Intro to PHYS514

- Website
- About AMO
- Topics

514 Website

http://courses.physics.illinois.edu/phys514/

- Lecture notes
- Homework
- Final project
- General Info

About AMO

Cold molecules

- Quantum computing
- Precision measurements / fundamental symmetries
- Collision physics
- BEC?

Exotic Atoms

- Alkaline earths
- Cr, Mn,…?
- Er, Dy
- Rydberg atoms

Ion Traps

- Quantum computing
- Quantum optics
- Precision measurements

Beam physics

- Ion-atom collisions, keV
- Connections with astro.

Quantum Gases

- BEC, Fermi gases
- Many-body quantum physics, CM

Atom optics

- Waveguides
- interferometers

Quantum optics

- Atoms in cavities (cQED)
- Non-linear optics

Optical Sciences

- Laser physics
- Photonic crystals and waveguides
- Quantum dots

Quantum computing

- ion traps
- Neutral atoms
- Molecules
- photons

Quantum cryptography

- Free-space, fiber

Precision measurement

- PNC, EDM
- Inertial sensors, clocks
- Charge radii
- Radioisotope dating
- Atomic structure, collision physics

Misc.

- Cold plasmas
- Warm/cold vapors
- Slow light
- Filamentation
- DLCZ
- Squeezing
- Magnetometry
- Hyper-polarized gases

Another point of view

Experimental tools

Neutral atoms
- warm, vapors
- MOTs
- Magnetic traps
- Laser cooling
- Zeeman slowers

Ions
- Paul traps
- Penning traps
- Laser cooling

Molecules
- Beams
- Stark deceleration
- Magnetic slowing

Cavities
- Ions, neutrals
- Strong, weak coupling

Non-linear optics

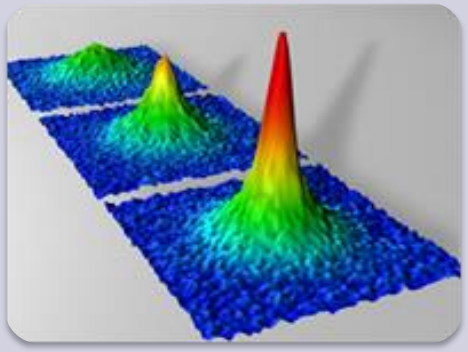
Linear optics

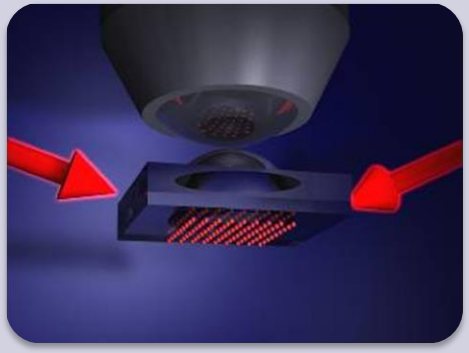
Ultra-fast lasers
- ps, fs, amplification
- High peak power

Traditional cryogenics
- Buffer gas cooling

AMO in this country

Centers





JILA

CUA

JQI

Texas A&M

- Fry: quantum optics
- Welch: slow light
- Scully: quantum optics
- Zubairy: quantum optics

UVA

- Sackett: BEC, interferometry
- Pfister: quantum optics
- Jones: ultra-fast
- Cates:hyper-polarized gases
- Gallagher: Rydberg atoms
- You: everything
- Kennedy: BEC
- Flannery: Rydberg, collisions

Georgia Tech

- Chapman:BEC, cQED, ions
- Raman:BEC
- Kuzmich: DLCZ, slow light

Texas @ Austin

- Heinzen: BEC, ultra-cold molecules
- Raizen: atom optics
- Ditmire: ultra-fast
- Downer: laser physics

Rice

- Hulet: BEC and Fermi gases
- Killian: ultracold plasmas
- Dunning: ultra-fast
- Linday: beam physics

U. Arizona Tucson

- Anderson: BEC
- Jessen: QC, lattices
- Cronin: atom interferometry
- Meystre: BEC, quantum optics

Berkeley

- Stamper-Kurn: BEC, cQED
- Budker: EDM, magnetometry
- Chiao: quantum optics

PSU

- Weiss: QC, BEC
- Gibble: precision measurement
- O'Hara: BEC & Fermi gases
- Gemelke: quantum gases
- Rigol: theory

