Proposal to handle inputs for IF8

Eric Dahl
Roxanne Guenette
Jen Raaf

Noble Element Topical Group Meeting
14 December 2020

Recap

- Ultimate goal of SNOWMASS is a report that includes the community views of where the field should go in the next 10 years

- For physics topics, sensitivity studies are useful to demonstrate future physics reach, but for Instrumentation, this is more challenging

- In addition, the recent BRN was also a huge community-led effort that we want to leverage (Noble Elements was a dedicated topic)

- After some discussions with other conveners, we came up with a proposal to make efficient progress towards the SNOWMASS report

Starting point: BRN

- The BRN made huge effort to cover all noble element-related instrumentation topics

- We will start from there:

Noble	PRD 4: Enhance and combine existing modalities to increase signal-to-noise and reconstruction fidelity
	PRD 5: Develop new modalities for signal detection
	PRD 6: Improve the understanding of detector microphysics and characterization
	PRD 25: Advance material purification and assay methods to increase sensitivity
	PRD 26: Addressing challenges in scaling technologies

Thrust 1: Improve and enhance light collection
Thrust 2: Improve and enhance charge collection
Thrust 3: Improve and enhance integration of charge and light collection
Thrust 4: Improve and enhance heat collection
Thrust 5: Enhance and develop doping and ion collection

We believe that these topics include every LOIs we have received

Proposed plan

- In order to avoid duplication of efforts from the BRN and to be efficient (and fully inclusive!) for the SNOWMASS report:

1. Take a look at the BRN to ensure that you feel and interpret the text as directly related to your LOI. If not, please let us know as soon as possible.

2. Decide if it makes sense to combine efforts with other LOIs (this will be discussed with the IF08 conveners to ensure coherent effort). See next slide.

3. Prepare a 1-2 pager IF08 Executive Summary (**USE TEMPLATE PLEASE**). These will include references to any existing material (arxiv, slides, papers). They will serve as the input to the report without necessary the need for White Papers.

4. If for any reasons, you would like to go ahead with a “White Paper”, you are welcome to (they may be useful for several purposes), but please complete step 3 anyway.

Potential Groupings

Key Concern / PRD	Subtopic	LOI	Title
Enhance and combine existing modalities to increase signal-to-noise and reconstruction fidelity			
	Pixels		
		IF2_IF8-I	Multi-modal pixels for noble element time projection chambers
		IF7_IF8-I	Q-Pix: kiloton-scale pixelated liquid noble TPCs
		IF7_IF8-I	An R&D collaboration for scalable pixelated detector systems
	Charge Gain		
		CF1_CF(	Search for low mass WIMPs with spherical proportional counters
		IF8_IF0-I	Electron multiplication in liquid argon TPC detectors for low energy rare event physics
		IF8_IF5-I	Scintillating and quenched gas mixtures for HPGTPCs
	Low-threshold TPCs (electron counting)		
		IF8_IF0_	R&D for low-threshold noble liquid detectors
		NF7_NF(	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 meta
		IF8_IF2_	Wavelength-shifting reflector foils in liquid Argon neutrino detectors
		IF3_IF8-I	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-I	Calorimetric readout of a superfluid 4He target mass
		CF1_CF(	The TESSERACT dark matter project
		IF8_IF0-I	A crystalline future for dual phase xenon direct detection instruments
	Barium Tagging		
		NF5_NF(	Barium tagging for a nEXO upgrade and future 136Xe 0vbb detectors
		NF5_NF(	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 neutri
		CF1_CF(	Metastable water: breakthrough technology for dark matter & neutrinos
	Directionality / micron-precision spatial reconstruction		
		IF9_IF8-I	Dual-readout time projection chamber: exploring sub-millimeter pitch for directional dark
		IF8_IF0-I	Towards directional nuclear recoil detectors: tracking of nuclear recoils in gas Argon TP(

Potential Groupings

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-I	Using metal organic frameworks for Krypton and Radon removal in low-background Xer
		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 explcitation of Xe large scale detector technology for a range of future rare event ph
		IF8_IF0-I	High-pressure xenon gas time-projection chambers for neutrinoless double-beta decay s
		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 ar
		IF6_IF8-	Nuclear recoil calibration techniques for dark matter and neutrino experiments
		IF8_IF9-(	Investigations of fundamental parameters of liquid argon for particle detection

Potential Groupings

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

Primarily Covered by other Fron			
	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_NI	Searches for proton-decay with additional signatures from nuclear deexitations and with
	Facilities		
		UF0_UF	The Sanford underground research facility
		UF6_UF	Solution-mined dalt 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

Next Steps (subject to change with ongoing delaying discussion)

- Undergoing discussion of pausing/delaying process would directly affect this plan (to be determined soon)

- Series of IF08 Topical Group meetings to discuss the grouped topics (see previous slides). There are 4 groups of topics and we plan 8 bi-weekly meetings (2 in Jan., 2 in Feb., 1 Mar. (overlap with CPAD), 2 Apr., 1 May).

- In mid-May, we will have met and discussed with all the groups (and all LOI submitters) twice and everyone will be able to proceed with their executive summaries which will be presented in IF08 meetings in May and June, to be submitted by July.

- For people going ahead with “White Papers”, please try to coordinate within your topic group (we can use bi-weekly to organise this). If you are not able to do so, at least coordinate for the Executive Summaries, as these need to have a coherent pitch.

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~ 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.)

Discussion…

- Comments/suggestions/concerns on this plan?