



Overview

Department of Physics

University of Maryland

External Review 2013

- Build a great department. This means
 - Research
 - Teaching
 - Development and Outreach
 - Campus citizenship
- This is what the Dean and Provost asked me to do!
 - And they know it's not cheap
 - Although they sometimes wish it were cheaper
 - Key thing at Maryland
 - I have a budget! This is not true for many (most?) physics dep'ts

- Commitment to excellence. Goes without saying
- High expectations for new hires
- Support the faculty
 - We work hard to help new faculty be successful
 - Maximize our investment, help them to realize their potential
 - Mentoring is a priority
 - We are more like Berkeley than Princeton (in and out)
 - Realize a positive collegial environment. This is one of our strengths here
 - Principle of superposition: coherence is extremely important
- Retention is one of the most important things I do
- Maintaining a large department is expensive and we need campus support (\$)
 - In return we try hard to be good campus citizens
 - Committees, and opportunities for interdisciplinary partnerships

- Faculty

- Quality continually rises: new hires > retirements
- Have a core group of outstanding “superstars”
 - Phillips, Mather, Das Sarma, Monroe, Sundrum, Gates, Williams, Fisher, Goodman, Jawahery, Drake, Yorke, Ott...
 - Williams to BP, Fisher retired, Yorke retires soon, Phillips plays a big role, Mather smaller but is still a presence
- Research program is broad, and very good
- Location (inside beltway) and innovative spirit
 - Have partnerships with NIST (JQI), NIH/NCI, GSFC
 - More in the works (VA, DOE/Fermilab,...)
 - Faculty get the importance of this and make the effort

National and International Awards and Recognition		Awards since 2000	
Nobel Prize	Phillips (97), Mather (06)	Stanley Corrsin Award	Lathrop (12)
National Medal of Science	Gates (2013)	David Turnbull Lectureship	Williams (03)
National Academy Sciences	Fisher (83), Sagdeev (87), Gloeckler (97), Phillips (97), Williams (92)	David Adler Award	Williams (01)
American Academy Arts and Sciences	Fisher, Williams, Misner, Sagdeev, Phillips, Gates	E.O. Lawrence Award	Dorland (09)
Japan Prize	Yorke (02)	Excellence in Plasma Physics	Milchberg (05)
Wolf Prize	Fisher (80)	Beckman Foundation Young Investigator	Ouyang (07)
PCAST member	Gates (09)	DOE Early Career	Hall (11)
Fellow APS	28 faculty	NSF Early Career	Ouyang (07), Appelbaum (08), Galitsky (09), Hoffman (09), Paglione (11)
Fellow AAAS	26 faculty	Young Investigator (ONR)	Ouyang (07)
Fellow AGU	Drake (12)	Oersted Medal (AAPT)	Redish (13)
Fellow Int'l Soc GR	Buonanno (10)	Richtmayer Memorial Lecture	Goodman (00)
Fellow Optical Soc Am	Clark (06), Lett(04), Phillips (04), Orozco/Rolston (08), Sprangle (10)	Maryland Young Scientist of the Year Award	Appelbaum (11)

University Awards	
USM Regents Professor	Fisher (93), Gates (13)
Distinguished University Professor	Fisher, Sagdeev, Das Sarma, Ott, Yorke, Webb, Gloeckler, Williams (00), Phillips (01), Sreenivasan (01), Ramesh (03), Sundrum (11), Jawahery (12)
Bice Zorn Professorship	Monroe
Gus Zorn Professorship	Jawahery
Board of Regents Mentorship Award	Gates (04)
Board of Regents Teaching Award	Redish, Goodman
Elkins Professorship (USM)	Sundrum (10, 11)
John S. Toll Chair	Gates, Sundrum
Kirwan Award Education	Goodman (04)
Kirwan Award Research	Das Sarma (08)
President's Medal	Goodman (10)
Richard E. Prange Chair	Das Sarma

