ultra-low-threshold (cryogenic) detectors w/ quasi-particle sensing		
		IF1_IF8-	Calorimetric readout of a superfluid 4He target mass
		CF1_CF1	The TESSERACT dark matter project
		IF8_IF0-	A crystalline future for dual phase xenon direct detection instruments
	Barium Tagging		
		NF5_NF5	Barium tagging for a nEXO upgrade and future ^{136}Xe 0vbb detectors
		NF5_NF5	Barium tagging in Xenon gas for neutrinoless double beta decay
	Metastable fluids		
		IF8_IF0	Enabling the next generation of bubble-chamber experiments for dark matter, and neutrinoless double beta decay
		CF1_CF1	Metastable water: breakthrough technology for dark matter & neutrinos
	Directionality / micron-precision spatial reconstruction		
		IF9_IF8-	Dual-readout time projection chamber: exploring sub-millimeter pitch for directional dark matter
		IF8_IF0-	Towards directional nuclear recoil detectors: tracking of nuclear recoils in gas Argon TPCs
		IF8_IF1	Instrumentation and R&D for the Global Argon Dark Matter collaboration

Topics

Topic 3

Topic 4

Challenges in scaling technologies	
	High Voltage
	IF8_IF0- High voltage cable feed-through
	NF10_NI Development of LArTPC vertical drift solutions with PCB anode readouts for DUNE
	Sourcing / purifying noble gasses
	NF5_NF Kilotonne-scale Xe TPCs for 0vbb searches at 10^{30} yr half-life sensitivity
	NF5_NF DUNE-Beta: searching for neutrinoless double beta decay with a large LArTPC
	IF8_IF0- Charcoal-based radon reduction systems for ultra-clean rare-event detectors
	IF8_IF0- Using metal organic frameworks for Krypton and Radon removal in low-background Xenon
	IF8_IF9 Applications for underground Argon
	TPC with magnetic field
	IF8_IF9- Magnetizing the liquid Argon TPC
	NF2_NF ICARUS in the next decade
	Next-generation large scale detectors
	CF1_CF The exploitation of Xe large scale detector technology for a range of future rare event physics
	IF8_IF0- High-pressure xenon gas time-projection chambers for neutrinoless double-beta decay searches
	IF8_IF9 Instrumentation and R&D for the Global Argon Dark Matter collaboration
	NF10_NI DUNE near detector
	NF10_NI Low background kTon-scale liquid Argon time projection chambers
Improve the understanding of detector microphysics and characterization	
	Calibration
	IF8_IF6 Precision calibration of large LArTPC detectors
	IF8_IF0- NEST, The Noble Element Simulation Technique: a multi-disciplinary monte carlo tool and
	IF6_IF8- Nuclear recoil calibration techniques for dark matter and neutrino experiments
	IF8_IF9- Investigations of fundamental parameters of liquid argon for particle detection

Plan

- We have discussed the 4 topics with all LOI submitters a few times to ensure fully inclusive groupings
- We will organize 8 mini-symposia to address the 4 topics to facilitate groups within those topics to discuss and reach agreement on important focus areas for each topic
- Each topic group will work on an *Executive Summary (ES)* to summarize the inputs (these will be instead of White Papers who were not the most appropriate format for the diversity of research directions for each topics)
- The ES will be presented by the teams in the 2 final mini-symposia to allow further discussions
- We will use these ES as main input for the IF08 Topical Group Report contribution to the SNOWMASS report
 - Also consider input from ECFA Detector R&D Roadmap

Back up

Executive Summary Template

Topic

Authors

Executive Summary (~1 page)

Instrumentation requirements to achieve physics goals (list)

E.g., Achieve track resolution of better than X microns to see CEvNS with $E \sim XX$ keV
E.g., Reduce noise by an order of magnitude to achieve XX physics

Significant instrumentation challenges (list)

E.g., SiPM quantum efficiency maximum is currently XX

Relevant physics areas (e.g., low-mass DM, solar neutrino oscillations, CEvNS)

Relevant cross-connections (e.g., other topical groups, other white papers)

Further reading (e.g., reference for existing TDR, reference paper, etc.)

Potential Groupings

- These are outside our direct remit, but would be mentioned in the report briefly, referring to other sections

Primarily Covered by other Frontiers	Computing	
		CompF1 : Wire-cell toolkit
		CompF2 : Fast simulations for noble liquid experiments
		CompF3 : The future of machine learning in rare event searches
	New TPC Physics Applications	
		CF7_CF : A next-generation LAr TPC-based MeV Gamma ray instrument
		NF7_NF : Noble liquids for the detection of CEvNS from artificial neutrino sources
		NF6_NF : Inelastic neutrino-nucleus interaction measurements with COHERENT
		NF10_NF : Searches for proton-decay with additional signatures from nuclear deexcitations and with
	Facilities	
		UF0_UF : The Sanford underground research facility
		UF6_UF : Solution-mined salt caverns as sites for underground physics experiments
		NF9_NF : ORNL neutrino sources for future experiments
	NF6_NF : Neutrino opportunities at the ORNL second target station	