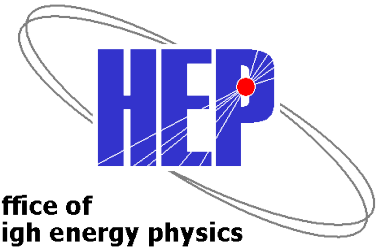




U.S. DEPARTMENT OF
ENERGY

Office of
Science



Theory @ DOE-HEP

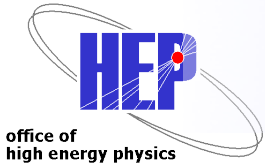
Simona Rolli

Program Manager

DOE Office of High Energy Physics

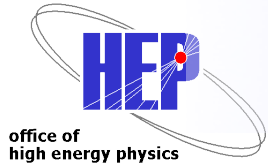
KITP- May 2013

Outline



- HEP Mission
- HEP Game Plan
 - Strategy
 - Budget
- Theory Funding trends
 - Labs
 - Universities
- Concluding Remarks
 - Or how to achieve Strength & Competitiveness in lean times...

HEP Mission



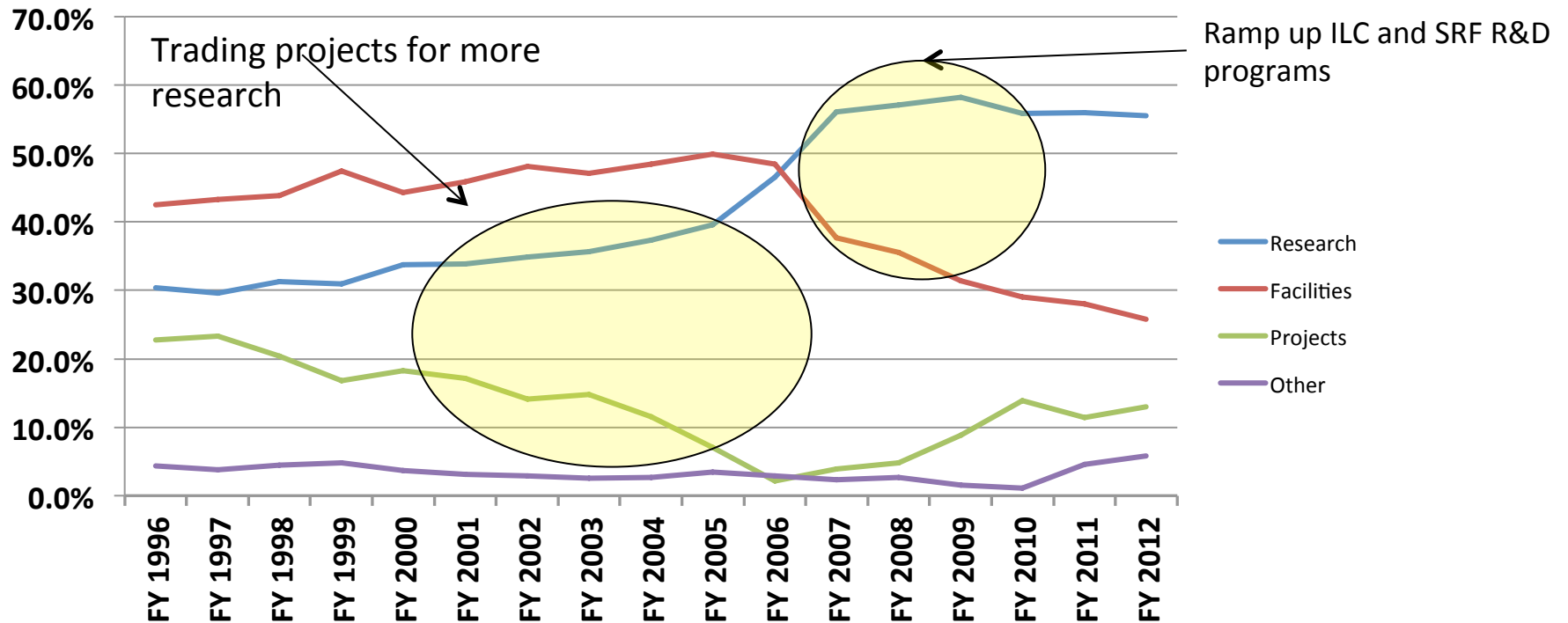
- **HEP's Mission:** To explore the most fundamental questions about the nature of the universe at the Cosmic, Intensity, and Energy Frontiers of scientific discovery, and to develop the tools and instrumentation that expand that research
- **HEP seeks answers to Big Questions:**
 - How does mass originate?
 - Why is the world matter and not anti-matter?
 - What is dark energy? Dark matter?
 - Do all the forces become one and on what scale?
 - What are the origins of the Universe?
- HEP offers high-impact research opportunities for small-scale collaborations at the Cosmic and Intensity Frontiers to full-blown international collaborations at the Energy Frontier.

