

Office of Science, U.S. Department of Energy
Office of Nuclear Physics, Nuclear Theory Division

FRIB Theory Center

A path for the science at FRIB

Progress Report for Year-1

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1 Abstract

Advances in theory provide the essential underpinning to understanding nuclei and their role in the cosmos. The FRIB Theory Alliance, working together with the theory community, has the goal to enhance theoretical efforts related to the Facility of Rare Isotope Beams (FRIB), across the country. It has been recognized as a key ingredient to the success of the science associated with FRIB. Its national FRIB Theory Fellow program attracts new young talent to the field. The FRIB theory faculty bridge program will create permanent positions nationwide. The FRIB theory visitors program will foster interdisciplinary collaborations and international initiatives. Last but not least, part of the mission of the FRIB Theory Alliance is to introduce educational initiatives that capitalize on new technology and introduce a modern and exciting view of low-energy nuclear theory.

2 Summary of FRIB Theory Alliance Year-1

The long term goals of the proposed FRIB-TA are: i) to deliver excellent research in theory relevant to the big science questions associated with FRIB; ii) to serve as a focal point for stimulating continuous interactions between theory and experiment, drawing theory activity toward those problems relevant for the science at FRIB; iii) to rejuvenate the field by creating permanent positions in FRIB theory across the country; iv) to attract young talent through the national FRIB Theory Fellow program; v) to strengthen theory in areas of most need; vi) to foster interdisciplinary collaborations and build scientific bridges to wider theory communities; vii) to coordinate a sustainable educational program in advanced low-energy nuclear theory; and viii) to coordinate international initiatives in theory of rare isotopes.

In this first year of existence, we have initiated a number of activities that pave the way toward these long-term goals. Until elections take place, Witek Nazarewicz has served as interim director, Filomena Nunes has served as managing director and the FRIB-TA steering committee has been serving as the Science Advisory Board. The FRIB-TA formed committees to address the various aspects concerning the establishment of the alliance:

FRIB Theory Alliance Organization Committee developed a Charter for the FRIB-TA and introduced a process whereby an FRIB Theory Alliance Executive Committee can be appointed through nominations from the wider theory community. *David Dean (chair), Dick Furnstahl, Witek Nazarewicz, Erich Ormand*

FRIB Theory Fellow Search Committee was responsible for the search of the new national FRIB theory fellow. *Joe Carlson, David Dean, Erich Ormand (chair), George Fuller, Brad Sherril*. A second search committee was responsible for the search of the FRIB theory fellow to reside at MSU. *Heiko Hergert, Robert Janssens, Erich Ormand (chair), Filomena Nunes, Sanjay Reddy, Michael Thoennessen*¹

FRIB Bridge Faculty Committee is responsible for studying the current possibilities for bridge positions, identifying a process for selection and developing a protocol between the FRIB-TA and the selected institution, for implementing a Bridge position. *Baha Balantekin (chair), Dick Furnstahl, Robert Janssens, Filomena Nunes, Sanjay Reddy*

¹Note that, since Brad Sherrill became director of NSCL, he stepped down from the FRIB Theory Alliance steering committee and was replaced by Michael Thoennessen.

FRIB Theory Education and Outreach Committee is responsible for developing the educational and outreach component of the Theory Alliance. *Morten Hjorth-Jensen, Dick Furnstahl, Filomena Nunes (chair), Sanjay Reddy*

FRIB Theory International Links Committee works with current and potential international partners to coordinate and leverage efforts. This committee is responsible for identifying potential partnerships to strengthen the FRIB-TA initiative. *Joe Carlson, Bao-An Li, Robert Janssens, Witek Nazarewicz (chair)*

During this first year of activities, we have set up a webpage; developed a charter; introduced the National FRIB Theory Fellow program, and run two searches for FRIB theory fellows; defined a procedure for the implementation of the FRIB Bridge Faculty program; and initiated discussions on the best strategy for improving the education of our students. These elements are all important to construct a solid base for robust growth because our goal is for a strong FRIB Theory Alliance to be in place by the time FRIB comes on line.

In addition, we have done outreach in the community not only to engage those in low-energy nuclear theory, but also in the broader nuclear physics community. The FRIB Theory Alliance has been highlighted in the 2015 Long Range Plan for Nuclear Science *Reaching for the horizon*, as a new theory initiative: “We recommend the establishment of a national FRIB Theory Alliance. This alliance will enhance the field through the national FRIB Theory Fellow program and tenure-track bridge positions at universities and national laboratories across the U.S.” Finally, we have organized an FRIB Theory Alliance inaugural meeting which will take place on March 31st and April 1st, 2016 (see Appendix A). This event is critical for bringing the community together, approving the Charter and helping to shape future activities of the FRIB Theory Alliance.

