

*Long-Range Plan Process:
Fundamental symmetries, neutrons,
neutrinos, and astrophysics*

Chicago, September 28-29

Hamish Robertson,
CENPA, University of Washington

Town meetings gather input

- **Computational Theory**, Washington DC, July 14-15
- **Education and Innovation**, East Lansing MI, August 6-8
- **Nuclear astrophysics and low-energy nuclear physics**, College Station TX, August 21-23
- **QCD**, Philadelphia, September 13-15
- **Fundamental symmetries, neutrons, neutrinos, and astrophysics (“FSnu”)**, Chicago, September 28-29

Building on a solid foundation

- http://science.energy.gov/~media/np/nsac/pdf/docs/nuclear_science_low_res.pdf (2007 Long Range Plan)
- http://science.energy.gov/~media/np/nsac/pdf/docs/NSAC_NeutronReport.pdf (2012 Neutron Report)
- http://science.energy.gov/~media/np/nsac/pdf/20130201/2013_NSAC_Implementing_the_2007_Long_Range_Plan.pdf (2013 “Tribble Report”)
- http://www.nap.edu/catalog.php?record_id=13438&utm_expid=4418042-5.krRTDpXJQISoXLpdo-1Ynw.0&utm_referrer=http%3A%2F%2Fwww.nap.edu%2Ftopics.php%3Ftopic%3D411 (NAS Decadal Survey 2013 -- Nuclear Physics: Exploring the Heart of Matter)

Talks

- Rapporteurs present the topics of the field.
- Speakers:
 - Please adhere strictly to your time, allowing 5 minutes for questions.
 - email your talk in Powerpoint, Keynote and/or PDF form to Robert Varner: varnerrl@ornl.gov in a file called “lastname_sessionID_otherinfo.xxxx”

“If you want shorter days, you should make shorter speeches.”
-- Eleanor Roosevelt

Discussion

- Only a few minutes available directly after each talk, but 15-20 minutes at session end.
- On Monday a working lunch and discussion period. A good time to hash out the recommendations.

Writing committees

- Each community makes a statement of its portfolio, goals, methods, capabilities, and interfaces with other communities.
- Resource for Resolution Meeting in March.
- Recommendations are key.
- As much prioritization at this stage as possible is a good idea.
- Writing committees for our WP are set up here. Many hands make light work.

Writing committees

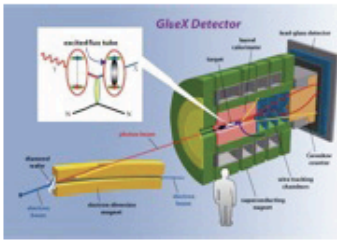
- Session A, P. Intro, summary, integration.
- Session B. EDM
- Session C. Double beta
- Session D, E. Lepton properties.
- Session F. Astrophysics
- Session G. Low energy weak interactions.
- Session H. Theory.
- Session J, K. New phenomena, initiatives.
- Session M, N. Capabilities, interfaces.

Speakers and Chairs are assumed to be members and will organize the membership and modus operandi. Others VERY WELCOME!

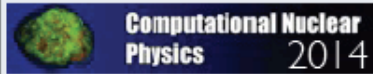
White paper to be complete by _____
Length roughly _____ pages.

A time of opportunity

- Nuclear Physics does long-range planning well. We have learned to support each other's efforts and still make hard choices when necessary.
- FSnu is at an exciting juncture with great accomplishment behind us and world-changing goals ahead.
- *Thank you all* for coming here to map out the road in front of us.

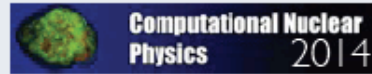


Endorsement requested: Future Computational Needs Computing for Nuclear Physics



Recommendation

Realizing the scientific potential of current and future experiments demands large-scale computations in nuclear theory that exploit the US leadership in high-performance computing. Capitalizing on the pre-exascale systems of 2017 and beyond requires significant new investments in people, advanced software, and complementary capacity computing directed toward nuclear theory.



Request

To this end, we ask the Long-Range Plan to endorse the creation of an NSAC subcommittee to develop a strategic plan for a diverse program of new investments in computational nuclear theory. We expect this program to include:

- new investments in SciDAC and complementary efforts needed to maximize the impact of the experimental program;
- development of a multi-disciplinary workforce in computational nuclear theory;
- deployment of the necessary capacity computing to fully exploit the nations leadership-class computers;

with support ramping up over five years towards a level of around \$10M per annum.

- Resources for entire field - not just for this community
- Endorsed by Low-Energy Town Hall (3rd Bullet)
- QCD Town Hall Endorsement ??