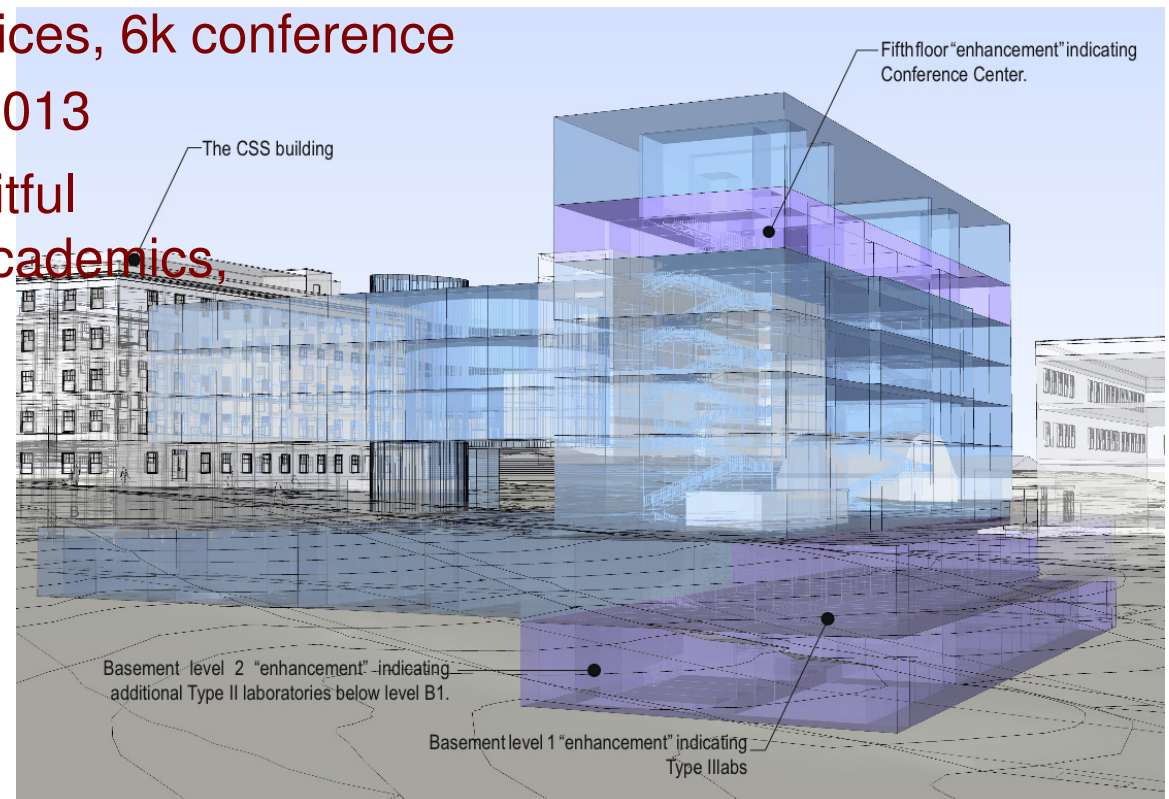
- Principle of superposition
 - Strategic effort to focus dept'l support for research in “centers”
 - Gives people and incentive to collaborate and work together
 - Helps empower everyone
 - Discourage use of funds for things that should come from grants
 - For example fund visitors, special opportunities, fluctuations in grants, center postdocs and students
 - Appoint director who understands the role of center
- Current centers:
 - JQI (NIST+AMO), JSI (GSFC+”astro”), CNAM (CME), CMTc (CM theory), MCFP (particle/gravity/astrophysics theory), CEFp (expt'l particle physics)
 - In the works: NIH/NCI Cancer Partnership (Losert), possible center with Fermilab on advanced accelerator R&D

- Budget
 - We keep our budget in the department
 - Oversight and approval by the Dean
 - If faculty go on leave, buyout, etc, we keep the savings
 - This allows us to do things without having to ask the College for money
- Carryforward
 - We keep it in the department
 - We have dept carryforward (unencumbered) plus what is committed to the faculty/center/institutes (encumbered)
 - We can often borrow from the “pool”, like a bank, and pay it back later
 - This gives us enormous flexibility
- I think it’s an important aspect of our successes

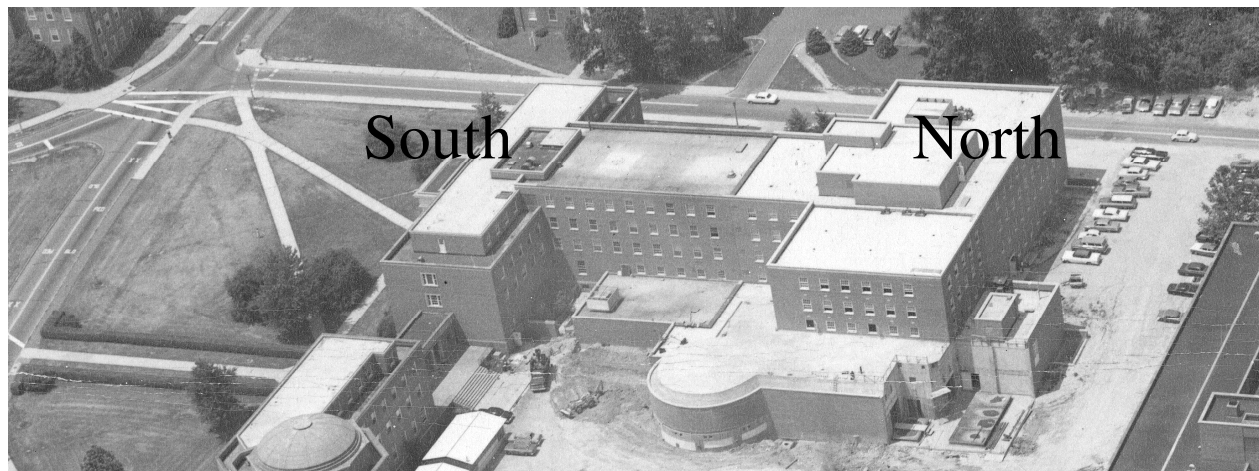
More on budgets below

- New Physical Sciences Complex

- \$130M funded by state (\$120M) and NIST/ARRA (\$10M)
- Goal: impact! Both in high performance AMO/CME labs and collaborative space to enhance social nature of science
- 142k GSF, 55% labs and 52% NASF/GSF
- NASF: 39k labs, 27k offices, 6k conference
- Occupancy: fall/winter 2013
- Has been a long and fruitful collaboration between academics, facilities, architects



- Toll Physics building
 - Built in ~1950 (south) and ~1960 (north) see below
 - Over 200k NASF
 - Dilapidated, hard to upgrade, expensive to maintain
 - Renovations expensive and maybe even dangerous
 - Fire in 2002, electrician died.
 - Cannot build a great dept without new facilities



- **Physical Sciences Complex**
 - Proposed new building for all of physics ~2000
 - Too big. Would have taken entire system capital budget for one year
 - Split into 2 (now 3) phases to make it affordable
 - No choice, we either agree to split the dept or we are doomed to mediocrity
 - Along comes JQI (ca 2005) and its enormous success
 - Within 1st 5 years is established as a powerhouse in AMO
 - Recruited Chris Monroe and now have an NSF PFC in AMO+CME
 - Department made a strategic move to leave condensed matter behind
 - Dedicated much (but not all) of PSC lab space to JQI
- **Department is now split. CM exp't and theory stay.**
 - Pushing for the 2nd phase (PSC2) now, will be attached to PSC1
 - Will contain enough space to bring all of CM
 - Critical that campus support this. More on this below.

