

Origin of EBSS

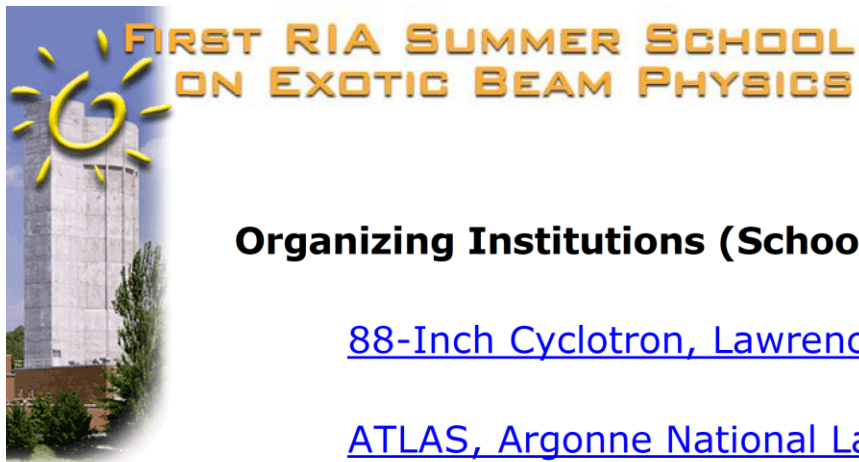
Witold Nazarewicz, FRIB@MSU

The twentieth Exotic Beam Summer School, FRIB, July 9 - 15, 2023

From RIASS to EBSS
2002-2023

It all started in 2002...

The Rare Isotope Accelerator (RIA) was recommended as the highest priority for major new construction in Nuclear Physics in the 2002 Long Range Plan for Nuclear Science prepared by the Nuclear Science Advisory Committee (NSAC).



Aug. 12-17, 2002

Organizing Institutions (School Directors):

[88-Inch Cyclotron, Lawrence Berkeley National Laboratory](#) (I-Yang Lee)

[ATLAS, Argonne National Laboratory](#), (Robert Janssens)

[HRIBF, Oak Ridge National Laboratory](#), (Witold Nazarewicz)

[NSCL, Michigan State University](#), (Brad Sherrill)

The challenging problem...

- Experiment and theory
- Various areas (structure, reactions, astrophysics, fundamental symmetries, applications, technology)
- Lectures and hands-on
- Social events

How Do You Keep
From Getting Bored?



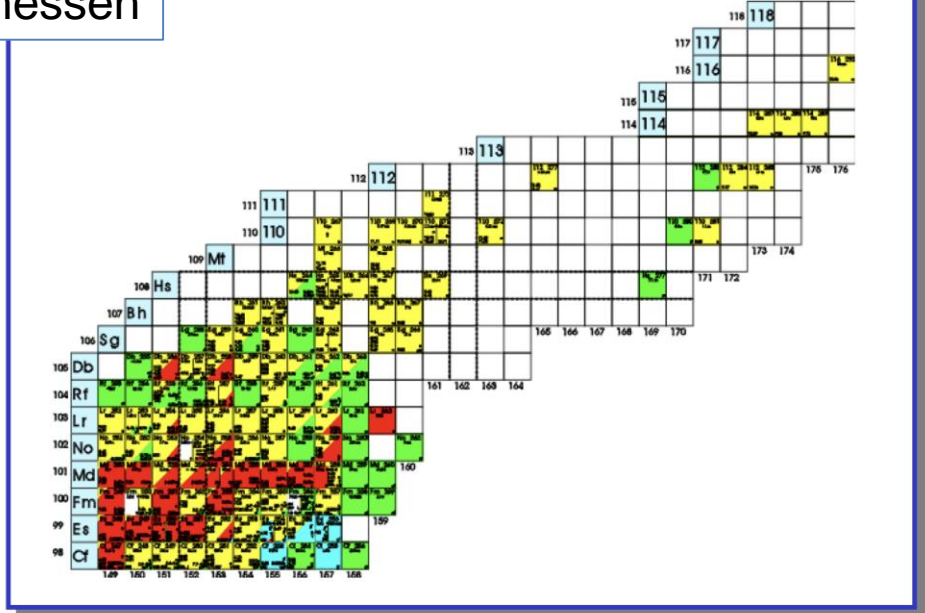
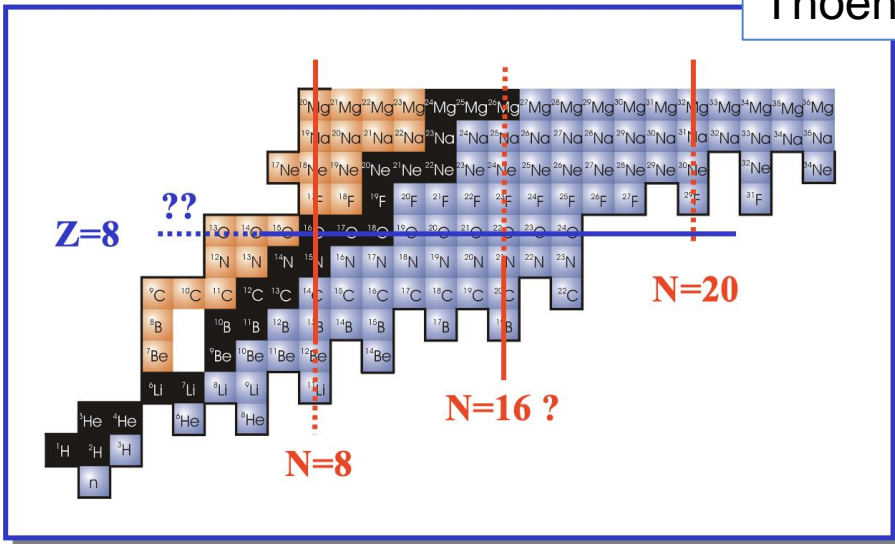
Credit:NPR

