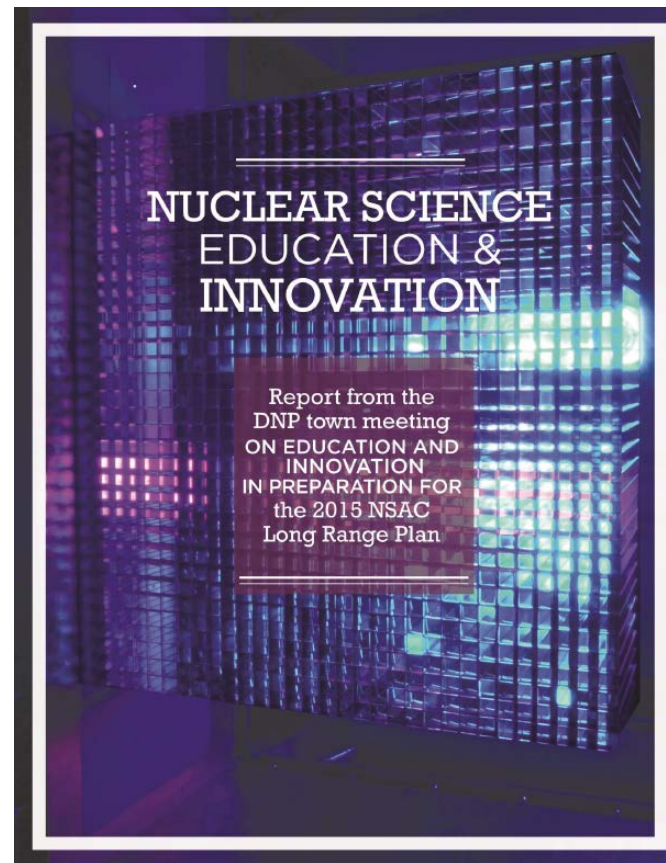


The Future of Nuclear Physics Education

Report from the DNP town meeting on Education and Innovation in preparation for the 2015 NSAC Long Range Plan



<http://meetings.nscl.msu.edu/Education-Innovation-2014/EducationInnovation2015.pdf>

DNP LRP Meeting on Education and Innovation

Wednesday, 6 August 2014

7:00 PM Welcome Reception - NSCL Atrium

Thursday, 7 August 2014

8:30 AM Breakfast

9:00 AM Plenary Session - NSCL Lecture Hall

Introduction and Overview

Remarks by DOE

Remarks by NSF

NSAC report on workforce development

Michael Thoennessen (MSU)

Jehanne Gillo (DOE)

Brad Keister (NSF)

Jolie Cizewski (Rutgers)

First official Town Meeting on Education and Application for a LRP

10:30 AM Break

10:45 AM Plenary Session - NSCL Lecture Hall

• Workforce Development

Analysis of workforce demographics

NNSA Workforce Development

The future MARS program at FIU

Educational aspects of the FRIB theory center

Workforce development in computational

nuclear physics

Michael Thoennessen (MSU)

Sean Liddick (MSU)

Joerg Reinhold (FIU)

Filomena Nunes (MSU)

Richard Furnstahl (OSU)

12:00 PM Lunch

Parallel Sessions

1:15 PM Education - NSCL Lecture Hall

• Graduate Education

Innovation - 1221A/B

• Defense and Security

2:30 PM Break

2:45 PM Education - NSCL Lecture Hall

• Undergraduate Education

Innovation - 1221A/B

• Energy and Climate

4:00 PM Break

4:15 PM Education - NSCL Lecture Hall

• K12

Innovation - 1221A/B

• Health and Medicine

5:30 PM Break

6:00 PM Dinner - NSCL Atrium

7:30 PM Parallel discussions on draft recommendations

Friday, 8 August 2014

8:30 AM Breakfast

9:00 AM Education - NSCL Lecture Hall

• Public Outreach

Innovation - 1221A/B

• Innovation, Art and Forensic

10:15 AM Break

10:30 AM Plenary Session - NSCL Lecture Hall

Summary discussions of recommendations

12:00 PM Adjourn

August 6-8, 2014

NSCL, Michigan State University

74 total participants

Organizing committee:

Ed Hartouni (LLNL)

Anna Hayes (LANL)

Calvin Howell (Duke)

Cynthia Keppel (JLab)

Micha Kilburn (Notre Dame)

Amy McCausey (Michigan State, conf. coordinator)

Graham Peaslee (Hope College, co-convenor)

David Robertson (Missouri)

Gunther Roland (MIT)

Mike Snow (Indiana)

Michael Thoennessen (Michigan State, co-convenor)



National Science Foundation
Michigan State University

Science town meetings

Joint DNP Town Meetings on Nuclear Structure and Nuclear Astrophysics

August 21-23, 2014

Mitchell Institute, Texas A&M University

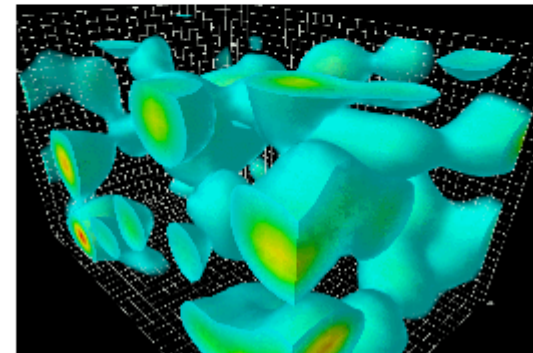
APS Division of Nuclear Physics: 2014 Long-range plan

Joint Town Meetings on QCD

Temple University

September 13-15, 2014

**Fundamental Symmetries, Neutrinos,
Neutrons and related Nuclear
Astrophysics
Long-Range Plan Town Meeting
Chicago, September 28-29, 2014**



Education and Innovation White Paper

NUCLEAR SCIENCE EDUCATION & INNOVATION

Preamble

Executive Summary

- Recommendations

Workforce and Education

- Workforce Development
- Graduate and Postgraduate Education
- Undergraduate Education
- K12 and Outreach

Innovation

- Defense & Security
- Energy & Climate
- Health & Medicine
- Innovations, art & Forensic

