

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

Department of Physics

- State of the Department

State of the Department?

Obviously, the state of the department is GREAT!

Frankly, I do not really know ☹

We are a big group of people!

We are a big group of people!

We are a big group of people!

We are a big group of people!

Aren't the 2012 students graduated?

They need to make room for 2018 batch – come on!

We are a big group of people!

People Count!

Role	Count
Non-major UG Students Served (<300-level)	2867
Physics Majors (Including AMEP, AP, double majors)	~175
Graduate Students	~186
Non-faculty Research Staff	~95
Faculty	44.25
Non-faculty Teaching Staff	11
Technical Staff	11
Administrative Staff	7
Emeritus Faculty	26
Affiliated Faculty	10
Total (Excluding Service course UGs)	**~3400 (~500)**

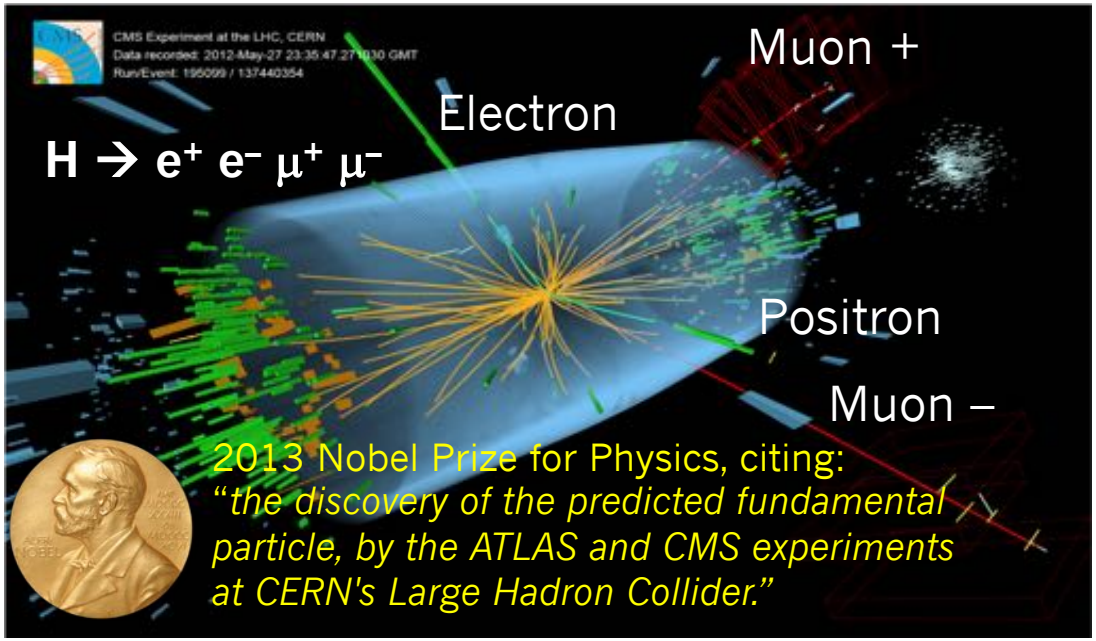
I certainly can't keep track of what 500 people are up to –
some times I have trouble keeping track of what I am doing myself!

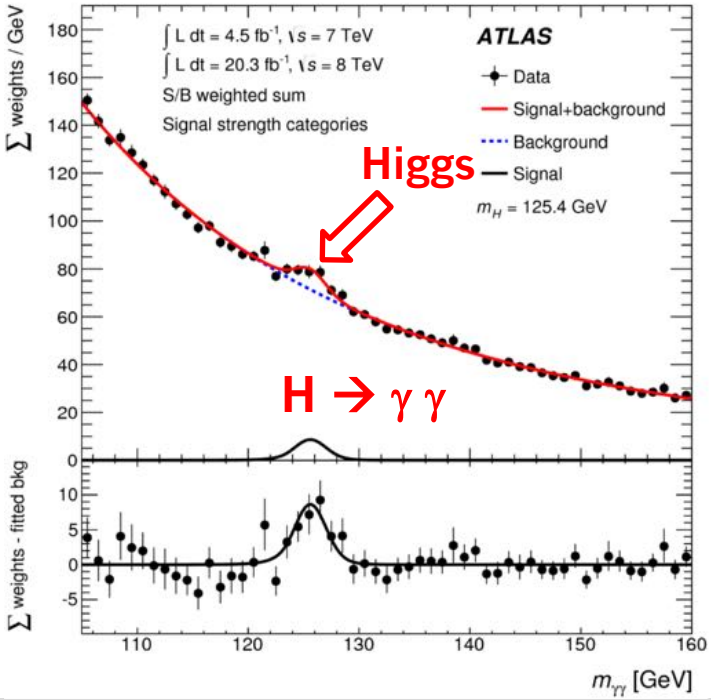
We do a lot of stuff!

Higgs Particle Discovery

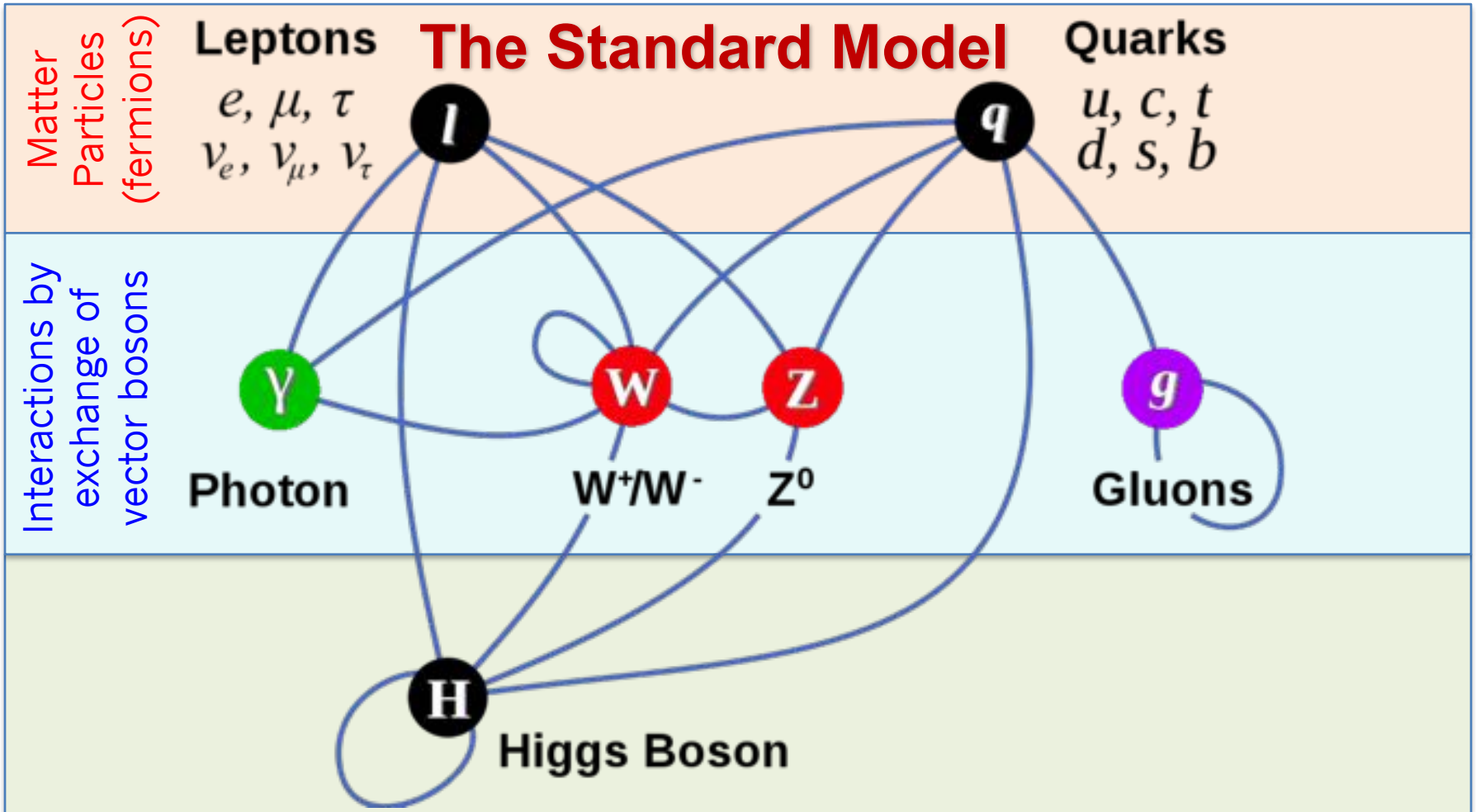
- There are two major experiments, ATLAS and CMS, at the Large Hadron Collider at CERN, which is currently the most powerful accelerator in the world.
- The University of Wisconsin has made major contributions to both experiments and to the discovery of the Higgs particle with 6 faculty making fundamental contributions to detectors and analysis.
- Strong theoretical particle group of 6 faculty.

Higgs discovered after analyzing billions of collisions





From Physics of Sizeless Particles ...



Theory: Bai | Balantekin | Barger | Chung | Everett | Halzen | Hashimoto | Shiu

Experiment: Black | Bose | Dasu | Herndon | Rebel | Wu

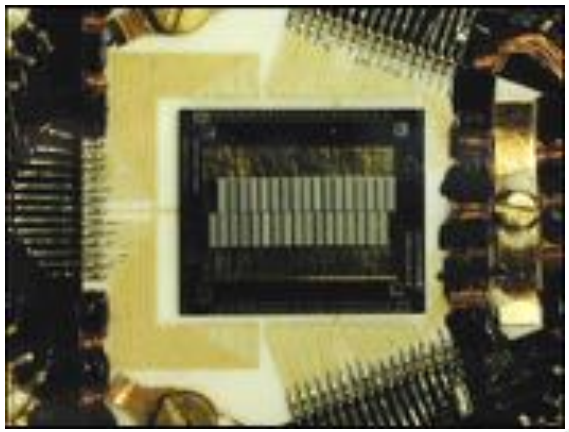
X-Ray Astrophysics, Observational Cosmology

X-Ray detection in space – micro-calorimetry

Cosmic Microwave Background studies

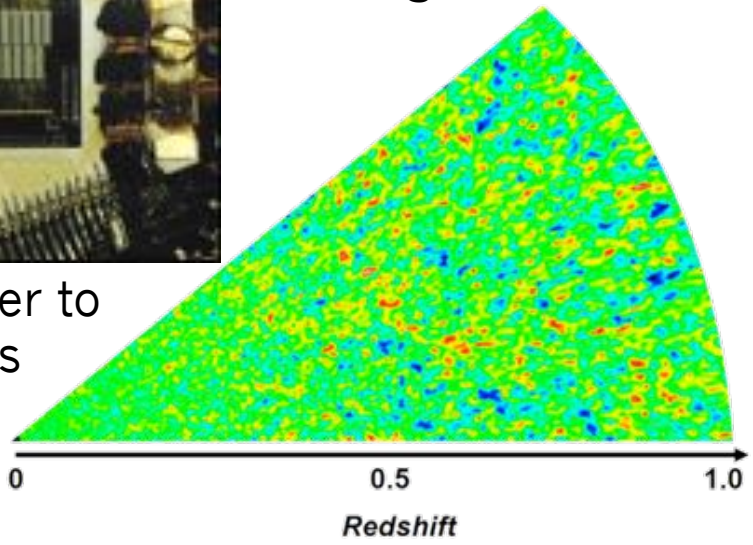
Large scale structure studies with sky-surveys

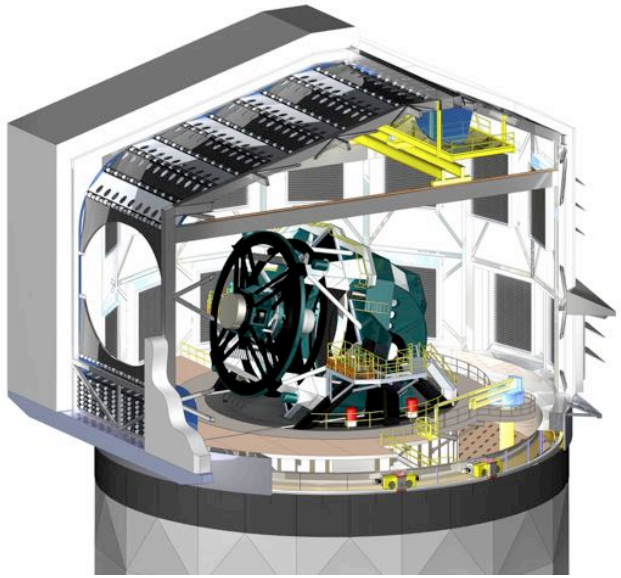
Large Synoptic Survey Telescope with Gigapixel Camera in construction in Chile



