UK Particle Theory: Programme Overview

Simon Hands (chair STFC PPGP[T])

PPT Town Meeting
IPPP, 17th December 2014

(based on talk to R-ECFA 7/11/14)

Most PPT activity in UK supported via funding from Science & Technology Facilities Council

Unique opportunity to bid every 3 years for *Consolidated Grant* support for theory groups in institutions - CG13 gives a "snapshot"

CG support covers a fraction of salary costs (FEC), PDRAs, travel, consumables and technical support - in last 2 rounds also covered HPC recurrent costs

PGR studentships and Fellowships awarded in a separate exercise

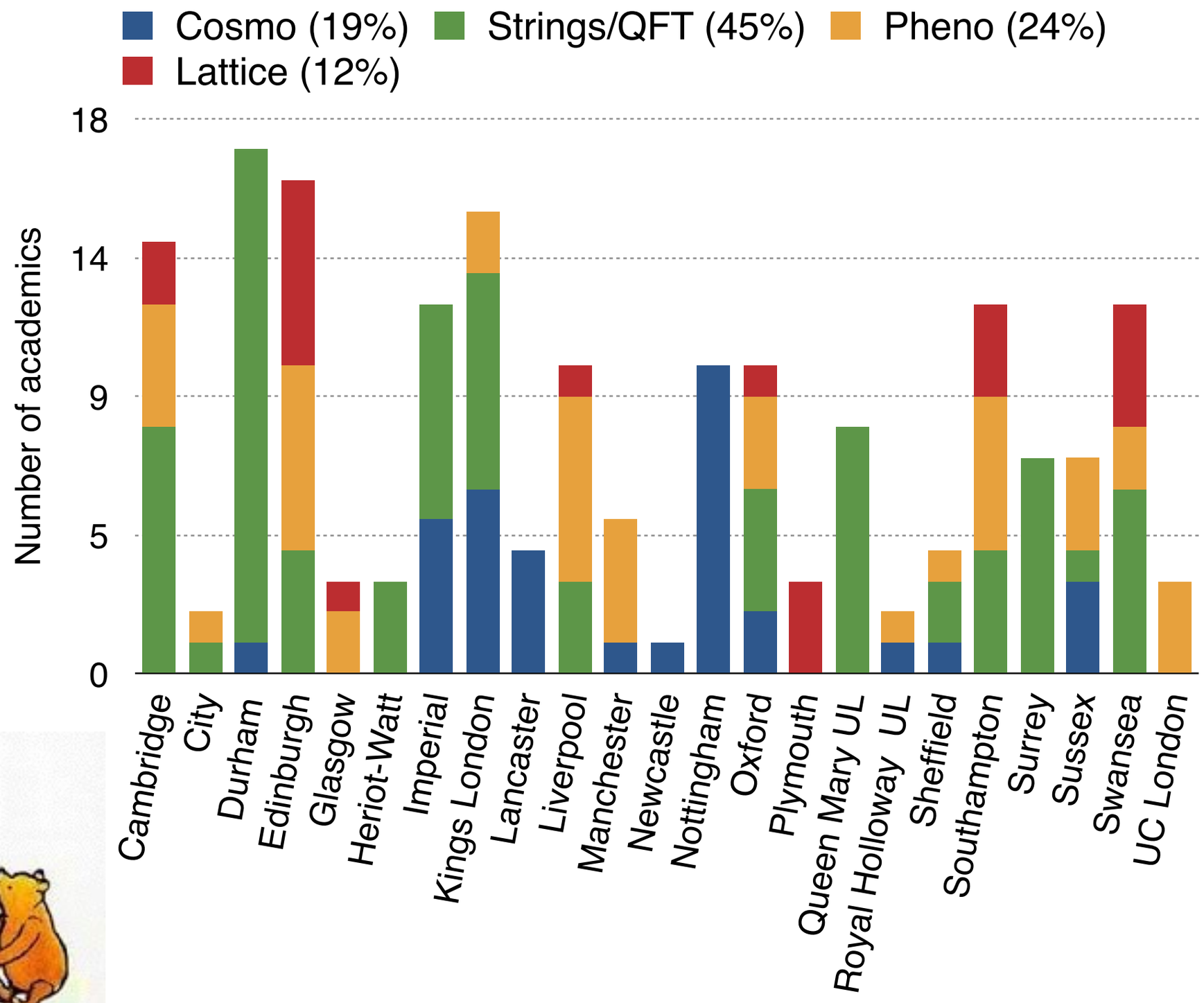
STFC's view of PPT mission…

Science & Technology Facilities Council

STFC supports theoretical research in particle physics, particle cosmology, theoretical astronomy and cosmology, and areas related or relevant to these. Its theoretical activity includes:

- **theoretical insight into physical phenomena;**
- **development and study of theoretical frameworks;**
- **development of models and theories with the aim of further enhancing or unifying our understanding of the physical world;**
- **development of models and theories with the aim of further enhancing or unifying our understanding of the origin and development of the Universe;**
- **analysis and interpretation of data from experiments and observations; guidance for further experiments and observations;**
- **development of calculational and computational techniques enabling more precise comparison of theory with experiment.**

What size/shape is the UK PPT Community?



~180 academics bid for support in CG13

Recent Physics Highlights

Phenomenology

UK plays leading role in LHC analysis

- leads 2/3 general purpose event generators
- leads 2/3 PDF models
- expertise in collider, neutrino, flavor physics
- construction of BSM models

String and Formal Field Theory

UK has led since first days of field

- M-theory, generalised geometry, integrability
- SUSY gauge theories, gauge-gravity duality
- applications to thermal/many-body systems
- advanced techniques for scattering amplitudes
- string-inspired phenomenology/cosmology

Lattice QCD

World-class support via *DiRAC* HPC facility

- flavor physics (q/Q) to constrain CKM
- kaon physics and $\Delta I=\frac{1}{2}$
- (g-2) for muon
- hadron excitations/transport for $T>T_c$
- near-conformal dynamics for EWSB
- new methods for $n_{baryon}>0$ and nuclear matter

Particle Astrophysics/Cosmology

Onset of Planck era (also *DiRAC*)

- direct and indirect Dark Matter searches
- connecting inflation with particle physics
- phase transitions, baryogenesis
- theories of dark energy, modified gravity
- extra dimensions, brane inflation, cosmic strings

Conduct of CG13

Peer review by a **standing panel** with range of subject expertise and geographical spread

PPGP membership

Simon Hands (Swansea, chair) lattice
Silvia Pascoli (IPPP Durham, core) pheno
Luigi Del Debbio (Edinburgh) lattice
Mark Hindmarsh (Sussex) cosmo
Neil Lambert (KCL) strings
Apostolos Pilaftsis (Manchester) pheno/cosmo
Radu Tatar (Liverpool) strings
Robert Thorne (UCL) pheno
Joel Goldstein (Bristol, exp chair)
Matthew Wing (UCL, exp core)

105 referees (UK + international) used - average of 6 per bid.

Referees comment on particular scientific areas, not whole bid.

Comments sent to PIs, responses considered by PPGP

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Matt Wingate (Cambridge) lattice
Anne Green (Nottingham) cosmo
Nick Evans (Southampton) strings
Apostolos Pilaftsis (Manchester) pheno/cosmo
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Frank Krauss (IPPP Durham) pheno
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Consolidated Grants 2013

17 applications from 23 institutions

(5 from consortia)

supporting 185 academics covering 48 "scientific areas"

1 new group (Surrey) bid in 2013

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Indicative Budget (GBP)

	14/15	15/16	16/17	17/18
PPGP(T) post PR/SR	5030	5030	5030	5030
Committed	2426	20	-	-
Conferences/New Applicants	23	25	25	25
Isaac Newton Institute	100	100	100	100
Available	2481	4885	4905	4905
Requested	8036	16242	15817	8097
Δ	-5555	-11357	-10912	-3192

Assessment Criteria

Category 1	Category 2
Scientific Excellence	Productivity
International Competitiveness	Quality of Leadership
Strategic Value	Suitability of Institution

Other aspects were assessed independently by specialists within STFC:

Knowledge Exchange

Public Engagement: evidence of excellent activity.