Below we expand on the activities of each committee and provide additional documentation that resulted from our activities.

3 FRIB Theory Alliance Charter

The FRIB-TA Organization Committee developed a charter and its executive board. The charter can be found at <http://fribtheoryalliance.org/content/charter.php> and we also attach it to the report for convenience (Appendix B). Dean, Furnstahl, Nazarewicz, and Ormand developed the charter for the FRIB-TA, and the FRIB-TA Steering Committee recommended its acceptance as a governing document for the overall FRIB-TA. The charter outlines functions of the Executive Board, the Director, and Executive Director of the Board. The charter also outlines procedures for populating the Executive Board, as well as procedures for populating the Executive Board. The charter also outlines the roles and responsibilities of standing committees of the FRIB-TA, including the Theory Fellow Search Committee, the FRIB Bridge Faculty Search Committee, the FRIB Theory Education and Outreach Committee, and the FRIB Theory International Links Committee.

This Charter is available to the community and will be voted following the upcoming inaugural meeting.

4 FRIB Theory Alliance webpage

The FRIB Theory Alliance has set up a website to serve as a communication tool for the FRIB-TA community, to promote and disseminate FRIB-related theory, and for outreach. The FRIB-TA has purchased a domain (fribtheoryalliance.com) and has contracted with the MSU IT services to provide web hosting for the site, which includes dynamical page content through PHP and database interaction with MySQL. The website is currently managed by Dick Furnstahl, with content supplied by the board members.

Present content includes a range of information on FRIB-TA science and governance such as links to “What is the FRIB Theory Alliance?”, “FRIB-TA Mission and Initiatives” a science overview, the FRIB-TA charter, and members of the Executive Board and committees, plus links to a wide range of relevant websites (e.g., theory collaborations and institutes). We will regularly include advertisements for important events, pointers to recognitions for FRIB-TA science, and job postings. Future content development will include additional science overviews and resources for high performance computing, education, and outreach initiatives.

The website enabled a rapid sign-up of FRIB-TA members by providing a form interface to the internal database that makes it easy for users to join the FRIB-TA and to modify their information. An email call to join the FRIB-TA went out at the beginning of December, 2015 and quickly resulted in well over a hundred inaugural members from the USA and around the world. The list of FRIB-TA members is directly available from a menu item at fribtheoryalliance.org, where it can be filtered by institution, country, and status (i.e., faculty, laboratory staff, postdoc, or student). The FRIB-TA leadership can also create internal targeted mailing lists from the member database.

5 National FRIB Theory Fellow program

The FRIB Theory Fellowship is a 5 year research position with an initial annual salary well above a postdoctoral salary and an independent annual budget for travel and visitors. The fellow is expected to develop high-caliber work on important theoretical problems relevant to research with FRIB. An initial 2 year appointment is renewed on a yearly basis for an additional maximum of 3 years depending on performance and the availability of funds. The program has proven to be highly competitive and has increased the visibility of low-energy nuclear theory worldwide. The FRIB theory fellow is expected to advance into an open faculty or permanent staff position in the field within 5 years of the initial appointment. Both fellows, Elena Litvinova and Heiko Hergert, have each successfully moved onto a faculty position after only one year in this position.

During this first year, the FRIB-TA has expanded the program to include fellows located in host institutions other than MSU. In November 2014, an ad for the position was sent out and potential partners were identified. The Selection Committee, chaired by Erich Ormand, interviewed applicants in January 2015 and selected Diego Lonardonì as the national FRIB theory fellow to be stationed at Los Alamos National Laboratory. A subcontract with LANL was enacted and Dr. Lonardonì began his appointment in October 2015.

In the fall of 2015, the FRIB-TA ran a second FRIB Theory Fellow search to replace the MSU FRIB theory fellow. The selection committee, chaired by Erich Ormand, interviewed the candidates in November 2015 and selected Gregory Potel as the FRIB theory fellow to be stationed at MSU. Dr. Potel will begin his appointment as an FRIB theory fellow in May 2016.