Uconn

- Gould: ultracold atoms, molecules
- Smith: quantum optics, cold atoms
- Eyler: Rydberg atoms, cold gases
- Stwalley: collisions
- Cote: everything

UIUC

- DeMarco: BEC, Fermi gases
- Kwiat: quantum optics

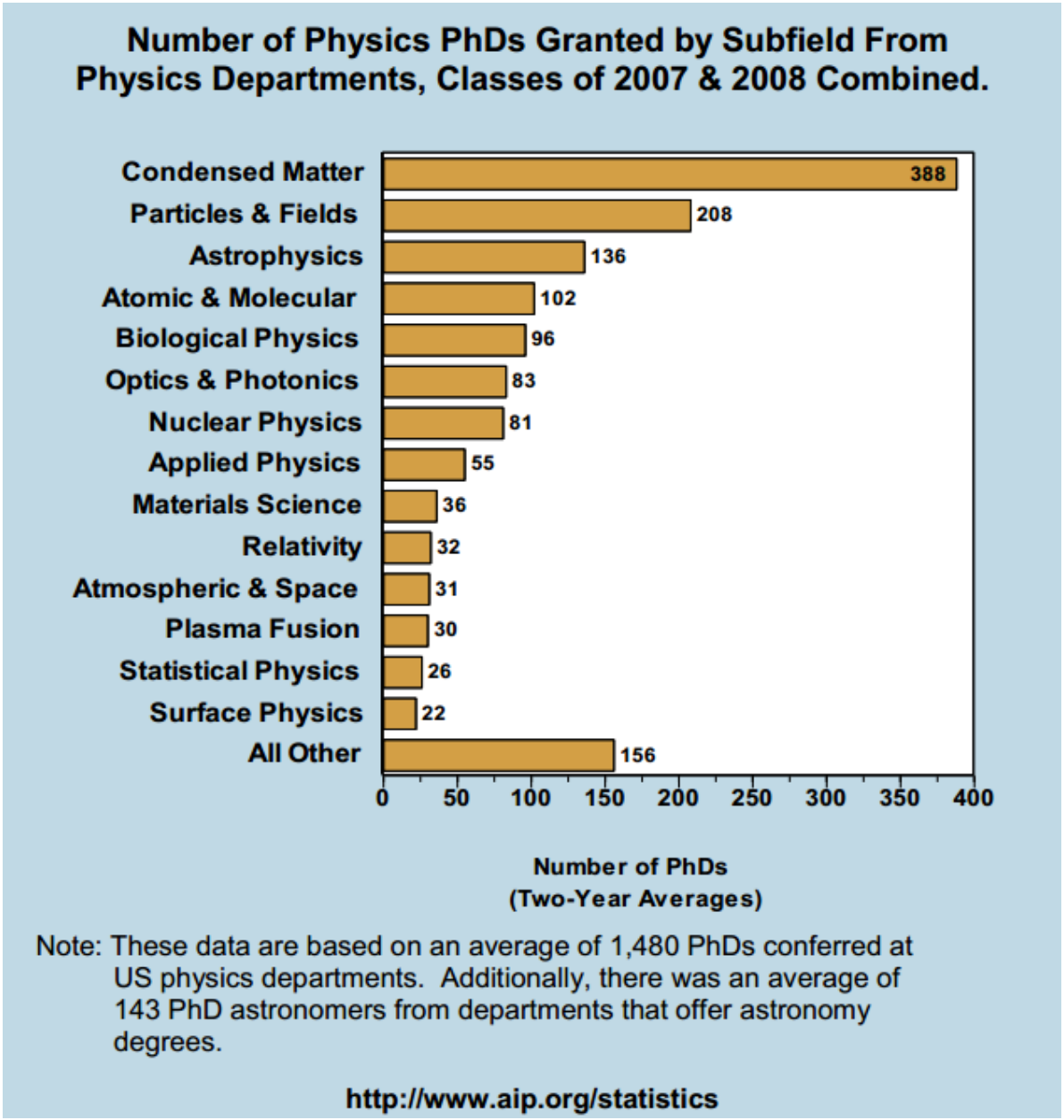
Wisconsin

- Saffman: Rydberg qubits
- Walker: medical imaging
- Yaviz: quantum optics, frequency combcs, slow light

