NF07 Report Outline & Feedback

N. Bowden, J. Link, W. Wang
Feb 25, 2022

NF07 - Applications Topical Group

NF07 - Scope

Adapted from the NF07 Snowmass wiki page:

- As our knowledge of neutrino physics and detection capabilities improve, the door is opened to using the unique nature of the neutrino to access information where it is otherwise difficult or impossible.
- Technology and skills that neutrino physicists develop are often pushing the boundaries of what can be achieved and may find use in other fields.
- NF07 will explore and develop the overlap between applications and active fields of research within the neutrino community, while also highlighting areas where stronger connections could be developed with other disciplines, user communities and sponsor agencies.

Based on the LOI process the specific topics NF07 addresses are:

- Nuclear reactor monitoring; using neutrinos emitted in fission for treaty verification and instrumentation
- Nuclear Data; using reactor neutrinos to improve the precision and accuracy of related nuclear data
- Applications of technology developed for HEP experiments
- Neutrino and HEP physics as a workforce pipeline for nuclear nonproliferation and security organizations

NF07 - LOIs

- 41 LOIs tagged or relevant for ‘Applications’
  - Several clear thematic groupings
  - Largest overlap with:
    - NF02 - Anomalies 21/41
    - NF09 - Artificial Neutrino Sources 24/41
    - NF10 - Neutrino Detectors 28/41

Grouping	# of LOIs
Synergies and Utility	3
Reactor Flux and Spectrum	3
Workforce Pipeline	2
Projects / Tech Development Efforts	
‘CEvNS’	8
‘Near-Field Inverse Beta Decay’	12
‘Far-Field Inverse Beta Decay’	9

NF07 - Relevant White Papers

"HEP Physics Opportunities Using Reactor Antineutrinos"

- Broad summary of all HEP opportunities at reactors. Detailed description of reactor flux & nuclear data. Application synergies described across all topics

"A call to Arms Control: Synergies between Nonproliferation Applications of Neutrino Detectors and Large-Scale Fundamental Neutrino Physics Experiments"

- Synergies specific to large experiments

"Future Advances in Photon-Based Neutrino Detectors" (NF10)

- Includes synergistic photon-based tech development activities

"Coherent elastic neutrino-nucleus scattering: Terrestrial and astrophysical applications"

If other relevant whitepapers, e.g.specific to Experiments or Tech Development efforts, are in development - **please let us know!**

NF07 - Report Outline

NF07 - Report Outline

Provide applications context for HEP community:

- *where could neutrinos find real-world application*
- *how could these applications be implemented technologically*

NF07 - Report Outline

Draw direction connections to topics relevant to Snowmass / Particle Physics community

- *Physics topics accessible with interaction channels and detectors appropriate for potential applications*
- *Organize along 'implementation' axis; cuts across multiple NF Topical groups*

NF07 - Report Outline

Draw direction connections to topics relevant to Snowmass / Particle Physics community

- *Describe technology development topics with mutual benefit*
- *Highlight workforce development opportunities in both directions and opening of alternative career pathway via applications topic*

NF07 - Report Outline

Suggested next steps to realize the synergies between Particle Physics and Applications

- *Describe opportunities for inter-agency coordination*
- *Encourage development of end-user engagement mechanisms to foster mutual understanding and provide guidance to technical R&D*
- *Describe current application R&D efforts and identify specific coordination opportunities*

Questions and Feedback?

Backup - LOIs

Thematic Groupings - ‘CEvNS’

- Efforts developing very low threshold detectors that may be able to detector reactor neutrinos via CEvNS

CF189	CYGNUS: A nuclear recoil observatory with directional sensitivity
CF012	Metastable Water: Breakthrough Technology for Dark Matter & Neutrinos
NF157	Magnetic Microcalorimeters for CEvNS Detection
NF017	Neutrino Physics with Noble Liquid Bubble Chambers
NF095	Future COHERENT physics program at the SNS
NF104	MIvER CEvNS Experiment - A Tool for Discovery of New Physics and Applied Reactor Monitoring
NF067	Far-Future COHERENT physics program at the SNS
NF011	Noble Liquids for the Detection of CEvNS from Artificial Neutrino Sources

Thematic Groupings - ‘Far-Field’

- large, underground experiments and R&D efforts - detect reactor neutrinos via IBD at medium-to-long baselines

NF185	Reactor and Geo Neutrinos at SNO+
NF186	Detecting Antineutrinos from Distant Reactors using Pure Water at SNO+
NF099	Neutrino Detection and Ranging
NF096	The deployment of kiloton-scale neutrino detectors at the Advanced Instrumentation Testbed in Boulby England
NF100	Encapsulation of Photosensors in kton–Mton Scale Neutrino Detectors
NF098	A kiloton-scale water-based liquid scintillator detection concept for the Advanced Instrumentation Testbed in Northern England
NF097	A kiloton-scale gadolinium-doped water detection concept for Neutrino Experiment One at the Advanced Instrumentation Testbed in Northern England
NF095	Antineutrino detection at THEIA
NF201	Ocean Bottom Detector

Thematic Groupings - 'Near-Field'

- small, shallow or surface experiments and R&D efforts - detect reactor neutrinos via IBD (mostly) at short baselines

NF179	NuLat: A Compact Anti-Neutrino Detector
NF075	CHANDLER: A Technology for Surface-level Reactor Neutrino Detection
NF168	Forthcoming Science from the PROSPECT-I Data Set
NF169	The Expanded Physics Reach of PROSPECT-II
NF035	The JUNO-TAO Experiment
NF030	LiquidO: a Novel Approach to Detecting Neutrinos
NF118	3D-projection Scintillator Tracker (3DST) in SAND, a DUNE Near Detector Subsystem
NF180	Neutrino Physics and Nuclear Security Motivations for the Continued Development of Organic Scintillators with Pulse Shape DiscriminationCapability and 6 Li-doping
NF149	An Application of Pulse Shape Sensitive Plastic Scintillator - Segmented AntiNeutrino Directional Detector (SANDD)
NF153	Measuring Inelastic Charged- and Neutral-Current Antineutrino-Nucleus Interactions with Reactor Neutrinos
NF108	ORNL Neutrino Sources for Future Experiments
NF184	ROADSTR: a Mobile Antineutrino Detector Platform for enabling Multi-Reactor Spectrum, Oscillation, and Application Measurements

‘Reactor Flux and Spectrum’

- Improving Reactor Flux and Spectrum knowledge

NF086	Legacy of the Daya Bay Reactor Antineutrino Experiment
NF140	High-Resolution Multiphysics Reactor Modeling for the Antineutrino Source Term
NF117	Prediction and Measurement of the Reactor Neutrino Flux and Spectrum

‘Pipeline’

- Importance of small experiments for training

CommF48	*Training a Diverse HEP Workforce in Small Neutrino Experiments*
NF135	Neutrino Town Hall Input

‘Synergies and Utility’

- Describing the utility case for nonproliferation applications and synergies with HEP topics

NF183	PROSPECT: a Case Study of Neutrino Physics Research providing Enabling Capabilities for Nuclear Security Applications
NF128	Mutual Benefits derived from the Application of Neutrino Physics to Nuclear Energy & Safeguards
NF136	Nu Tools: Exploring Practical Roles for Neutrinos in Nuclear Energy and Security