Microcalorimeter to measure X-Rays

mK fluctuations in CMB Temperature using 21-cm H-line

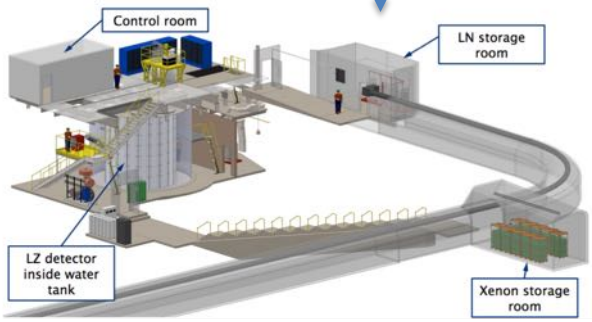




Deep Underground searches …

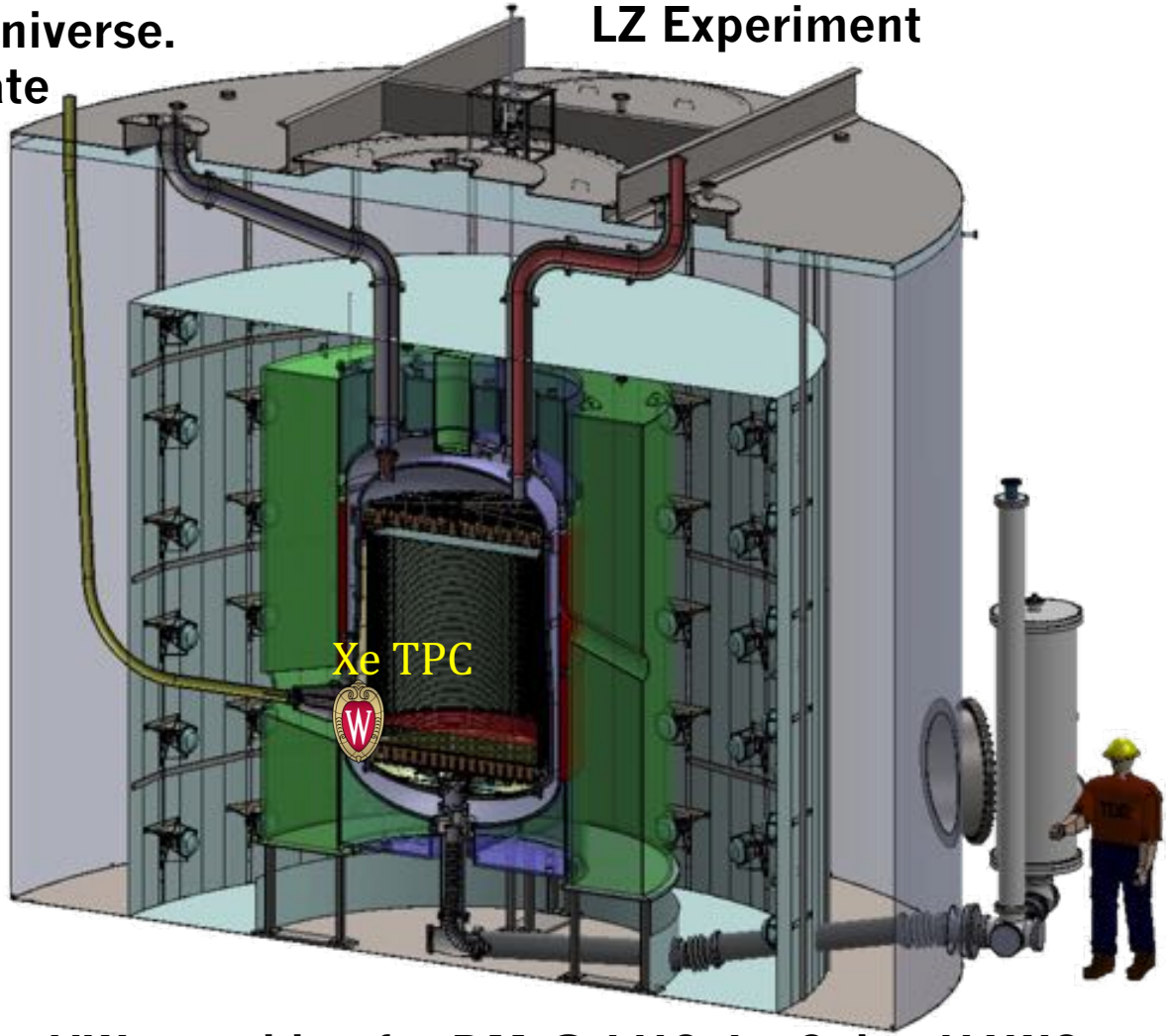
Dark Matter is 27% of our Universe.
SM has no DM candidate

About one mile underground in South Dakota



UW playing a lead role in construction

LZ Experiment



UW searching for DM @ LHC, IceCube, HAWC
Latest effort is to look for DM interactions in its feeble interaction with Xenon, deep underground

… To Deep Antarctic Ice Discoveries

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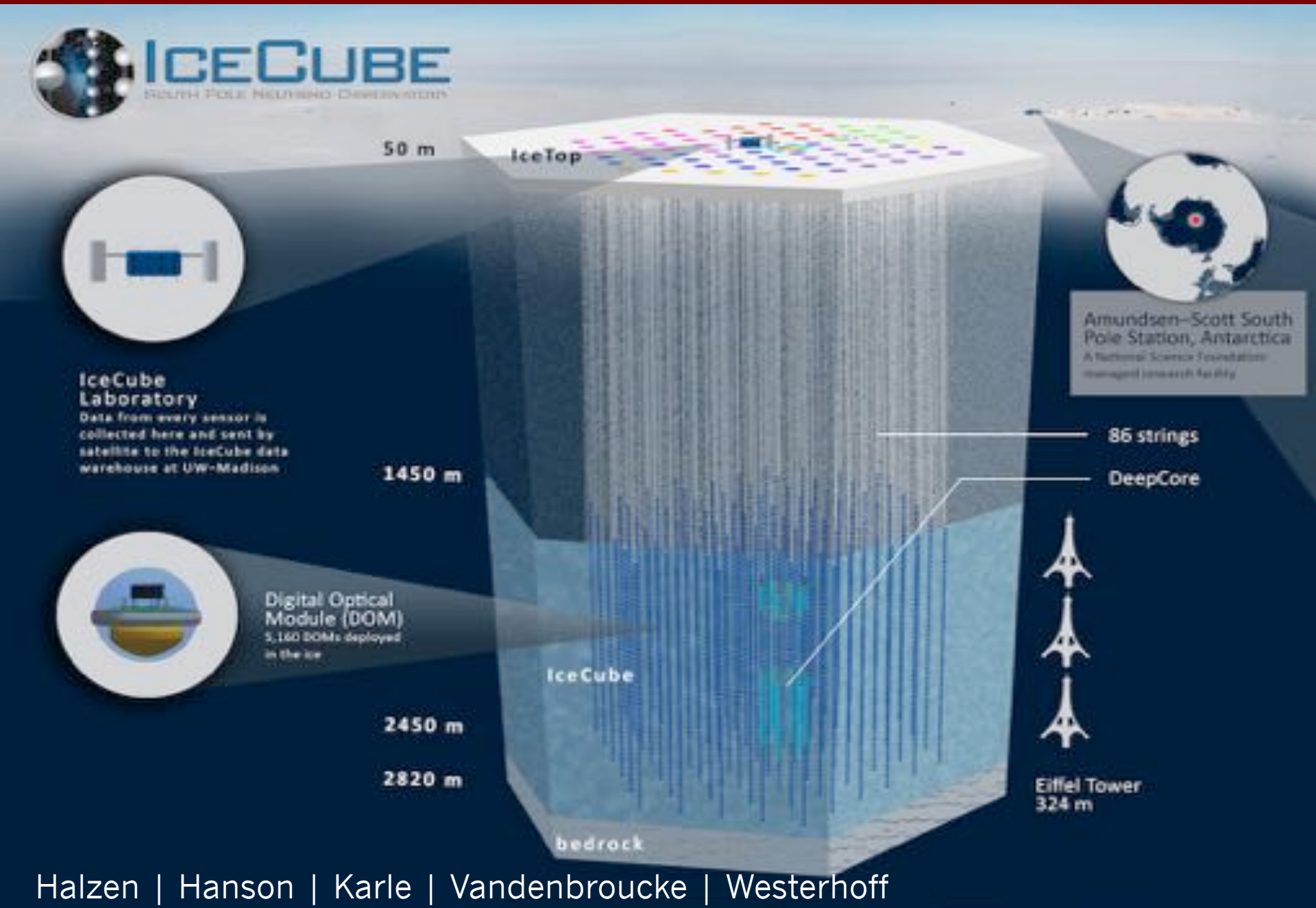

Halzen | Hanson | Karle | Vandenbroucke | Westerhoff

… To Deep Antarctic Ice Discoveries

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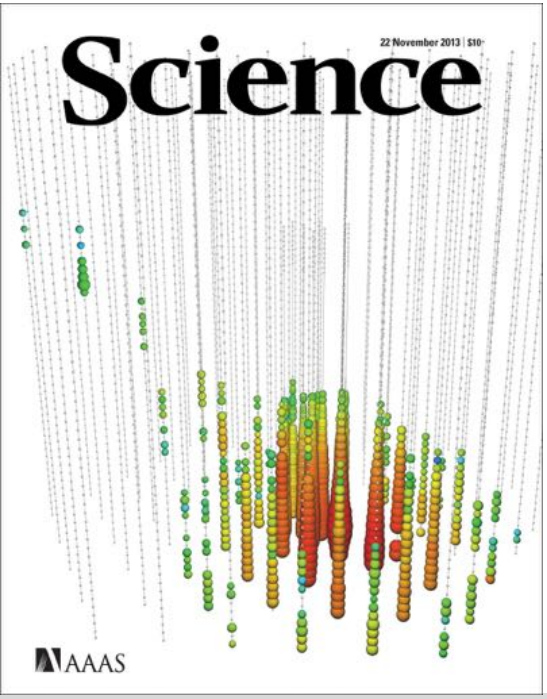
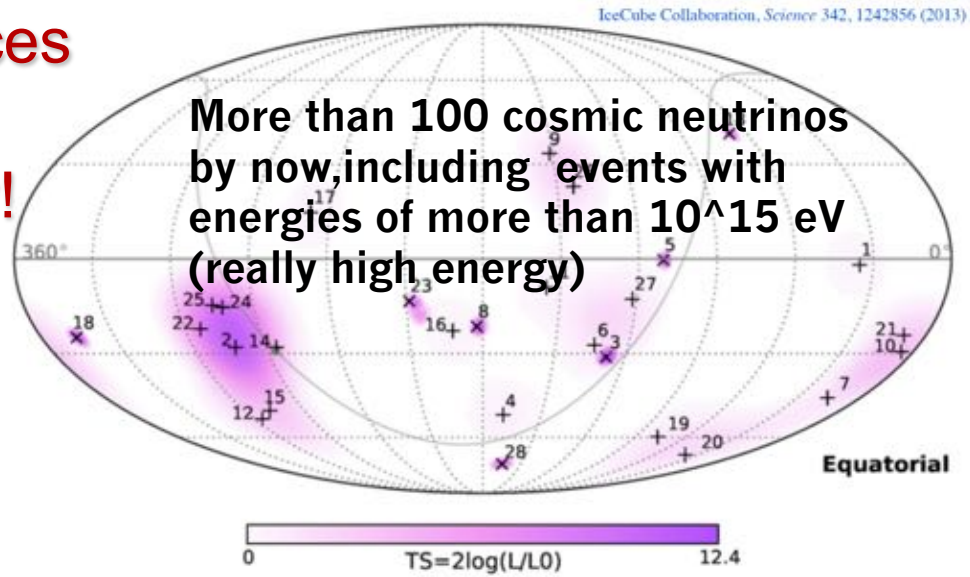
Discovery of cosmic neutrinos of very high energy

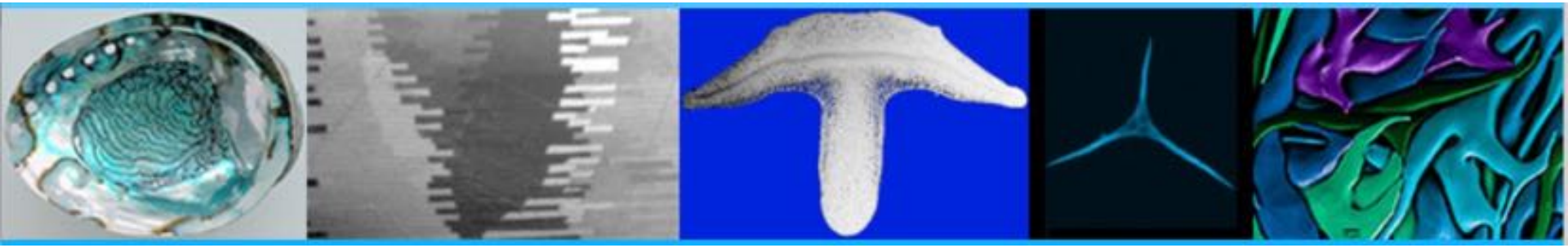
Discovery of cosmic ray sources using emerging field of multi-messenger astronomy!