The HEP Game Plan

- 2008 P5 Recommendations
 - Three Frontiers
 - US one of the leaders in Energy and Cosmic
 - LHC & LHC Upgrades; Dark Matter & Dark Energy
 - US the leader in Intensity
 - Neutrino and Kaon/Muon programs
 - Strategic Program in Accelerator R&D
 - Society return...
- The HEP budget plan puts in place a comprehensive program across the three frontiers.
 - In five years,
 - NOvA, Belle-II, g-2 will be running on the Intensity Frontier.
 - Mu2e will be in commissioning preparing for first data.
 - The CMS and ATLAS detector upgrades will be installed at CERN.
 - DES will have completed its science program and new mid-scale spectroscopic instrument and DM-G2 should begin operation
 - The two big initiatives, LSST and LBNE, will be well underway.

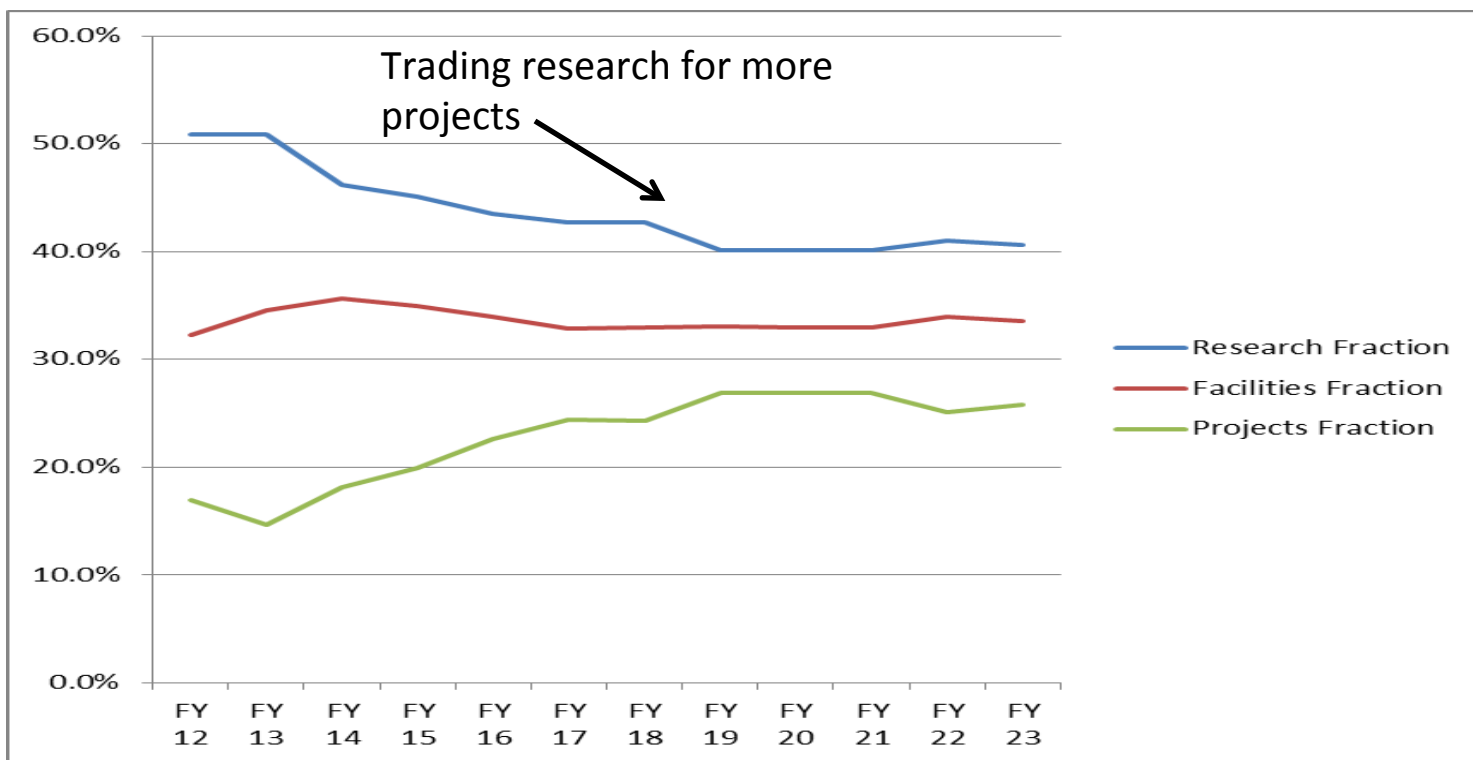


Recent Funding Trends



- In the late 90's the fraction of the budget devoted to projects was about 20%.
- Progress in many fields require new investments to produce new capabilities.
- The projects started in 2006 are coming to completion.
- New investments are needed to continue US leadership in well defined research areas.
- Possibilities for future funding growth are weak. Must make do with what we have.

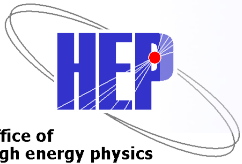
One Possible Future Scenario



- About 20% (relative) reduction in Research fraction over ~5 years.
 - *In order to address priorities, this will not be applied equally across Frontiers.*
- This necessarily implies reductions in scientific staffing. Some can migrate to Projects but other transitions are more difficult.
- We have requested labs to help manage this transition as gracefully as possible.

FY14 Budget

- FY2014 budget philosophy was to enable new world-leading HEP capabilities in the U.S. through investments on all three frontiers
 - **Accomplished through ramp-down of existing Projects and Research**
 - **When we were not able to fully implement this approach, converted planned project funds to R&D: Research → ~~Projects~~ → Research**
 - **Therefore the FY14 Request shows *increases* for Research which are driven by this R&D “bump”, while Construction/MIE funding is only slightly increased**
- Impact of these actions:
 - **Several new efforts are delayed: LBNE, LHC detector upgrades, 2nd Generation Dark Matter detectors**
 - **US leadership/partnership capabilities will be challenged by others**
 - **Workforce reductions at universities and labs**
- Key areas in FY2014 Request
 - **Maintaining forward progress on new projects via Construction and Research funding lines**