The school was attended by more than 40 graduate and postdoctoral students from the US universities, and also by several students from Canada, Europe, and Japan. The mornings were devoted to lectures on major breakthroughs in RIA science. The lectures covered broad topics in both the experimental and theoretical physics of nuclei far from stability as well as radioactive ion beam production and applications of RIA science.

- Limits of stability - Michael Thoennessen (NSCL,MSU)
- Collective excitations in exotic nuclei - David Radford (ORNL)
- Origin of the elements - Ernst Rehm (ANL)
- Reaction theory - Jeff Tostevin (Surrey)
- Nuclear structure theory - Erich Ormand (LLNL)
- Fundamental interactions - Stuart Freedman (LBNL, UC Berkeley)
- RIA applications - Michael Kreisler (DOE/LLNL)
- ISOL production - Jim Beene (ORNL)

The afternoons provided opportunities for hands-on demonstrations of experimental equipment and techniques useful in RIA research. The hands-on part of the program was held at the HRIBF facility and was organized by the ORNL Physics Division staff.

On Friday, August 16, the students performed real experiment with a nickel-58 beam. Twenty-six participants had an opportunity to present 10-minute talks on their research. There was also an opportunity for an open discussion between students and lecturers.



Adiabatic approximations: (\equiv sudden approximation)

- Identify $\begin{cases} \text{Fast} \\ \text{Slow} \end{cases}$ degrees of freedom

"fast" \rightarrow $\hat{Q} \propto \begin{cases} E_2 \\ E_1 \\ E_0 \dots E_0 \end{cases} \quad g \Rightarrow \infty$

Fix \hat{Q} , calculate $f(\theta, \hat{Q})$ for all \hat{Q}

Amplitude for transition $\alpha \rightarrow \beta$ $f_{\alpha\beta}(\theta) = \langle \beta | f(\theta, \hat{Q}) | \alpha \rangle_{\hat{Q}}$

"fast" \rightarrow $\hat{R} \propto \begin{cases} E_1 \\ E_0 \dots E_0 \end{cases} \quad M \Rightarrow \infty$

Calculate for all fixed \hat{R} , $f_{\alpha\beta} = \langle \beta | f(\hat{R}) | \alpha \rangle_{\hat{R}}$

Tostevin

Conclusions

- Nuclear structure experiments with heavy post-accelerated RIBs are:
 - \rightarrow Exciting
 - \rightarrow Challenging
 - \rightarrow Feasible!
- Need a good clean trigger
 - combine detection of γ , light-ion, recoil, etc.
- Have already shown that we can do fusion-evaporation and Coulex
- Transfer reactions are harder
 - \rightarrow Will need high-efficiency γ -detection to select populated levels

2022 FRIB launched

\rightarrow Waiting for RIA with much anticipation!