Endorsement requested: Education and Innovation

- Education and mentoring of the next generation nuclear scientists as well as dissemination of research results to a broad audience are integral parts of research. The funding agencies must ensure that these essential aspects become the responsibility of all researchers.
- Nuclear science is an active and vibrant field with wide applicability to many societal issues. It is critical for the future of the field that the whole community embraces and increases its promotion of nuclear science to students at all stages in their career as well as to the general public.
- Researchers in nuclear physics and nuclear chemistry have been innovative leaders in the full spectrum of activities that serve to educate nuclear scientists as well as other scientists and the general public in becoming informed of the importance of nuclear science. The researchers are encouraged to build on these strengths to address some of the challenges in educating an inclusive community of scientists as well as those on the path to future leadership in nuclear science.
- The interface between basic research in nuclear physics and exciting innovations in applied nuclear science is a particularly vital component that has driven economic development, increased national competitiveness, and attracts students into the field. It is critical that federal funding agencies provide and coordinate funding opportunities for innovative ideas for potential future applications.

Resolutions from the Joint Low Energy and Nuclear Astrophysics Town Meetings

Contents:

- Nuclear Astrophysics Resolutions
- Low Energy Nuclear Science Resolutions
- Joint Resolutions

Nuclear Astrophysics Town Meeting Resolutions

Resolutions: August 2014 NAP Texas Town Meeting

1. FRIB's unprecedented intense beams of fast, stopped, and reaccelerated rare isotopes offer game changing opportunities for nuclear astrophysics, in particular in the areas of explosive nucleosynthesis and neutron stars.

- We strongly support the timely completion of the Facility for Rare Isotope Beams (FRIB) and the implementation of the full science program as the highest priority for the nuclear astrophysics community.
- To operate a broad nuclear astrophysics program we strongly recommend the development and implementation of critical equipment such as SECAR, GRETA, and the HRS for nuclear astrophysics measurements.

Resolutions: August 2014 NAP Texas Town Meeting

2. To address the compelling questions in nuclear astrophysics and to operate an effective and competitive nuclear astrophysics program a broad range of nuclear probes, techniques, and theory is essential. This requires appropriate utilization of the available nuclear physics facilities, in particular university-based laboratories, and strong theory support.
- We recommend to appropriately support operations and planned upgrades at ATLAS, NSCL, and university-based laboratories as well as the utilization of these and other facilities for enabling measurements with the broad range of beams required to achieve the science goals in nuclear astrophysics. It is essential that strong support for research groups is provided.
 - We support strengthening support for nuclear theory and the founding of an FRIB theory center that addresses the needs of a broader nuclear astrophysics community. In addition we recommend focused multi-institutional research collaborations in theory and simulation to take advantage of new opportunities created by increased computing capabilities and large data science.

Resolutions: August 2014 NAP Texas Town Meeting

3. High intensity underground accelerator measurements have emerged as a critical tool for directly studying reactions in stellar burning that govern stellar evolution and provide the seeds for explosive nucleosynthesis.

- We recommend the construction and operation of a high intensity underground accelerator facility for the study of stable beam reactions near quiescent stellar burning conditions.

Resolutions: August 2014 NAP Texas Town Meeting

4. Interdisciplinary centers are important for advances in nuclear astrophysics as they overcome field boundaries between nuclear physics and astronomy, and bring together the diverse experiment, theory, and observation communities that comprise the field of nuclear astrophysics.

Data compilation, dissemination, and distribution is an essential component for such interdisciplinary efforts.

- We recommend the continued support for the operation of the Joint Institute for Nuclear Astrophysics as Physics Frontiers Center and other field bridging initiatives.
- We recommend continued robust support of the operation of data centers and other data compilation efforts of importance for nuclear astrophysics.

Resolutions: August 2014 NAP Texas Town Meeting

5. Education and innovation are key components of any vision of the future of the field of nuclear science.

- We fully endorse the recommendations of the Education and Innovation White Paper.

Low Energy Nuclear Science Town Meeting Resolutions

Resolutions: August 2014 LENP Texas Town Meeting

The town meeting culminated in the formulation of the following statement of recommendations for the LRP planning committee:

1. The study of atomic nuclei is the core of nuclear science. The frontier of this field lies in the new opportunities and intellectual challenges offered by FRIB's ability to produce intense beams of rare isotopes. This ability will lead to an unprecedented understanding of nuclei, of their role in the cosmos, and studies of fundamental interactions. The field is ideally positioned, as well, to advance applications in medicine, energy, national security, and materials science. The health of this field is required to train the talented national workforce needed to assure continuing societal benefits in these critical areas. FRIB provides an essential and unparalleled opportunity to pursue compelling science and maintain world leadership in this field.
- We reaffirm in the strongest possible terms the scientific vision of FRIB and endorse the recommendation laid out in the 2012 National Academy Decadal Study for the timely completion of this advanced rare ion beam facility and the initiation of its full scientific program. Once completed, FRIB will be the world-leading nuclear physics facility that enables tremendous discovery potential for the physics of nuclei, nuclear astrophysics, and the study of fundamental symmetries, with the added benefit of significant applications potential in many areas of societal importance.