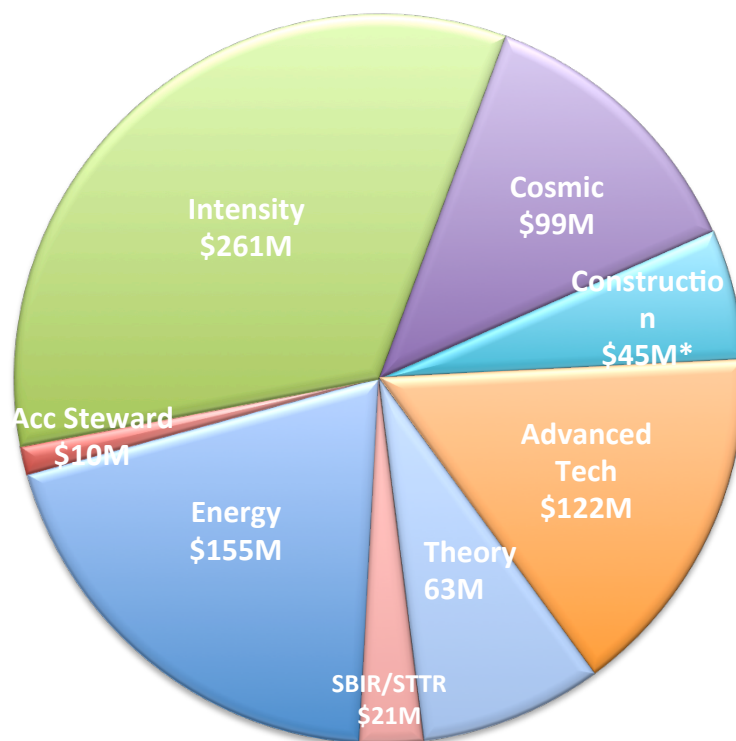
FY12 vs FY14 Budget

Description	FY 2012 Actual	FY 2014 Request	Explanation of Change
Energy Frontier Exp. Physics	159,997	154,687	Ramp-down of Tevatron
Intensity Frontier Exp. Physics	283,675	271,043	Completion of NOvA (MIE), partially offset by Fermi Ops
Cosmic Frontier Exp. Physics	71,940	99,080	Ramp-up of LSST
Theoretical and Computational Physics	66,965	62,870	Continuing reductions in Research
Advanced Technology R&D	157,106	122,453	Completion of ILC R&D
Accelerator Stewardship	2,850	9,931	FY14 includes Stewardship-related Research
SBIR/STTR	0	21,457	
Construction (Line Item)	28,000	35,000	Mostly Mu2e; no LBNE ramp-up
Total, High Energy Physics	770,533*	776,521	Down -1.8% after SBIR correction
Office of Science	4,873,634	5,152,752	

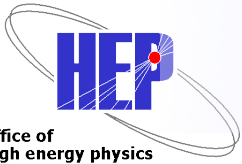
*The FY 2012 Actual is reduced by \$20,327,000 for SBIR/STTR

Budget breakdown

By "Frontier"