Radford



1. *Was the mix of experiment and theory OK?*

Yes – 27

- • “Yes, but the time devoted to experimental presentations was too long”
- • “The mix was fine, but since most of the students are experimentalists, perhaps the theory lectures could be toned down a bit”
- • “OK, sometimes a bit too many level schemes”
- “Yes, they should be presented hand in hand”
- “I think that the mix was excellent and fulfilling. It should stay this way”
- “Definitely”
- “It was excellent! Experiment and theory knowledge is crucial for today’s physics”
- • “I think that putting experiment and theory in the same week is a little bit too much”

4. *Were you satisfied with the level of lectures?*

- “Yes” – 24
- “Yes, and I think, a high level of lectures pushes students to work harder”
- “Some of the lectures were too advanced and hard to follow”
- “Experimental lectures were fine. Theoretical lectures could be toned down a bit”
- • “The theory got too deep... But, I did get some things out of the talks, so it wasn’t all negative!”
- • “Generally, yes. I thought both of the theory talks could have been more fast-paced; certainly no slower.”
- “It makes you want to learn more”

F. Would you recommend this school to other students?

- **Yes – 27**
- “It was very valuable school. More students should attend such one”
- “Yes, definitely”
- “Yes, it was really great! So I will”
- “Yes, and I would like to attend it next year again”
- “Yes, however, I think that you need to narrow the focus of students. I found the theory talks informative but experimental talks a little basic. I think grad student with at least 1-3 years would be ideal for the talks and first year for the ‘hands-on’ stuff”

G. Will this school be helpful in (a) your research, (b) your future career?

- **Yes - 26**
- “Yes, It gave me new ideas and insights”
- “Yes, especially if RIA is built”
- “This was good for personal academic development. Good compliment for what I’ve done to-date”
- “Yes, at the end of school, I could have a kind of big picture on the field”
- “(a) Not so much; (b) Probably. I enjoyed the broad focus. It exposed me to the state of research across the field.”
- “Yes to both. I wish I had gone to a summer school like this when I started my Ph.D. (I would have been much further ahead)”
- “I hope so!,” “don’t know yet,” “possibly”

(DOE) Proposal description: 2003 RIA SUMMER SCHOOL ON EXOTIC BEAMS PHYSICS

The School is jointly organized by the 88-Inch Cyclotron, ATLAS, HRIBF, and NSCL, and is an annual event, rotating among these laboratories. The first school was held at the HRIBF in Oak Ridge, **August 12-17, 2002**. The first school was extremely successful with over 70 applicants for only 40 slots available. We intend to continue the general format. The second instalment will be held at the National Superconducting Cyclotron Laboratory at Michigan State University from **August 4-9, 2003**. In Europe, already eight Euro Summer Schools on Exotic Beams have been held and proved to be important, successful, and popular. We studied the format of Euroschools carefully in the context of our program. Currently, since there are several facilities in Europe which carry out the RIB research, this gives more opportunities for European students to get some practical RIB experience. For that reason, we decided to introduce the hands-on training as a part of our program. (European Schools consist of lectures only.)

Source	Projected Support
DOE	10,000
NSF	5,000
ATLAS	5,000
88-Inch	5,000
NSCL/MSU	10,000
JHIR/ORNL	5,000
Total	40,000

Later, LLNL and ARUNA
Joined the club...

SECOND RIA SUMMER SCHOOL ON EXOTIC BEAM PHYSICS

AUGUST 4-9, 2003

NATIONAL SUPERCONDUCTING CYCLOTRON LABORATORY
MICHIGAN STATE UNIVERSITY
EAST LANSING, MICHIGAN

Motivation: In years to come, substantial progress in low-energy nuclear physics will have a broad impact on society, ranging from our understanding of the origin of the elements to the enhancement of National Security. An important element in this task will be to extend the study of nuclei into new domains of isospin. This will require new radioactive ion beam facilities, together with advanced multi-detector arrays and mass spectrometers.

Based on the outstanding scientific opportunities that would be enabled by an advanced radioactive ion beam facility, the Rare Isotope Accelerator (RIA) has been endorsed in the 2002 Nuclear Physics Long Range Plan as the highest priority for major new construction in nuclear physics for the United States. The RIA concept brings together a unique combination of technologies to produce high-quality beams of short-lived nuclei of all chemical elements at intensities far exceeding what is currently available.

