Particle Astrophysics Program in the NSF/Physics Division

Dark Matter Meeting

December 5-6, 2016

Berkeley

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Program Directors for PHY/Particle Astrophysics

Reorganization of Experimental Particle Astrophysics (PA)

Particle Astrophysics – Cosmic Phenomena:

This area supports university research that uses astrophysical sources and particle physics techniques to study fundamental physics. This includes the study of ultra-high energy particles reaching Earth from beyond our atmosphere (cosmic-rays, gamma-rays, and neutrinos with the exception of IceCube); searches for supernova neutrinos; and studies of the Cosmic Microwave Background (CMB) and Dark Energy.

Particle Astrophysics – Underground Physics:

This area supports university research that generally locates experiments in low background environments. Currently supported activities include: studies of solar, underground and reactor neutrinos; neutrino mass measurements; and searches for the direct detection of Dark Matter.

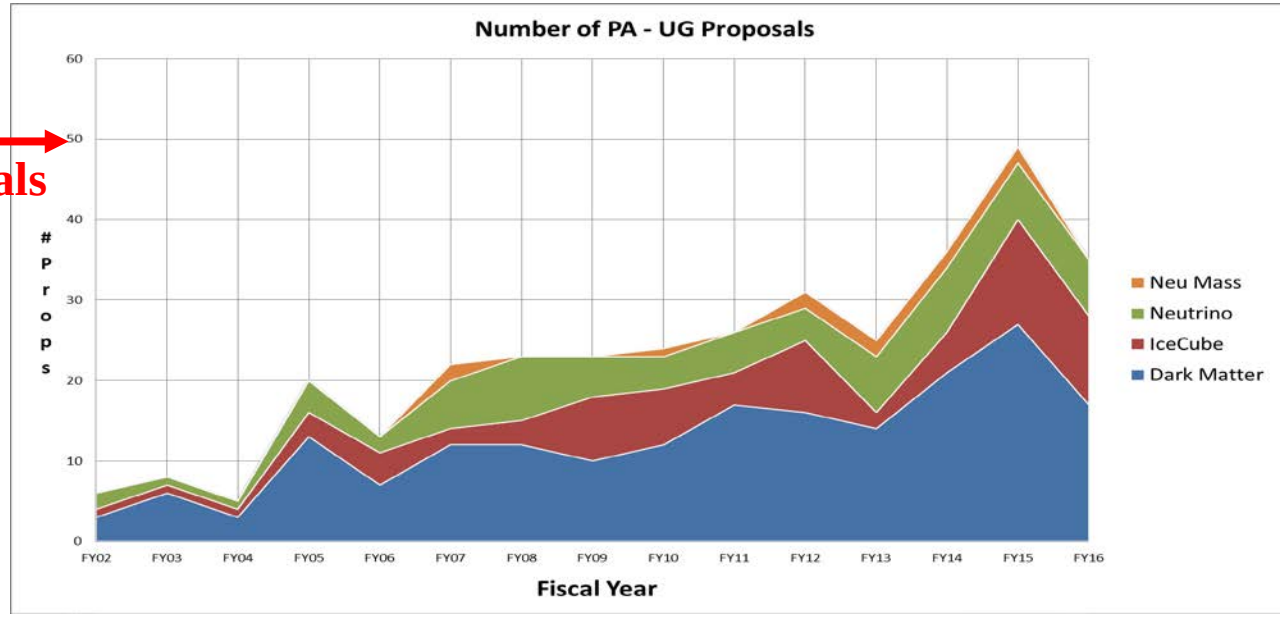
Particle Astrophysics – IceCube Research Support:

This area supports university research that utilizes the facilities of IceCube at the South Pole. Currently supported activities include: searches for ultra-high energy neutrinos and studies of the properties of neutrinos.

Neutrinoless Double Beta Decay: This has been moved to Nuclear Physics.

Proposals to PA-UG (including IceCube)

50 proposals



Panel:
FACA so we get consensus advice from "community"