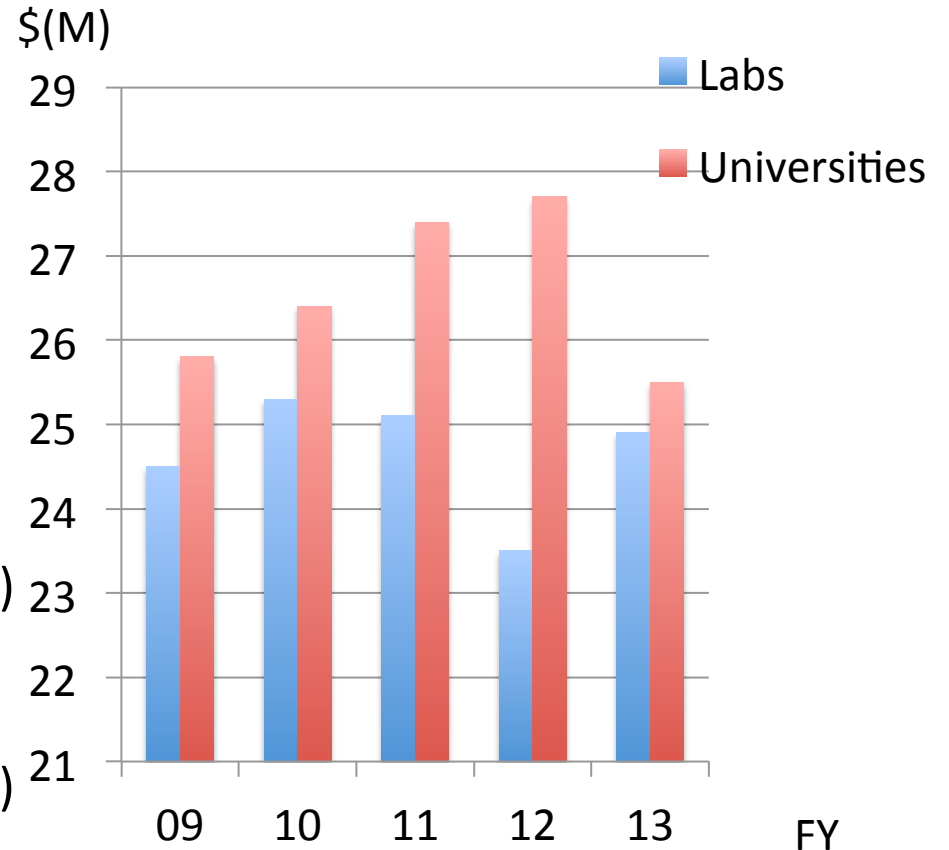


* Includes Other Project Costs (R&D) for LBNE



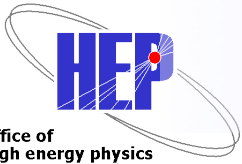
Theory Budget

- 2009
 - Labs 24,500M
 - Universities 25,800M*
- 2010
 - Labs 25,300M
 - Universities 26,350M *
- 2011
 - Labs 25,100M
 - Universities 27,400M** (26,972M)
- 2012
 - Labs 23,600M
 - Universities 27,700M ** (25,232M)
- 2013
 - Labs 24,950M
 - Universities 25,500 *



* Does not include EC

**Universities numbers include EC numbers w/o EC in parenthesis



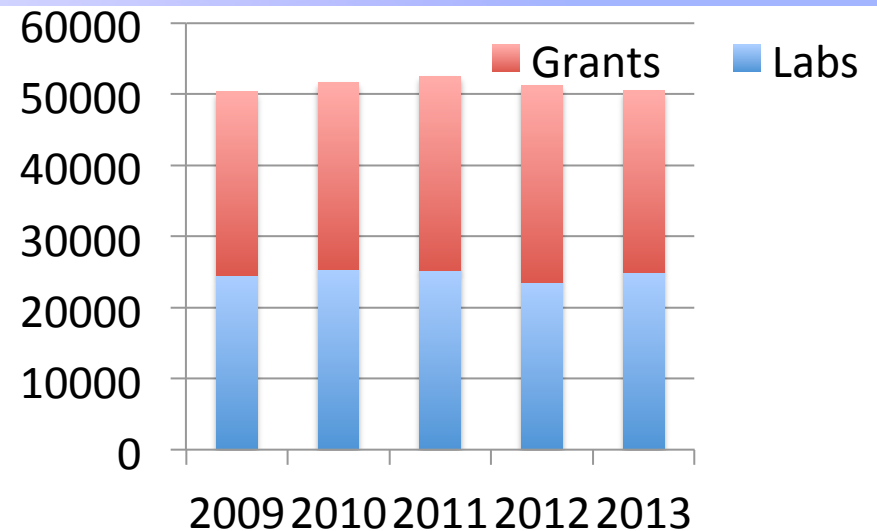
FTE/month Distribution (FY13)

- Labs FTE

- FNAL: 15 @ 12-months equivalent
- SLAC: 9.5 @12-months equivalent
- BNL: 8 @12-months equivalent
- ANL: 5 @12-months equivalent
- LBNL: 3.25 @12-months equivalent
- TOTAL: $40.75 \times 12 = 489$ months-equivalent

- Universities FTE:

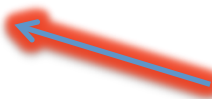
- FY12 Comp Rev : 42 @ 2-months equivalent (84 months)
- FY13 Comp Rev : 102.25 @ 2-months equivalent (204.5)
- FY14 Comp Rev : 70 @ 2-months equivalent (140)
- TOTAL: $216.25 \times 2 = 428.5$ months-equivalent (not including EC recipients)



53k/month per Lab / per FTE

56k/month per Grant/ per FTE (not including EC)