Univ. Wisconsin is the lead institution, for construction and operation, with four physics faculty contributing





Biophysics

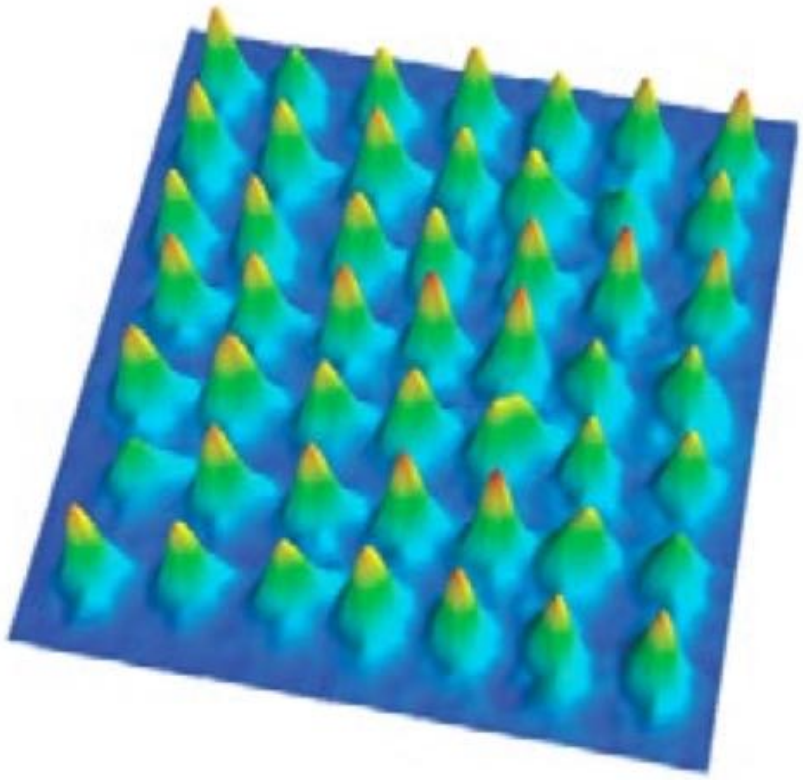


Biomineralization, cancer therapy, protein misfolding and aggregation

- Nacre (Pearls, inner surfaces of shells)
- Sea Urchin Teeth
- Organic – Mineral Interface
  - Studies using Synchrotron Radiation
  - Spectroscopy
  - Spectromicroscopy
  - PIC Mapping

Atomic, Molecular & Optical Physics

- Manipulation of quantum systems at the level of individual atoms.
- Advances in the control capability of quantum physics in small systems opens fundamental new insights.
- Future development from quantum information to quantum computing within reach.
- Madison is at the forefront of this development.



49 laser cooled atoms are lined up, waiting to be manipulated further in Saffman's lab.

The Hybrid Quantum Dot Qubit:

How three electrons can be better than one or two

Shi et al., *Phys. Rev. Lett.* **108**, 140503 (2012).

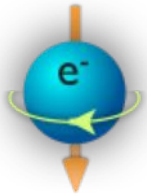
Any bit — classical or quantum — can be a zero or one, up or down.

Spin up

$|0\rangle$

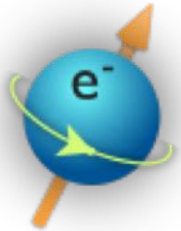
or

Spin down



$|1\rangle$

Only a quantum bit can be both at the same time.

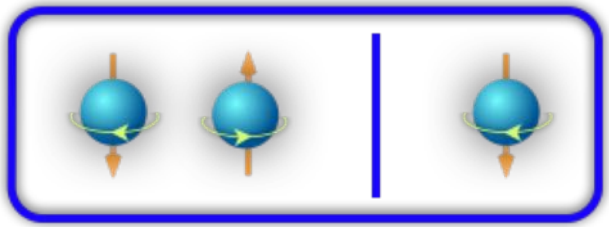


$$\alpha|0\rangle + \beta|1\rangle$$

A single electron spin is the simplest qubit. It can be manipulated using the same techniques as MRI imaging, but this method is slow: the spin must be rotated.

Professor Coppersmith and collaborators proposed that three electrons could offer much greater speed:

$$|1\rangle_L = \sqrt{\frac{1}{3}}|T_0\rangle|\downarrow\rangle - \sqrt{\frac{2}{3}}|T_-\rangle|\uparrow\rangle$$



Exchanging electrons is intrinsically fast.

Enabling next gen energy sources

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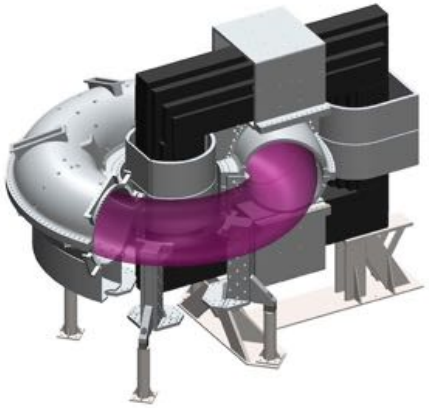
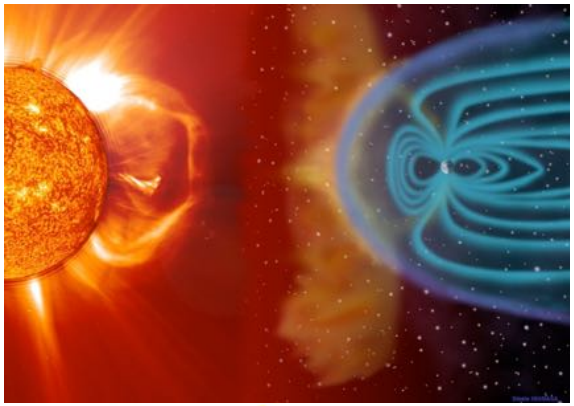
Wisconsin Plasma Physics Laboratory (WiPPL)

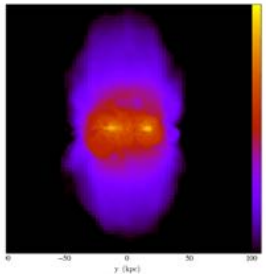
Experimental and Theoretical Plasma Physics for Power and Understanding Nature

Fusion

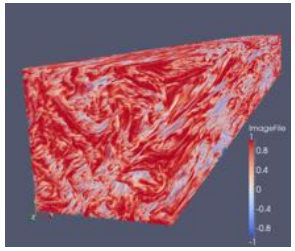


The Madison Symmetric Torus: Pursuit of fusion energy using toroidal magnetic confinement





Cosmic ray wind



Solar wind

Plasma astrophysics

Wisconsin Plasma Astrophysics Lab (WiPAL): studying the magnetized plasma universe in the lab: solar flares, magnetic stars, black hole accretion, cosmic ray acceleration

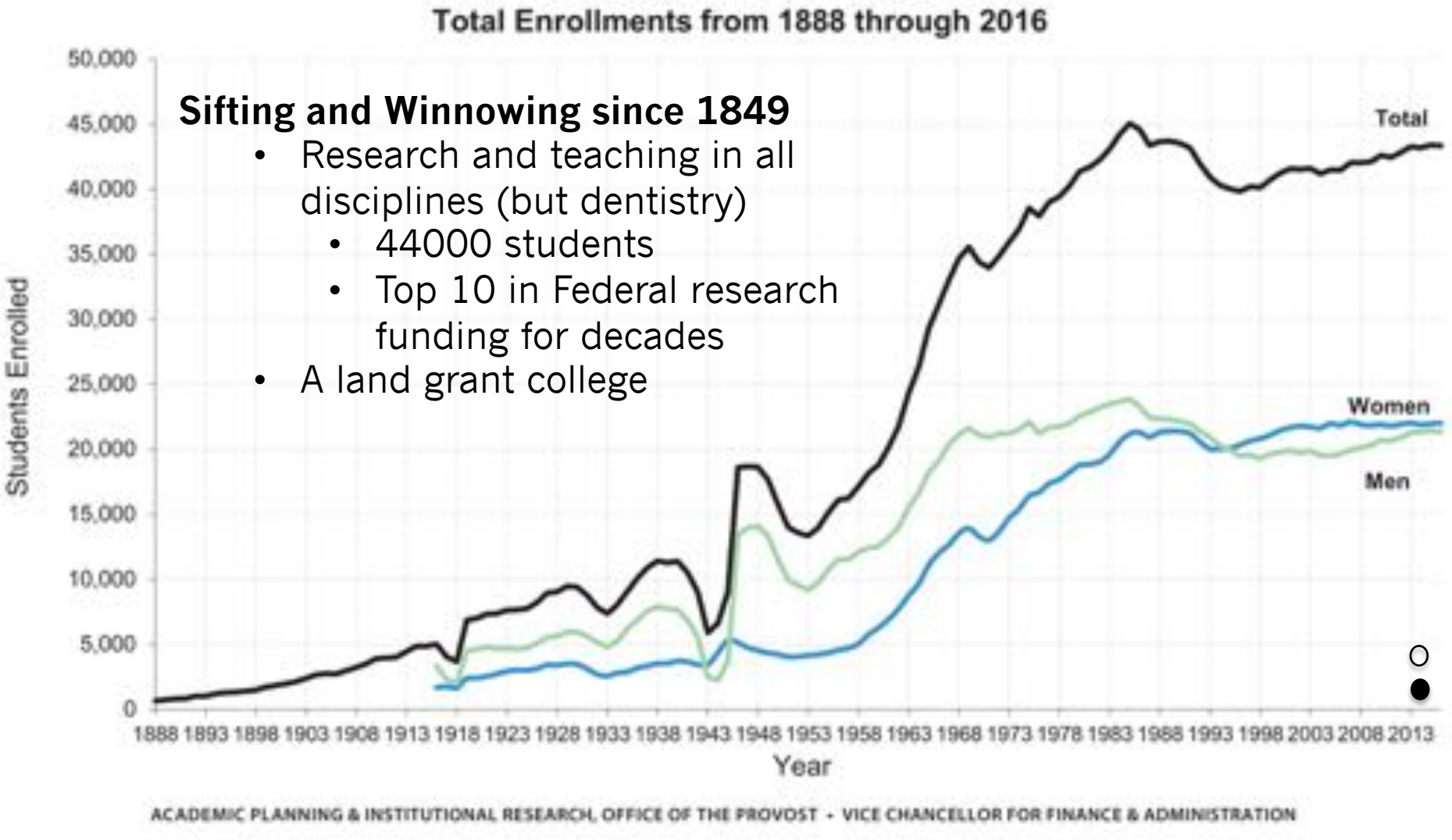
- A top ranked program in graduate studies
- Strong undergraduate involvement

Boldyrev | Egedal | Forest | Sarff | Terry | Zweibel

Yet, tiny by UW-Madison Scale

Sifting and Winnowing since 1849

- Research and teaching in all disciplines (but dentistry)
  - 44000 students
  - Top 10 in Federal research funding for decades
- A land grant college



While general UG population is diverse, physics population is far from it.

Strategic Plan

DEPARTMENT OF PHYSICS STRATEGIC PLAN

AUGUST 2, 2016

2015-2016 Strategic Planning Committee

Lisa Everett, Cary B. Forest, Robert McDermott, I

, Mark Saffman(chair), Stefan Westerhoff

Get back to top 15 and improve

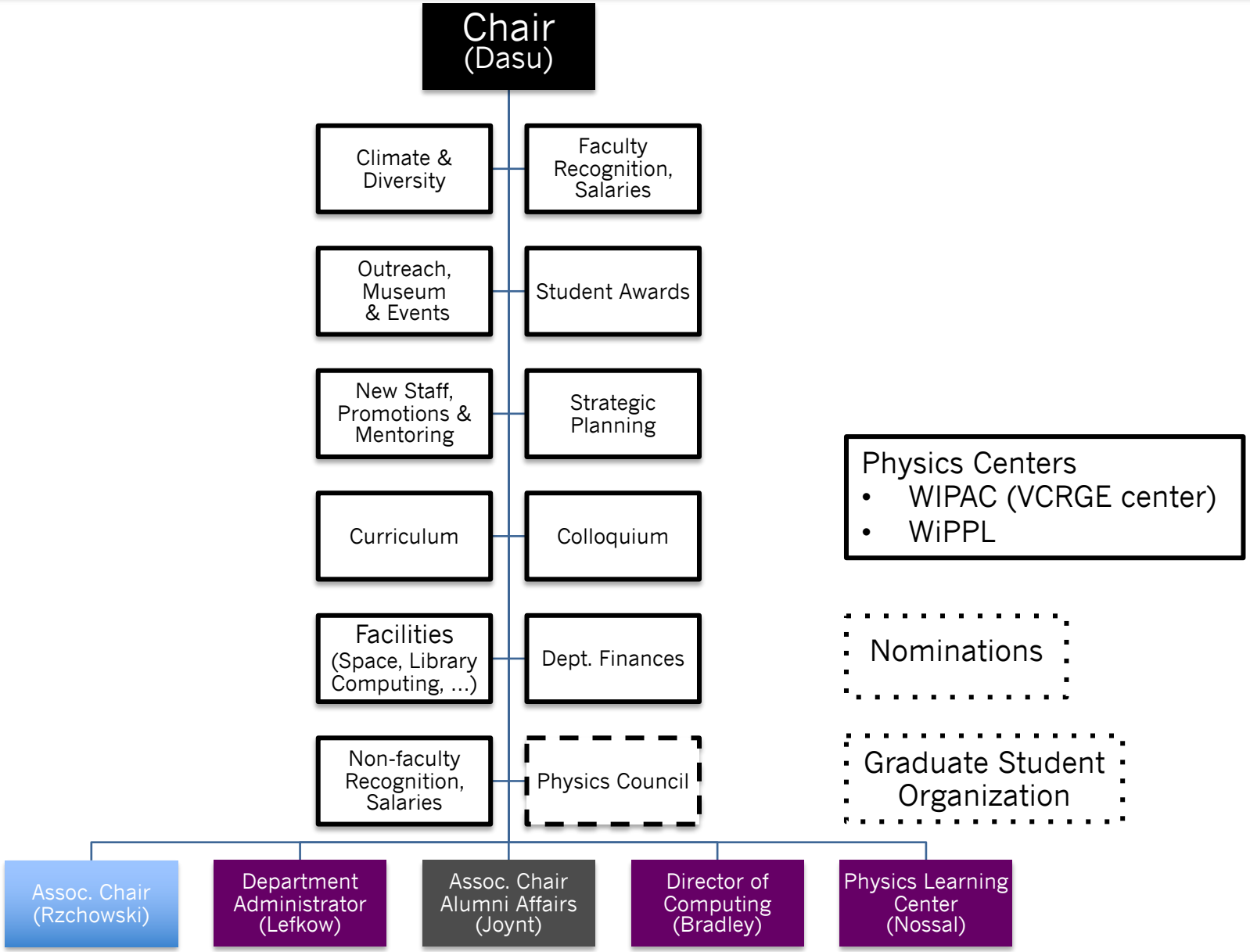
- Better **organization** of work, diligent **committees**, improve **efficiency** with **automation**
- **Hire more faculty and staff**
  - Retain top talent
  - Replenish successful groups when retirements are foreseen
  - Invest in well-supported and intellectually promising research areas
  - Possibly also in areas relevant for the society (& industry) at large

Challenges

While we are proud of the many achievements of the department we are also cognizant of serious challenges that impede fulfilling our mission.