Appendix A: Program

Appendix B: List of Participants

Appendix C: Presentation Abstracts

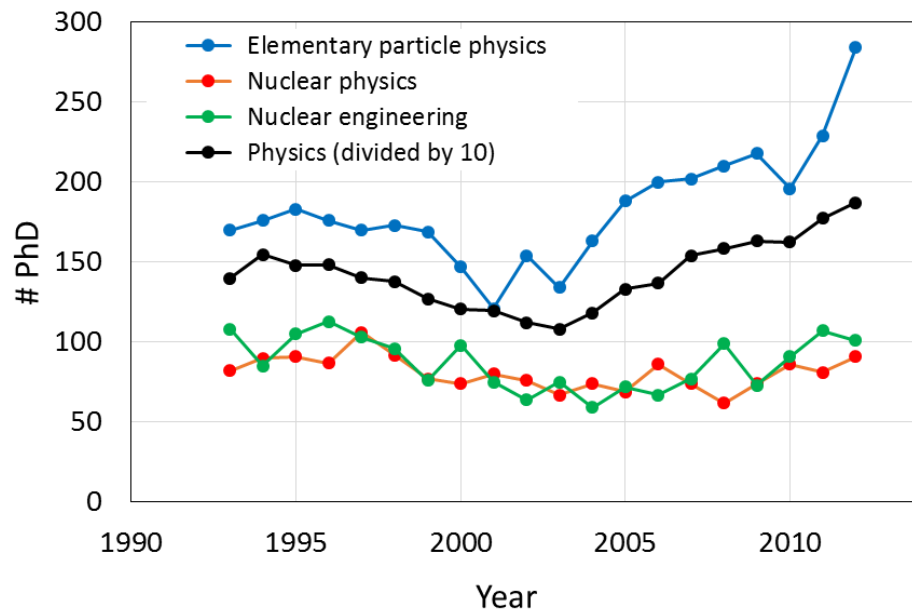
Appendix D: Examples of Present Outreach Activities



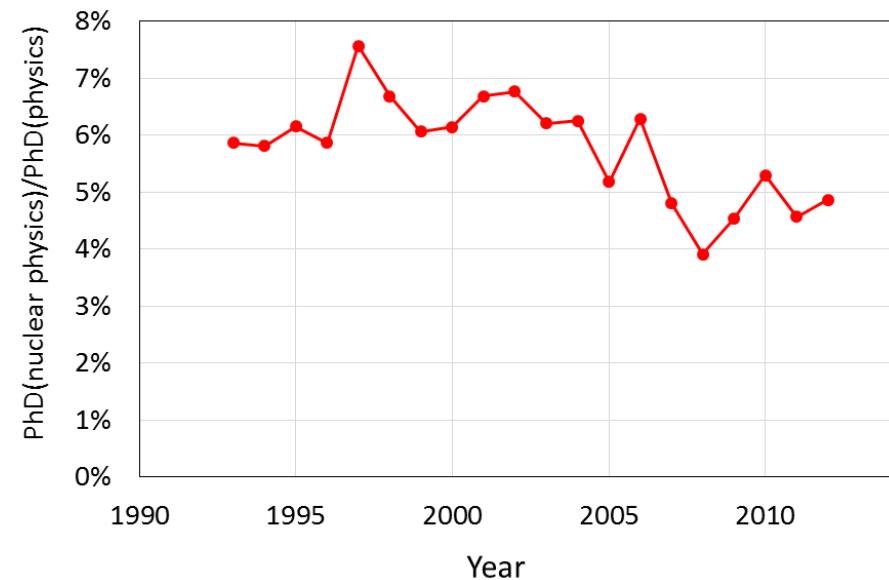
Workforce Development

“Encourage the funding agencies to continue to capitalize on the direct educational benefits of their primary missions. Federal dollars spent in basic research at universities have a major impact on the quality and depth of undergraduate science education”