Resolutions: August 2014 LENP Texas Town Meeting

Recommendation of the National Research Council Decadal Study, 2012

Finding: The Facility for Rare Isotope Beams is a major new strategic investment in nuclear science. It will have unique capabilities and offers opportunities to answer fundamental questions about the inner workings of the atomic nucleus, the formation of the elements in our universe, and the evolution of the cosmos.

Recommendation: The Department of Energy's Office of Science, in conjunction with the State of Michigan and Michigan State University, should work toward the timely completion of the Facility for Rare Isotope Beams and the initiation of its physics program.

Resolutions: August 2014 LBNL Texas Town Meeting

2. In support of our science goals, we must continue forefront research to enable new discoveries, to train the next generation of scientists, and to develop new detector and accelerator technologies. Hence:

● We recommend that appropriate funds for operations and near-term upgrades of existing research capabilities at ATLAS, NSCL, university and other facilities be provided. Improvements and developments of instrumentation at existing facilities should be adequately supported. It is essential that strong support for research groups is provided.

● We recommend that enhanced support for nuclear theory be provided to address key questions in nuclear physics and astrophysics and to realize the full potential of the experimental program at FRIB. We recommend the creation of a national FRIB theory center to drive this exciting science and the computational nuclear physics initiative to take maximum advantage of high performance computing critical to this effort.

● To realize the full scientific discovery potential of FRIB and existing facilities, it is essential that major experimental systems are available. We recommend:

- the construction of the 4π GRETA in a timely manner.
- the timely construction of other new state-of-the-art instruments for FRIB, such as the High Rigidity Spectrometer and the separator for capture reactions SECAR.
- the construction of ReA12 in a timely manner.

Resolutions: August 2014 LENP Texas Town Meeting

3. We endorse the recommendation of the 2014 Computational Nuclear Physics Meeting: “Capitalizing on the pre-exascale systems of 2017 and beyond requires significant new investments in people, advanced software, and complementary capacity computing directed toward nuclear theory.”

4. Education and innovation are key components of any vision of the future of the field of nuclear science. We therefore fully endorse the recommendations of the Education and Innovation Town Meeting.

Joint Resolutions: LENP and NAP Town Meetings

Joint Resolutions: LENP and NAP Town Meetings

The Low Energy Nuclear Physics and Nuclear Astrophysics town meetings culminated in the formulation of the following joint statement of recommendations for the LRP planning committee:

Science and society rely on our understanding of the atomic nucleus. Its relevance spans the dimensions of distance from 10^{-15} m (proton's radius) to 12 km (neutron star radius) and timescales from fractions of a second after the Big Bang to today; i.e., 13.8 billion years later. As reaffirmed by the 2012 National Academies of Sciences' decadal study "*Nuclear Physics: Exploring the Heart of Matter*," the path to understanding the nucleus requires the completion of the Facility for Rare Isotope Beams (FRIB) and its effective operation. Unprecedented access to a vast new terrain of nuclei will result in scientific breakthroughs and major advances in our understanding of nuclei and their role in the cosmos, and will open new avenues in cross-discipline contributions in basic sciences, national security, and other societal applications.

- ***The highest priority in low-energy nuclear physics and nuclear astrophysics is the timely completion of the Facility for Rare Isotope Beams and the initiation of its full science program.***

Joint Resolutions: LENP and NAP Town Meetings

In support of our science goals we must continue forefront research, exploit existing facilities, develop new capabilities and equipment, and enable major advances in nuclear theory.

- ***We recommend appropriate support for operations and planned upgrades at ATLAS, NSCL, and university-based laboratories, as well as for the utilization of these and other facilities, for continued scientific leadership. Strong support for research groups is essential.***
- ***We recommend enhanced support for theory in low-energy nuclear science and nuclear astrophysics, which is critical to realize the full scientific promise of our fields.***
- ***We recommend targeted major instrumentation and accelerator investments to realize the discovery potential of our fields.***

Joint Resolutions: LENP and NAP Town Meetings

Realizing the scientific potential of Low Energy Nuclear Physics and Nuclear Astrophysics demands large-scale computations in nuclear theory that exploit the US leadership in high-performance computing.

- ***We endorse the recommendation of the 2014 Computational Nuclear Physics Meeting: “Capitalizing on the pre-exascale systems of 2017 and beyond requires significant new investments in people, advanced software, and complementary capacity computing directed toward nuclear theory.”***

Joint Resolutions: LENP and NAP Town Meetings

Education, outreach, and innovation are key components of any vision of the future of the field of nuclear science. Our fields play a leading role in education and training of the nation's nuclear science workforce. Our fields are ideally positioned, as well, to advance applications in medicine, energy, national security, and materials science. The health of this field is required to train the talented national workforce needed to assure continuing societal benefits in these critical areas. Continuation of this role is a major goal of our fields.

We endorse the recommendations of DNP Education and Innovation Town Meeting.