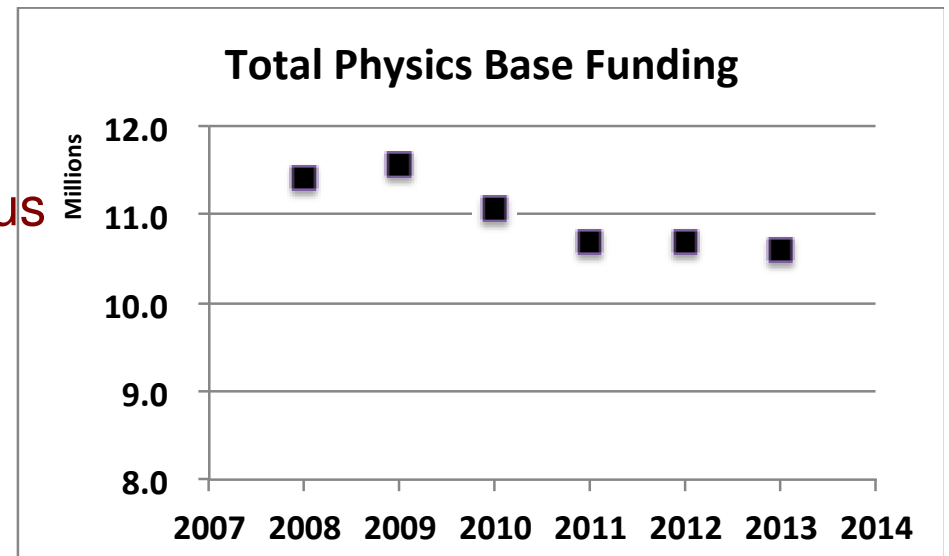
WE HAVE THE TIGER BY THE TAIL

- Budget cuts are part of life

- Not hiring is not an option - have to build on strengths to keep up
- Have managed to survive by combination of belt tightening, reorganization, liberalizing buyouts, losing faculty lines via attrition
 - Operations are “at the bone”. Further cuts will be into that bone from now on.
- Have reduced TAs
 - So far so good but we have >4000 non-majors per year to teach, plus our majors

- Provost reallocation. ☹️

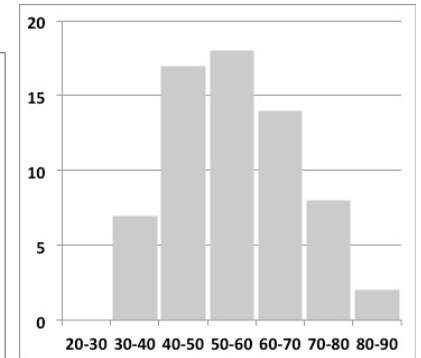
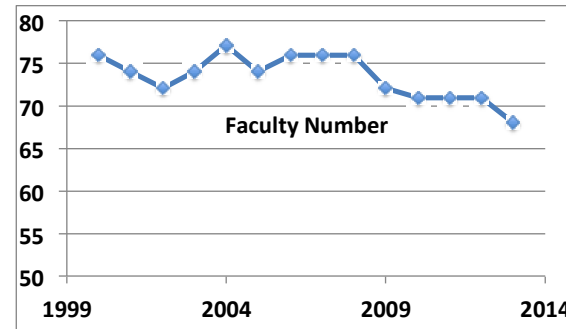
- Political.
- We are fighting it, Dean supports us



- Faculty: 68 warm bodies, ~60 FTE

- Long tail in age histogram
- Down by ~10 since budget cuts

Rank	Number	<Age>	Female
Asst	9	40	2
Assoc	11	42	1
Full	48	61	5

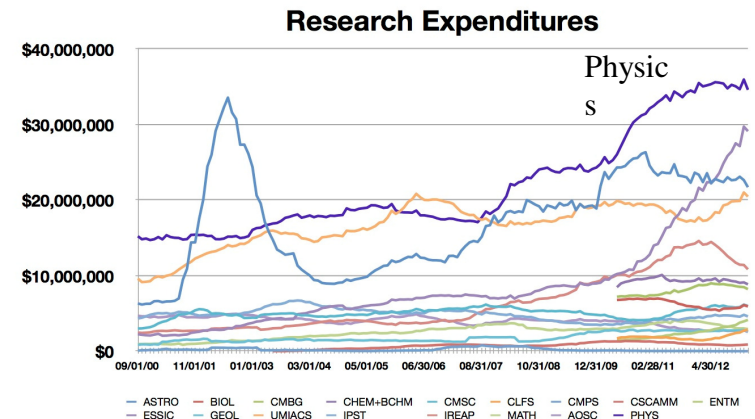
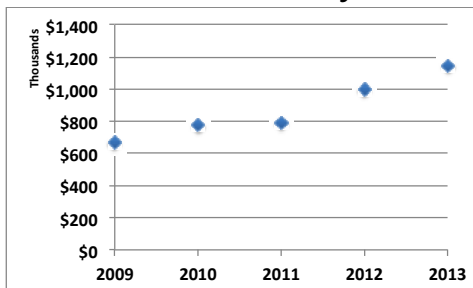