Purpose: This one-week school is the second of a series of summer programs aimed at educating young researchers of the challenges of radioactive ion beam physics. Through these annual schools the research community will be able to exploit fully the opportunities created by RIA. The RIA summer school is jointly organized by the 88-Inch Cyclotron, ATLAS, HRIBF, and NSCL, and will be an annual event, rotating among these laboratories.

Who should apply and attend: Senior undergraduates, graduate students, and postdoctoral researchers within 2 years of their degrees.

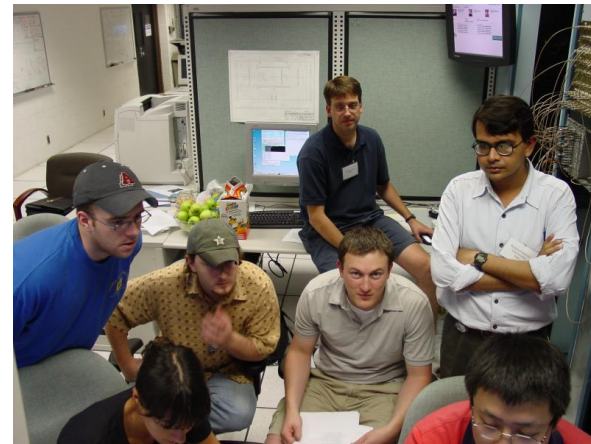


- ANNOUNCEMENTS
- PROGRAM
- LECTURE NOTES
- APPLICATION PROCEDURE
- PARTICIPANTS
- SUMMER SCHOOL PHOTOS
- ORGANIZERS
- CONTACT & E-MAIL

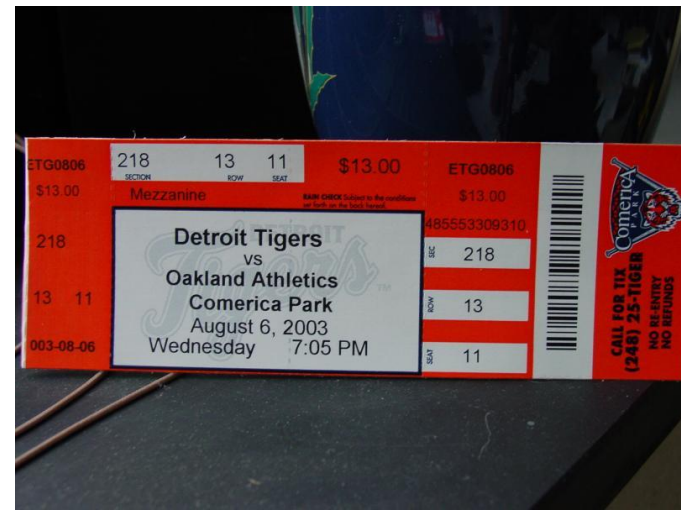


- The context of RIA - Richard Casten (Yale University)
- Collective excitations in exotic nuclei - Kim Lister (ANL)
- Origin of the elements - Michael Smith (ORNL)
- Nuclear structure theory - Stuart Pittel (University of Delaware)
- Test of the Standard Model using rare isotopes - Tim Chupp (University of Michigan)
- Gamma ray tracking techniques - Augusto Macchiavelli (LBL)
- Nuclear Reactions - Filomena Nunes (Michigan State University)

Info for students: For the “hands-on” part of the school, you will be divided into 6 teams of roughly 7 students each. On Friday afternoon to Saturday ~1 PM, each team will be given 4 hours with the NSCL cyclotron facility and the A1900 fragment separator to develop and identify a radioactive ion beam. The working group sessions throughout the week are intended to prepare you for this task.