5.1 Update on Diego Lonaroni's activities

Our new national fellow, Diego Lonaroni, has been working on the extension of Quantum Monte Carlo (QMC) methods for medium-heavy nuclear systems. On the one hand, the latest version of the auxiliary field diffusion Monte Carlo (AFDMC) has been applied to the study of nuclei as heavy as ^{48}Ca with phenomenological two- plus three-body forces. The derivation of an effective interaction suitable for QMC calculations for systems with $A \geq 16$ is in progress. Among the goals are the study of isotope chains (such as Oxygen and Calcium) with the derivation of properties like densities and skins, and the investigation of open-shell systems close to the island of inversion such as ^{27}F . AFDMC is also being used to investigate the isospin dependence of hypernuclear interactions for hypernuclei in the mass region around $A = 40 - 48$ in connection with the proposed hypernuclear experimental program at JLab. On the other hand the Cluster Variational Monte Carlo (CVMC) algorithm has been optimized and applied as a complementary method for the study of momentum distributions and charge form factors of closed-shell nuclei such as ^{16}O and ^{40}Ca .

Publications and presentations resulting from this period:

- S. Gandolfi, D. Lonaroni: The EOS of neutron matter and the effect of Λ hyperons to neutron star structure; arXiv:1512.06832 [nucl-th] Proceedings of the 12th International Conference on Hypernuclear and Strange Particle Physics, Sendai, Japan, September 07-12, 2015.
- “From hypernuclei to neutron stars: looking for the pieces of the puzzle” Contributed talk for the 54th International Winter Meeting on Nuclear Physics, January 28, 2016, Bormio (SO), Italy.
- “A variational Monte Carlo approach for the study of medium-mass nuclei” Contributed talk for the Annual Fall Meeting of the APS Division of Nuclear Physics, October 29, 2015, Santa Fe, US-NM.

6 FRIB Theory Bridge Faculty program

While the FRIB Theory Fellow program can serve as an attractive growth path for excellent post-doctoral fellows, the program would fail if there were no permanent positions to retain those excellent researchers. Indeed, the incredible list of theoretical developments needed to accomplish the broad scope of science at FRIB requires an increase in Theory Principal Investigators, especially in critical areas identified in the FRIB Theory Alliance proposal.

For this reason, we proposed an FRIB Bridge Faculty program to enhance the opportunities of Theory Faculty hires at Universities or Theory Staff hires at National Labs. These positions will be modeled after those created by the RIKEN/BNL program at RHIC, with 50% of the salary being covered by DOE and 50% by the home institution, for an initial period of time. Although no funding is available to initiate the bridge program during this initial phase, it is important to work out the details of the program in anticipation of the availability of funds in FY2017. The FRIB Theory Bridge Faculty Committee has discussed criteria and worked out a procedure for the selection of institutions interested in partnering in the FRIB Theory Bridge Faculty program. A one-page document describing the procedures is attached in Appendix C. This document will be discussed with the community in the upcoming inaugural meeting

7 FRIB Theory Alliance and education

Part of the Theory Alliance’s mission is to also play a role in enabling a broad, modern, and attractive educational curriculum addressing the nuclear many-body problem and related areas. A thorough knowledge of up-to-date theoretical methods and phenomenology will be required to tackle the theoretical and experimental challenges that will be faced by the next generation of nuclear physicists working in FRIB science. Most university low-energy nuclear theory groups are small and, therefore, unable to offer a broad spectrum of advanced research-based nuclear physics courses. Fortunately, with recent advances in educational technologies, we are in a situation where globally coordinated efforts can make a significant qualitative difference in the way nuclear physics students are educated.

To improve the situation, nuclear physicists in North America and Europe have teamed up to launch an educational initiative dubbed Nuclear TALENT which stands for Training in Advanced Low-Energy Nuclear Theory (nucleartalent.org). The long-term vision of TALENT is to develop a coherent graduate curriculum that will provide the foundations for a cross-cutting low-energy nuclear theory research program, and will link modern theoretical approaches with on-going experimental efforts. One of the major challenges is coordination and sustainability. In our original proposal we had envisaged working with universities to develop a model for transferring academic credit, with the TALENT courses becoming part of the academic curricula of the participating institutions, and transferring teaching duties, such that both students and lecturers could be shared. We have initiated conversations with the TALENT board (three members of the FRIB Theory Alliance board are on the TALENT board). At this point, the Theory Alliance is providing basic organizational support to this initiative (which includes the Academic Jobs Online membership as well as a home for the talent webpage).

In addition, the FRIB Theory Alliance education committee has identified an important opportunity in senior undergraduate education. Most universities do not offer a survey class exclusively in nuclear physics. There are two universities currently offering such a course, namely MSU and OSU, and this course has become very popular amongst undergraduates. The FRIB Theory Alliance is videotaping a few lectures and will produce advertising material for this course so we can reach out to other institutions that may be interested in offering such a course in the future. Next year we plan to develop materials associated with this survey course.