Beise, Buonanno, Eno, Girvan, Hoffman, Seo, Upadhyaya, Williams

- Bringing home the bacon

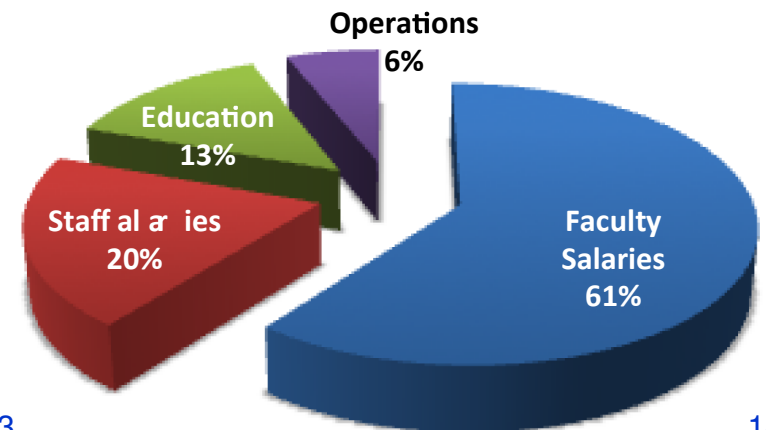
- IDC kickback based on expenditures
 - Comes to dept 2 years after
 - DRIF == Designated Research Initiative Fund
- We use DRIF to operate
 - Research generates direct income via DRIF and indirect via buyouts

Each data point is sum of previous 12 months expenditures



“The key to success in running a dept: never spend any dollar more than twice.” John Toll

- Ongoing income comes from state money and DRIF
- Departmental expenditures are what we DID spend this year
 - Education is TA, Lecturers, Labs, Lecture Demo
 - Operations is telecom, IT, supplies, furniture, recruitment, visitors, subdepartment budgets, etc
- We do not have enough state money to meet expenditures
 - We rely on DRIF and buyouts
 - This is good. I’d rather have this than have all funds kept by Dean
- Every cut by state/campus has hits that fraction of the state funds that goes to operating
 - Cuts are to base. Cannot fund soft
 - “Small” cuts are to “small” base so are large



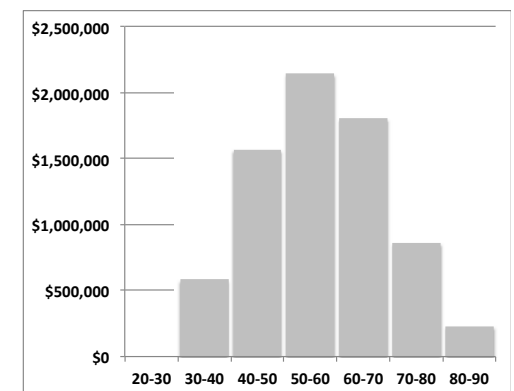
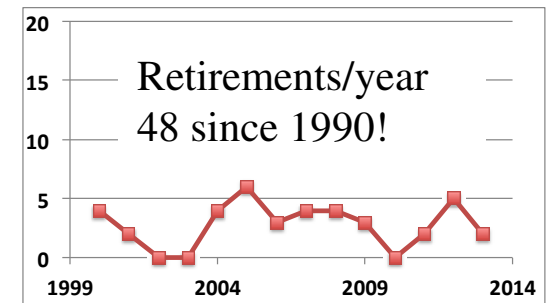
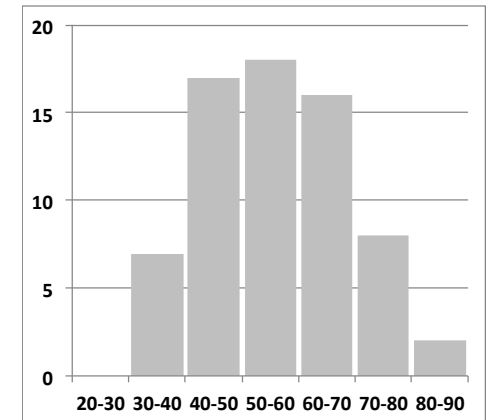
- We have worked hard to survive the cuts AND to keep hiring > 0
 - Revamped IT (now collaborate with ECE and Math) and trimmed excess phones and IP addresses
 - Reduced TAs (10%, 55 down to 50)
 - Reduction of services (layoff student shop supervisor, layoff of lecture demo supervisor)
 - Base reductions (CNAM reductions)
 - Staff reorganization (combined w/CNAM)
 - Loss of lines (100% return to Dean for some retirements)
 - Reduced chargeback centers (like printing)
 - DRIF no longer goes to faculty except ad hoc
- We are still down quite a bit from when I started in 2006
 - ~\$1M to \$1.5M depending how you count it

- We have a “carry-forward”! (aka “soft”, aka “savings”)
- What do we need it for?
 - We need to save for startup so we are not at the mercy of the Dean and Provost
 - LEVERAGE makes the world go round
 - Money is “lubication”. We need it so that we can use it to make things happen **for us**.
 - If at the end of the year we spent > income, we have to cover it with “soft”
- Where does soft (carryforward) come from?
 - Buyouts, sabbaticals, retirements, sometimes luck and trickery
- *We live entirely on the edge*
 - Still losing base funding ☹
 - Hiring continues even though budgets are falling ☺ but hiring < retirements
 - DRIF increases ☺ (so far but ...ARRA gone, sequestration...crystal ball?)
 - Education costs are increasing (both non-majors sequences and majors)
 - Faculty going on leave, can be unpredictable, hard to plan
- One has to keep one’s head in this business
 - Like the airlines. Sometimes you have to overbook and hope for the best.

“Fear is the path to the dark side. Fear leads to anger. Anger leads to hate. Hate leads to suffering.”