Budget and Comparative Reviews

- Two goals are accomplished with the Comp Reviews:
 - Comparatively evaluate all proposals at the same time
 - Synchronize the starting date of all grants to April 1st
 - Why April 1st? Blame the US (dysfunctional) budget cycle
 - In the first three rounds → bridge funding
 - If the groups going into comp review in FY13 were funded at X level, in FY13 the level will be:
$$X' = X * .98 - (X * .98) * Z$$

 - Cannot be avoided
 - Will be better starting in 2015
 - Bridge Funding: Z up to 25%

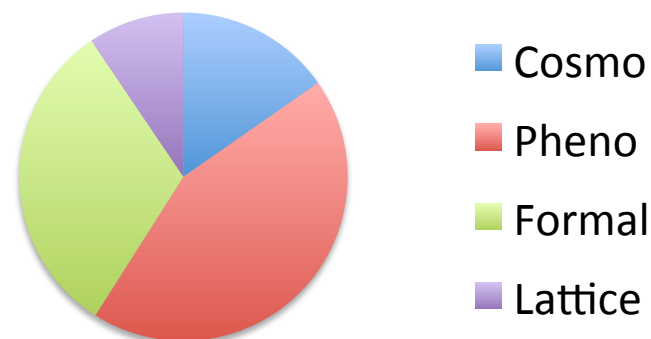
Demographics Universities

Postdocs: 95 FTE (0.43/PI)
Students : 122 FTE (0.55/PI)

Total: 221 PI
Cosmo 34
Pheno 97
Formal 70
Lattice 20

- **Comp Rev 2012: 45 PI**
 - Cosmo 12
 - Pheno 16
 - Formal 16
 - Lattice 1
- **Comp Rev 2013:114 PI**
 - Cosmo: 16
 - Pheno 57
 - Formal: 31 passed
 - Lattice 14 passed
- **Comp Rev 2014: 58 PI**
 - Cosmo 6
 - Pheno 24
 - Lattice 5
 - Formal 23

PIs



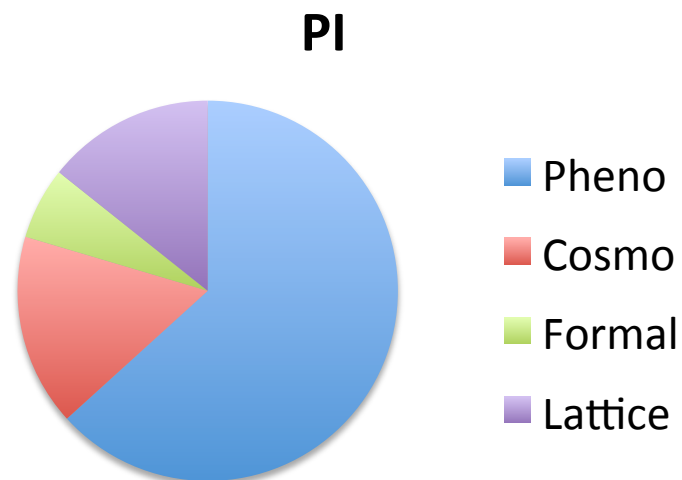
Demographics Labs

- **FNAL**
 - Astro 5 (3 RA)
 - Particle Physics (8 RA)
 - Pheno 12
 - Lattice 3
- **SLAC**
 - KIPAC 3 (1.5 FTE) (1.5 RA, 1.4 GS)
 - Particle Physics (7 RA, 7 GS)
 - Pheno 6
 - Formal 3 (2)
- **BNL (3 RA)**
 - Lattice 3 (+1)
 - Pheno 4
- **LBNL (2 RA)**
 - Pheno 3
- **ANL (4 RA)**
 - Pheno 6
 - Formal 1 (phased out)

Postdocs: 28.5 FTE (.58/PI)

Students: 7.4 FTE (0.15/PI)