1996 LRP

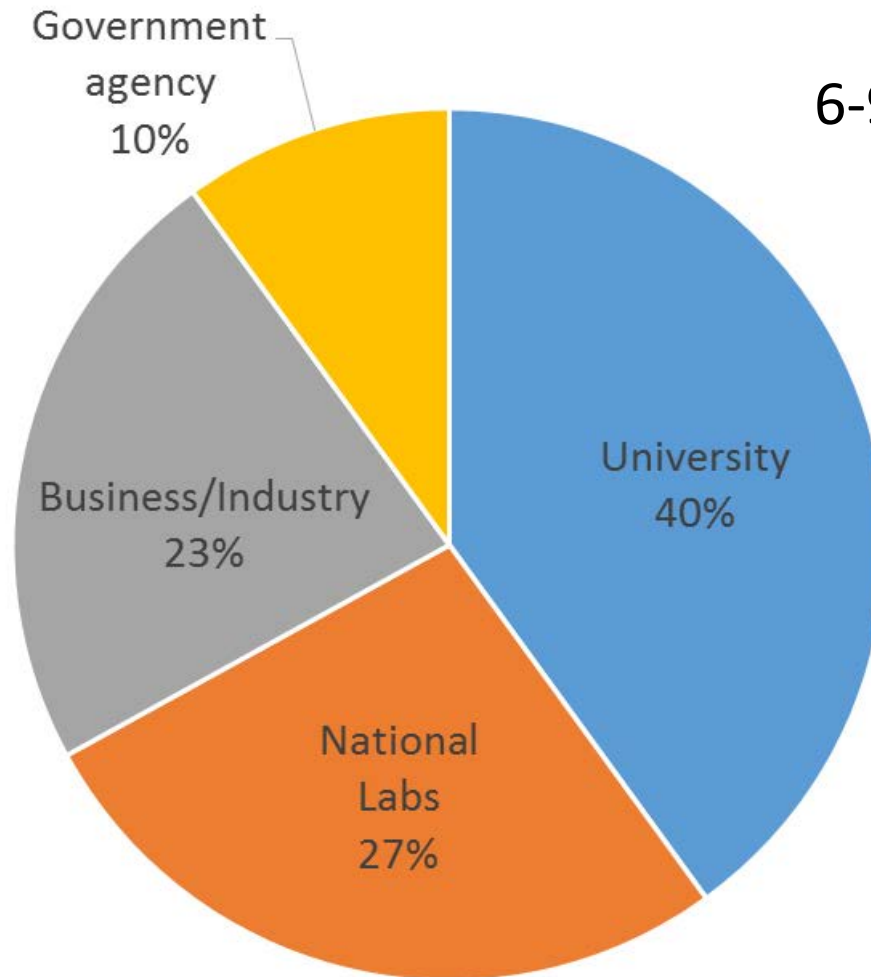


Number of PhDs per year

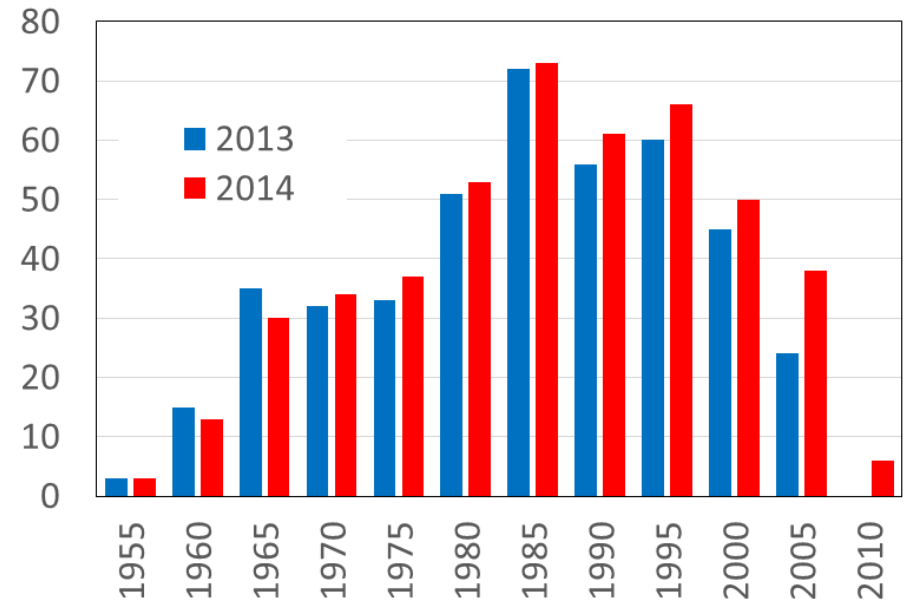
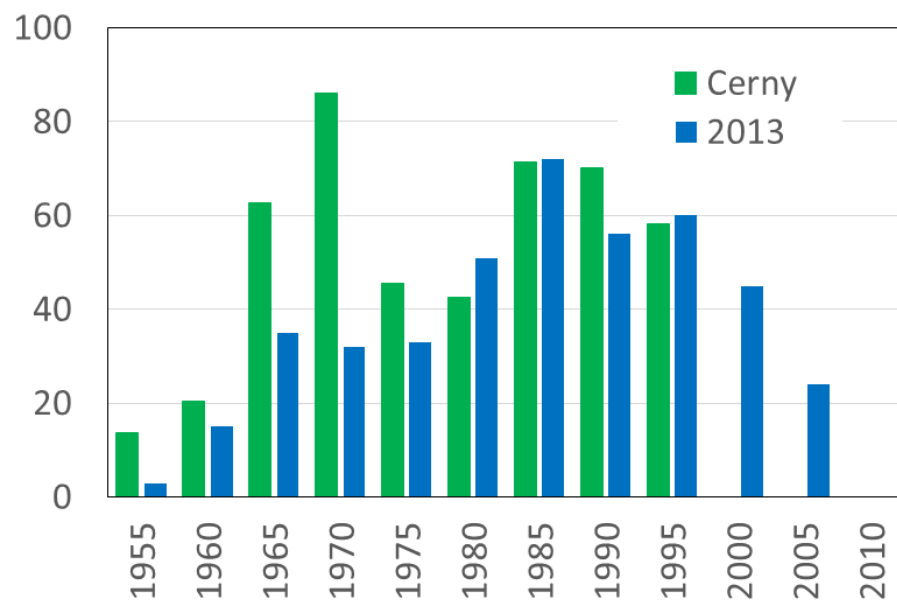


Fraction of PhDs in Nuclear Physics

Careers of Nuclear Physics PhD



Faculty



US faculty “year-of-degree” distributions

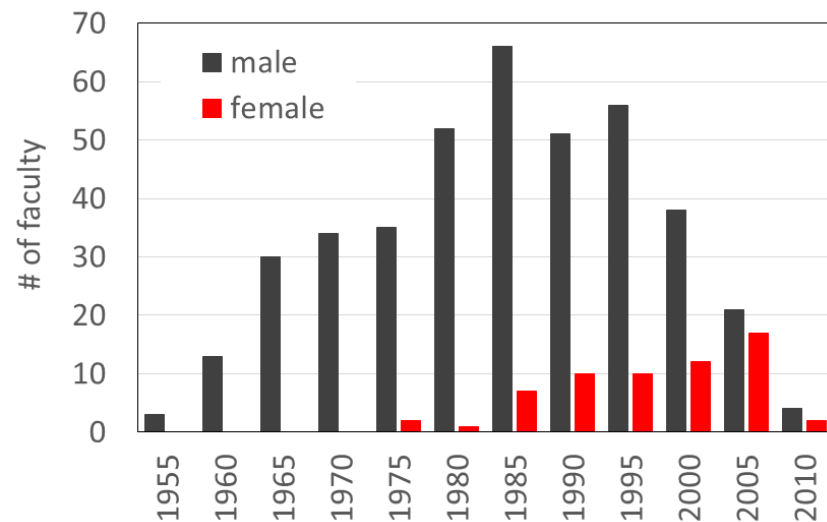
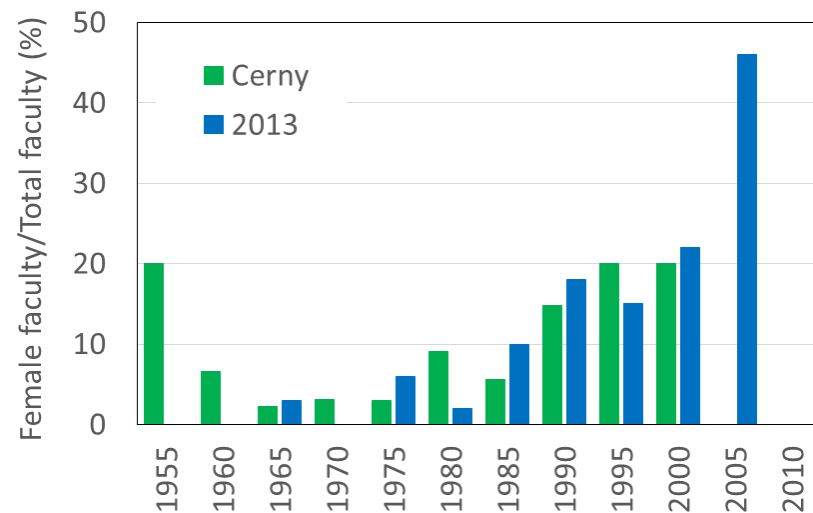
Female Faculty