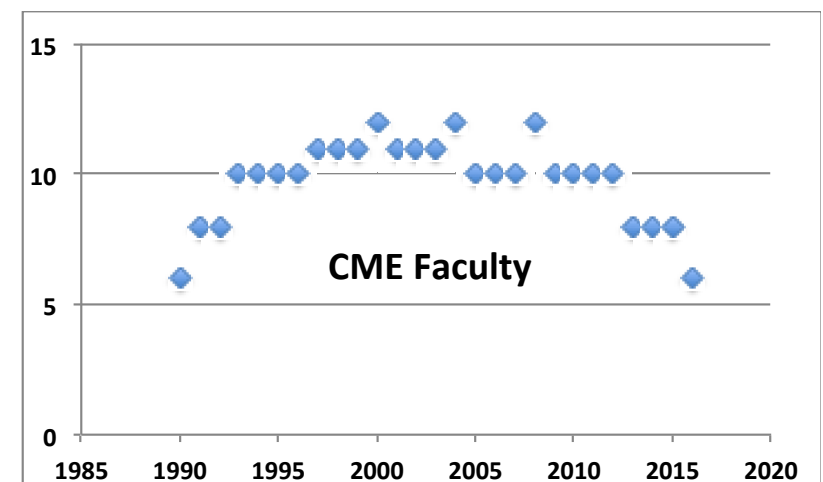
Yoda

- In 10 years maybe 10 >70 & $\sim \frac{1}{2} \times 16 >60$ retire?
 - That's around 18, or 1.8/year
- Follow the money...
 - That's around \$1.8M in state salaries, or \$100k/faculty state salary (not 12 month!)
 - Some joint appointments with other units paying a share
 - The calculation:
 - Traditionally we keep ~half, ~\$50k
 - New junior faculty: maybe \$80k-\$90k
 - Difference has to come out of "operating"
 - This is typical – we have lost ~\$20k/hire since ~2000.
 - I calculated that we've lost >\$500k in "operating" due to this
 - Now you know why the department needs to keep DRIF!
 - Not to mention increased enrollment, etc.
 - Retiring faculty invariably bring in more DRIF than new faculty!
 - Important to keep the research strong so we can operate!
- Bottom line: we may have to periodically not recycle retirement(s), use the funds to shore up operations



- Core areas (theme groups)
 - TG1: Condensed matter and AMO
 - 6 theory $\langle \text{age} \rangle = 52$; 12 exp $\langle \text{age} \rangle = 55$
 - TG2: “Particles” (HEP, particle astro, dark matter, LIGO)
 - 14 theory $\langle \text{age} \rangle = 54$; 13 exp $\langle \text{age} \rangle = 52$
 - TG1: Plasma, NLD, “other” (physics education)
 - 13 theory $\langle \text{age} \rangle = 65$; 10 exp $\langle \text{age} \rangle = 53$
- Total faculty: 33 theory $\langle \text{age} \rangle = 58$; 35 experimental $\langle \text{age} \rangle = 53$
 - Includes Williams (BP), Beise (Assoc Prov), Roberts (Assoc Dean UG), Dorland (Honors College), Dean Banavar, Assoc Dean Lathrop, Yorke (math chair), Roy (IPST director), Kirkpatrick (never here)
- Our ranking is due overall excellence but also to our having a broad high quality program
 - We can shrink some but if too much then we lose our edge and our DRIF goes down and the whole thing can unravel.

- AMO core of Rolston, Orozco, Monroe is truly excellent
 - Will be searching for asst prof AMO soon. Have 1 we may go after this year, young woman from JILA
- CMT
 - Very strong but small. Das Sarma, Galitsky, Levin, Sau, Yakovenko, Einstein, Kirkpatrick
 - Das Sarma is the overall leader. Extremely productive and a great colleague
 - Sau just hired, Levin 3rd year, Galitsky a rising star. Terrific young core
- CME
 - Significant losses. Need to shore up
 - Have 2 we are trying to hire this year
 - Very high priority! (lots of \$ needed)



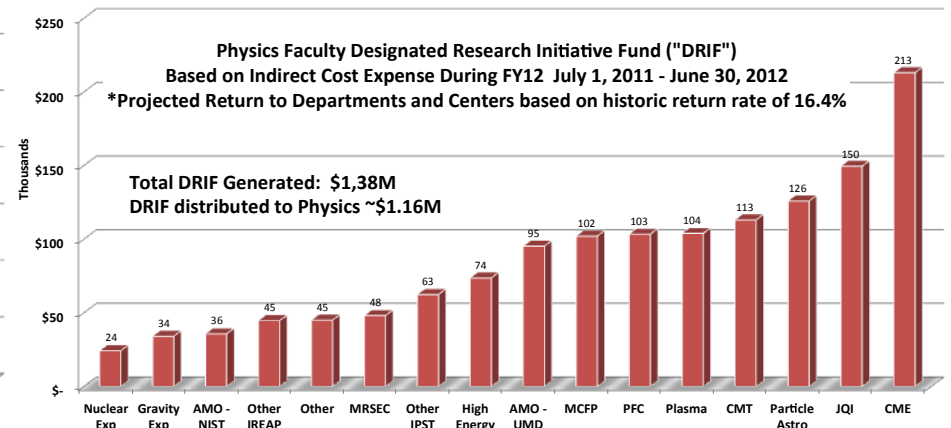
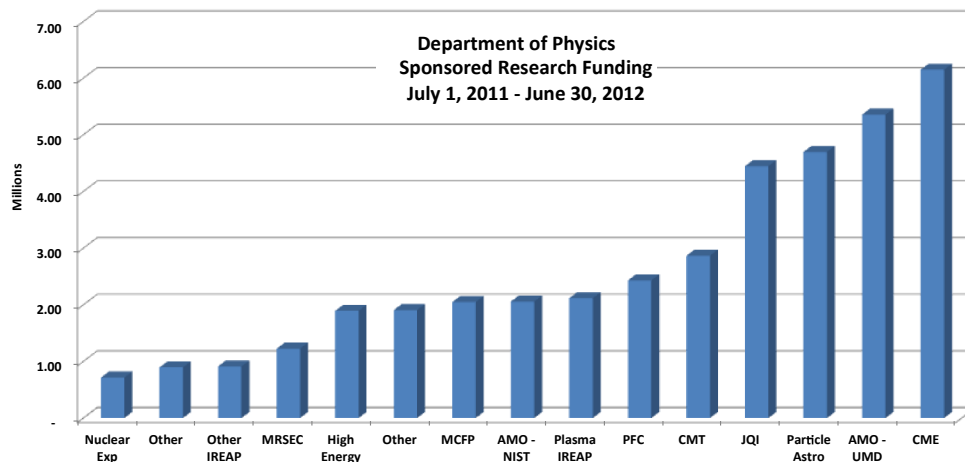
- Center for Superconductivity Research
 - Established late 1980s, \$2M 5-year “base” and \$10M renovations
 - Did not cover all of CME and no CMT
- Hired Rick Greene from IBM to direct
 - Built a great group, hired terrific young people and brought in excellent senior people (Venkatesan, Ramesh, Webb)
- Established Center for Nanophysics and Advanced Materials 2006
 - Widen the umbrella to include all of CM physics
 - Reflects evolving nature of CM physics
 - Protect the base funds by widening the constituency (Williams and Das Sarma under the new umbrella)
- Significant budget cuts but center is alive and well
 - Largest single recipient of base funds to support research
 - Appropriate, they have large facilities costs