Total: 49 PI
Pheno 31
Cosmo 8
Lattice 7
Formal 3

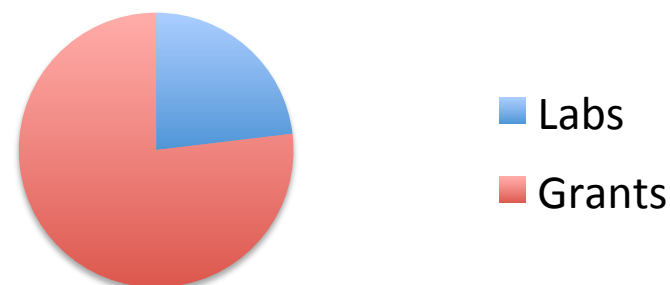


Students and PD at Universities

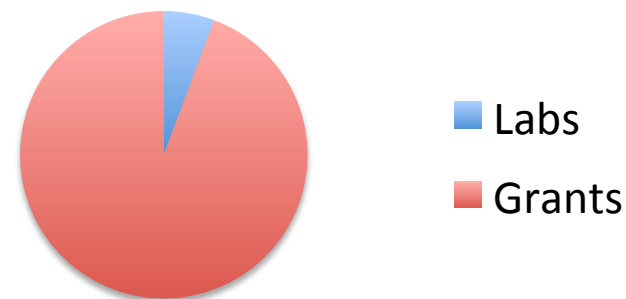
- Comp rev 2012 group
 - Students 30 FTE
 - PD 21.65 FTE
- Comp rev 2013 group
 - Students 52.6 FTE
 - PD 47.46 FTE
- Comp rev 2014 group
 - Students 39 FTE
 - PD 26.07 FTE