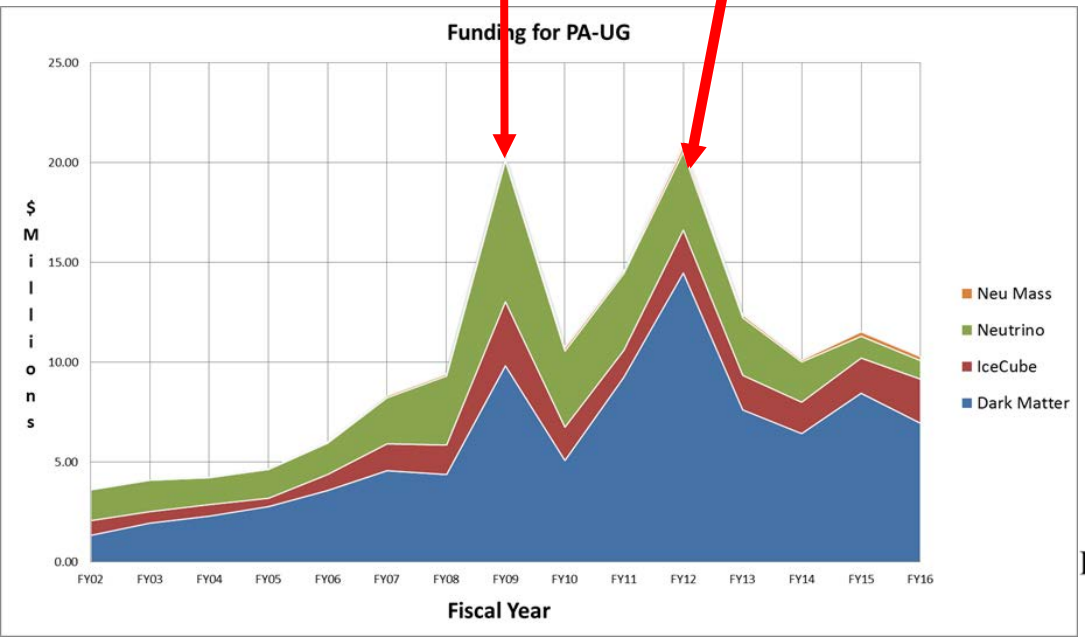
Fiscal Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
# Proposals to UG	22	23	23	24	26	31	25	36	49	35
Acceptance Rate UG	77%	57%	74%	58%	50%	48%	32%	36%	37%	26%
New/Total Awards	9/17	5/13	6/17	8/14	3/13	3/15	1/8	0/13	7/18	2/9

Close to the overall NSF rate (23%)

Funding for PA-UG and IceCube

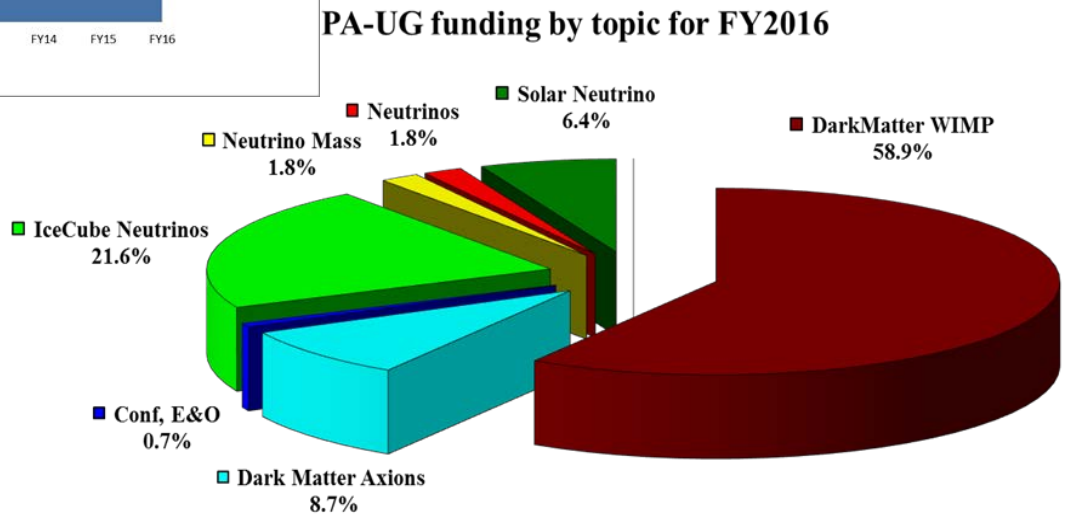
ARRA

DCL: NSF 12-043

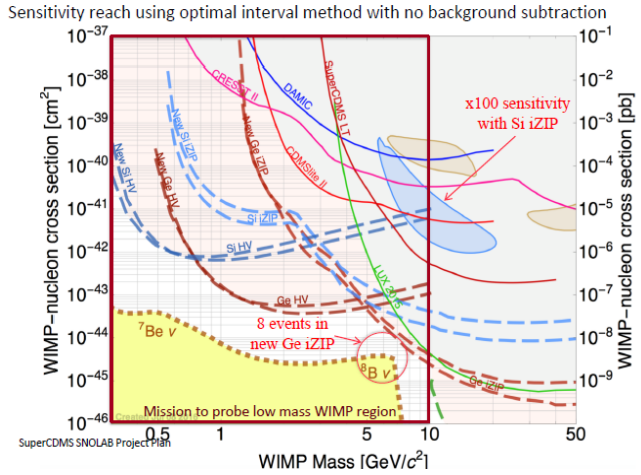


This funding for IceCube is matched by PLR

All 4 categories compete from the same "pot" of funds.



