Snowmass2021 - Letter of Interest

LOI: Neutrino Town Hall Input

NF Topical Groups:

■ (NF1) Neutrino oscillations
■ (NF2) Sterile neutrinos
■ (NF3) Beyond the Standard Model
■ (NF4) Neutrinos from natural sources
■ (NF5) Neutrino properties
■ (NF6) Neutrino cross sections
■ (NF7) Applications
■ (TF11) Theory of neutrino physics
■ (NF9) Artificial neutrino sources
■ (NF10) Neutrino detectors
■ (Other) Cosmic Frontier, Instrumentation Frontier, Underground Facilities Frontier, Computing Frontier, Community Engagement Frontier

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Abstract: This is a brief summary of several points made at the Neutrino Town Hall Meeting on July 17, 2020, for the Snowmass record.

The Neutrino Town Hall meeting was held by Zoom on July 17, 2020. More than 400 people registered and about 250 people were in attendance at the peak. The format included a few introductory talks, followed by panels organized around three general themes. For each panel, several panelists were invited to comment, prompted by a few specific questions developed by NF conveners, as well as some questions that were collected from community members via the meeting registration form. These comments were followed by comments from community members.

The slides and recording of the meeting are available at https://indico.fnal.gov/event/43581/.

Below we summarize several common themes among the comments. These notes are in no way meant to be comprehensive.

1 Physics goals and motivation

Questions to spark discussion were:

- How are the limitations of existing neutrino sources and detectors affecting our physics reach?
- What kinds of new physics searches should we prioritize, especially considering that there are no decisive hints regarding what lies beyond the standard model from other fundamental physics experiments?
- What can neutrino physics do for other fields of science and technology?

Selected summarized/synthesized comments:

- The importance of improved models and measurements of neutrino interaction cross-sections, particularly for heavy nuclei, as well as the continued importance of event generators incorporating these improvements was emphasized. The need for collaboration across the boundary of nuclear and particle physics was highlighted. The role of NuSTEC in coordinating these activities and pushing for joint funding was discussed.
- Community interest in experimental sensitivity to ν_τ measurements was expressed.
- Community interest in developing higher power beams and beams with reduced systematics, as well as other alternative sources for neutrinos, for next-next generation experiments was expressed.
- The community expressed interest in finding applications or extensions of our work that would be of more direct benefit to society. There was extended discussion in the Zoom comments of ways to contribute to COVID research.

2 Theory and neutrinos

Questions to spark discussion were:

- What is the theory motivation to go beyond the current program?

- How can theorists best support the experimental program?

Selected summarized/synthesized comments:

- A community concern was expressed about the placement of NF08 Neutrino Theory inside NF and if it would be more visible if it were at home in theory frontier (TF). In a follow-up to this concern the TF and NF conveners met and in consultation with the NF08 topical conveners it was agreed to move NF08 into the TF as TF11.

3 Structure of the program

Questions to spark discussion were:

- How do we maintain the necessary breadth of physics, including smaller experiments, auxiliary measurements, and activities within larger projects?
- How can we ensure that experimental and theoretical efforts have enough resources to pursue questions of significant interest, even if those questions cross the boundaries of Frontiers or funding umbrellas?

Selected summarized/synthesized comments:

- Small experiments are important; there must be a balance between large and small experiments for the health of the field. Small experiments are important for training. Large experiments should not take all the oxygen from small ones. Although large projects are necessary for project, we need to be careful also to achieve the breadth that we would like. The Snowmass process should consider what we value in terms of physics breadth and scale breadth. However, we need to avoid replication of experiments and must make sure that experiments are of high quality.
- "Repurposing" can be pursued, i.e., we should think how to make use of large experiments for a breadth of physics topics. Technology developments can also have broad applications.
- Data should be open as much as possible, and comprehensive data releases should be shared.
- We should encourage strong collaboration with nuclear physics, as well as adjacent fields such as nuclear non-proliferation and condensed matter physics.
- A specific example of an area addressing critical neutrino physics questions for which there are funding stewardship divisions in the U.S. is the area of neutrinoless double beta decay searches. To fully cover the inverted mass ordering region, experiments larger than current neutrino and dark matter experiments will be needed, which will require new thinking, and broad collaboration between nuclear and particle physicists as well as the respective agencies.

4 Acknowledgements

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