UNM

- Deutsch: QC, QO
- Geremia: QO, AO, coherent control

Student interest

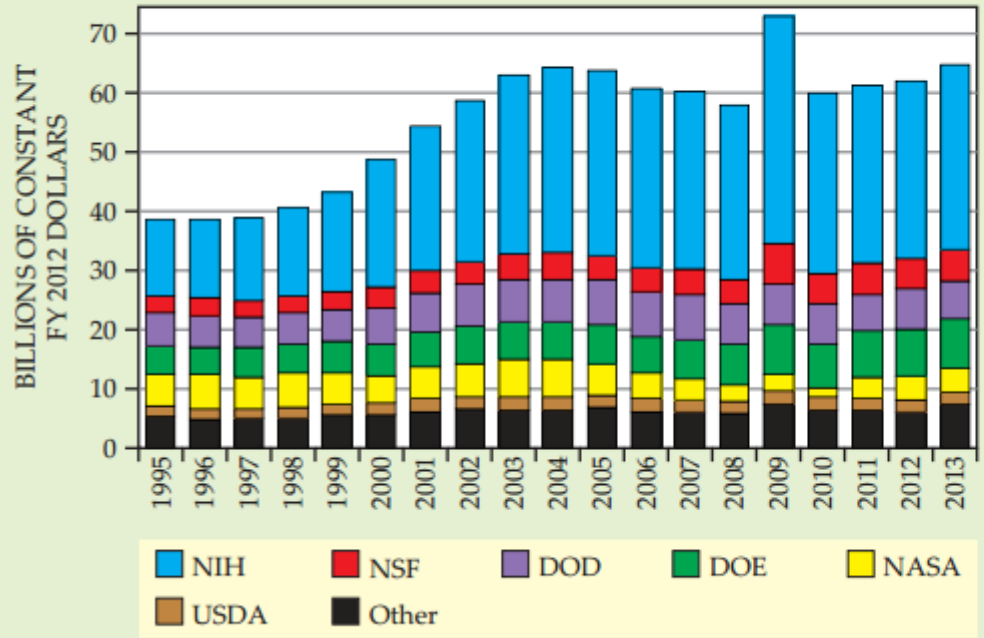


http://www.aip.org/statistics/trends/reports/physgrad2008.pdf

Jan 2012, Physics Today, funding report

http://scitation.aip.org/getpdf/servlet/GetPDFServlet?filetype=pdf&id=PHTOAD000065000004000033000001&idtype=cvips&doi=10.1063/PT.3.1517&prog=normal

Federal research funding by agency, FY 1995–2013



Federal funding for basic and applied research under President Obama's budget request for fiscal year 2013 would rise 3.3%, to $64 billion, matching levels last seen in the mid 2000s (excluding 2009, which included funding from the American Recovery and Reinvestment Act). Overall, the president proposed $140 billion for federal R&D, a 1.4% increase compared with the amount appropriated in FY 2012. Whereas defense R&D, totaling $75.9 billion, would decline 1.5%, non-defense-related R&D would increase 5%, to $65 billion. Increases sought for NSF, DOE's basic research programs, and NIST's laboratory programs fall well short of the amounts needed to double their budgets over a 10-year period. The budget reemphasizes clean energy research and proposes new initiatives in manufacturing technology research.

Department of Commerce (NOAA and NIST) R&D programs

	FY 2012 actual	FY 2013 request	FY 2012–13 percent change
	(millions of dollars)*		
National Oceanic and Atmospheric Administration R&D			
Total	574	552	–3.8
NIST R&D			
Total	751	857	14.1
Scientific and Technical Research Services (STRS)†	567	648	14.3
Technology Innovation Program‡	—	—	
Construction of research facilities	55	60	8.3

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.
†STRS includes NIST's laboratories.
‡Terminated in FY 2012.