- HEP (5 on CMS and 2 on LHCb)
 - Baden, Belloni, Eno, Hadley, Jawahery, Roberts, Skuja
 - Many have leadership roles
- Particle Astrophysics (3), all spokepeople
 - IceCube and LBNE (Sullivan), HAWC (Goodman), Hoffman (Askaryan Radio Array @ South Pole)
- Dark matter/Nuclear (2)
 - Betsy Beise (currently assoc prov, nucleon and fundamental measurements), Hall (EXO and LUX)
- Gravity (1)
 - Peter Shawhan, LIGO
 - Paik retired but still active in squid based tests of gravity at mm scale
- Very productive group, work on experiments with very long time scales. Dept invests in shop and electronics engineer.

- Maryland Center for Fundamental Physic (\$300k/year)
 - Particles, nuclear/soft QCD, gravity, gravity wave, astrophysics
 - No explicit cosmology
- Joint Space-sciences Institute (Physics, Astronomy, Goddard) (\$60k/year, money from Goddard)
 - Focus on black hole physics plus whatever else people are working on
 - Close collaboration with people from Goddard (experimentalists)
- Resources target needs that do not come from grants
- Support of theory is very important. NSF and DOE starve theorists and theory attracts people to the department
 - This is true for all the theme groups!!!
- Sundrum hired 2010. Will build on his being here.
 - Very strong core. Excellent gravity people (Buonanno, Jacobson, Hu)
- PSC is designed to enhance theoretical physics at Maryland

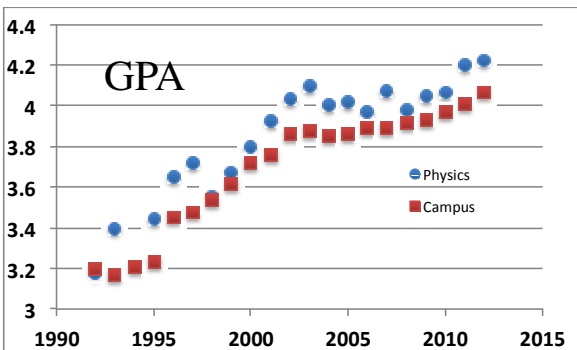
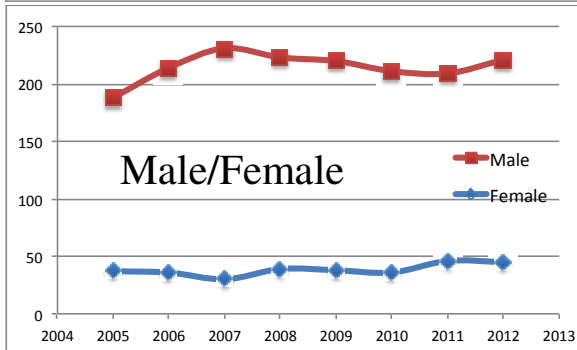
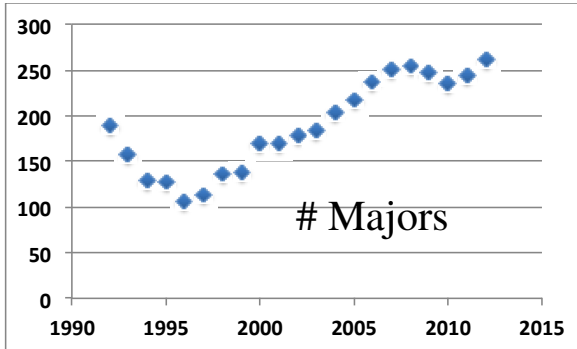
- Plasma/NLD theory
 - Antonsen (63), Hassam (63), Sprangle (65), Drake (66), Yorke (72), Ott (72), Liu (75), Papadopoulos (76), Sagdeev (80)
 - Dorland (48), Girvan (36)
- Chaos and network/complexity theory, plasma and space applications, magnetic reconnection
 - Age distribution is not good.
 - We will have to face this as a dept.
- Redish is 71 and our only physics education person
 - Should we invest? Can we?
- Banavar is Dean but very active in theory/biophysics
 - Dept is pursuing senior hire in this field

- CME has 2 MURI's and money from LPS for postdocs
 - Group is aging, we are negotiating to hire 2 junior faculty now
- AMO has Monroe and 2 MURI's
 - A junior faculty may be hired this year or next. Needs to be soon.
- PASTRO has IceCube, ARA radio array, HAWC
 - Only 3 faculty. A hire is needed here, and soon.
- CMT has Das Sarma and Galitsky
- MCFP theory has 17 faculty