	Percent female faculty	
	Physics	Nuclear Physics
Full Professor	8%	7.5%
Associate Professor	15%	12.9%
Assistant Professor	22%	29.7%
Total	14%	12.2%

Fraction

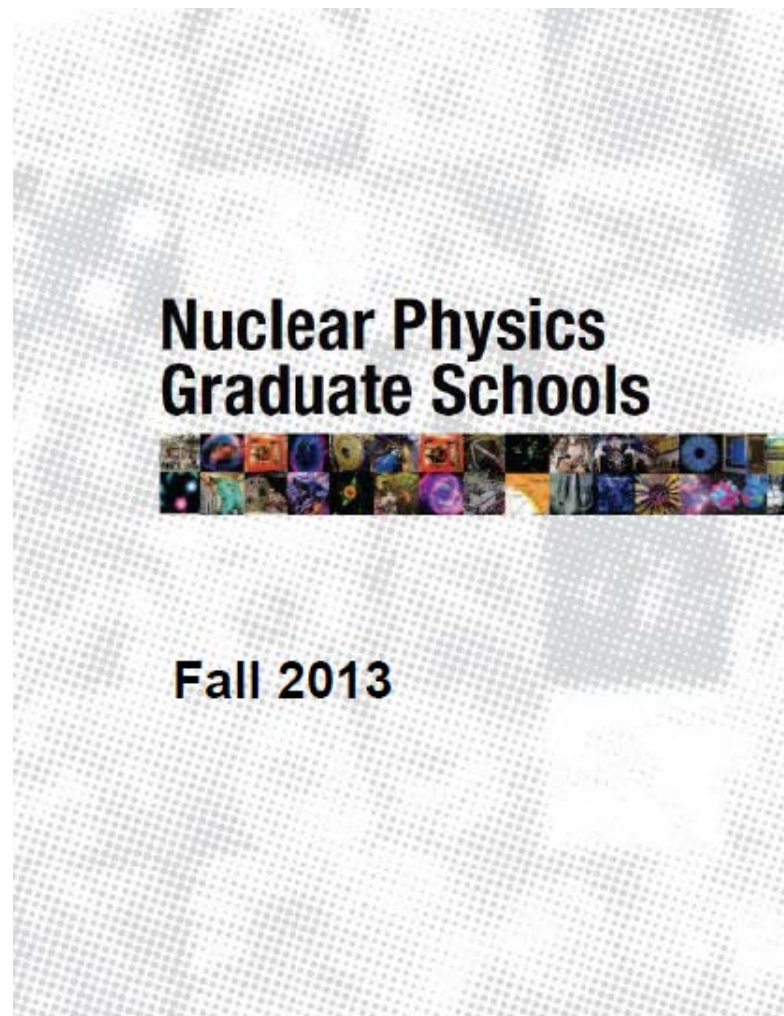
“year of PhD”
distributions

Numbers



Graduate and Postgraduate Education

- Recruiting
 - Graduate brochure
 - CEU
 - Fellowships
- Mentoring
- Education
 - Distributed graduate courses
 - Summer schools
 - Topical collaborations



Is there an image problem?

GradSchoolShopper.com

Research Specialties
Princeton University

Specialties for Degree Program

Research specialty	Degree type	
	PhD (Theoretical/Experimental)	Master (Final degree/Enroute to PhD)
Astronomy	Theoretical	-
Astrophysics	Experimental	-
Atomic, Molecular, & Optical Physics	Experimental	-
Biophysics	Both	-
Condensed Matter Physics	Both	-
Particles and Fields	Both	-
Relativity & Gravitation	Both	-