Dark Matter



"Projections from ton-scale noble liquid detectors should discover or rule out WIMPs from the remaining parameter space of these surviving models." H. Baer et al., arXiv:1609.06735v2, (Sept 2016)

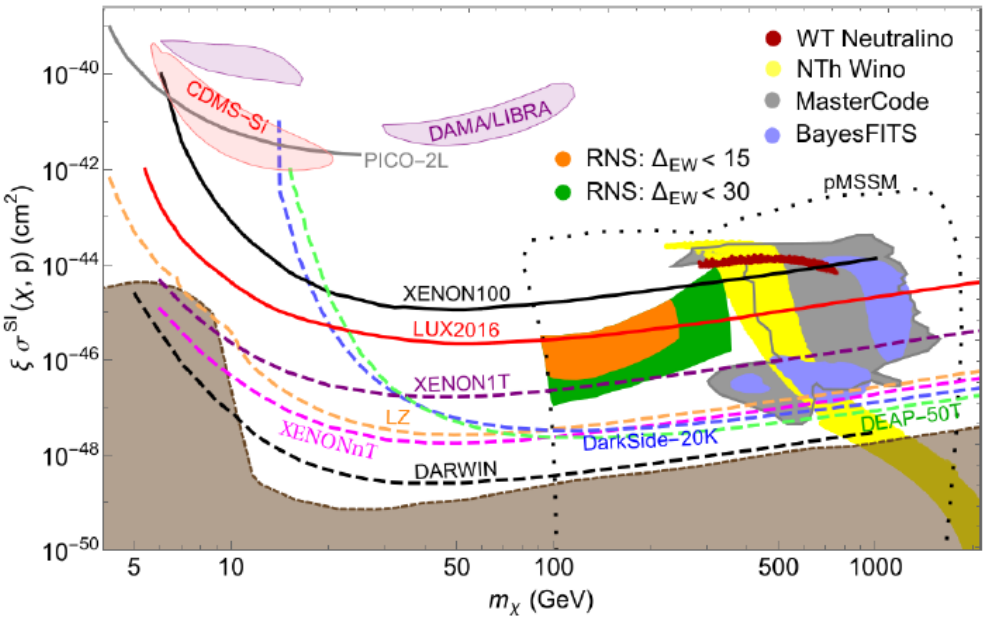


Figure 1: Plot of rescaled spin-independent WIMP detection rate $\xi\sigma^{SI}(\chi,p)$ versus m_χ from several published results versus current and future reach (dashed) of direct WIMP detection experiments. $\xi = 1$ for all models except RNS and pMSSM.

"Map" for the heavy WIMPs (> 0.5 GeV) has many possibilities
What about lower mass DM candidates?

