Draft Resolutions

Nuclear sciences in the US boasts a vibrant portfolio of experimental and theoretical research that probes physics beyond the Standard Model (BSM) and sheds light on a number of important open questions, such as: How do neutrinos get masses and what are their values? Why is there more matter than antimatter in the present universe? Are there new forces in nature, weaker than the weak force? What is the nature of dark matter? The ``targeted program of fundamental symmetries and neutrino research'' established in previous LRPs has generated world-leading results and created a number of compelling opportunities for future discovery. In order to maintain the world-class program and expand U.S. leadership, the FSNN community has identified the following priorities:

1) **We recommend the timely construction of ton-scale neutrinoless double beta decay experiments with multiple isotopes.**

This will enable a US-led program of discovery science, jointly with international partners, that could elucidate the nature of neutrinos and fundamentally alter our understanding of the origin of mass and matter in the Universe. Integral part of this endeavor is a robust research program in theory and R&D exploring multiple promising isotopes and technologies with sensitivity beyond the inverted mass ordering. These could provide further insight into the neutrinoless double beta decay mechanism in the case of a discovery by the ton-scale experiments.

2) **We recommend increased investments in targeted initiatives with unique sensitivity to violation of time reversal invariance, interactions beyond the Standard Model, and the neutrino masses.**

We highlight the most compelling scientific opportunities:

a. The expeditious **completion** of high-impact experimental campaigns, including the nEDM@SNS, the world's most ambitious search for the neutron electric dipole moment (EDM); and MOLLER@JLab, planning the most precise low energy measurement of a purely leptonic weak neutral current interaction

b. Realizing the full potential of the existing experimental program to address recent questions surrounding CKM unitarity, substantially improve constraints on CP violation, and extend the precision frontier's capability to discover BSM physics.

c. Support of R&D efforts targeting emerging opportunities with demonstrated scientific cases. These include the next generation measurements of the absolute neutrino mass (Project 8), lepton flavor universality in the weak interactions (PIONEER), search for new neutral current interactions (SoLID), as well as EDM searches enabled by FRIB.

3) **We recommend pursuing a set of initiatives aimed at enlarging and supporting the nuclear theory efforts in FSNN, which include phenomenology, effective field theories, lattice QCD, and nuclear structure.**

Key elements of this program, essential to keep pace with the growing experimental effort and fully exploit the emerging physics opportunities, include:

a. Increased support of collaborative efforts such as Theory Hubs, Topical Collaborations, and Physics Frontier Centers, to tackle the multi-scale problems relevant to FSNN discovery science.

b. The creation of a faculty bridge program to enlarge and support the FSNN theoretical workforce with procedures and best practices that develop and sustain a diverse, equitable, welcoming, and inclusive workforce and culture.

4) **We recommend enhanced investment in the growth and development of a diverse, equitable workforce.**

The nuclear-physics research program serves an important role in developing a diverse STEM workforce for the critical needs of the nation. Creating and maintaining an inclusive, equitable, productive working environment for all members of the community is a necessary part of this development.

● Part of recruiting and maintaining a diverse workforce requires treating all community members with respect and dignity. Supporting the recent initiatives by the APS and DNP to develop community-wide standards of conduct, we recommend that experimental and theoretical collaborations establish and/or adopt enforceable conduct standards. The enforcement of such standards is the combined responsibility of all laboratories, theoretical and experimental collaborations, conference organizers, and individual investigators supported by the nuclear physics research program.

● We recommend development and expansion of programs that enable participation in research by students from under-represented communities at National Labs and/or Research Universities, including extended support for researchers from minority-serving and non-PhD granting institutions.

● We recommend development and expansion of programs to recruit and retain diverse junior faculty and staff at universities and national laboratories through bridge positions, fellowships, traineeships, and other incentives.

5a) **Endorsements: Computational Nuclear Physics**

Accurate theoretical calculations, with uncertainties reliably quantified, are essential to the planning of, and the interpretation of the results of, the FSNN experimental program, especially its flagship program in searches for a neutrinoless double-beta decay. Such calculations are enabled by adequate high-performance computing resources. Therefore, we endorse the Computational NP workshop resolutions:

COMPUTATIONAL WORKSHOP RESOLUTIONS
High-performance computing is essential to advance nuclear physics on the experimental and theory frontiers. Increased investments in computational nuclear physics will facilitate discoveries and capitalize on previous progress. Thus, we recommend a targeted program to ensure that the utilization of ever-evolving HPC hardware via software and algorithmic development, which includes taking advantage of novel capabilities offered by AI/ML.
The key elements of this programs are:
1. Strengthen and expand programs to support immediate needs in HPC and AI/ML, and also to target development of emerging technologies, such as quantum computing, and other opportunities.
2. Take full advantage of exciting possibilities offered by new hardware and software and AI/ML within the nuclear physics community through educational and training activities.
3. Establish programs to support cutting-edge developments of a multi-disciplinary workforce and cross- disciplinary collaborations in high-performance computing and AI/ML.
4. Expand access to computational hardware through dedicated and high-performance computing resources.

We add that dedicated software- and algorithm-development programs, such as successful DOE SciDAC programs, and concerted community efforts, following e.g., the USQCD model, for acquiring and maintaining access to leadership-class facility resources will be critical to meet the FSNN experimental-program's needs in a timely manner.

5b) **Endorsements: Nuclear data.**

Nuclear data play an essential role in all facets of nuclear science. Access to reliable, complete and up-to-date recommended nuclear data is crucial for the fundamental nuclear physics research enterprise, as well as for the successes of applied missions in the areas of defense and security, nuclear energy, space exploration, isotope production, and nuclear medicine diagnostics and treatments. It is imperative to maintain an effective US role in the stewardship of nuclear data.

- We endorse support for identifying and prioritizing opportunities to advance and enhance the stewardship of nuclear data and efforts to build a diverse, equitable and inclusive workforce that maintains the currency and reliability of the nuclear databases.
- We recommend prioritizing opportunities that enhance the currency and quality of recommended nuclear data and its utility for propelling scientific progress in fundamental symmetry, neutrino and neutron projects and the broader nuclear science program.
- We endorse identifying interagency-supported crosscutting opportunities for nuclear data with other programs that enrich the utility of nuclear data in both science and society.