8 FRIB Theory Visiting program

The FRIB Theory Alliance provides multiple opportunities to leverage effort and funds, adding value to existing programs. In this context, a partnership with China has benefited from the Theory Alliance’s leadership.

The first FRIB-China Workshop on Physics of Nuclei and Hadrons took place May 28-30, 2015 at NSCL. The goal was to explore various forms of collaborative endeavors in experiment and in theory relevant to the FRIB science program. The Workshop was organized by a joint US-China committee, including some members of the FRIB-TA Executive Board. It was sponsored by NSCL, FRIB, the Department of Physics and Astronomy of MSU, and by the Chinese-US Theory Institute of Physics of Exotic Nuclei (CUSTIPEN). The Workshop was attended by about 70 participants, including 22 attendees from China.

The FRIB-China Workshop participants unanimously endorsed a set of resolutions, which can

be found in the Workshop's report at http://us-china-rib.org/7_DOCS/2015_report.pdf. The adopted resolutions represent a first step towards a comprehensive plan to jointly address the compelling scientific opportunities in the study of atomic nuclei and their role in the Cosmos.

Following the workshop, an FRIB-China Task Force (<http://us-china-rib.org>) was formed to assess a path forward towards realizing the many possible collaborative efforts described at the Workshop. The first joint activity is the establishment of the FRIB-CSC-fellow program, based on the MOU between FRIB and Peking University and IMP-Lanzhou. On the Chinese side, the program will be supported by the China Scholarship Council (SCC). Under the agreement signed with PKU, CSC will support 5 junior researchers every year for two-year visits. The program is intended to last three years (resulting in 15 junior researchers), and can be extended if successful. The intention is to have this program available to the broad US rare isotope community, including nuclear theory. The candidates will be selected by a joint US-China committee, including representatives of FRIB-TA, and placed in those U.S. research groups that have demonstrated interest in hosting.

9 FRIB Theory Alliance Inaugural meeting

A meeting marking the creation of the FRIB Theory Alliance (FRIB-TA) will be held at Michigan State University. The meeting will begin at 2 p.m. on Thursday, March 31, and will end after lunch on Friday, April 1st. The first day will be devoted to the goals of FRIB-TA and planned activities in the context of FRIB science and theory programs at the DOE and NSF. A panel discussion involving the FRIB-TA Steering Committee will cover the organizational aspects, including the charter, FRIB-TA Fellows program, FRIB-TA Bridge Faculty program, education, international collaboration, and communications.

The second day will review the current status of the field and showcase the opportunities in a broad FRIB theory program, ranging from Lattice QCD to stellar explosions and complex systems. The meeting website (<https://indico.fnal.gov/internalPage.py?pageId=3&confId=11098>) contains the agenda, also attached in Appendix A for convenience.

10 Presentations of the FRIB Theory Alliance

In order to inform the broader community, members of the FRIB Theory Alliance board presented the scientific and organizational vision of the Theory Alliance at a variety of meetings. Below a representative list of the presentations:

- *Educational aspects of the FRIB theory center*, DNP Education and Innovation Town Meeting, Michigan State University, August 8, 2014.
- *Theory of Nuclei and Their Reactions*, Joint DNP Town Meetings on Nuclear Structure and Nuclear Astrophysics, Texas A&M University, August 21-23, 2014.
- *FRIB theory: a broad perspective*, Colloquium at University of Washington St. Louis, October 2014.
- *Nuclear Structure and Reactions*, NSAC Long Range Plan Working Group Resolution Meeting, Kitty Hawk, NC, April 16-20, 2015

- *FRIB Theory Center*, FRIB China collaboration meeting, May 28, 2015.
- *2015 NSAC Nuclear Physics Long Range Plan: a status report*, Nuclear Chemistry Gordon Research Conference, New London, NH, June 4, 2015.
- *Opportunities in nuclear structure and reactions*, Division of Nuclear Physics Fall Meeting, October 2015.
- *Computational nuclear structure in the eve of exascale*, Symposium on Quarks to Universe in Computational Science (QUCS 2015), Nara, Japan, Nov. 4-8, 2015.
- *Theory opportunities in nuclear science at the limits of stability*, Colloquium at Rutgers University, December 2015.

11 Milestones and Deliverables

Following our plans from the FRIB TA proposal, below we address each of the milestones for Year-1 and update the milestones for Year-2.