Departmental Research and Staff

THEORETICAL

- Biophysics
- Condensed Matter Physics
- Relativity & Gravitation

EXPERIMENTAL

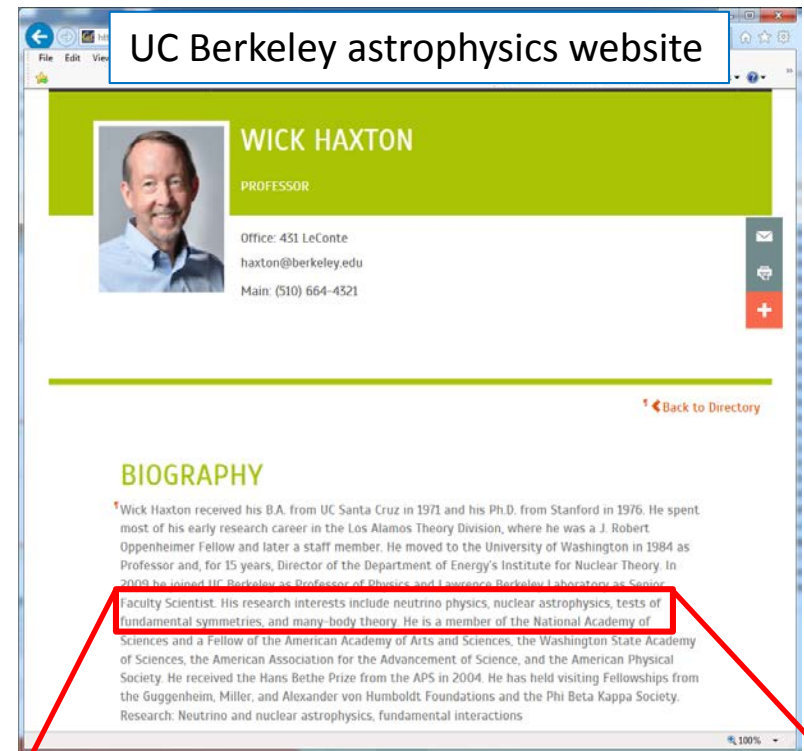
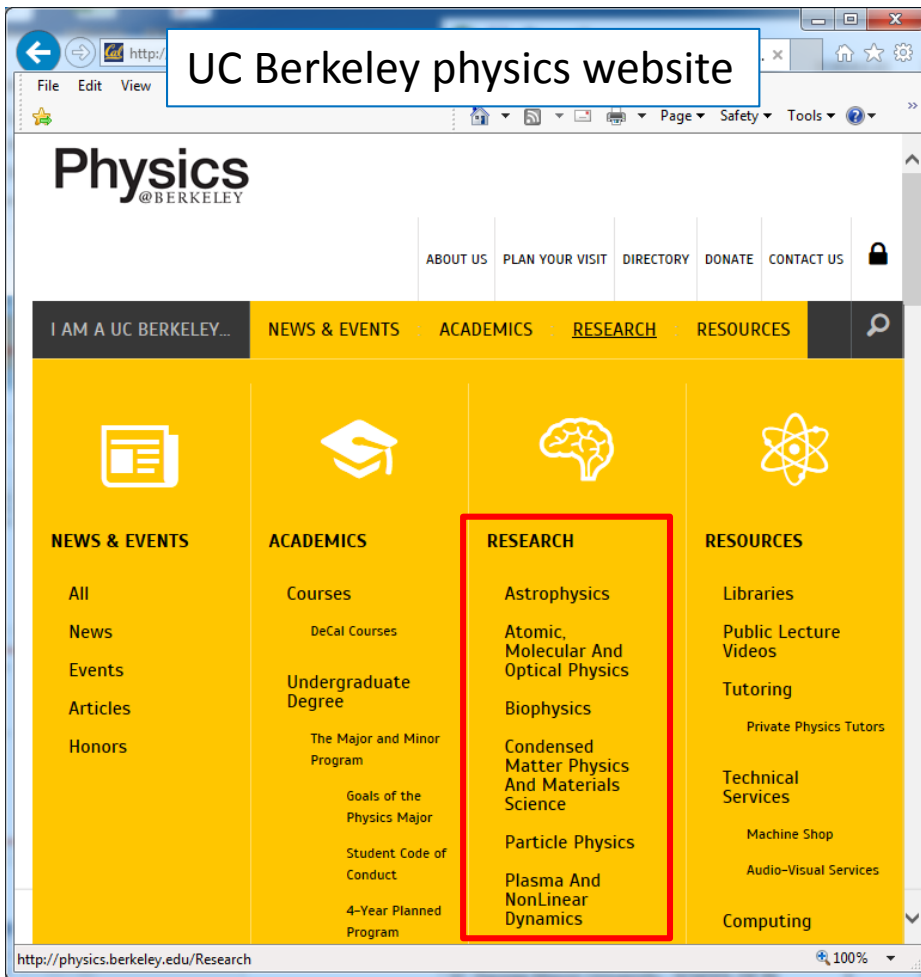
- Atomic, Molecular, & Optical Physics
- Biophysics
- Condensed Matter Physics
- Nuclear Physics**
- Particles and Fields

UC Riverside physics website

- Astrophysics
- Biophysics
- Experimental Condensed Matter Physics
- Theoretical Condensed Matter Physics
- Environmental Physics
- High Energy Physics
- Relativistic Heavy-Ion Physics
- Nucleon Spin Physics

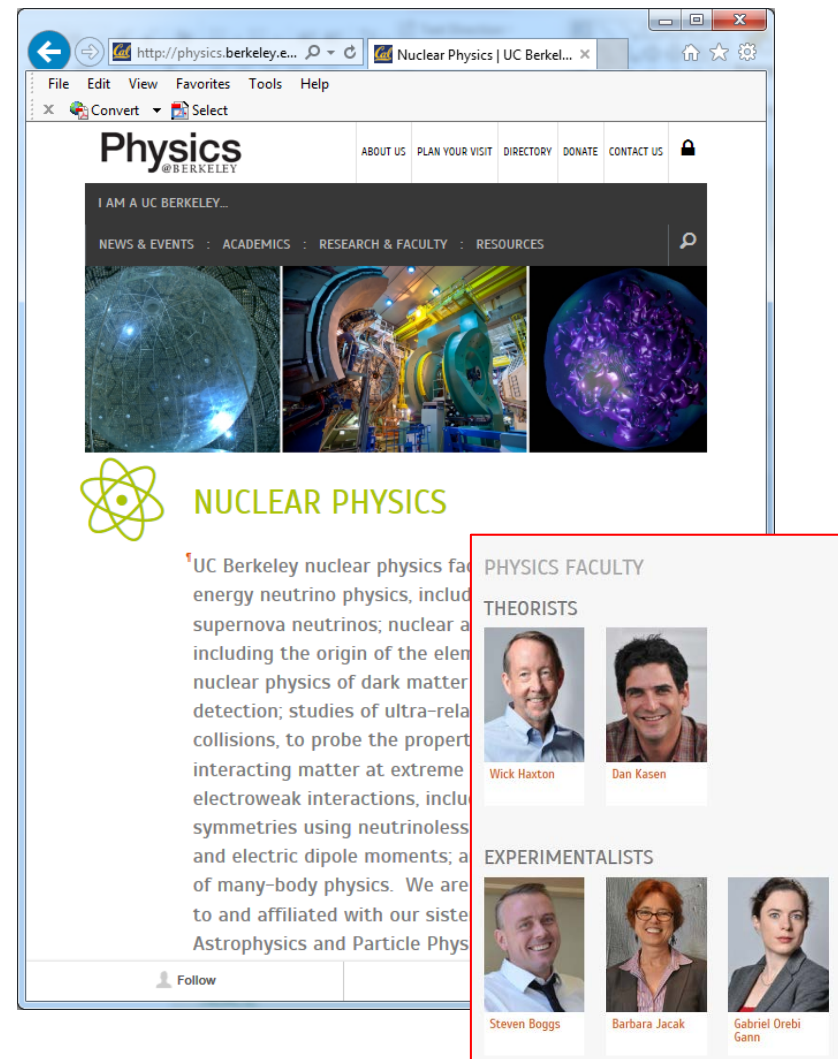
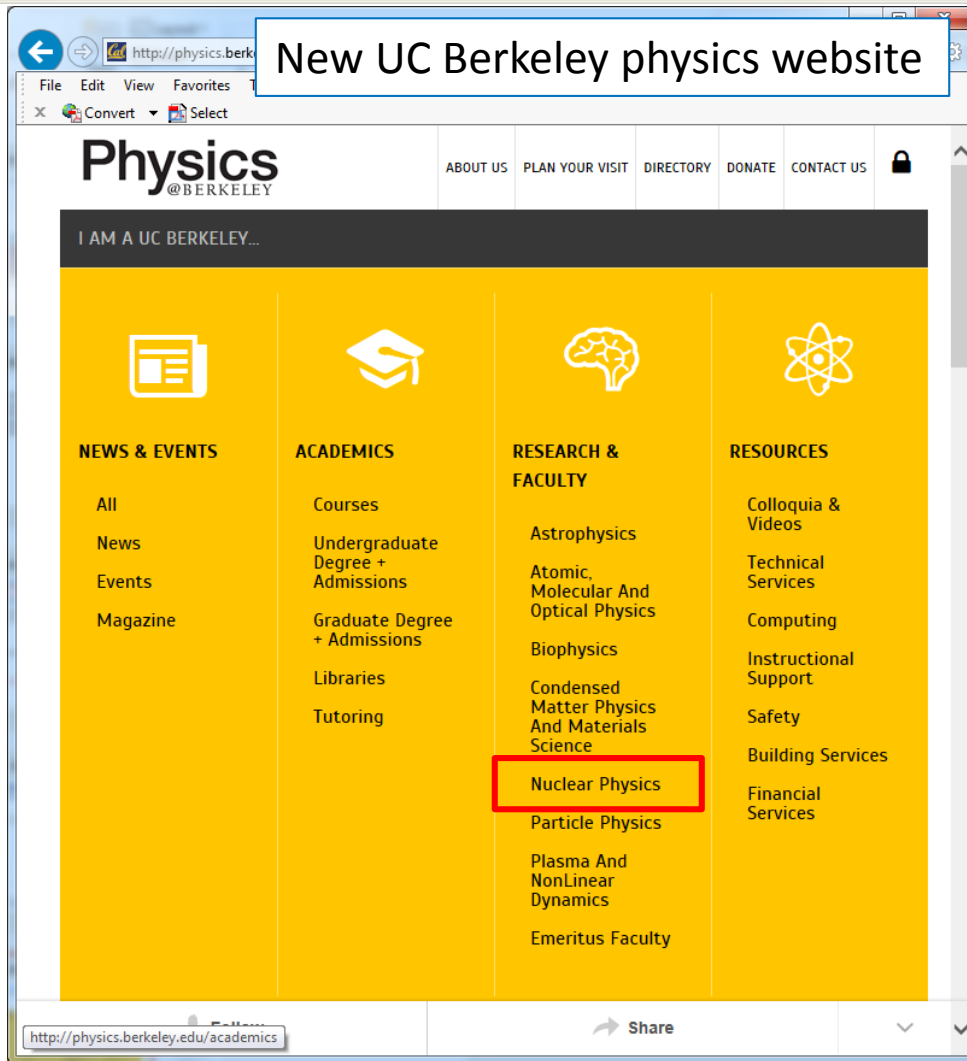
Many departments
do not identify their
research area as
“nuclear” anymore!