2003 Detroit Tigers season

[Article](#) [Talk](#)

From Wikipedia, the free encyclopedia

The **2003 Detroit Tigers season** was the team's 103rd season. They finished with the most losses in [American League](#) history (119), and came within one loss of tying the [1962 New York Mets](#) for the [most losses in modern major league history](#). This would be the last year in which the team would lose 100 or more games in a season until [2019](#). The team went 43–119, which surpassed the [1916 Philadelphia Athletics](#) for the most losses in American League history. But due to a shorter season in 1916, the Athletics had a worse winning percentage and seven fewer wins (36-117 record) than the 2003 Tigers. The Tigers were outscored by 337 runs over the course of the season (928 to 591) and finished 47 games behind the [Minnesota Twins](#). Blame for the dismal season was shared by both the pitching staff, which had an ERA of 5.30, and the batters, who finished with a team batting average of .240, 19 points below the American League's .259 batting average. On August 22, the Tigers were eliminated from playoff contention, the fastest playoff elimination until being surpassed by the [2018 Baltimore Orioles](#), who were eliminated on August 20 that same year.



The 3rd RIA 2004 Summer School, August 8-15, 2004, at ANL

Saturday August 8 Afternoon Students Arrive

Hdg. 617

18:00 Welcome Reception and Registration

Monday August 9

Hdg. 223

08:00 – 08:15 Welcome and Introduction

08:15 – 09:30 HS&H Lecture

10:00 – 11:00 Nuclear Structure and Rare Isotopes (I)

11:15 – 12:15 Nuclear Reactions and Rare Isotope Physics (I)

Hdg. 223 & 203

14:00 – 16:45 Hands-On Program (I)

Hdg. 223

17:15 – 18:30 Student Seminars and Q&A on the lectures of the day

Tuesday August 10

Hdg. 223

08:45 – 09:45 Experimental Techniques for Spectroscopy with Rare Isotopes (I)

10:00 – 11:00 Nuclear Astrophysics and Rare Isotopes (I)

11:15 – 12:15 Production of Exotic Beams at AILAS

Hdg. 223 & 203

14:00 – 16:45 Hands-On Program (II)

Hdg. 223

17:15 – 18:30 Student Seminars and Q&A on the lectures of the day

Wednesday August 11

Hdg. 223

08:45 – 09:45 Nuclear Reactions and Rare Isotope Physics (II)

10:00 – 11:00 Nuclear Structure and Rare Isotopes (II)

11:15 – 12:15 The fundamentals of the RIA concept (I)

Hdg. 223 & 203

14:00 – 16:45 Hands-On Program (III)

Hdg. 223

17:15 – 18:30 Student Seminars and Q&A on the lectures of the day

Hdg. 203

19:00 – 21:30 Hizza Party

Presentation of RIA-RSD what does the hardware look like?

T Millen (ANL)

J Dbaczewski (Warsaw Univ., CRN)

K Kemper (Florida State Univ.)

S Fischer (DePaul Univ., ANL)

W Nazarewicz (Univ. Tennessee, CRN)

T Gasmacher (Michigan State Univ., NSCL)

G Fuller (Univ. California San Diego)

R Pardo (ANL)

S Fischer (DePaul Univ., ANL)

W Nazarewicz (Univ. Tennessee, CRN)

K Kemper (Florida State Univ.)

J Dbaczewski (Warsaw Univ., CRN)