11.1 Reviewing Year-1

- A charter was developed and will be approved by the community at the inaugural meeting, following which the Science Advisory Board will be appointed.
- On March 31st and April 1st, an event to launch the FRIB-TA will be hosted at MSU.
- Two searches for FRIB Theory Fellows were conducted. One fellow, Diego Lonardoni, initiated activities at Los Alamos National Laboratory in October 2015, and the other fellow, Gregory Potel, will initiate activities at MSU in May 2016.
- A procedure for bridge positions was developed and will be approved by the membership following the inaugural meeting.
- FRIB-TA worked closely with the FRIB Users Group on white papers for the NSAC Long Range Plan.
- The Director of FRIB-TA has initiated conversations with FUSTIPEN, CUSTIPEN, and ICNT to coordinate activities.
- The FRIB-TA has officially joined TALENT as an affiliated institution. We are developing a survey course in nuclear physics at the undergrad level that will complement TALENT's advanced modules. A short publicity video will be made available for advertising the course in the second year of the Theory Alliance.
- The progress report describing the FRIB-TA's activities, and a work-plan for Year-2 will be made available on our webpage.

11.2 Plans for Year-2

- FRIB Theory Fellows will continue/initiate research activities.
- The pilot version of the new survey course on nuclear physics will be recorded/broadcast and made available for a wide range of students at various U.S. institutions that cannot offer such a course to their students. During this year, we will collect feedback from the remote students to adjust the course for the future.
- The FRIB-TA director and the managing director will work with NSCL management and MSU on improving theory infrastructure (offices, meeting space, computers).
- We will facilitate a Topical Program of direct relevance to FRIB.
- We will work on the new proposal for the FRIB-TA, including the full scope of activities and the ramp-up funding plans. This proposal will be submitted to DOE in the Fall 2016.
- The second FRIB-TA annual meeting will be held at FRIB.
- In anticipation of a potential growth in the budget, we may call for proposals for bridge positions and, consequently, identify the first bridge position partner.
- We anticipate to identify 1-2 FRIB-China fellows to enhance FRIB Theory Alliance activities.

12 Comments on the budget

Most of the activities of the Theory Alliance involved organizational development and had no incurred costs. The only employee on the grant during this first year of activities was the fellow located at Los Alamos National Laboratory, since the MSU fellow accepted a faculty position in the summer 2015 and that person will only be replaced in May 2016. The salary and travel of the Los Alamos fellow was covered by the Theory Alliance grant at the 50% level: \$25.6k through January, with projected fully burdened expenditures through May 31, 2016 of \$20.9k. Identical costs were incurred by Los Alamos, which included in addition to salary and travel, the purchase of a laptop for the fellow. Materials and supplies of \$4k include the domain account, the MSU web-hosting account, the academic jobs online account, as well as other materials in preparation for the inaugural meeting.

A Agenda for Inaugural meeting

**032016 FRIB Theory Alliance Inaugural Meeting
 Facility for Rare Isotope Beams (FRIB)
 March 31-April 1, 2016**

AGENDA

Start	Duration	Agenda Item	Discussion Leader
Thursday, March, 31 2016 - NSCL Conference Room			
2:00 PM	0:10	01 Welcome	Steve Hsu
2:10 PM	0:20	02 FRIB	Thomas Glasmacher
2:30 PM	0:20	03 Theory program at DOE	George Fai
2:50 PM	0:20	04 Theory program at NSF	Bogdan Mihaila
3:10 PM	0:45	05 Short highlights from FRIB theory fellows	Litvinova, Hergert, Lonardonì
3:55 PM	0:30	06 <i>Coffee break</i>	
4:25 PM	0:20	07 FRIB: experiment-theory coupling	Brad Sherrill
4:45 PM	0:20	08 FRIB theory alliance: science and goals	Filomena Nunes
5:05 PM	1:00	09 Panel discussion on FRIB theory alliance with the Steering Committee	Moderator: Witek Nazarewicz
6:30 PM	2:00	10 Dinner at Cowles House	
Friday April 1 2016 - NSCL Conference Room			
8:30 AM	0:30	01 <i>Breakfast</i>	
9:00 AM	0:20	02 Ab-initio approaches to nuclear structure	Gaute Hagen
9:20 AM	0:20	03 Ab-initio approaches to nuclear reactions	Dean Lee
9:40 AM	0:20	04 Heavy nuclei and beyond	Nicolas Schunck
10:00 AM	0:20	05 Open quantum systems	Alexander Volya
10:20 AM	0:20	06 Reactions with heavy nuclei	Kouichi Hagino
10:40 AM	0:40	07 <i>Coffee break</i>	
11:20 AM	0:20	08 Nucleosynthesis	Rebecca Surman
11:20 AM	0:20	09 Neutron Matter and Neutron Stars	Andrew Steiner
11:40 AM	0:20	10 Stellar explosions	Sean Couch
12:00 PM	0:20	11 Neutrino astrophysics and cosmology	John Beacom
12:20 PM	0:20	12 Fundamental symmetries	Vincenzo Cirigliano
12:40 PM	1:00	13 <i>Boxed lunch</i>	
1:40 PM	0:20	14 Lattice QCD	Amy Nicholson
2:00 PM	0:20	15 Intersections with complex systems	Joaquin Drut
2:20 PM		<i>Adjourn</i>	