Department of Defense R&D programs

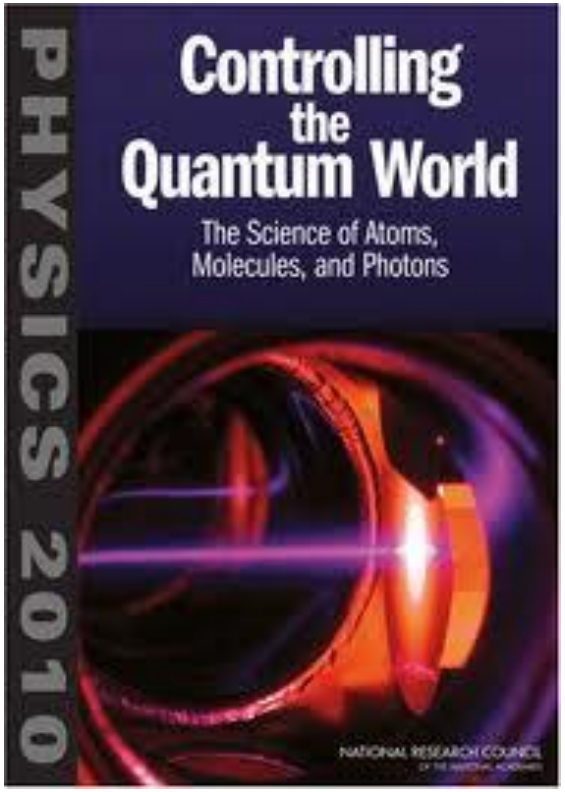
	FY 2012 actual	FY 2013 request	FY 2012–13 percent change
	(millions of dollars)*		
Research, development, test, and evaluation (RDT&E)			
Total basic research (6.1)	2 112	2 117	0.2
US Army			
In-house independent research	21	21	−0.8
Defense research sciences	214	219	2.6
University research initiatives	81	81	0.1
University and industry research centers	141	123	−12.5
Total US Army	456	444	−2.6
US Navy			
University research initiatives	133	114	−14.6
In-house independent research	18	18	0.9
Defense research sciences	454	473	4.1
Total US Navy	605	605	0.0
US Air Force			
Defense research sciences	364	362	−0.7
University research initiatives	152	141	−7.3
High-energy laser research	14	13	−8.1
Total US Air Force	531	516	−2.7
Defense-wide basic research programs†			
DTRA basic research initiative	48	45	−5.6
Basic research initiatives	7	19	159.4
Defense research sciences‡	291	309	6.3
National defense education program	84	88	5.3
Basic operational medical research science	38	40	4.8
Chemical and biological defense research	53	51	−3.9
Total defense-wide basic research programs	520	552	6.1
Applied research (6.2)	4 739	4 478	−5.5
Advanced technology development (6.3)	5 411	5 266	−2.7
Total science and technology (6.1–6.3)	12 263	11 861	−3.3
Other RDT&E§	60 574	57 792	−4.6
Total RDT&E‖	72 837	69 653	−4.4

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.
†Includes the basic research budgets of DOD agencies such as DARPA, the Defense Advanced Research Projects Agency; DTRA, the Defense Threat Reduction Agency; the Missile Defense Agency; and the Office of the Secretary of Defense.
‡Includes DARPA's basic research budget. The bulk of DARPA's budget is provided from the applied research (6.2) and advanced technology development (6.3) categories. DARPA's overall FY 2013 request is $2.8 billion, virtually even with its FY 2012 appropriations.
§Includes RDT&E categories 6.4 through 6.7.
‖Excludes medical research and R&D support in military personnel, construction, chemical agents and munitions destruction, and other programs.

NSF R&D programs

	FY 2012 actual	FY 2013 request	FY 2012–13 percent change
	(millions of dollars)*		
Total NSF	7 033	7 373	4.8
Research and related activities (R&RA)			
Mathematical and physical sciences (MPS)			
Mathematical sciences	238	245	3.0
Astronomical sciences	235	245	4.3
Physics	277	280	1.0
Chemistry	234	244	4.2
Materials research	295	303	2.7
Multidisciplinary activities	31	29	–5.1
Total MPS	1 309	1 345	2.8

National Academy Reports: 1994, 2002, 2006, 2010



http://www.nap.edu/catalog.php?record_id=11705#toc

PHYS514 Topics

- Atoms: hydrogen, fine structure, hyperfine structure, Lamb shift, Zeeman effect, alkalis
- Classical and Quantum 2-level systems: Rabi problem, density matrices, Bloch vectors, decoherence
- Atoms and Light: semiclassical and quantum, laser cooling and trapping, optical lattices, quantum optics, cavity QED
- Quantum optics: cavity QED, Jaynes-Cummings model, Mollow transformation, dressed states and resonance fluorescence
- Evaporative cooling, quantum gases, magnetic traps
- Ion traps: stimulated Raman transitions, resolved sideband cooling
- Electromagnetically Induced Transparency (EIT), “slow light”