- **Research:** Our national ranking has slipped over the last decade to the current position of 18. Our goal is to reinvigorate the department and return to the top 15. Doing so will require hiring the very best people we can attract, and making strategic choices regarding which areas to strengthen. This will require careful balancing of core competency areas with the need to anticipate future developments in physics, and include topics that are currently underrepresented in the department.
- **Course Offerings:** Diminished faculty size combined with large increases in service course enrollments limit the breadth of our course offerings at both the undergraduate and graduate levels. A comprehensive educational program is essential to continue to attract high quality students. New approaches to meeting this challenge include expanded summer offerings and a possible Professional Masters Program.
- **Undergraduate Majors:** Physics has averaged 32 undergraduate majors per year for the last decade. Astronomy-Physics and AMEP majors take many of the same Physics courses as Physics majors. When they are accounted for, Physics courses are required for about 52 students per year as part of their major. Our ambitious goal is to increase this by 50% over the next five years. Doing so while providing research opportunities for undergraduates (which are currently oversubscribed) requires more faculty.
- **Physical Infrastructure:** The department has inadequate space in Chamberlin and Sterling Halls for all of our research, teaching, and outreach activities. The Wisconsin IceCube Particle Astrophysics Center (WIPAC) is currently housed in rented space in downtown Madison. Returning WIPAC to campus will strengthen intra- and inter-departmental collaboration and would be a key element in establishing a shared home in the central campus area for the physical and mathematical sciences including the Physics, Astronomy, and Mathematics departments.
- **Diversity:** Underrepresentation of minority groups at all levels from undergraduate to senior faculty is a systemic problem in Physics that requires attention at the national level as well as local action. There are numerous local efforts underway to strengthen diversity, an example being our hosting of the Conference on Undergraduate Women in Physics (CUWiP) in 2017. Initiatives to improve diversity in physics are ongoing.

Department of Physics (2018-19)



Physics Teaching Organization

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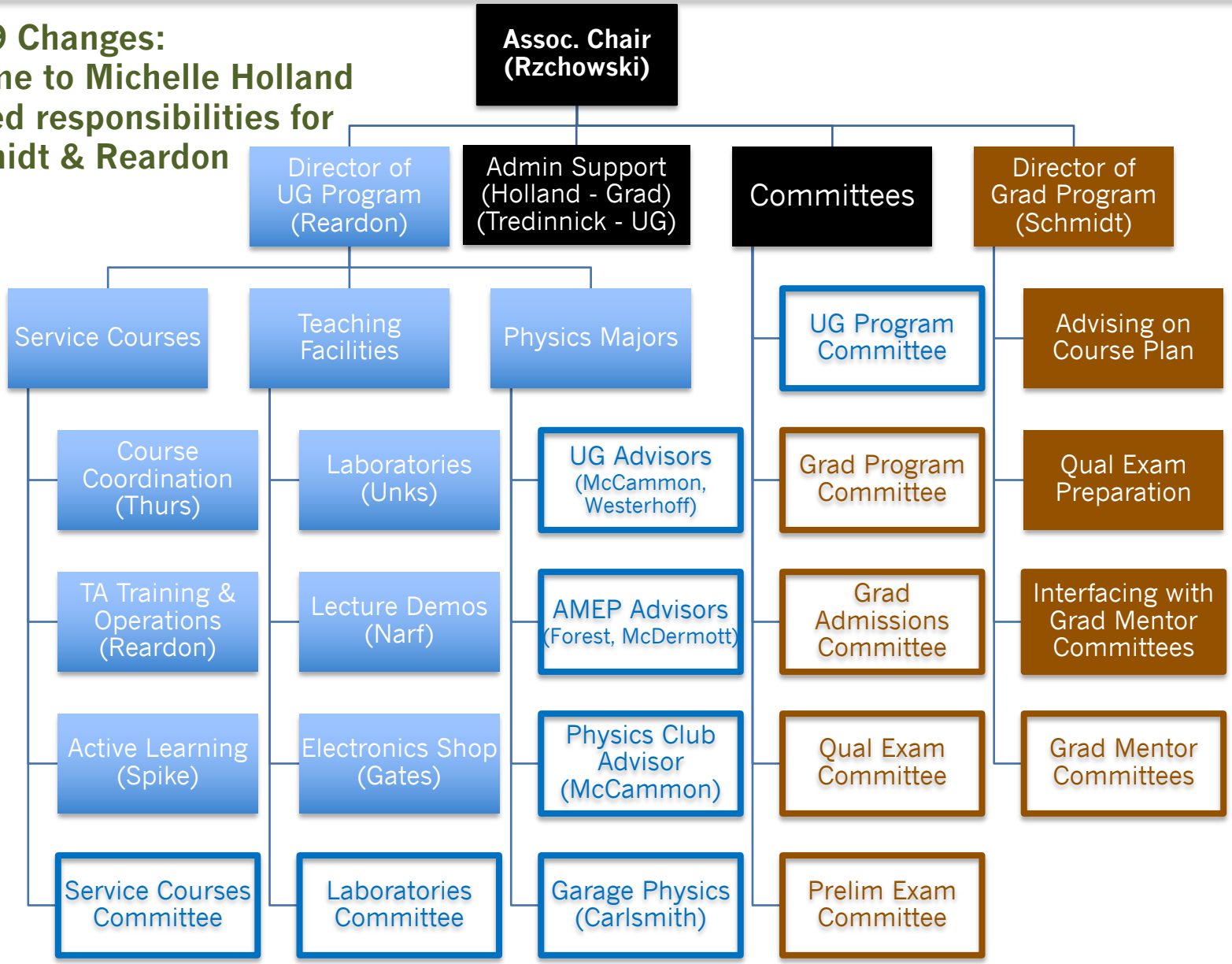
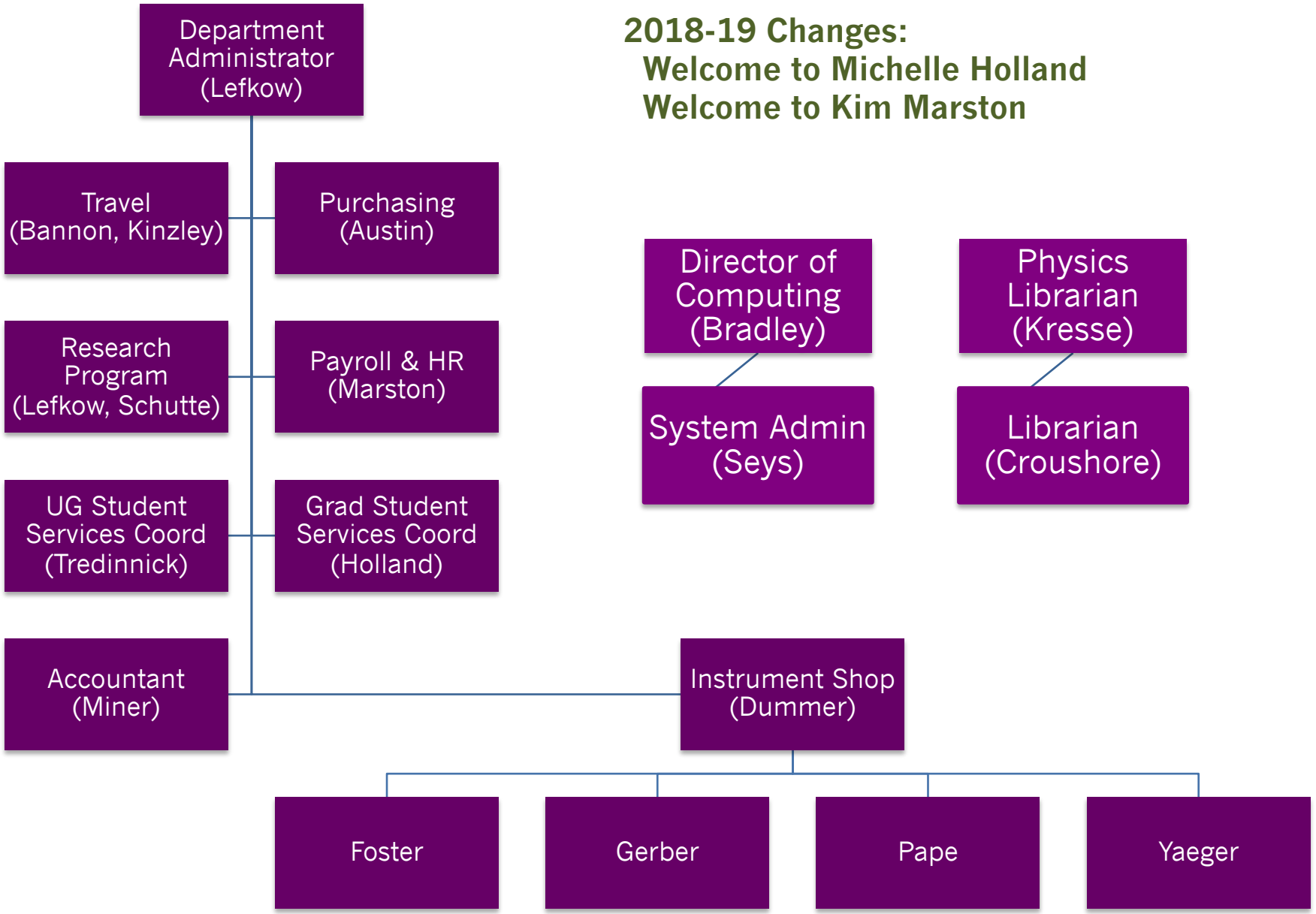
2018-19 Changes:
- **Welcome to Michelle Holland**
- **Updated responsibilities for Schmidt & Reardon**



Physics Administration & Services

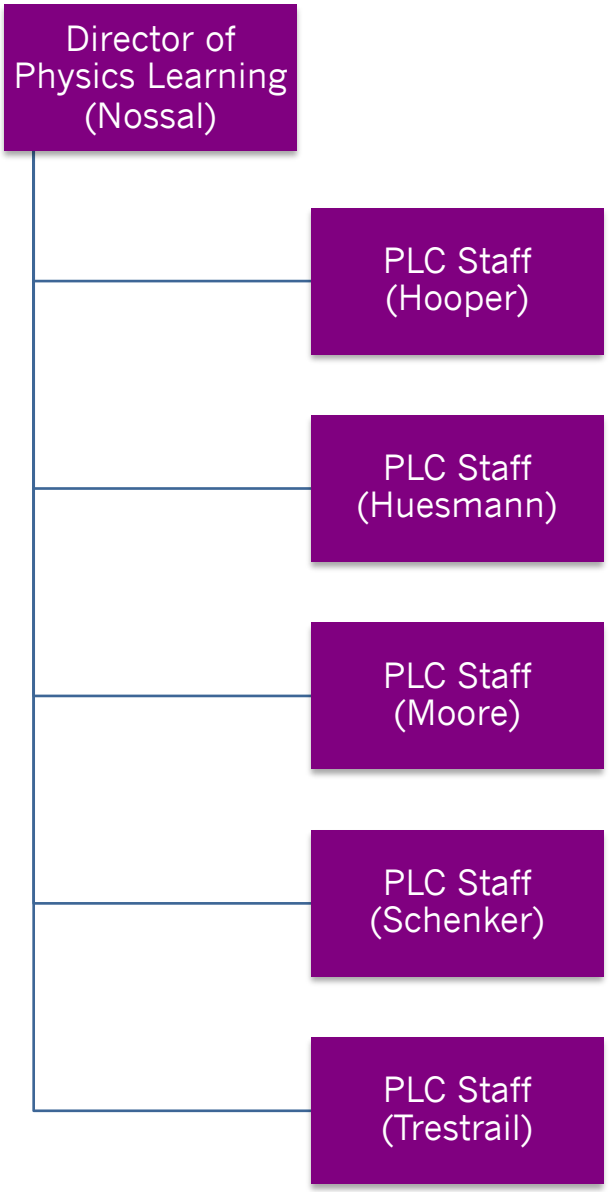


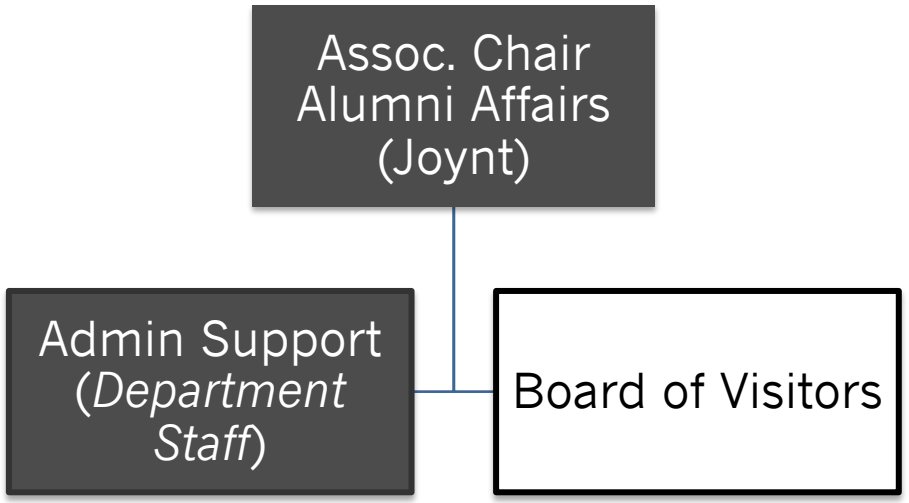
2018-19 Changes:

Welcome to Michelle Holland

Welcome to Kim Marston

Physics Learning & Physics Earning ☺





This is very important effort which funds student scholarships, visiting speaker funds, outreach and lately new faculty!

