Nuclear Structure, Reactions, and Astrophysics Town Meeting

Resolutions

Preamble

Nuclear science is at a unique moment: experimental facilities and astronomical observatories promise a wealth of data in the next decade, while advances in theory and computing, together with emerging artificial intelligence, machine learning, and quantum computing technologies provide unprecedented opportunities for fundamental discoveries with broad implications throughout physics and astrophysics. The low-energy nuclear science community is developing a predictive understanding of atomic nuclei and their interactions; elucidating the chemical history of the Universe; revealing the fingerprints of nuclear structure, decays and reactions in astrophysical processes; using atomic nuclei as laboratories to test nature's fundamental symmetries; and providing accredited data, tools, and related technologies to advance important societal applications of nuclear science. Investments in national user and university-based facilities delivering beams of stable and rare isotopes, state-of-the-art instrumentation, and initiatives have laid the foundation for the scientific output of our field for the next decade. A healthy and robust research program, upgrades and new instruments, and the development and retention of a diverse and equitable workforce are now needed to capitalize on these investments and accelerate progress toward achieving the broad science goals of our community.

Affirmation

Our community affirms in the strongest possible terms its commitment to foster a diverse and equitable workforce and to support and respect diversity in all its forms. Individually and collectively we commit to ensuring an inclusive and accessible environment for all and taking action if these values are not being upheld.

Resolution 1

The highest priority for low-energy nuclear physics and nuclear astrophysics research is to maintain U.S. world leadership in nuclear science by capitalizing on recent investments. To this end, we strongly support:

- Robust theoretical and experimental research programs and the development and retention of a diverse and equitable workforce;
- The optimal operation of the FRIB and ATLAS national user facilities;
- Investments in the ARUNA facilities, and key national laboratory facilities;
- The FRIB Theory Alliance and all its initiatives.

All are critical to fully realize the scientific potential of the field and foster future breakthroughs.

Resolution 2

The science case for an energy upgrade of FRIB to 400 MeV/u is compelling. FRIB400 greatly expands the opportunities in the field. We strongly endorse starting the upgrade during the upcoming Long Range Plan period to harness its significant discovery potential. We support instrument developments, including the FDS and ISLA, now that GRETA and HRS are underway. These community devices are important to realize the full scope of scientific opportunities.

Resolution 3

Computing is essential to advance all fields of nuclear science. We strongly support enhancing opportunities in computational nuclear science to accelerate discoveries and maintain U.S. leadership by:

- Strengthening programs and partnerships to ensure the efficient utilization of new high-performance computing (HPC) hardware and new capabilities and approaches offered by artificial intelligence/machine learning (AI/ML) and quantum computing (QC);
- Establishing programs that support the education, training of, and professional pathways for a diverse and multidisciplinary workforce with cross-disciplinary collaborations in HPC, AI/ML, and QC;
- Expanding access to dedicated hardware and resources for HPC and new emerging computational technologies, as well as capacity computing essential for many research efforts.

Resolution 4

Research centers are important for low-energy nuclear science. They facilitate strong national and international communications and collaborations across disciplines and across theory and experiment. Interdisciplinary centers are particularly essential for nuclear astrophysics to seize new scientific opportunities in this area. We strongly endorse a nuclear astrophysics center that builds on the success of JINA, fulfills this vital role, and propels innovation in the multi-messenger era.

Resolution 5

Nuclear data play an essential role in all facets of nuclear science. Access to reliable, complete and up-to-date nuclear structure and reaction 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 medical applications. It is thus imperative to maintain an effective US role in the stewardship of nuclear data.

- We endorse support for the compilation, evaluation, dissemination and preservation of nuclear data and efforts to build a diverse, equitable and inclusive workforce that maintains reliable and up-to-date nuclear databases through national and international partnerships.
- We recommend prioritizing opportunities that enhance the prompt availability and quality of nuclear data and its utility for propelling scientific progress in nuclear structure, reactions and astrophysics and other fundamental physics research programs.
- 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.

Conclusion

The low-energy nuclear science community comprises a dynamic and skilled workforce. The members of this community, with diverse educational backgrounds and research interests, assembled at Argonne National Lab during its first snowstorm of the season to discuss exciting science from the past seven years and to look to the future. We agree that a broad research program at a diverse array of institutions is essential to enable discovery in an era when a wealth of new data is expected. The sum of the large- and small-scale facilities, together with overarching theory, computing, and data efforts, and the development and growth of a world-leading, diverse workforce will ensure the vitality of our community. FRIB and its key FRIB400 upgrade will provide access to the extremely neutron-rich isotopes required to build a more complete picture of nuclear matter and its role in the Cosmos. ATLAS provides a complementary suite of beams and tools the research community needs. The ARUNA laboratories offer unique, specialized facilities and research opportunities, while providing outstanding training for the next generation of nuclear scientists. Primarily undergraduate and minority serving institutions are essential pillars for developing a robust and diverse workforce. Key national laboratory facilities contribute targeted capabilities and programs. Instruments and techniques are developed and shared among the community. The FRIB-TA, a future nuclear astrophysics center that builds on the success of JINA, and Nuclear Data efforts tie the research to the broader goals of our field and are essential components. Investments in these endeavors are necessary to maintain U.S. leadership worldwide in low-energy nuclear science.