Total Students : 122 FTE
Total Postdocs: 95 FTE

Postdocs



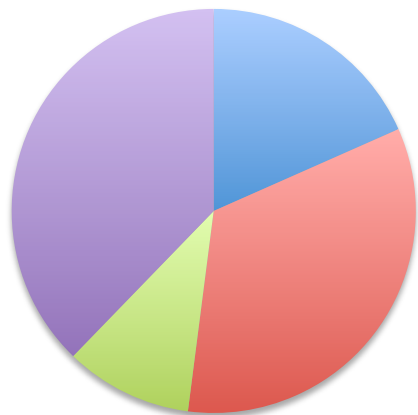
Students



Demographics numbers refer to FY12
1FTE = 12 months

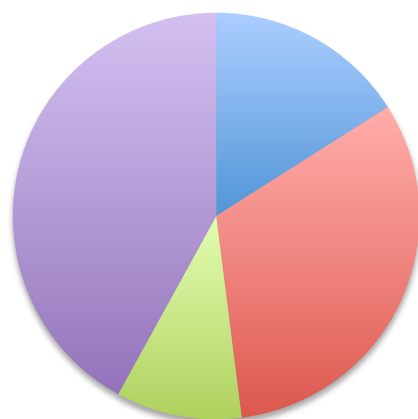
Students and PD at Universities

Students



- Cosmo
- Formal
- Lattice
- Phenomenology

Postdocs

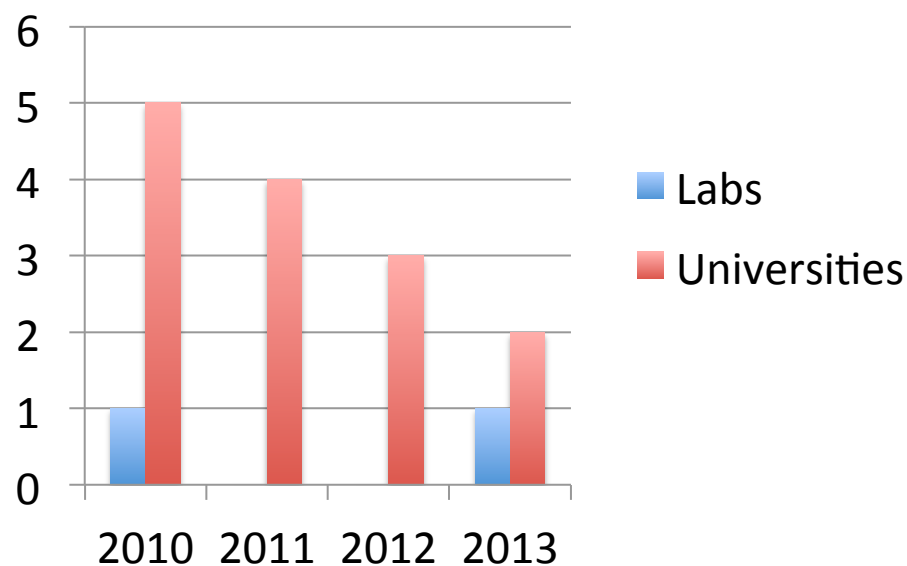
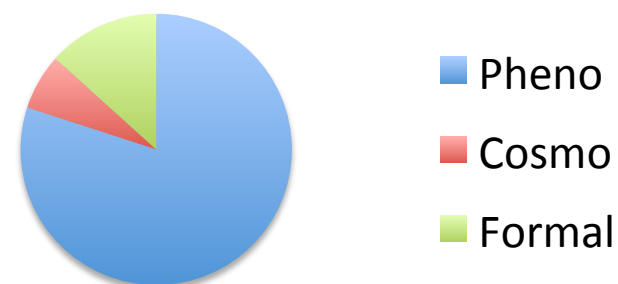


- Cosmo
- Formal
- Lattice
- Phenomenology

Early Career Awards (16)

- 2010: 6 awards (out of 43)
 - 5 Universities (first 4 years from ARRA 5th year to be taken from theory budget)
 - 1 Lab (fully forward funded for 5 years - ARRA) 500k
 - Pheno 6
- 2011 : 4 awards (out of 45)
 - 4 Universities 600k
 - Pheno 2
 - Cosmo 1
 - Formal 1
- 2012 : 3 awards (out of 23)
 - 3 Universities 450k
 - Formal 1
 - Pheno 2
- 2013: 3 awards (out of 20)
 - 1 Lab 500k
 - 2 Universities 300k
 - 2 Pheno, 1 Cosmo

PI



The most successful Frontier in the HEP Office!

The award money is added every year and is shielded (except 2010 5th yr)

Comparative Review and Young Investigators

- In general young investigators (2nd-3rd year of tenure track career path) do well in the comparative review
 - Most of them have been funded
 - When there are other sources of funding (including startup) precedence is given to those who do not have other support
 - Submitting to both Comp Review and EC might weaken proposals
 - Office of Science does not accept the same proposal submitted to 2 different FOAs
 - NSF Career and EC/DOE grants cannot cover the same scope of work
 - But you can submit the same proposal to NSF and DOE → decide later which agency go with