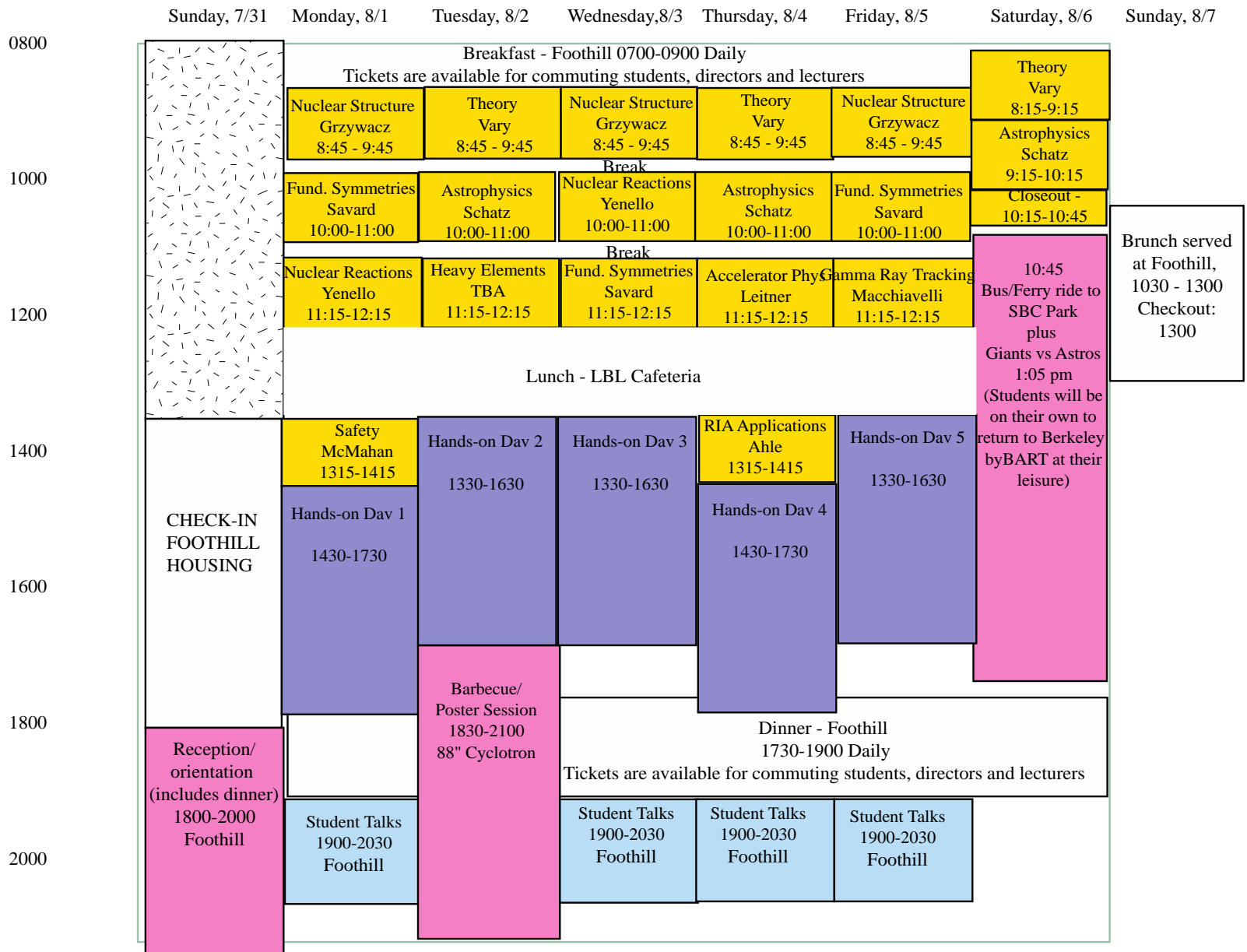
G Seward (Univ. Chicago, ANL)

S Fischer (DePaul Univ., ANL)

W Nazarewicz (Univ. Tennessee, CRN)

52 graduate and postdoctoral students attended the school. This number was larger than that of the previous two schools (40). A list of applicants exceeded 100. The participants came predominantly from 25 US universities and national laboratories.

The 4th RIA Summer School, July 31-Aug 6, 2005, at LBNL



Alumni highlights (RIASS 1-4)...

Tan Ahn, Stony Brook \Rightarrow Notre Dame

Kelly Chipps, Mines \Rightarrow ORNL

Jason Clark, University of Manitoba \Rightarrow ANL

Calem Hoffman, FSU \Rightarrow ANL

Kate Jones, GSI \Rightarrow UTK

Shelly Leshner, UK \Rightarrow University of Wisconsin-La Crosse

Sean Liddick, MSU \Rightarrow MSU

Elizabeth McCutchan, Yale \Rightarrow NNDC, BNL

Alexandre Obertelli, Saclay \Rightarrow TU Darmstadt

Marina Petri, Liverpool \Rightarrow York

Ryan Ringle, MSU \Rightarrow MSU

Andrew Rogers, MSU \Rightarrow UMass Lowell

Ionel Stetcu, LSU \Rightarrow LANL

Mathis Wiedeking, FSU \Rightarrow iThemba

... and many others!

A perspective...

2002 First RIASS

2006 NAS RISAC report endorsing construction of FRIB

Fifth RIASS at ORNL

2007 NSAC LRP strongly endorses FRIB

Sixth Summer School on Exotic Beam Physics at MSU

∴ ▷▷

2015 NSAC LRP recommends FRIB completion

∴ ▷▷

2022 FRIB launched

2023 Twentieth EBSS2002