We look forward to colloquia from candidates of Martin L Perl Endowed Professorship this year!

Committees, Committees, Committees

Meetings, Meetings, Meetings

1. Undergraduate Program Committee
   - Advise Associate Chair on UG Education & Curriculum issues
   - McCammon (Chair) | Carlsmith | Levchenko | Reardon | Spike

2. Laboratories Committee
   - Oversight of advanced undergraduate and graduate laboratories, working with staff to coordinate updates to laboratory curriculum and modernization exercises.
   - Lawler (Chair) | Gates | Hanson | Yavuz | McDermott | Reardon | Unks

3. Service Courses Committee
   - Oversight of service courses, including laboratories and teaching assistants. Review TA performance report and recommend TAs for annual department and university awards. Includes oversight of course coordination and REACH effort.
   - Karle (Chair) | Palladino | Pan | Onellion | Reardon | Gates | Thurs | Spike

Undergraduate Advisors, etc.

Physics Majors

Dan McCammon
Faculty Undergraduate Advisor
6207 Chamberlin Hall
608.262.5916
mccammon@physics.wisc.edu

AMEP Majors

Cary Forest
Faculty Undergraduate Advisor
3277 Chamberlin Hall
608.263.0486
cbforest@wisc.edu

Robert McDermott
Faculty Undergraduate Advisor
5112 Chamberlin Hall
608.263.4476
rfmcdermott@wisc.edu

Astronomy-Physics Majors

Richard Townsend
Faculty Undergraduate Advisor
4550 Sterling Hall
608.262.1752
townsend@astro.wisc.edu

Snezana Stanimirovic
Faculty Undergraduate Advisor
4514 Sterling Hall
608.890.1458
sstanimi@astro.wisc.edu

Advanced Placement & Honors: Michael Winokur mwinokur@wisc.edu
Physics Club Advisor: Dan McCammon mccammon@physics.wisc.edu
Garage Physics: Duncan Carlsmith duncan@hep.wisc.edu
Curriculum Committee Chair: Mark Rzchowski rzchowski@physics.wisc.edu
Physics Major Curriculum Committee Chair: Duncan Carlsmith duncan@hep.wisc.edu
Non-Phyics Major Curriculum Committee Chair: Peter Timbie pttimbie@wisc.edu

Physics Learning Center: Susan Nossal | 2334 Chamberlin Hall | 262.9107 | nossal@physics.wisc.edu

Physics Library: Kerry Kresse | 4220 Chamberlin Hall | 262.9500 | kkresse@library.wisc.edu

Physics Club: University Physical Society (UPS) | 2328 Chamberlin Hall | 263.2805 | ups-officers@googlegroups.com

Graduate Committees

4. Graduate Program Committee
   - Advise Associate Chair on graduate education, curriculum and research related matters.
   - Yavuz (Chair) | Schmidt | Vavilov | Everett | Joynt | Saffman | Black | Sorensen | Fraser | Holland

5. Graduate Admissions Committee
   - Committee to review applications to the graduate program and make recommendations on acceptances. The number of offers must be decided in consultation with the chair and associate chair. Committee duties extend additionally to proactive involvement in the recruitment process.
   - Boldyrev (Chair) | Bechtol | Brar | Eriksson | Herndon | Kolkowitz | Palladino | Pan | Holland

6. Qualifying Examination Committee
   - Committee responsible for conducting qualifying exam that includes assembling problems, grading, making recommendations on passing grade, and overall grades distribution, placement.
   - Everett (Chair) | Boldyrev | Brar | Egedal | Herndon | Ioffe | Lawler

Graduate Committees … 2

7. Graduate Preliminary Examination Committee
   - Serving on prelim committees of students and develop a concrete plan to "keep track" of students after the exam, providing additional monitoring of student's progress towards PhD.
   - Hashimoto (Chair) | Coppersmith | Vavilov | Vandenbroucke | Yavuz | Herndon | Terry | Pan | Black | Holland

Graduate Recruitment Liaisons

- Help with graduate student recruitment once the admissions committee decisions are made. Phone calls, providing information, helping with visits, entertainment, etc.
- Taylor, Oxholm, Leonard
- Joelle Baer suggested this idea in 2017-18 and served admirably, which is one of the reasons why we have a diverse class this year. Thank you, Joelle.

Committees Reporting to Chair

8. Climate and Diversity Committee
    - Promotes equitable climate and higher diversity in the department by reviewing and formulating policies and recommend action on any issues arising..
    - Palladino (Chair) | Barger | Everett | Gates | Nossal | Vandenbroucke | Yavuz | López-Barquero

9. Colloquium Committee
10. Curriculum Committee
11. Facilities (Space, Remodeling, Computing and Shops)
12. New Staff (Faculty), Promotions & Mentoring
13. Outreach, Communications, Web Content & Museum
14. Non-faculty Recognition and Salaries
15. Faculty Recognition and Salaries
16. Department Finances
17. Student Awards
18. Strategic Planning
    - Review and update the department strategic plan. ** Update 2018-19 **
    - Balantekin (Chair) | Brar | Forest | Saffman | Shiu

Faculty Hiring vis-à-vis Strategic Plan

Long term strategic plan, Top priority

- **Experimental neutrino physics**
  - **Department welcomes Brian Rebel (2018)**
- **Atomic, Molecular, Optics (AMO) and quantum physics**
  - **Department welcomed Shimon Kolkowitz in 2017**
- Theoretical cosmology and astrophysics

Keith Bechtol welcomes Observational Cosmology (2018) (from prior strategic plan)

Second priority

- Condensed matter experiment and theory
- **High energy particle experiments**
  - **Department welcomes Kevin Black and Tulika Bose (2018)**

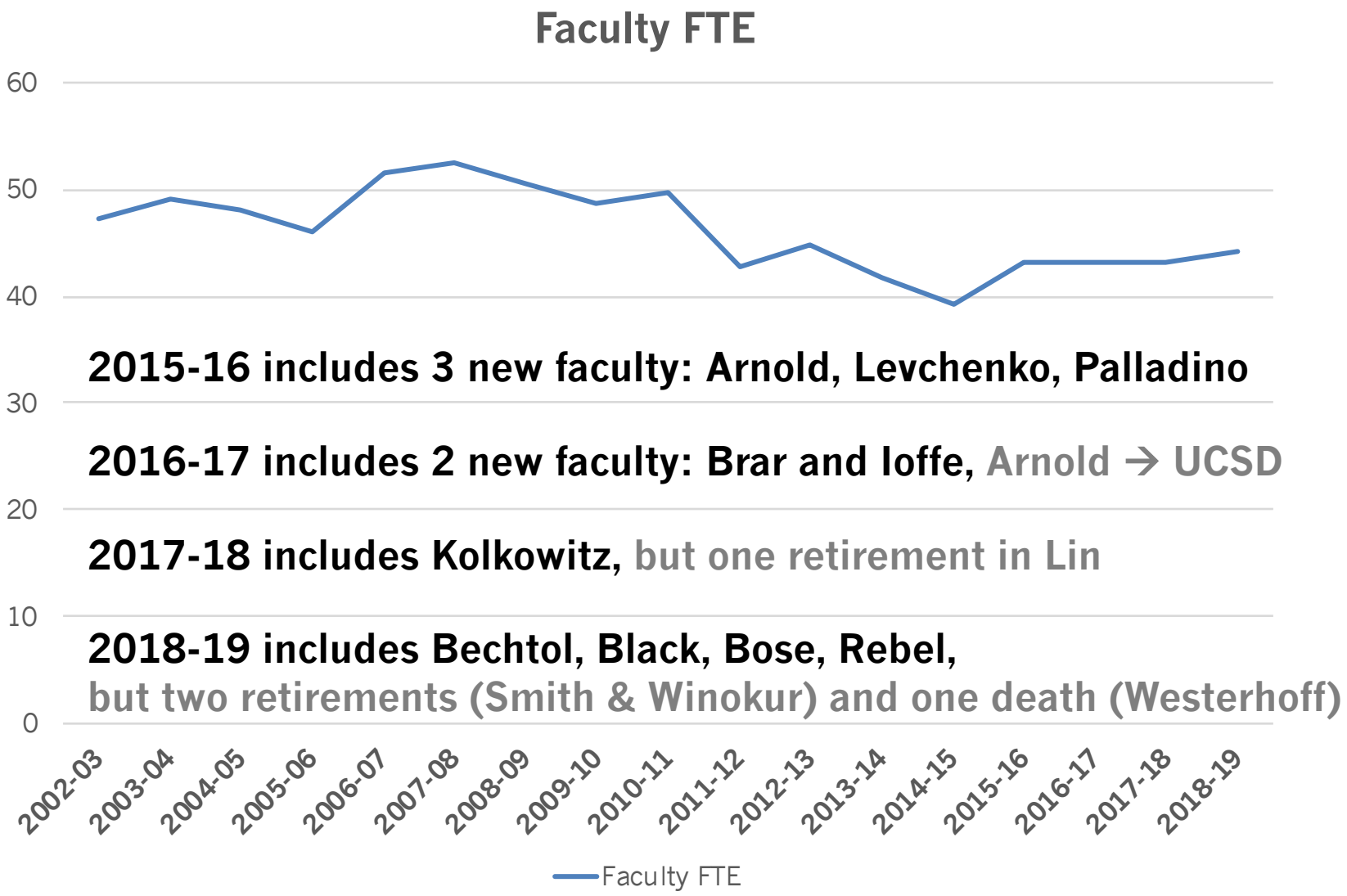
Additional targets

- Computational physics and high performance computing
- **Biological physics, nonlinear physics & soft matter (Offer pending)**
- Exoplanets

2018-19 hiring plan

- Multidisciplinary cluster proposal for Quantum computing approved
- Martin L Perl Endowed Professorship approved

Size of Physics Faculty



2015-16 includes 3 new faculty: Arnold, Levchenko, Palladino

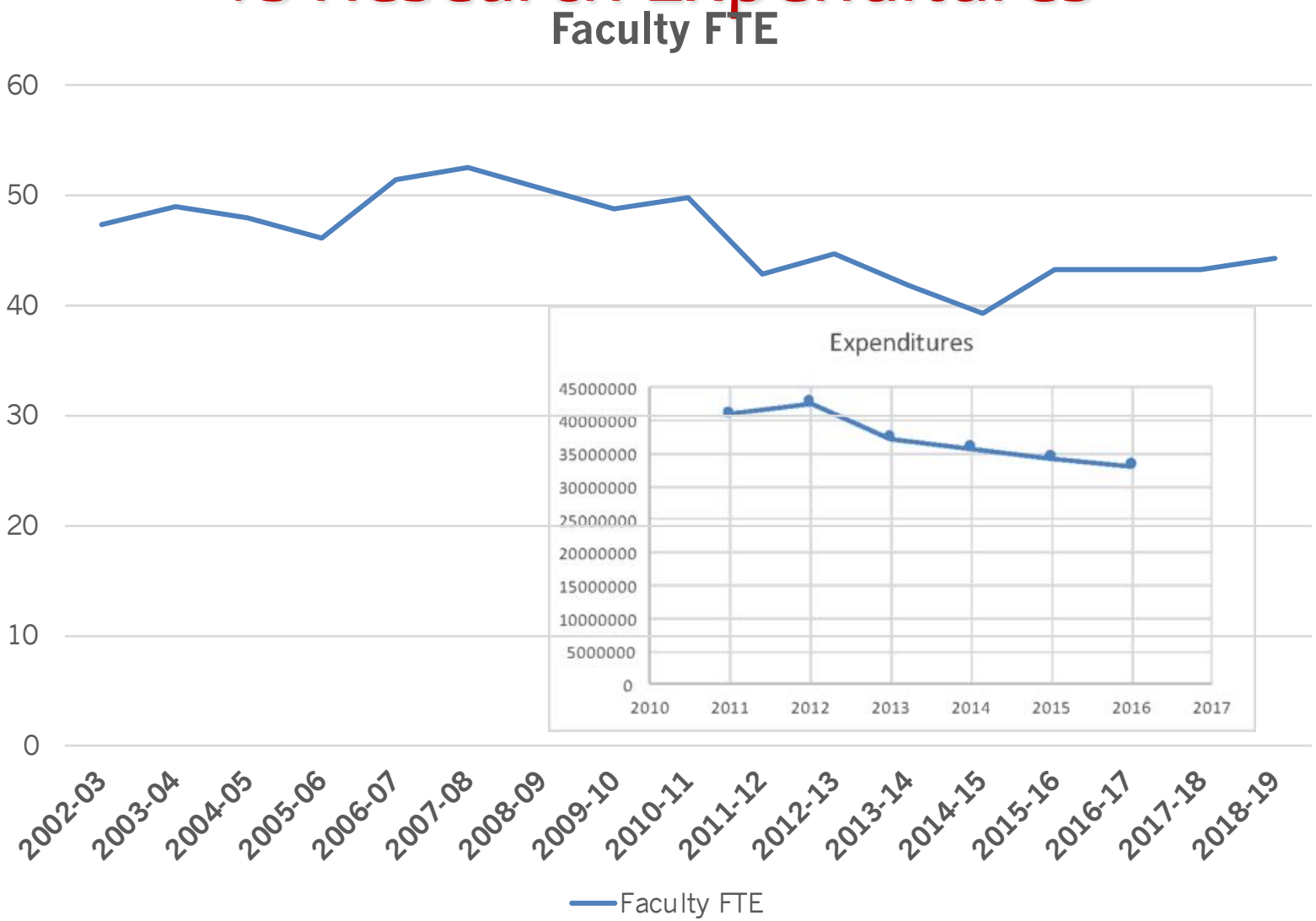
2016-17 includes 2 new faculty: Brar and Ioffe, Arnold → UCSD