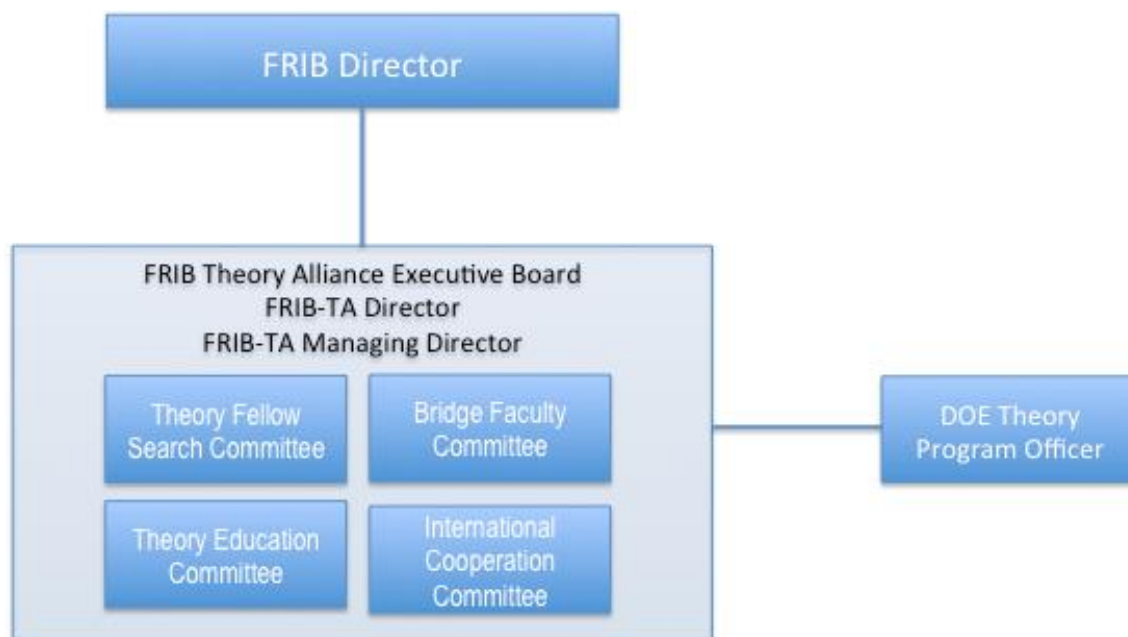


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B FRIB TA Charter

Appendix: FRIB TA Charter

Our task laid out in the proposal: the FRIB Theory Alliance Organization Committee will develop a Charter for the FRIB-TC and introduce a process whereby an FRIB Theory Center Executive Committee can be appointed through nominations from the wider theory community. David Dean (chair), Dick Furnstahl, Witek Nazarewicz, Erich Ormand.



Charter

1. Purpose. The FRIB Theory Alliance (TA) will foster advancements in theory related to diverse areas of FRIB science, optimize the coupling between theory and experiment, and rejuvenate the field by creating permanent theory positions across the country, attracting young talent through the national FRIB Theory Fellow Program, fostering interdisciplinary collaborations, and shepherding international initiatives.
2. Membership. Members of the TA include scientists from both national laboratories and universities across the nation. Scientists based in foreign institutions can join TA as associate members. Initial membership will be drawn from the FRIB Theory Users Group. Voting members are TA members who are PhD scientists from US national laboratories and universities.
3. This charter establishes in broad outlines the Executive Board and Standing Committees associated with the TA.
4. FRIB TA Executive Board (TA-EB)
The TA-EB consists of the Director, Managing Director, and up to nine members drawn from the TA community. The TA-EB represents different subfields and institutions of FRIB-TA science. The TA-EB oversees project execution, integration, and coordination. It coordinates the project timetables and deliverables. It also makes recommendations to DOE regarding the scientific direction of the project and its budget. The TA-EB shall be accountable to the overall Nuclear Physics community for its operation and scientific direction.

