Guidance for the Working Groups: First Years at FRIB

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FRIB Users Executive Committee Chair

FRIB USERS ORGANIZATION

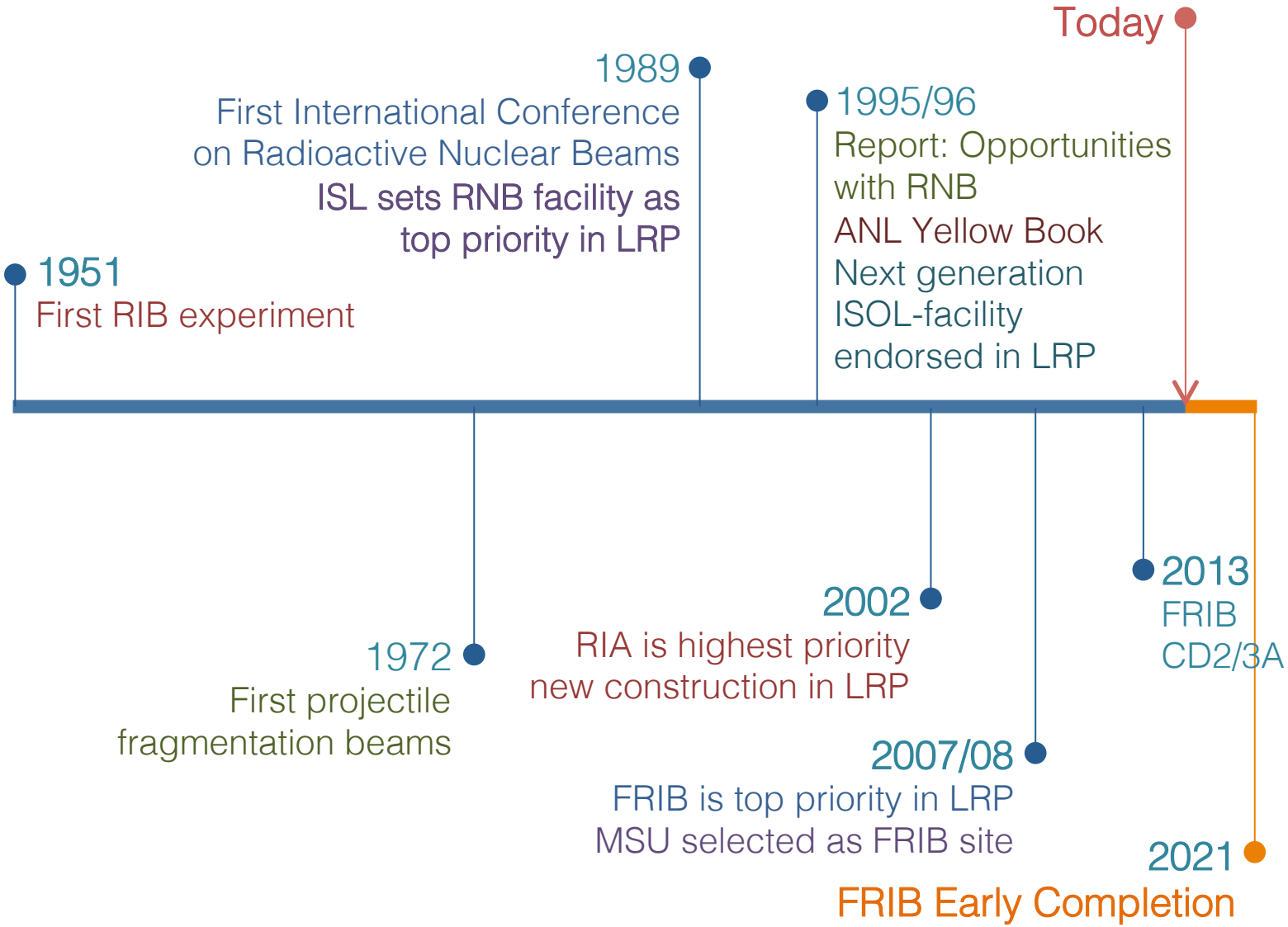
FACILITY FOR RARE ISOTOPE BEAMS

BERKELEY LAB

FRIB

Towards 'Day 1' Physics at FRIB

Consider today in the context of the path to get to FRIB…



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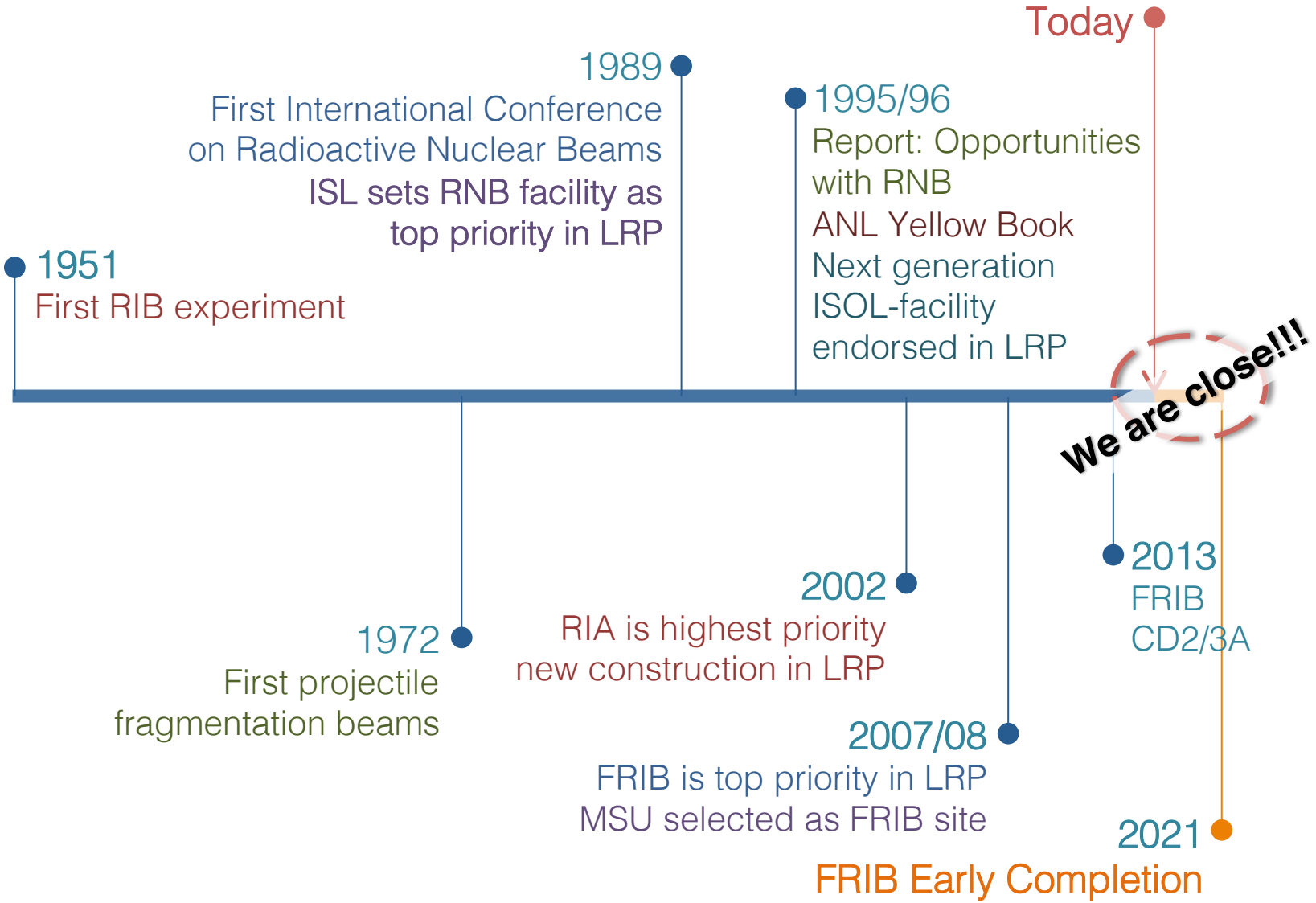

FRIB Science Program

- The overall science program is driven by the users community, planning is guided by the 17 scientific benchmarks from the RISAC report
- These benchmarks drive beam development priorities
- The working groups should exploit discovery potential of existing and new instruments
- Goals and progress are discussed at this meeting and will then be reviewed by the Science Advisory Committee (SAC) in December

Science drivers (thrusts) from NRC RISAC 2007

Nuclear Structure	Nuclear Astrophysics	Tests of Fundamental Symmetries	Applications of Isotopes

Intellectual challenges from NRC Decadal Study 2013

How does subatomic matter organize itself and what phenomena emerge?	How did visible matter come into being and how does it evolve?	Are fundamental interactions that are basic to the structure of matter fully understood?	How can the knowledge and technological progress provided by nuclear physics best be used to benefit society?