3 outstanding PE requests awards totalling £21k

DiRAC

(Distributed Research utilising Advanced Computing)

STFC's HPC facility supports theoretical research in particle physics, astronomy and nuclear physics since 2009. The main **PPT** usage is at

Cambridge Data Analytic Cluster

200Tflop/s, 9600x4GByte RAM, 0.75PByte storage

Cambridge COSMOS Shared Memory Service

42Tflop/s 1856x8GByte RAM (globally shared), 146TByte storage

Edinburgh BlueGene/Q

1.3Pflop/s

www.dirac.ac.uk

DiRAC HPC recurrent costs

BIS/STFC capital investment in HPC not
initially matched by sustainable recurrent funding
(electricity, system support…)

DiRAC recurrent costs tensioned
against rest of PPT programme in CG11 and CG13

CG13: total bid £1.86M for 2014-17 (~11% of programme)
revised downwards to £1.19M in consultation with
DiRAC PMB, Project and Technical Directors

PPGP recommended award £893k over 3 years
(~5.3% of PPGP(T) programme)

DiRAC HPC recurrent costs

Following the publication of the 2012/13 Programmatic Review report, a separate funding line has been set up for DiRAC from FY 2014/15 onwards.

This means that operating costs for DiRAC will no longer be considered as requests to grants panels or directly tensioned against grant panel proposals.

Funds will be transferred from the new DiRAC funding line to the PPGP(T) line to take account of any PPGP(T) grants already awarded with DiRAC operating costs for 2014/15 onwards. Any PPGP(T) grant awarded after the publication of the PR report did not include DiRAC costs.

Future proposals to PPGP(T) should **not** include requests for DiRAC operating costs.
Any researcher needing time on DiRAC should apply via the DiRAC Resource Allocation Committee.

The Outcome

Initial scan of bids yielded *optimal funding scenario*

	PDRAs	students	core FTE	academic FTE
Fundable	51.7	3	1.4	88.6
Funded	28	1	1→0 (DiRAC)	23.7

Projects recommended funding in three bands:

	# projects	PDRAs	academic FTE	max FEC
leading	20	23	11.7	20%
important	15	5	9.3	15%
competitive	12	-	2.7	10%
not funded	1	-	-	-