5. The TA-EB Director

The Director is responsible for the overall governance of the TA-EB. His/her other responsibilities are to:

 - a. Appoint various committee chairs with approval of the TA-EB;
 - b. Convene and lead meetings of the TA-EB;
 - c. Represent the FRIB-TA to the broader community and be the liaison with experiment through the FRIB Users Group;
 - d. Coordinate the FRIB Theory Visiting program.
6. The TA-EB Managing Director

The Managing Director reports to the TA-EB Director. He/she shall be the PI of the DOE grant that funds the FRIB-TA. Together with TA-EB Director and TA-EB members, he/she should take care of all fiduciary responsibilities associated with maintaining the grant, and reporting.
7. Meetings of TA-EB
 - a. The TA-EB shall meet yearly to assess the progress of the FRIB-TA.
 - b. From time to time it may be necessary to engage the TA-EB in broader discussions.
 - c. Minutes of the TA-EB meetings prepared by the TA-EB member designated by the Director are approved by TA-EB and posted on fribtheoryalliance.org.
8. Procedures
 - a. No institution may have more than 2 members on the TA-EB at a given time.
 - b. Initial TA-EB membership consists of members of the FRIB Theory Steering Committee, appointed by the FRIB Director.
 - c. The Director of the TA-EB shall be nominated from within the TA-EB membership and shall serve a 3-year term. The FRIB Director and DOE shall concur with the choice of Director of the TA-EB.
 - d. The Managing Director shall serve 3-year terms, and shall be chosen by the FRIB Laboratory Director in coordination with DOE.
 - e. Committee members, aside from the Managing Director, shall serve for a period of 3 years, staggered at up to 4 new members per year.
 - f. Newly appointed members shall not serve as Standing Committee Chairs, nor as the Director.
 - g. No member, other than the Managing Director, shall serve more than 2 consecutive terms, or 3 discontinuous terms.
 - h. Filling TA-EB positions
 - i. The TA-EB Director shall appoint one TA-EB member to be responsible for yearly solicitation of names from the community of candidates who could serve on the TA-EB board. From this list, the TA-EB shall select up to 6 candidates for open positions.
 - ii. The Director shall contact candidates to determine their willingness to serve on the TA-EB.
 - iii. The Director shall consult with the DOE Theory Program Manager to ensure appropriateness of the candidate list.
 - iv. The Director shall appoint a current member of the TA-EB as an Elections Coordinator who shall hold elections for open seats.
 - v. Candidates with the highest vote count will become members of the TA-EB.
 - vi. Once elected, new members shall begin their service on January 1, and shall serve for a period of 3 years.
 - vii. At least one TA-EB position will be filled by an experimentalist.
9. Standing Committees

- a. FRIB Theory Fellow Search Committee
 - i. The FRIB Theory Fellow Search Committee will be responsible for the search for new FRIB Theory Fellows.
 - ii. The Chair shall be a member of the TA-EB, and the committee shall be appointed to ensure broad representation of the field.
 - iii. Appointments to the committee (up to 4 members) shall be the responsibility of the Chair of the search committee and shall be approved by the TA-EB.
 - iv. The Theory Fellow Search Committee members shall serve for a period of two years.
 - v. The Theory Fellow Search Committee members shall establish rules for their operations that will be approved by the TA-EB.
- b. FRIB Bridge Faculty Search Committee
 - i. The FRIB Bridge Faculty Committee will identify the optimal cases for implementing bridge positions and develop a protocol between the TA and host institutions. Members of this committee will be involved in the search process.
 - ii. Each Bridge Faculty appointment will likely require individualized arrangements between the FRIB-TA and the University partner engaged in hiring the bridge position. With this in mind, the FRIB-TA Managing Director shall have primary responsibility to negotiate terms of bridge positions with participating institutions.
 - iii. The TA-EB Director shall report progress on any bridge positions to the TA-EB and shall invite the chair of the partner University search committee to also present progress and plans to the TA-EB.
- c. FRIB Theory Education and Outreach Committee
 - i. The FRIB Theory Education and Outreach Committee will oversee the educational initiative in advanced FRIB theory and coordinate outreach efforts.
 - ii. The chair shall be a member of the TA-EB, and the committee shall be appointed to ensure broad representation of the field.
 - iii. Appointments to the committee (up to 4 members) shall be the responsibility of the Chair of the Education and Outreach committee and shall be approved by the TA-EB.
 - iv. Education and Outreach Committee members shall serve for a period of two years.
 - v. The Education and Outreach Committee shall establish rules for their operations that will be approved by the TA-EB.
 - vi. The Education and Outreach Committee provides the link to TALENT.
- d. FRIB Theory International Links Committee
 - i. The FRIB Theory International Links Committee will work with current and potential international partners to coordinate theory efforts and strengthen TA.
 - ii. For the FRIB Theory International Links Committee, the chair shall be a member of the TA-EB, and the committee shall be appointed to ensure broad representation of the field.
 - iii. Appointments to the committee (up to 4 members) shall be the responsibility of the Chair of the International Links committee and shall be approved by the TA-EB.
 - iv. International Links Committee members shall serve for a period of two years.