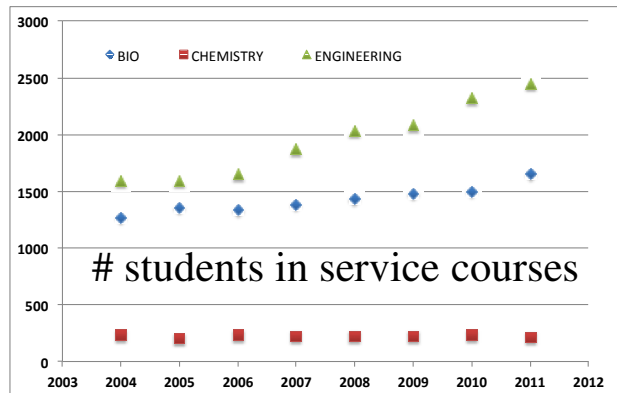


- Plasma Experiment is evolving away from fusion
 - Focus is on laser/matter and advanced accel R&D
 - Trying to find a way to partner with Fermilab, important field
- Lathrop is incredible
 - Sodium dynamo experiment, quantum vortices
 - Can't wait for him to stop being assoc Dean!
- Biophysics is growing
 - Lathrop, LaPorta, Upadhyaya
 - Good core group, significant progress in partnering with NIH and NCI
 - Missed a Physical Science Oncology Center grant 2 years ago
- Biophysics: We need to beef this up or it will always remain small with insufficient impact given the discovery potential here
 - Discussions ongoing with Dean. Am optimistic we can make progress budgets allowing

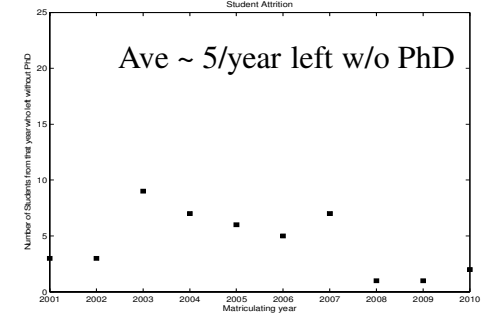
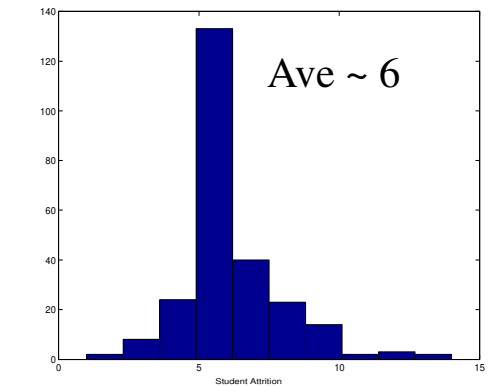
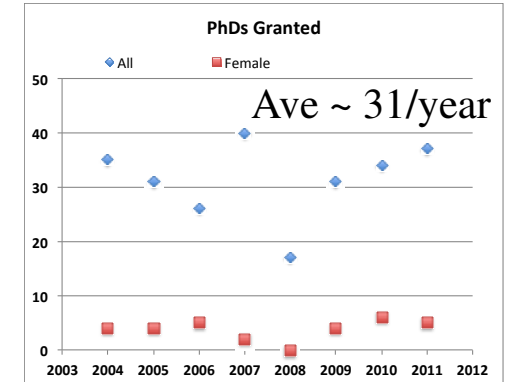
Physics Majors (~250)



non-Majors UG (~4500)



Grad Students (~230)



Some Stats:

- 35 incoming students
- 30% from foreign institutions
- 40% theory, 40% experiment, 20% undecided
- By theme group: 50% 1, 36% 2, 14% 3
- 28% female

Many faculty stepped up in advising: Hoffman, Kim, Appelbaum, Orozco, Sullivan, Paglione, Shawhan, Wellstood, Hall, Beise, Hassam, Yakovenko

Entering Freshmen—44

This is typical of the last several years and about a factor of 2 more than in 2000

Bachelor's awarded—38

This is also about a factor of 2 more than in 2000

Total in program—252

This is typical of the last several years and about a factor of 2 more than in 2000.

Note this number looks inconsistent with freshmen entering but we have a large number of transfers

Average SATs:

721 Math, 665 Verbal

Total merit scholarships including Banneker-Key,
Presidents, or Dean:

20 nearly 1/2 the class

Banneker-Key: (highest scholarship, full ride)

4 more than 9% of incoming students; in
comparison fewer than 2% of students in the
University have BKs

- A very high fraction of our students ~80% are involved in research at some point.
- We encourage faculty to help this continue by taking undergrads into their research groups.

- Times are changing. We are having to do more and more new things in student services, e.g.
 - “learning outcome assessments”, mentoring, teaching evaluations, outreach, minority bridge programs, teacher prep programs, summer interns for high school kids, TA training, curriculum enhancements, Gen-Ed, and so on
 - Physics majors are up, more and more advising and advising is becoming more important
 - We should be doing more to get external funding for LecDemo, outreach, etc.
- Our Student Services office:
 - 2 associate chairs, Jane Hessian, Linda O’Hara, Sonali Shukla, Tom Gleason. This is inadequate if we want to really do a great job in this
- We need to get ahead of the curve and not always be behind it
 - Have brought in high level staff person to help bring this important department up to snuff – Donna Hammer

- Plan to pool engineering and technical resources among all groups (CNAM, TG2E, JQI, IREAP?)
 - The group with primary salary responsibility has priority for that person's time
 - Develop a system to have other groups in need, borrow and pay that person if available
 - Set some threshold of couple(?) hours per pay period to avoid billing nightmare...
- TG2E (“particle” physics) and JQI have each hired a new electrical engineer
 - Will have them together in PSC
- Combine with CNAM and IREAP and...