2017-18 includes Kolkowitz, but one retirement in Lin

2018-19 includes Bechtol, Black, Bose, Rebel,
but two retirements (Smith & Winokur) and one death (Westerhoff)

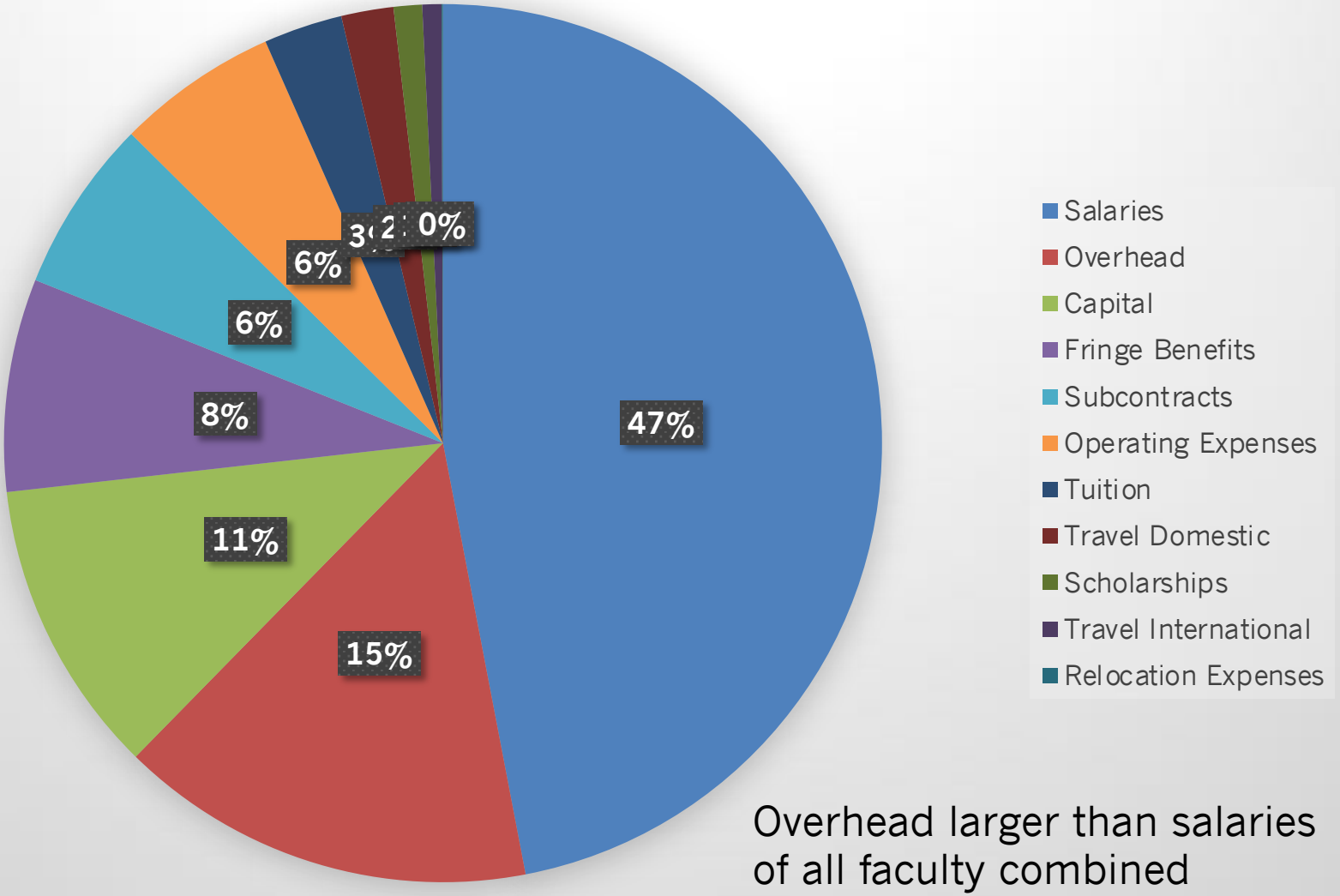
Size of Physics Faculty

vs Research Expenditures



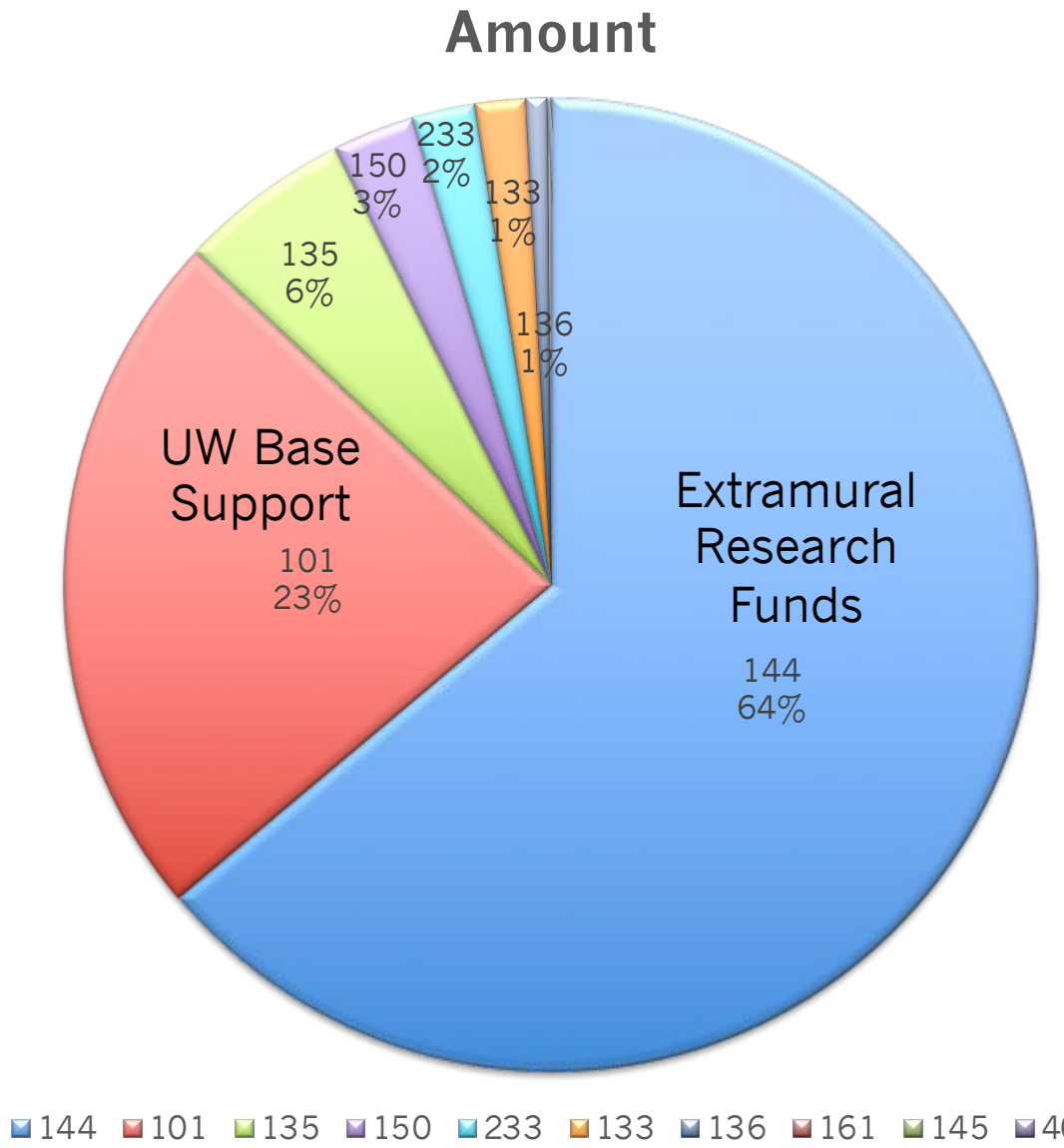
Expenditure Pie

Total Expenditure in AY2016-17 : $32.4M



Overhead larger than salaries of all faculty combined

Another Slice of Expenditure Pie



FUNDING SOURCES AND ASSOCIATE

101- State tax, Federal indirect cost, and

104- Funding from UW-Extension used fo

128- Cost recovery funding used by units

131-Tuition generated by self-supporting

133- Non-Federal grants and contracts.

135-VCRGE(aka Grad School).

136- Cost recovery outreach funding mec

144- Federal grants and contract funding.

150- Federal indirect cost reimbursement

161- University administered trust funds.

233- Gift funding.

402- Minority and disadvantaged program

Funded Research Areas & Faculty

Astro-particle / Neutrino-astrophysics (WIPAC)

- Halzen, Hanson, Karle, Vanderbroucke, Westerhoff

Astrophysics & Cosmology (Cosmo)

- McCammon, Timbie

AMO and Quantum Computing with Neutral Atoms (AMO)

- Saffman, Walker, Yavuz, Lawler, Kolkowitz

Biophysics (Bio)

- Gilbert

Condensed Matter, Quantum Computing & Nanostructure Experiment (CMP-E)

- Brar, Erikkson, McDermott, Rzchowski

Condensed Matter, Quantum Computing Theory (CMP-T)

- Coppersmith, Levchenko, Joynt, Vavilov, Ioffe

High Energy Physics Experiment (HEP-E)

- Dasu, Herndon, Palladino, Smith, Wu

Nuclear, Particle, Astro-particle, Cosmology & String Theory (NPACS-T)

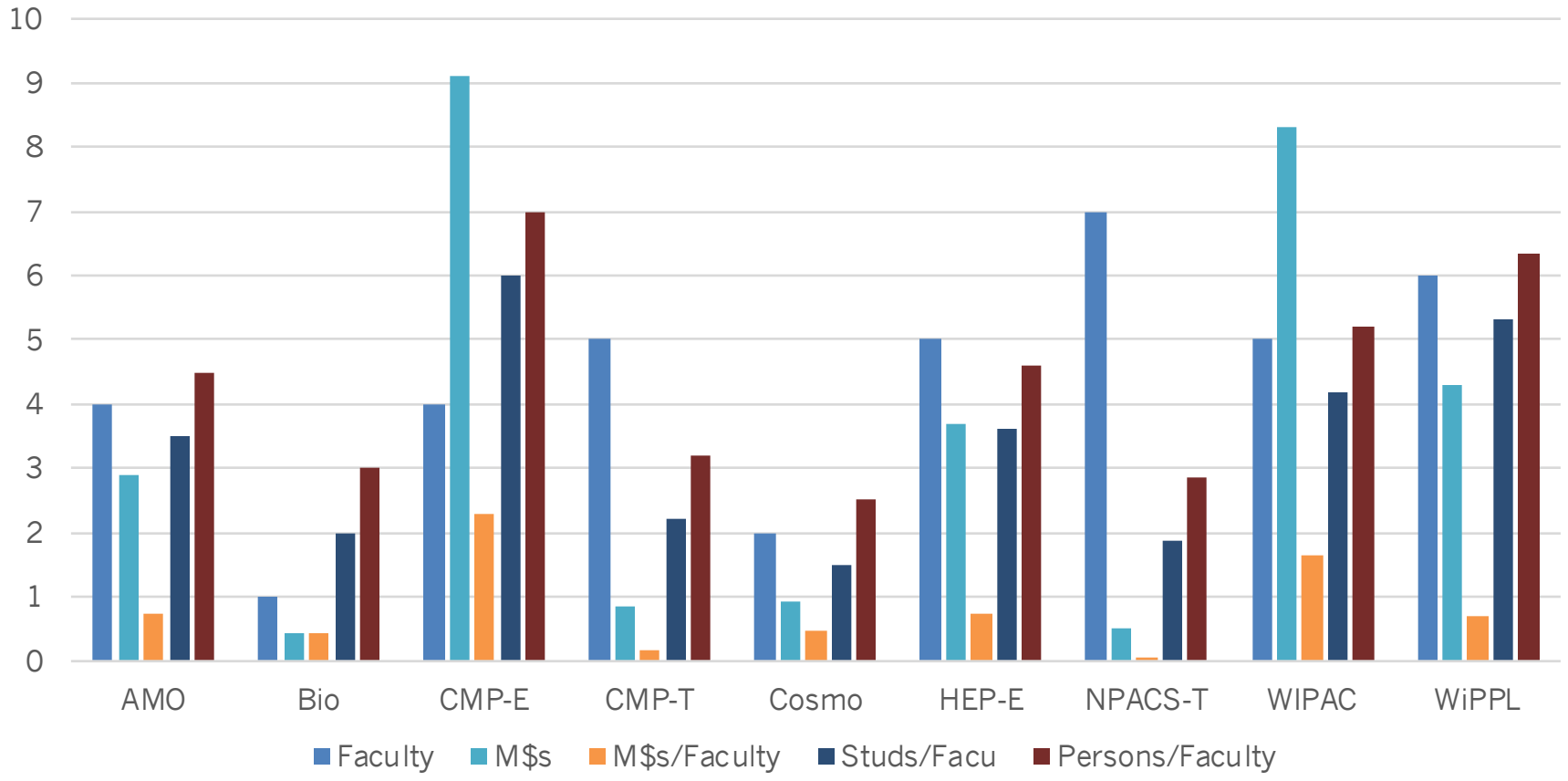
- Bai, Balantekin, Barger, Chung, Everett, Hashimoto, Shiu