Food for thought

- Role of theory in DOE-supported research
 - HEP mission at the frontiers
 - **Intensity Frontier** leadership → is the theory effort adequate?
 - **Energy Frontier** co-leadership → is the US effort comparable and competitive with the European one?
 - **Cosmic Frontier** co-leadership → DM and DE, relationship with astrophysics, active role of theorists in experimental collaborations
 - Relationship with other sectors/agencies
 - **Nuclear Physics** → neutrino physics at low/medium energy; Heavy Ions Physics (holography applications); IF synergies
 - **BES and Condensed Matter** → the re-branding of String Theory?
 - **Computational aspects of HEP theory** → Cosmology initiatives; Lattice (HEP vs NP); Monte Carlo simulation

Food for thought (II)

- The US budget climate for research is precarious
- The US does not rank as appealing as it used to be only 10-15 years ago
 - How many offers from Zurich??
 - How many Montecarlos from European groups ?
 - 70% of top hep-lat papers have European authors
- As a community we need to concentrate on **strength and competitiveness of our field in an international setting**
 - This might mean consolidating funding at centers of excellence and fund the best groups in the best places
 - Labs and University “faculty” fulfill different roles and places where research is allowed 100% of time should be preserved.
 - We can’t fund everything and everybody
 - We need to consider the job perspective of students and postdocs and train them accordingly
 - How many more Quants ?