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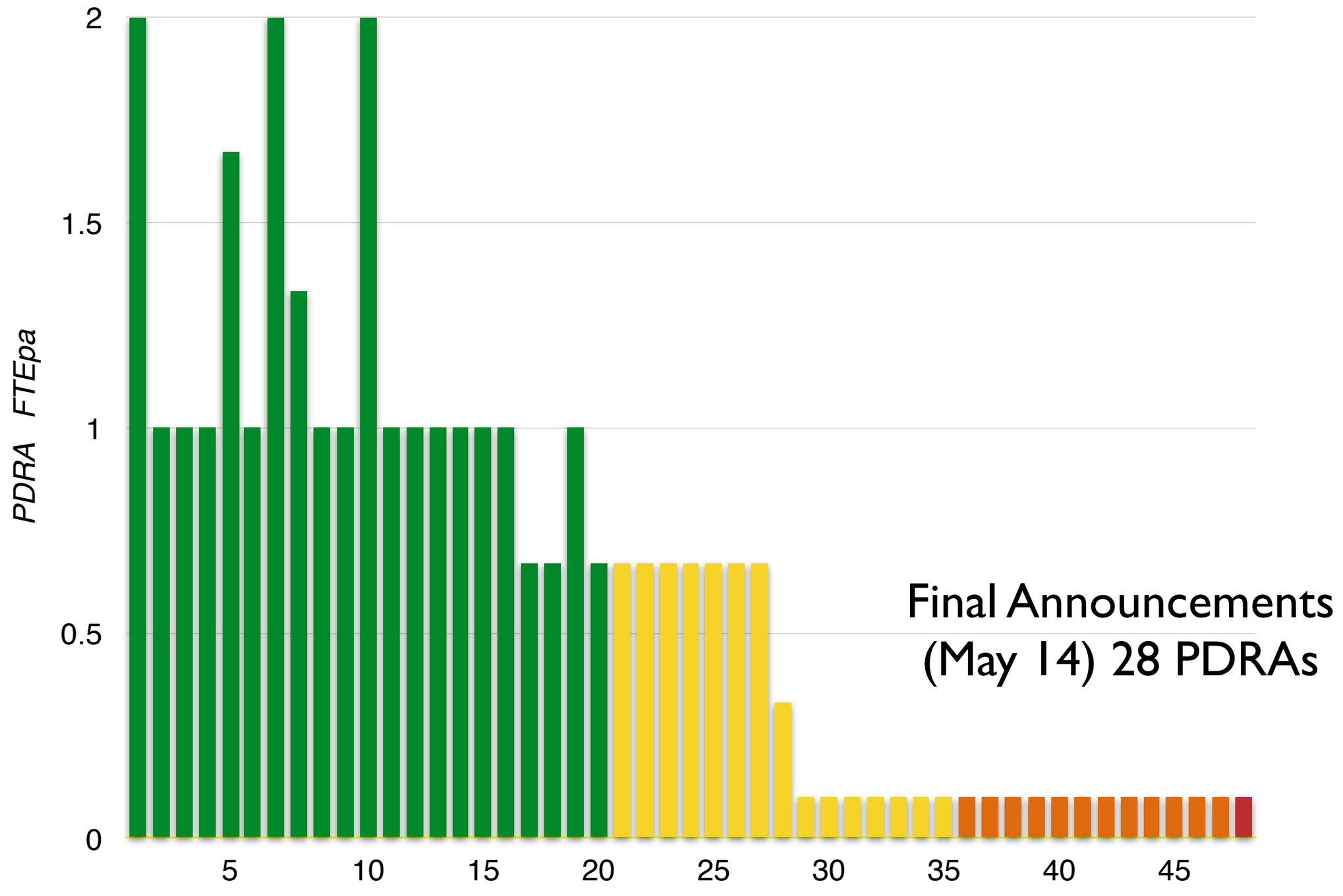
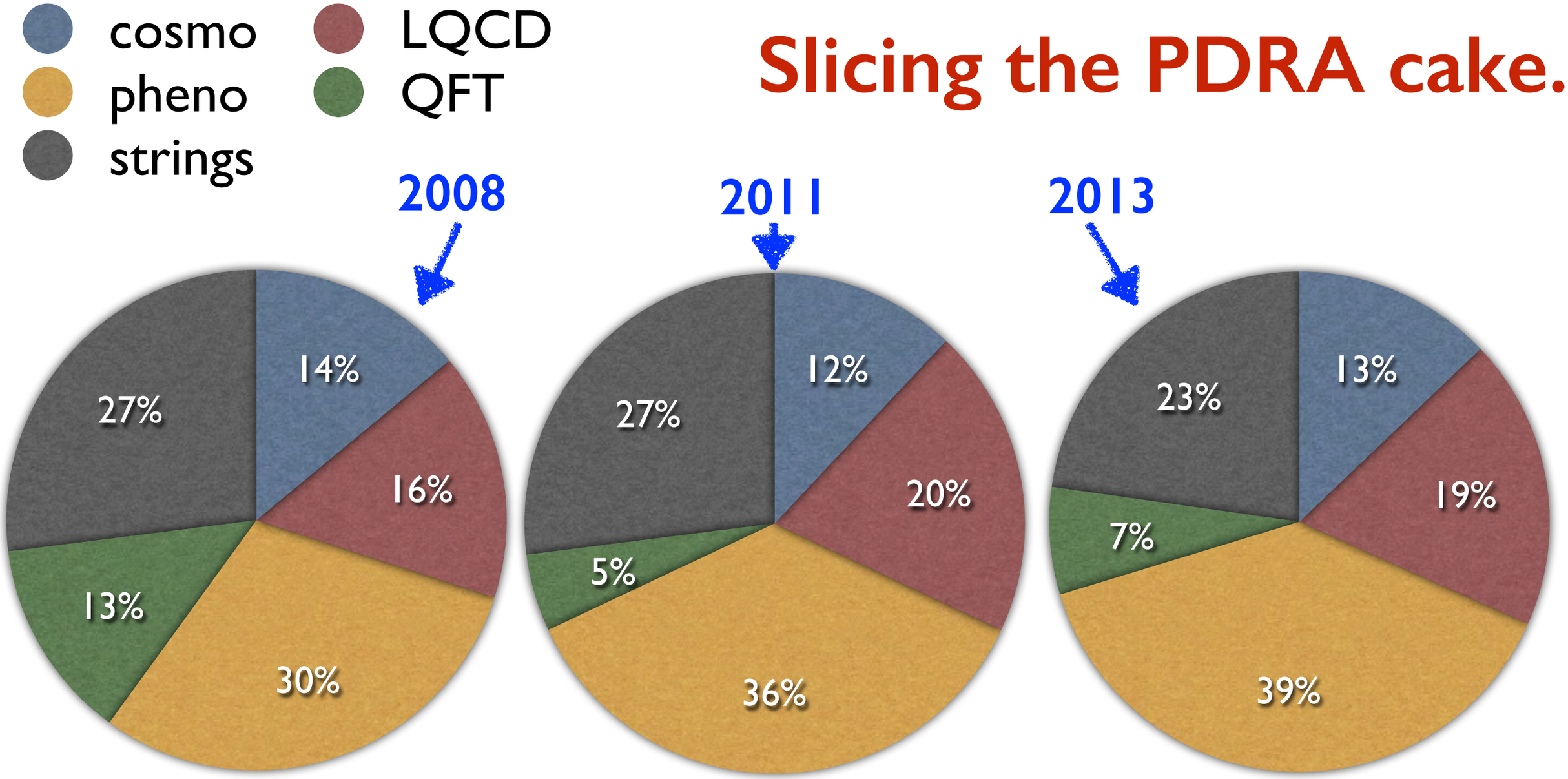
In the same CG13 snapshot PPT activity also supported by 7 **ERC** Grants (3 Advanced, 4 Starter) spread across 4 institutions