Wisconsin Plasma Physics Laboratory, Plasma-astrophysics (WiPPL)

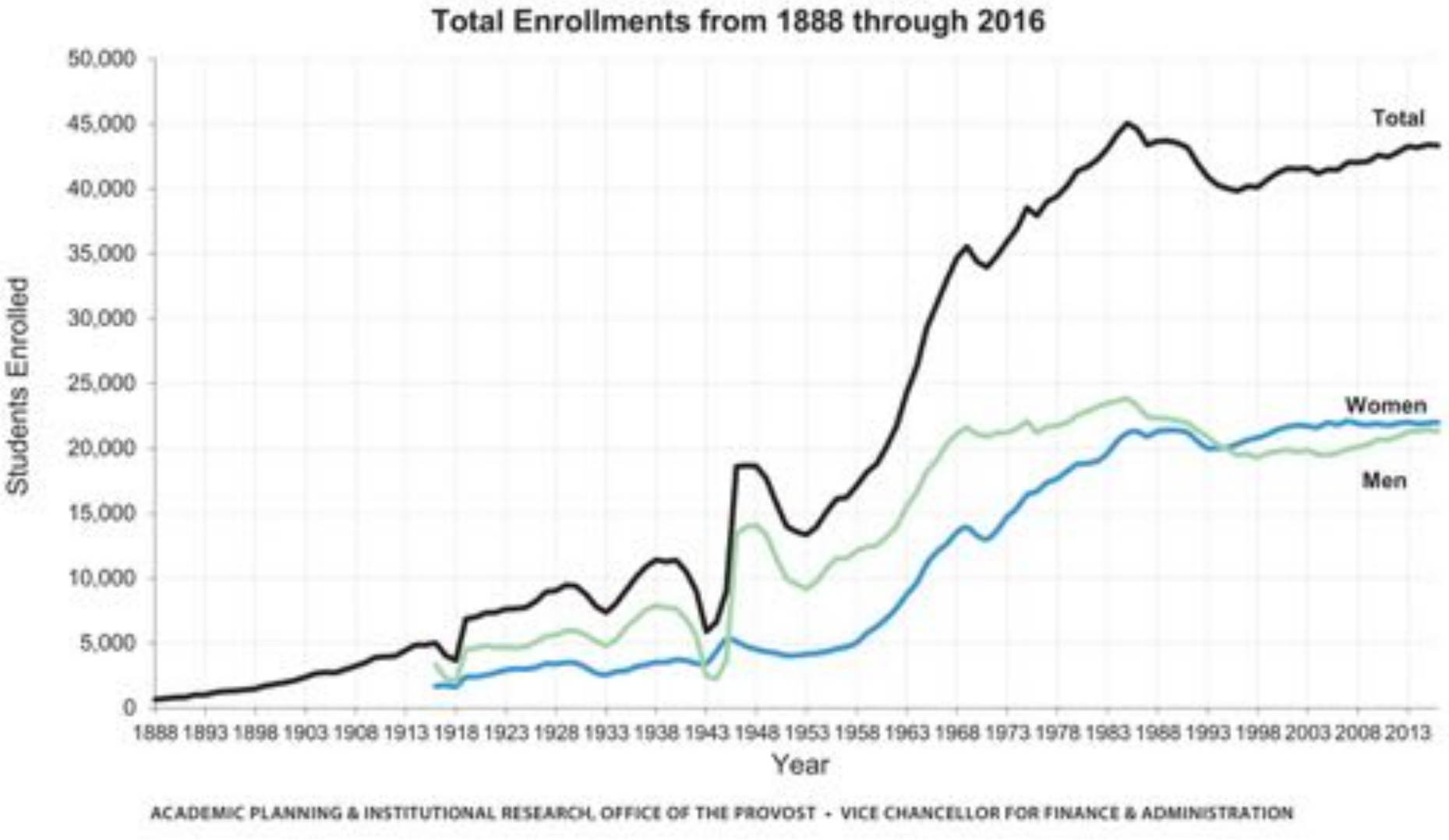
- Boldyrev, Egedal, Forest, Sarff, Terry, Zweibel

Broad groupings, trying to put one faculty in one group (not perfect!)