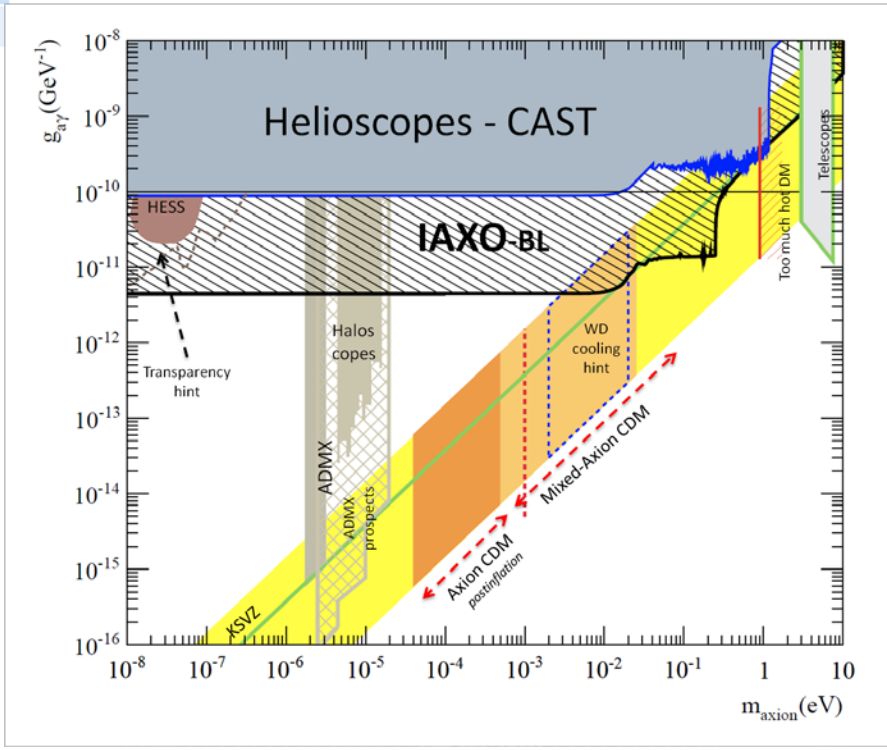
Axions & ALPS

ALP parameter	LSW (laboratory)	Helioscopes	Dark matter searches
Parity and spin	yes	perhaps	yes
Coupling $g_{a\gamma}$	yes	no	no
Coupling · flux	(does not apply)	yes	yes
Mass	perhaps	perhaps	yes
Rely on astrophysical assumptions	no	yes	yes
QCD axion	no	yes	yes

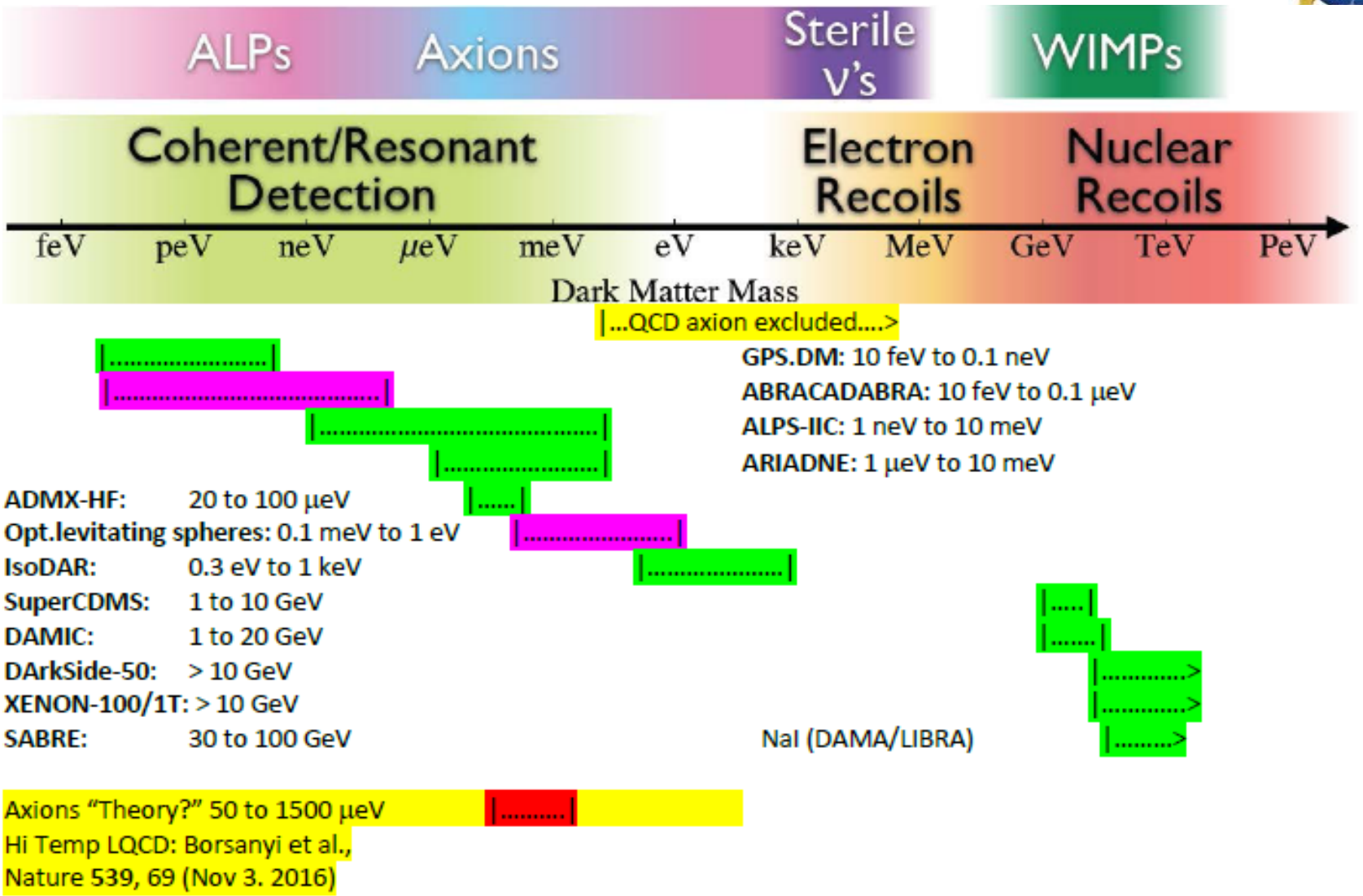
LSW in the laboratory is very well suited to look for axion-like particles.