- v. The International Links Committee shall establish rules for their operations that will be approved by the TA-EB.
10. Ad hoc Committees

From time to time, the business of the FRIB-TA will require ad hoc committees. The Director shall establish these committees utilizing a TA-EB member as a chair. Terms of these committees shall be limited to one year, or until business of the ad hoc committee is concluded.
11. Annual Meeting

A meeting of the FRIB-TA shall be held each year in parallel to the Low Energy Community Meeting.
12. Website and communications
 - a. The Theory Alliance website, initially called fribtheoryalliance.org, shall serve as a communication tool and as an outreach window into TA science. The website shall be supervised by a member of TA appointed by the TA-EB and maintained by a communication coordinator.
 - b. The website shall provide a means to maintain a list of TA members and to add new members.
13. Modification to the Rules

The TA-EB shall, with the concurrence of the FRIB Director, be empowered to modify its rules of operations as necessary for improved operations of the FRIB-TA.
14. Removal from the TA-EB
 - a. A member of the TA-EB can be removed by 2/3-majority vote of the TA-EB. The seat will remain unfilled until the next election cycle.
 - b. In the event of TA-EB membership vacancy, the vacated TA-EB seat will remain unfilled until the next election cycle.
 - c. For every departing member under 10.a. or 10.b., an additional candidate shall be added to the list of candidates standing for election to the TA-EB during the next election cycle.
15. This Charter shall be accepted as a document providing guidance and rules of operation for the TA following a ratification vote in which 2/3-voting members favor adoption of the charter. The TA-EB shall administer the ratification vote.

C Selection procedure for faculty bridge positions

PROCEDURES FOR HIRING INTO THE FRIB THEORY ALLIANCE (FRIB-TA) BRIDGE FACULTY OR NATIONAL LABORATORY STAFF POSITIONS:

The FRIB-TA bridge position will be initiated by announcing a call to the FRIB-TA membership informing them about the opportunity of FRIB-TA bridge positions and requesting that interested research university departments and national laboratory divisions submit proposals for these positions, with a specific deadline. In parallel, a letter will be sent to as many as possible physics department chairs, copied to a nuclear theory faculty contact in those departments. A separate letter addressing national laboratory nuclear physics program points of contact will be prepared and sent as well.

When departments or divisions show substantive interest, they will be asked to prepare a brief proposal indicating the time-scale they will be working on for the advertisement, interviews and hire. If several proposals are received for hiring in the same year, the FRIB-TA Bridge Faculty Committee will rank order them (The composition of the FRIB-TA Bridge Faculty Committee is described in the Charter of the FRIB-TA). The committee may attempt to stagger them as appropriate. In selecting physics departments to carry out the bridge faculty search, the main selection criterion will be that the science scope of the search is aligned with FRIB Science. The committee will select physics departments at research universities using additional criteria including the intellectual environment of the university, diversity of its physics research program and access to good students. Once departments are selected, a Memorandum of Understanding (MoU), that specifies procedures for establishing the bridge positions, will be signed. For national laboratories, it would be expected that the divisions interested are involved in FRIB-related research.

It is desirable that the university physics departments and the divisions at national laboratories inform the FRIB-TA about the progress of the search. The chair(s) of the search committee(s) will keep the director of the FRIB-TA informed throughout the search process. Once the university department identifies a candidate, he or she also needs to be approved by the FRIB-TA board and the FRIB-TA PI who will act as a liaison with the DOE concerning this hire. Similarly a national laboratory candidate needs to be approved by the FRIB-TA board.

If a search fails then, during the following year, an additional search can take place. Such carry-over searches need to be reauthorized by the FRIB-TA Bridge Faculty Committee.