Overarching questions from NSAC Long Range Plan 2015

How are nuclei made and organized? What is the nature of dense nuclear matter?	Where do nuclei and elements come from? What combinations of neutrons and protons can form a bound atomic nucleus? How do neutrinos affect element synthesis?	Are neutrinos their own antiparticles? Why is there more matter than antimatter in the present universe?	What are practical and scientific uses of nuclei?

Overarching questions are answered by rare isotope research

17 Benchmarks from NSAC RIB TF measure capability to perform rare-isotope research 2007

1. Shell structure 2. Superheavies 3. Skins 4. Pairing 5. Symmetries 6. Equation of state 13. Limits of stability 14. Weakly bound nuclei 15. Mass surface	1. Shell structure 6. Equation of state 7. r-Process 8. $^{15}O(\alpha,\gamma)$ 9. ^{59}Fe s-process 13. Limits of stability 15. Mass surface 16. rp-Process 17. Weak interactions	12. Atomic electric dipole moment 15. Mass surface 17. Weak interactions	10. Medical 11. Stewardship

Where We Are Today

- FRIB is making rapid progress toward early completion in as little as 4.5 years
- The low-energy community has articulated and laid the out a solid scientific program, identifying key experimental equipment and top priority capabilities to enable forefront science at FRIB

Now it is important to jumpstart more concrete discussions toward first experiments at FRIB – we've just heard the status of the FRIB project and it's progress, it's time for the users, through the working groups to hold up their end of this dialogue.

Questions to the Working Groups

- With the constraint that beam power will ramp up to 100kW in the first years (Y1: 10kW, Y2: 50kW), does your working group have strong views on high-priority rare isotopes that should be produced?
  - What are the top priority fast beams? Stopped beams?
  - Does your working group envision an initial program with ReA3? What are the top priority beams?
  - Assuming that funding can be secured for ReA6-12, what are the priority reaccelerated beam programs to begin early?
- What experimental equipment does your working group envision having available for first experiments at FRIB (~2020)? At FRIB full power (~2025)?
- For both fast and reaccelerated beams, what requirements do you have regarding beam properties, ion-by-ion tagging and identification upstream of an experimental end-station?
- Does your working group expect a unified FRIB DAQ system? Or are individual experimental devices planning for development of their own DAQ systems?
- Does your working group have other questions/concerns for the FRIB facility (or other working groups)?

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Primary Beam Priorities

Beam	Bench-marks
Year One	
^{238}U	7, 10, 12, 15
^{48}Ca	2, 14
^{78}Kr	3, 8, 9, 16, 17
^{124}Xe	1, 11, 17
^{18}O	2, 8
^{86}Kr	1, 3, 4, 6, 14, 15
^{16}O	2, 8
^{36}Ar	8
Year Two	
^{82}Se	1, 3, 4, 5, 6, 13, 14, 15
^{92}Mo	1, 3, 9, 11, 16, 17
^{58}Ni	1, 3
^{22}Ne	2
^{64}Ni	1, 13, 14

- Primary beams estimated to be best to produce key rare isotopes in the 17 benchmarks
- ^{86}Kr and ^{36}Ar used to demonstrate FRIB Project's Key Performance Parameters at CD4
- Beam power:
  - Year One – 10 kW
  - Year Two – 50 kW
- Secondary beams driven by scientific benchmarks
- Time scale:
  - Early completion in FY21
  - CD4 in FY22

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Comments

- The goal is to identify areas that need further discussion between users and the FRIB Management to optimize the early scientific program at FRIB
- The goal is *NOT* to plant flags for specific measurements
- Working groups are asked to discuss their specific questions and/or comments in preparation for the plenary discussion tomorrow morning – David Dean

Working group (and workshop) organizers: Please keep in mind we are requesting 1-2 slide summaries in advance of the discussions tomorrow morning.

Please send these to: *hlcrawford@lbl.gov* or *fribusercontact@fribusers.org* or give them to me on a flash-drive.

Working Group X:

Priority Physics (at 10, 50, 100 kW)

Priority Beams (at 10, 50, 100 kW)

Priority (Planned) Equipment (at 10, 50,100 kW)

Beam property and DAQ requirements?