One more example



His research interests include neutrino physics, nuclear astrophysics, tests of fundamental symmetries, and many-body theory.

...already success!!!



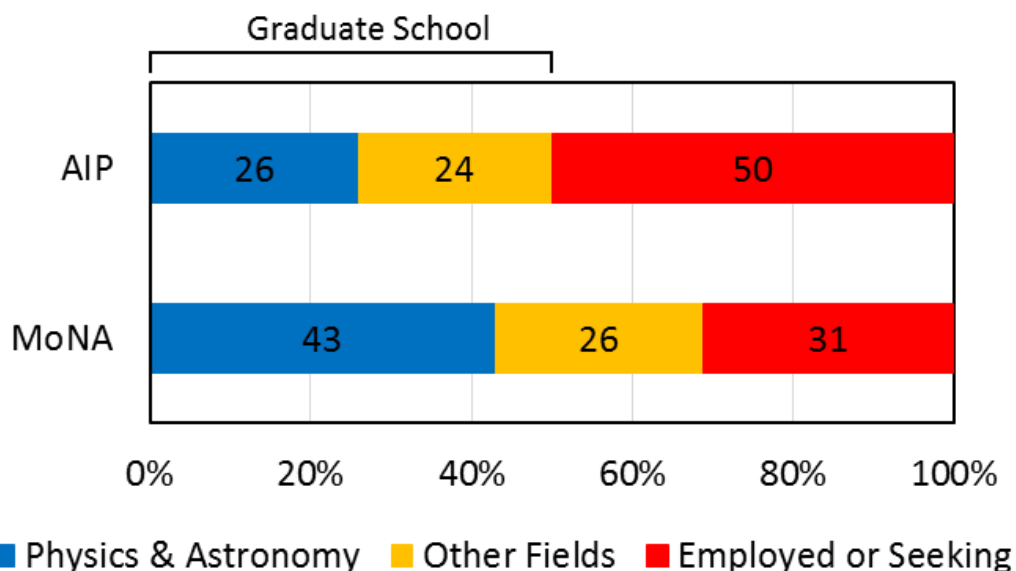
National Science Foundation
Michigan State University

Undergraduate Education

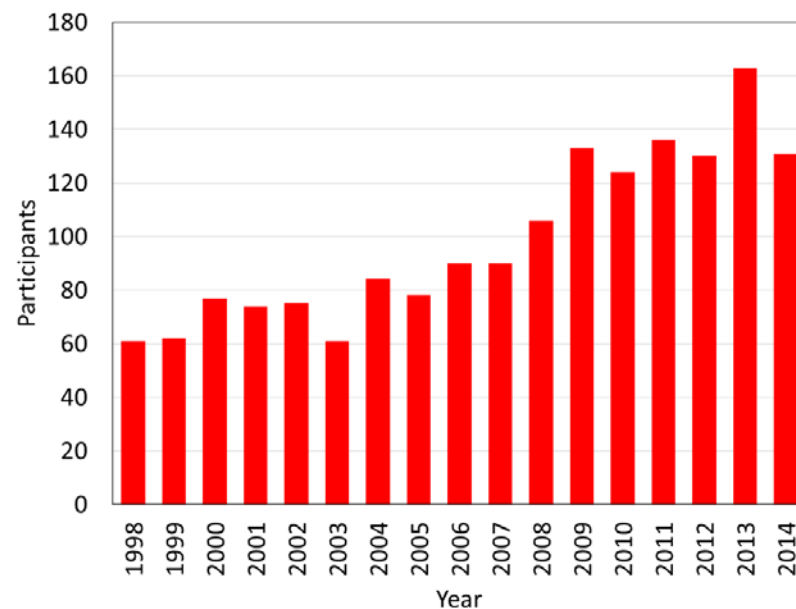
Importance of undergraduate research experience:

“The nuclear science community should increase its involvement and visibility in undergraduate education and research...”