From A. Lindner
"Beyond Colliders"
CERN Sept 2016

From I. G. Irastorza
"Beyond Colliders"
CERN Sept 2016



Dark Matter Candidates



NSF FY2017 Budget Request

NSF's FY 2017 Budget Request is $7.964 billion, an increase of $500.53 million (6.7 percent) over the FY 2016 Estimate.

FY 2017 BUDGET REQUEST

NSF Budget by Appropriation (dollars in millions)					
	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate	
				Amount	Percent
Research and Related Activities	$6,041.57	$6,033.65	$6,425.44	$391.79	6.5%
Education and Human Resources	$886.33	$880.00	$952.86	$72.86	8.3%
Major Research Equipment and Facilities Construction	$144.76	$200.31	$193.12	-$7.19	-3.6%
Agency Operations and Award Management	$306.56	$330.00	$373.02	$43.02	13.0%
National Science Board	$4.15	$4.37	$4.38	$0.01	0.2%
Office of Inspector General	$14.60	$15.16	$15.20	$0.04	0.3%
TOTAL	**$7,397.97**	**$7,463.49**	**$7,964.02**	**$500.53**	**6.7%**

Totals may not add due to rounding.
The FY 2017 Request for NSF is $7,964.02 million, of which $7,564.02 million is discretionary funding and $400.0 million is new mandatory funding. New mandatory funding is $346.01 million in Research and Related Activities and $53.99 million in Education and Human Resources.

Removing the $346.01 M in R&RA: requested R&RA is $6,079M

As of Sept 14, 2016:

Senate appropriators are proposing to hold funding for NSF research steady in fiscal year 2017 ($7,510M/$6,034M), while House appropriators would increase it by 0.8% ($7,406/$6,079M).

PHY and MPS Budget

MPS Funding

(Dollars in Millions)

	FY 2015 Actual	FY 2016 Estimate	FY 2017 Request	Change Over FY 2016 Estimate Amount	Change Over FY 2016 Estimate Percent
Astronomical Sciences (AST)	$245.23	$246.73	$262.61	$15.88	6.4%
Chemistry (CHE)	246.29	246.31	262.16	15.85	6.4%
Materials Research (DMR)	337.62	310.03	329.71	19.68	6.3%
Mathematical Sciences (DMS)	235.43	234.05	249.17	15.12	6.5%
Physics (PHY)	276.10	277.03	295.26	18.23	6.6%
Office of Multidisciplinary Activities (OMA)	35.65	35.00	37.54	2.54	7.3%
Total, MPS	**$1,376.32**	**$1,349.15**	**$1,436.45**	**$87.30**	**6.5%**

Totals may not add due to rounding.

Congress passed a continuing resolution (CR) that funds the federal government through Dec. 9

NSF – Big Ideas for Future Investments

- NSF director France Cordova has unveiled a list of ten big ideas where increased NSF funds provided by Congress could make a big difference. This is part of NSF's argument for increased funding as NSF is drafting its 2018 FY budget request.
- **Research:**
- **Harnessing data for 21st century science and engineering**
- **Work at the Human -Technology Frontier: Shaping the Future**
- **Understanding the Rules of Life: Predicting Phenotype**
- **The Quantum Leap: Leading the next Quantum Revolution**
- **Navigating the new Arctic**
- **Windows on the Universe: The Era of Multi-messenger Astrophysics**
- **Process**
- **Growing Convergent Research at NSF**
- **NSF-Includes: Enhancing Science and Engineering through Diversity**
- **Support for mid-scale Research Infrastructure (costing tens of millions of dollars)**
- **NSF 2050 (i.e., a common fund to seed large, ambitious projects)**

https://www.nsf.gov/about/congress/reports/nsf_big_ideas.pdf