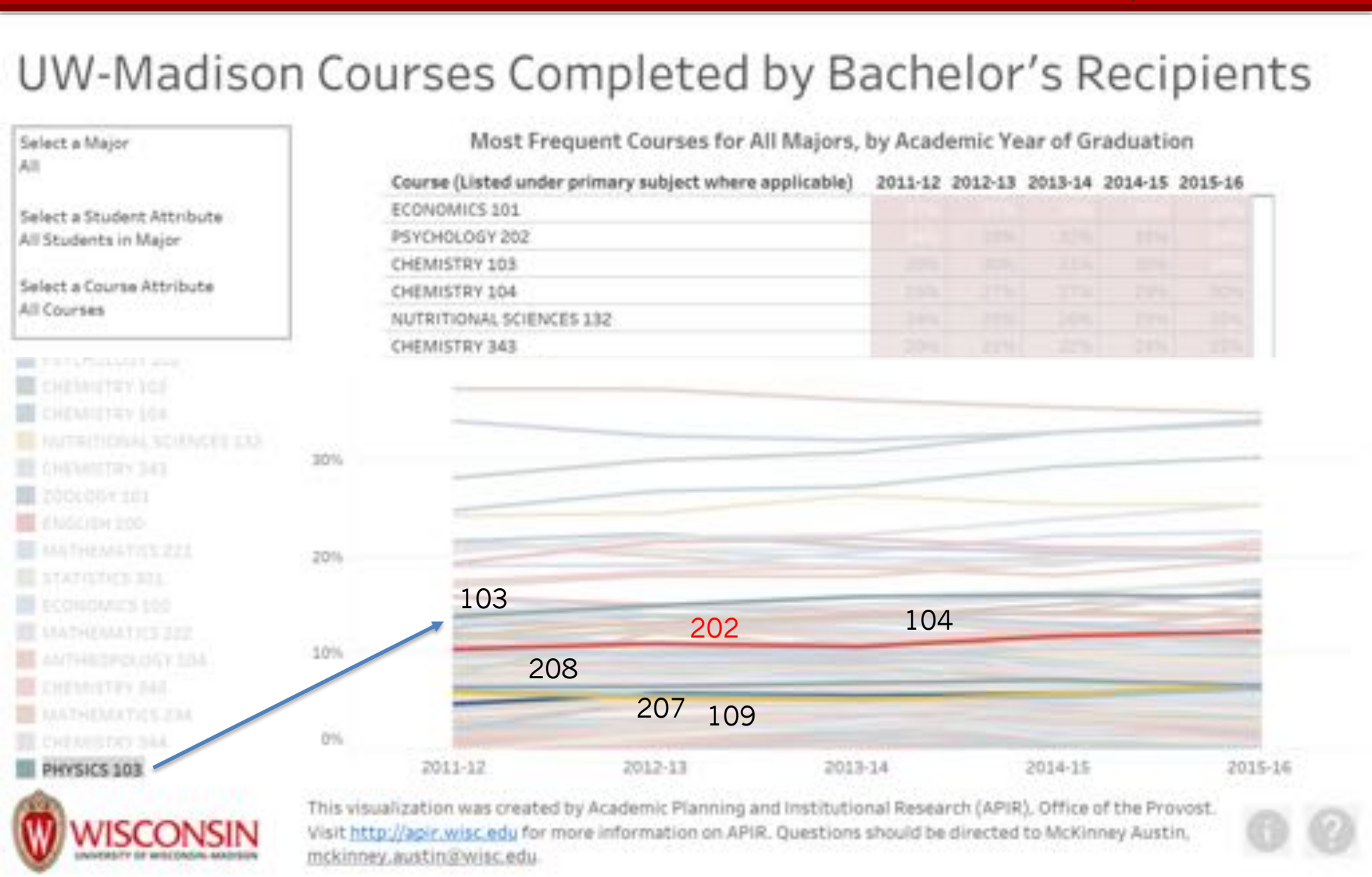
Research Areas, Funding & People



UW-Madison Student Population



Service Course Enrollments

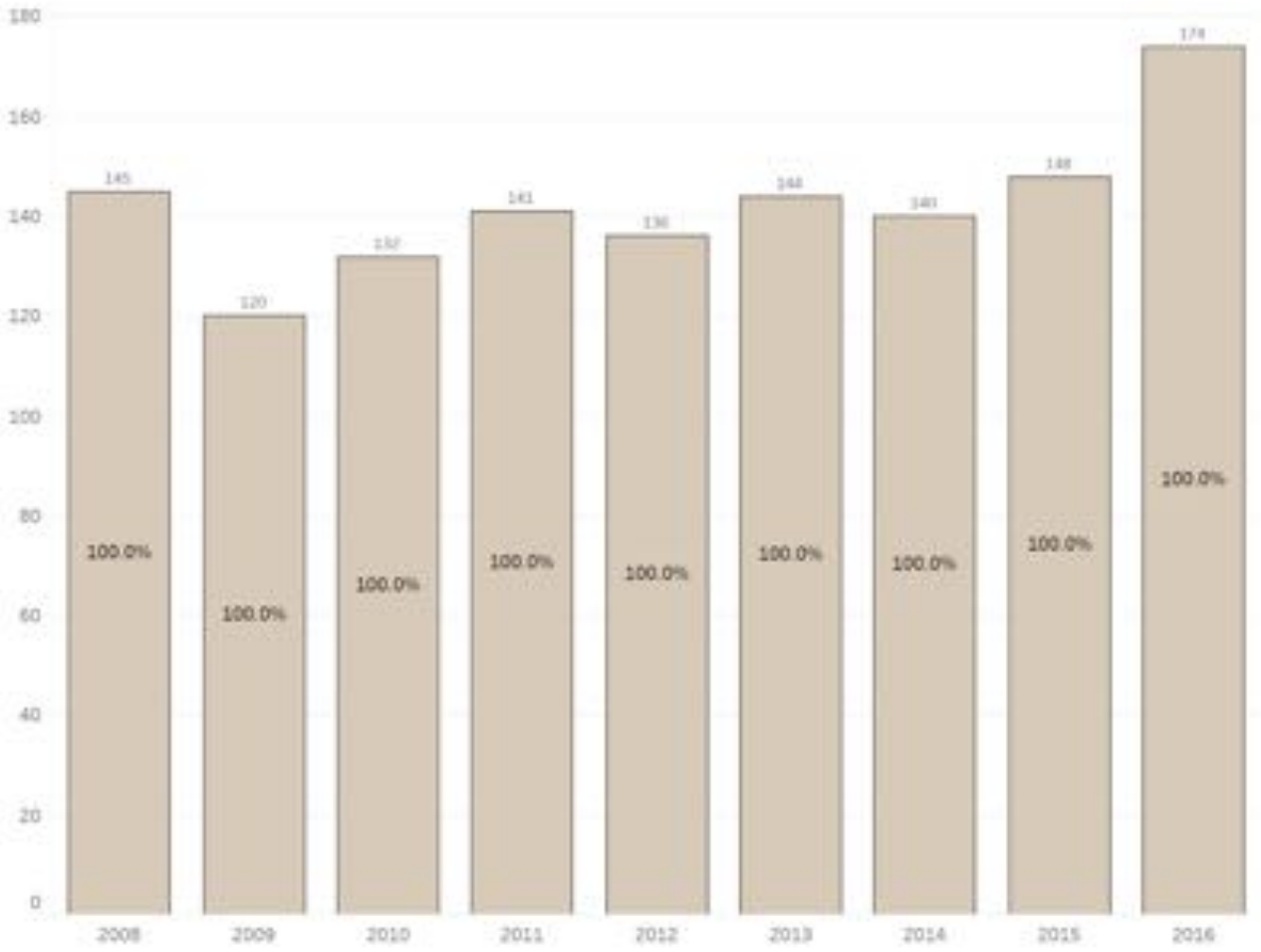


Physics Undergraduate Students

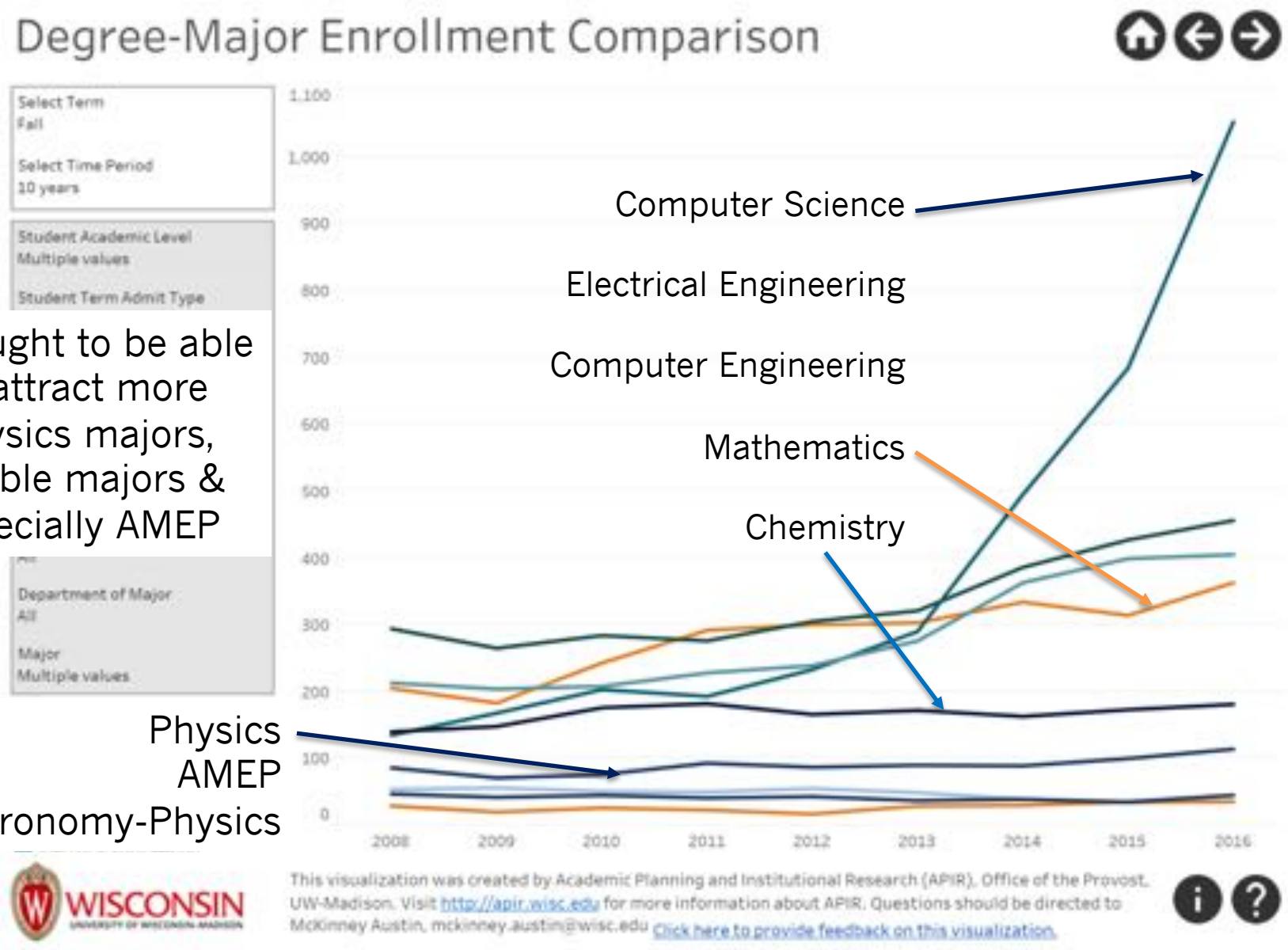
From UW DataViz site:
https://dataviz.wisc.edu/views/TrendsinStudentEnrollments/Homepage?%3Aiid=1&%3AisGuestRedirectFromVizportal=y&%3Aembed=y

My selection includes all Undergrad Majors in the programs:

Physics
Astronomy-Physics
AMEP



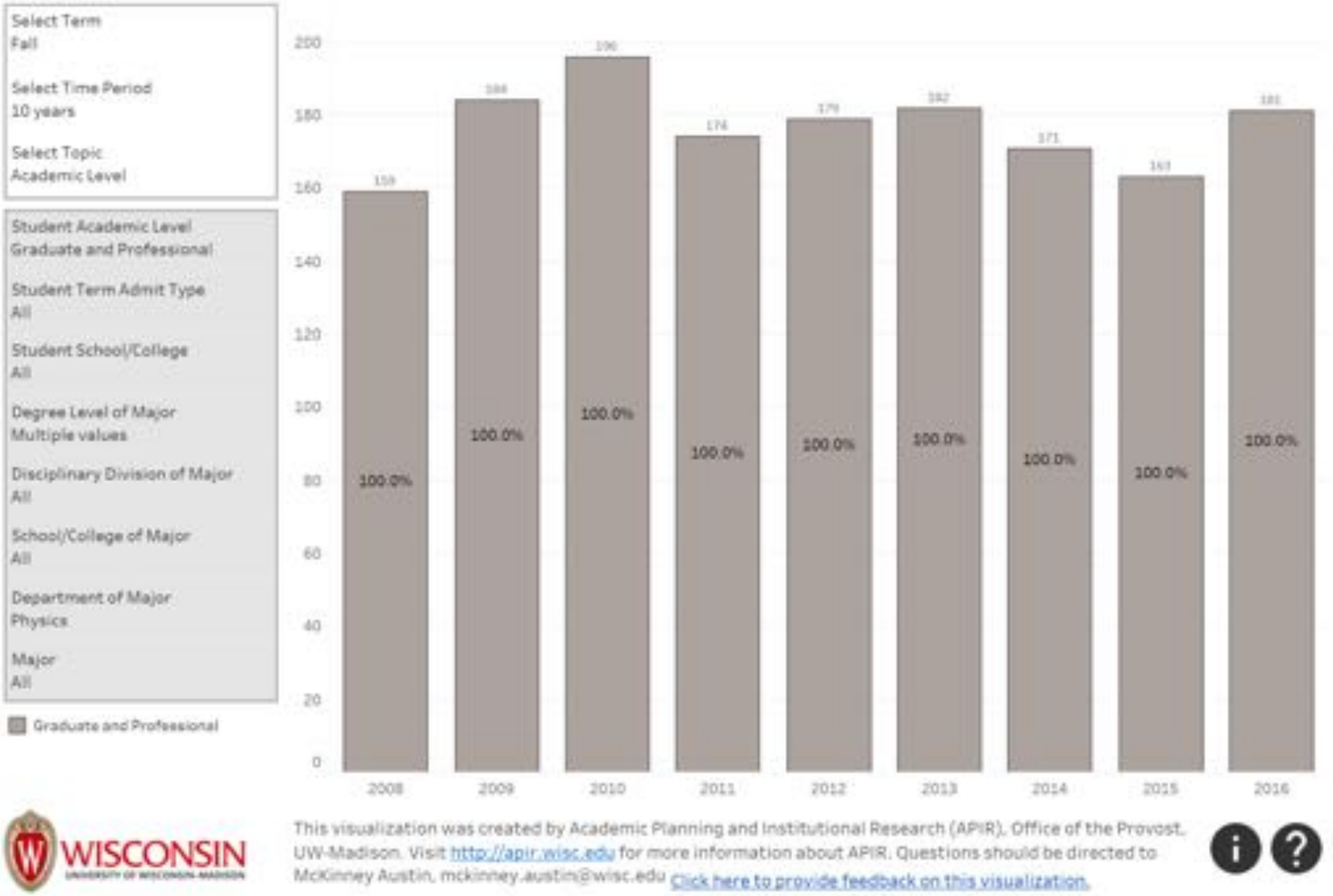
UG Peer Departments



We ought to be able to attract more Physics majors, Double majors & especially AMEP

Graduate Students

Counts of Degree-Seeking Students



This visualization was created by Academic Planning and Institutional Research (APIR), Office of the Provost, UW-Madison. Visit http://apir.wisc.edu for more information about APIR. Questions should be directed to McKinney Austin, mckinney.austin@wisc.edu Click here to provide feedback on this visualization.

Funded Research Areas & Faculty

Astro-particle / Neutrino-astrophysics (WIPAC)

- Halzen, Hanson, Karle, Vanderbroucke

Astrophysics & Cosmology (Cosmo)

- McCammon, Timbie, Bechtol

AMO and Quantum Computing with Neutral Atoms (AMO)

- Saffman, Walker, Yavuz, Lawler, Kolkowitz

Biophysics (Bio)

- Gilbert

Condensed Matter, Quantum Computing & Nanostructure Experiment (CMP-E)

- Brar, Erikkson, McDermott, Rzchowski

Condensed Matter, Quantum Computing Theory (CMP-T)

- Coppersmith, Levchenko, Joynt, Vavilov, Ioffe

High Energy Physics Experiment (HEP-E)

- Black, Bose, Dasu, Herndon, Palladino, Rebel, Wu

Nuclear, Particle, Astro-particle, Cosmology & String Theory (NPACS-T)

- Bai, Balantekin, Barger, Chung, Everett, Hashimoto, Shiu

Wisconsin Plasma Physics Laboratory, Plasma-astrophysics (WiPPL)

- Boldyrev, Egedal, Forest, Sarff, Terry, Zweibel

Broad groupings, trying to put one faculty in one group (not perfect!)

New Faculty Recruiting

- Two approved PVLs
  - Martin L Perl Endowed Professorship
  - Cluster Professorship in Quantum Computing
- Targets of opportunities
  - Strong people want to come to UW-Madison
- Physics Board of Visitor's established the first !
  - Bernice Durand Endowed Chair in Physics Fund
  - Solicitation for Contributions began

Space Issues

Sterling Hall Accelerator Vault and Associated Rooms

- Currently the accelerator is unused
- Space is utilized by Knutson and visitors from Wittenberg faculty
- Cleanup of the area underway
- Possible decommissioning and repurposing plan in discussion
  - Physics would like to get the space back for new research labs

WIPAC move back to campus (Chamberlin + Sterling)

- Plans were somewhat stalled due to remodeling sticker shock
- Just revived the discussion with alternate plans
- Benefits due to the move are significant
  - College of L&S and Graduate School are both supportive

Involving Young Minds in Research …

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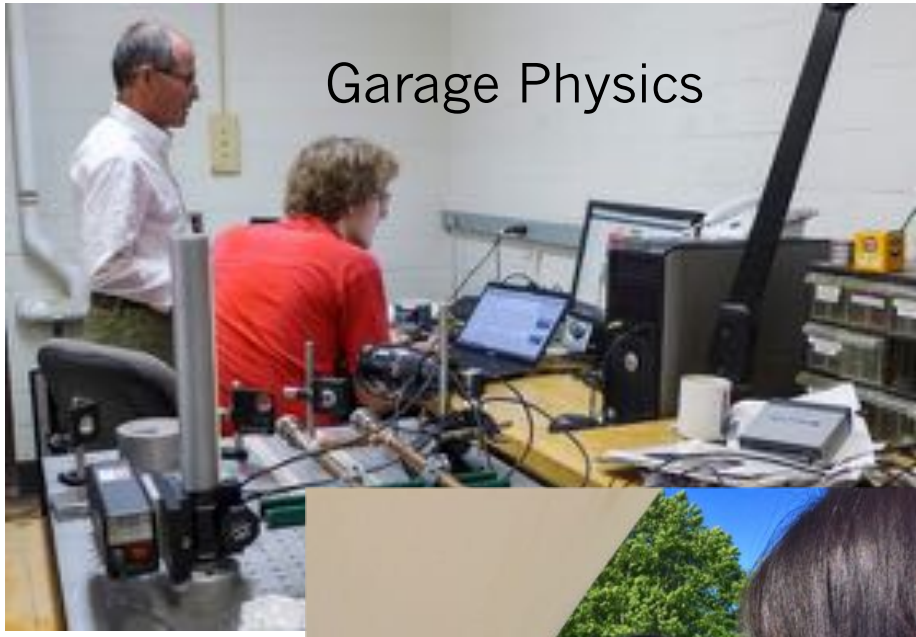
Research opportunities for undergraduates



Badgerloop team develops maglev technology and wins 3rd place in the SpaceX Hyperloop competition featured on international news

… Training Next Gen of Scientists

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THE WONDERS OF PHYSICS

Traveling Outreach Program

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HOME | BOOK A PROGRAM | ANNUAL EVENTS | UPCOMING EVENTS | JUST FOR TEACHERS | EXOTIC PLASMA TRADING CARDS

HOME / ANNUAL SHOWS

ANNUAL SHOWS

Scheduled presentations of **The Wonders of Physics** and a Physics Fair are given on the UW-Madison campus for the general public in mid-February each year. Free tickets are recommended and are available after January 1st using the On-Line Ticket Form. Alternately, you may call (608) 262-2927 or e-mail wonders@physics.wisc.edu.
The next public presentations of **The Wonders of Physics** are scheduled as follows:

> *Saturday February 10, 2018 1, 4, and 7 pm*
>
> *Sunday February 11, 2018 1 and 4 pm*
>
> *Saturday February 17, 2018 1, 4, and 7 pm*
>
> *Sunday February 18, 2018 1 and 4 pm*

These presentations will be held in 2103 Chamberlin Hall, 1150 University Avenue, Madison, WI. The presentations last a bit over an hour and are suitable for all ages.

Enjoy the Reception!

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UNIVERSITY OF WISCONSIN–MADISON