2007 LRP



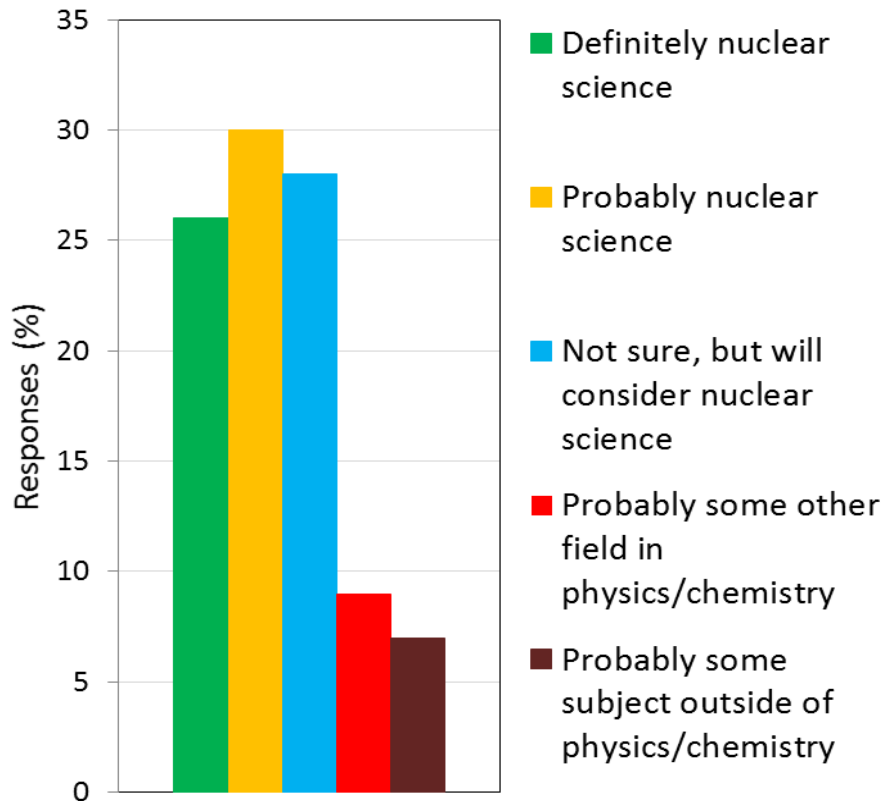
Fraction of students
attending graduate school



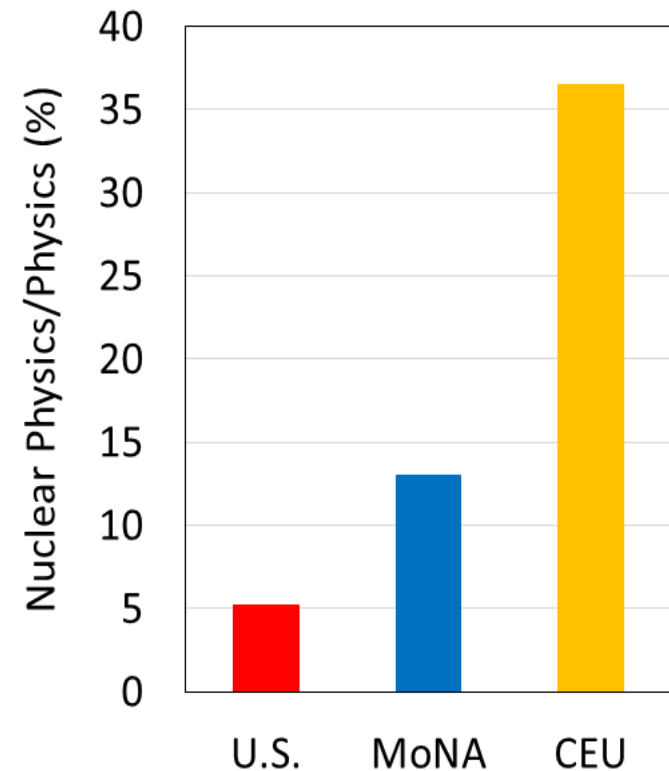
CEU participants

Undergraduate Education

If you are planning to attend graduate school, which field of study are you currently considering?



CEU 2014 survey



Fraction of students selecting nuclear physics

Examples of CEU and REU students

Mustafa Rajabali
MoNA, CEU 2002
Assistant Professor,
Tennessee Tech



Anne Sickles
REU/CEU 1999 and 2000
Assistant Professor,
University of Illinois

CEU 1998

Michael Binger

1998 REU University of Washington, INT, Martin Savage

1998 CEU "Multiloop Diagrams in Non-Relativistic Field Theories and the Deuteron Quadrupole Moment

1999 BS Physics and Applied Mathematics, North Carolina State University

2006 PhD Theoretical Particle Physics, Stanford University

....

2010 Total live tournament winnings exceed \$6,500,000



Michael Binger at the 2008 World Series of Poker

Nickname(s)	The Machine
Residence	Atherton, California

World Series of Poker

Bracelet(s)	None
Money finish(es)	23
Highest ITM	3rd, 2006
Main Event finish	

Research Experience for Undergraduates

The Nuclear Physics community has recognized the importance of early research experience for a long time:

- In 1983 the NSAC Long Range Plan stated as the first recommendation with regards to manpower and training: “Programs which involve undergraduates in nuclear science research are extremely important in attracting students to the field... efforts should be made to strengthen and expand these... if necessary with specific funding from the agencies”
- When the NSF (re)instituted the Research Experience for Undergraduates (REU) programs in 1987, **half of the first successful proposals were led by nuclear physicists.**
- The Nuclear Physics community continues to take advantage of the REU and the DOE sponsored Science Undergraduate Laboratory Internships (SULI) program.
- Out of 48 sites posted on the NSF physics REU site which specify subfield research options, 19 (**40% of the programs**) **list nuclear physics** as an option.