- Back in the early 2000s when Geoffroy was provost, we proposed PSC to include all of physics
 - This did not fly because the entire building would cost more than the entire \$ allocation to the whole system in a year
 - Note: back then when you built a building, the legislature allocated ~90% of the funds in a single year even though construction is always over 2-3 years
- So we proposed building it in 2 steps.
 - It ballooned to 3, then back to 2 with caveats...not relevant
- We knew this was a risky thing to do
 - It is much more likely to stop a 2nd building than to stop after half of an entire building was built
 - But this was our chance so we took it

- The CIP is the budget for capital projects for the year
 - Highways, bridges, schools, buildings, prisons, etc.
 - Total is around \$1.4B this year, about \$1B from bonds
- The CIP is political soil, well fertilized
 - USM CIP is 10 years or more
 - The governor's CIP is 5 years
 - The legislature votes on each year separately
- The total MD higher Ed CIP this year is \$300M
 - USM portion that comes from bonds is around \$200M
 - UMCP is around \$40M this year. It's all on the web

- PSC2 would be finished by 2022! ☹️
- But....
 - They have allocated \$43M to renovate Toll, finishing 2018
 - Also extensive chemistry renovations are needed
 - \$76M, over next 8 years
- These are approved by the campus and Board Of Regents but are only placeholders!
 - No one believes can renovate Toll or Chem without surge space
- What to do....

- Since ~2002...
 - Science has evolved
 - STEM education is growing and growing
- There is a feeling on campus that Physics got it's lollipop (PSC1)
 - We have argued furiously for PSC2. This is now the CMNS highest priority. A victory? Maybe but it's still not approved down the line
- The best way to get PSC2 is for campus to WANT to build it
 - That means multidisciplinary, STEM, and so on
- Our goal should be to be able to abandon Toll and put the department back together ASAP
 - That means we have to be pragmatic and politically savvy
- So the plan as it has evolved (and is still evolving) is...

- Get PSC2 onto next CIP (2014)
 - Planning would start in the next 2 years, will take 3 more to build.
 - Add significant space for primarily for Chem and rest of physics (CME)
 - Emphasis on above labs
 - Cannot have significant chemicals below grade so need above ground labs
- Move Chem and all Physics admin & research in Toll into PSC2
- Renovate Chem
- Move physics teaching labs and classes into Chem
 - Toll is now totally clear
 - Chem renovation much cheaper and easier for teaching labs than for research labs
- Campus can then do what they want with Toll

- Will this fly?
 - Dean Banavar says PSC2 is the number 1 priority for CMNS and he approves this plan
 - Chemistry is also on board
 - Many people on campus (VPs) agree it's the right thing to do
 - New Provost has seen it and wants to make it happen but....we have to make the case
- We are working on getting this to be UMCP's official plan
- Jayanth completely supports getting us out of this crappy and dangerous building
 - And is working hard to find a donor. That would put us over the top.
- Stay tuned....

- Student Services coordinates a number of outreach programs:
 - Maryland Physics Olympics
 - Physics Summer Girls Program
 - Many others as in internal review
- If at all possible, we encourage PIs to include some funds for outreach programs in NSF and other proposals
 - If we can build up an infrastructure then we can take advantages of economies of scale and leverage grants for outreach
- Donna Hammer (new student services director) will play a big role here.
 - She directed MRSEC and did an outstanding job

- Effort at increasing the number of traditionally under-represented groups in physics

Sonali Shulka is spearheading this effort

- In graduate school she worked on the Vanderbilt-Fisk bridge program aimed at preparing members of under-represented groups to go to physics graduate school.
- While something along that line has been considered here, our first effort is at the undergraduate level—to help ensure that students who might successfully study physics, do.
 - The step to becoming an undergraduate major, is a critical leak in a leaky pipeline

– The department is starting a program entitled
Focus on Physics

- a) academic support and a sense of community to entering freshman and transfer students starting out as physics majors
- b) financial support to need-based students successfully completing the introductory sequence (usually by end of second year)
- c) clear expectations of what it takes to successfully complete an undergraduate degree in physics
- d) career planning information, personalized advice, mentoring and development workshops to assist students

– An NSF proposal in support of this with Jim Gates as PI has been submitted

- Curriculum reform is being undertaken based on the committee and two committees: .
 - A committee on the labs chaired by Raj Roy (with Carter Hall and Peter Shawhan) has identified steps for the rewriting of the 174, 275, 276 based on Matlab and has identified possible victims to rework the courses.
 - A committee on the implementation of the remainder of the program chaired by Ted Einstein has been moving forward with all deliberate speed. Preliminary discussions have taken place and issues—including resource issues—have been brought forward to the chair.

- Teaching Peer review

- We do have a system for this in place. However, it has been largely restricted to faculty coming up for promotion.
- The initial idea of this was that it would be done more broadly including for senior faculty and I hope to figure out a way to do this without overburdening the faculty
- We will need to put something in place to review our non-tenure track instructors (who are making up an increasing fraction of our teaching load) given new university guidelines.

- New course on “Physics for decision makers”
 - “Core” course, open to all UMD undergrads
 - Teach them how scientists think and analyze and solve problems
 - Based on issues of energy and sustainability
 - Very popular, very successful
- New course that attempts to bring science/technology students together with public policy students
 - Met last fall, worked on cyber security issues
 - Involved NSA in bringing real problems to the students
 - Very interesting experiment. Learned a lot about how and whether to push this idea further