K12 and Outreach

The Nuclear Physics Community has traditionally provided national leadership through its work with K-12 students, both at its major laboratories and through smaller laboratories and also individual nuclear physicists.

- Accelerator labs offer great opportunities (Open Houses)



- Utilization of modern communication...
 - Social media
 - Nuclear chart as a mobile
 - Video game
 - ...



Web Activities



Organization: University of Notre Dame
Michigan State University

Grade Level: K-12 + Adult

Contact: JINA Outreach
(574) 631-5326
jinaout@nd.edu

Funding source: NSF

The JINA Educational Gallery offers something for everyone, from movies, coloring sheets, and a slide show based on Harry Potter character names, to teaching materials and advanced course-based lectures. The gallery pages continue to receive 1000+ unique visits each year.

JINA is active in social media on its Facebook, Twitter, Google+, and YouTube pages. The most popular Facebook post to date, about International Women's Day, was seen by over 900 people. Most of the FB fans are women, ages 35-44 who live in or near South Bend. These are most likely mothers of students who have attended a JINA outreach program. We use FB to notify them of other local outreach events throughout the year. Almost 20% of the fans live outside of the United States.

JINA has posted 13 videos on YouTube, which have been viewed 1000+ times. These videos are a combination of educational content and videos about outreach events. The most popular video was a 'fun' experimental parody of the 12 days of Christmas, which was a joint project between scientists at MSU and ND. While growth on Twitter and Google+ have been slower than FB and YouTube, scientists and committees often use Google+ hangouts as a new way to video conference.



NSCL Public Talks



Organization: NSCL at MSU

Audience/Grade Level: Any

Contact: NSCL Outreach
visits@nscl.msu.edu

517-908-7363

Funding source: NSF

Groups that are too large for NSCL tours or can't travel to the lab are offered talks about nuclear science or, for school groups that request it, careers in research (and STEM) fields. NSCL faculty, staff and students often travel around Michigan to tell their story to these audiences. Such talks have been attended by over 2400 guests in 2014.

One talk organizer said: "Your presentation was outstanding and the highlight of the day. Literally every conversation I had the rest of the day included very positive comments about your presentation!"



Jefferson Lab Physics Fest



Organization: Jefferson Lab

Audience/Grade Level: K-12

Contact: Jan Tyler

Funding source: Jefferson Lab

Jefferson Lab's Physics Fest is a two-hour field trip highlighting nuclear physics, demonstrations with cryogenics and plasmas, and career opportunities in the STEM fields. Nearly 6,000 students attended the events at Jefferson Lab in FY2014.



Nuclear Science Day for Girl Scouts & Boy Scouts



Organization: Nuclear Science Division LBNL

Audience/Grade Level: 7-12

Contact: Alan Poon, AWPoon@lbl.gov

510-495-2467

Funding source: LBNL and support fund from foundations

The Nuclear Science Division at LBNL has been hosting the Nuclear Science Day for Girl Scouts and Boy Scouts event annually since 2011. About 200 youths, along with leaders, come to this event each year. Girl Scouts and Boy Scouts in the San Francisco Bay Area learn about the ABC's (alpha, beta and gamma) of Nuclear Science and participate in a number of exciting and educational activities.

The participants have opportunities to construct atomic models, build a simple electroscope, use survey meters to look for hidden radioactivity, tour an accelerator, and also discuss career options with guest scientists. In addition to using Geiger counters in the survey activities, the scouts saw other types of radiation detector in action as well.

Upon completion of the day's activities, all participants get the event patch. Boy Scouts who also complete a prerequisite worksheet will earn the Nuclear Science Merit Badge. This is a very popular community event, and NSD was honored with a community partnership award by a local scout council in 2013.



Neutrino Day



Organization: Sanford Underground Research Facility

Audience/Grade Level: Public / All

Contact: Peggy Norris
pnorris@sanfordlab.org
(605)-722-5049

Funding source: Sanford Lab and local businesses and foundations

Neutrino Day is an annual science festival held in the Lead, SD community the second Saturday of July that has grown to attract more than 1000 participants. In 2013, the festival outgrew the surface facility at the Sanford Underground Research Facility and expanded downtown.

The whole community is now involved. At the Sanford Lab site, visitors can tour the Holst Room, visit displays or ask questions of scientists working at the 4850L of the underground lab via high-definition videoconference. Down the hill in town, science lectures and hands-on activities for kids of all ages take place at the Historic Homestake Opera House, the Library, the Lead-Deadwood Middle School, the Homestake Open Cut and the Black Hills Mining Museum. Buses take participants between locations. Partners include the Lead Chamber of Commerce, the Lead-Deadwood Arts Council, South Dakota Public Broadcasting, Black Hills Power and many community volunteers.



RHIC Features and Press Outreach



Organization: Brookhaven National Laboratory, Media & Communications Office

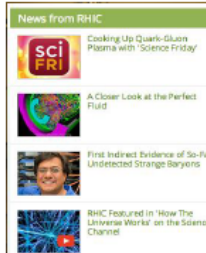
Audience: General Public

Contact: Karen McHulity Walsh, kmchulity@bnl.gov

Funding source: DOE Office of Science

Brookhaven Lab regularly features engaging stories about the research at the Relativistic Heavy Ion Collider (RHIC) on its public-facing web pages, distributes these stories to the mainstream media, and points to them via social media (Twitter, Facebook, and Tumblr) to encourage wider distribution and independent coverage of our nuclear physics research. Examples include stories at the start and end of the most recent experimental run, features on the careers of physicists trained at RHIC, and updates on scientific findings such as the search for strange baryons and the source of gluon spin. We also routinely attend scientific meetings and science communication events where we pitch coverage of RHIC physics to reporters.

Examples of the payoff from these efforts include: a "How to Make Quark Soup" video featured on NPR's *Science Friday* broadcast and website, a segment in the *Discovery Science* series "How the Universe Works," a column on the "awe-inspiring" research at RHIC in *The Wall Street Journal*, prominent coverage in a popular book, *Heat: Adventures in the World's Fiery Places*, stories appearing on a variety of news sites and blogs, and high-tech elements of RHIC experiments featured in ads for the New York State Empire Development Corporation and Apple Computers.



Summary

- Education and dissemination has to be an integral part of research
- Nuclear science has to be promoted by the whole community
- Innovative approaches to address some of the challenges should be fostered and appreciated