PDRA distribution by band…



Slicing the PDRA cake...



- steady growth of pheno - onset of LHC
- lattice stable - onset of DiRAC
- cosmo stable - onset of Planck
- decline in strings/QFT over time…

How do we compare with the rest of the STFC family?

Grants Round	# Acs FEC > 0	average FEC	Max FEC	unfunded Ac/ total Ac	# PDRAs	# PDRA/ # Ac
NPGP 2011	44	15%	20%	15%	19	0.42
PPGP(T) 2011	146	14%	20%	10%	29	0.20
PPGP(T) 2013	162	16%	20%	12%	28	0.17
PPGP(E) 2012	167	17%	23%	8%	116	0.69
AGP 2011-2013	404	17%	30%	37%	216	0.53

Trends over time

	2005	2008	2011	2013
# bidding academics	122	155	163	185
Budget (inc FEC)	-	£16.4M	£14.5M	£14.5M
maximum FEC	-	28.5%	20%	20%
average FEC	-	20%	14%	16%
PDRAs	34 (+7 SPG)	34.3 (+1SPG)	29.3	28

Institute for Particle Physics Phenomenology

Joint support from STFC and Durham University

16 academics, 20 PDRAs

coordinates pheno activity (theo/exp) in the UK via

- Senior Fellowships
- Associateships
- Workshops

www.ippp.dur.ac.uk

Isaac Newton Institute for Mathematical Sciences

Joint support from RCUK and Cambridge University

Visitor research programmes on selected themes in mathematics and mathematical sciences

£100k pa from STFC PPT funding line

www.newton.ac.uk

- New Applicants

£10k pa set aside for new appointments

typically funds travel and consumables

2014 CG Review recommends continuation

- Conferences/Short Courses

£15k pa (small increase)

enquiries to Jane Long Jane.Long@stfc.ac.uk

Title	Date	Venue	PPGP(E) /NPGP	PPGP(T)	Total
UK Particle Cosmology Series of Workshops 2012/13	2012/13	Nottingham		£8,000	£8,000
Workshop on Non-Equilibrium Field Theory in Cosmology	20-21 Sep 2012	Imperial		£1,000	£1,000
Kibble Conf (Symmetry & Fundamental Physics	13 Mar 2013	Imperial		£10,000	£10,000
Strong Fields, Strings & Holography	16-23 Jul 2013	Swansea		£6,000	£6,000
Quantum Fields, Gravity and Information	Apr 2013	Nottingham		£907	£907
IOP Conference 2013	8-10 Apr 2013	Liverpool	£3,000	£1,000	£4,000
The Violent Universe	31 Oct & 1 Nov 13	London	£1,000	£1,000	£2,000
Strangeness in Quark Matter 2013	22-27 July 13	Birmingham	£3000	£500	£3,500
New Frontiers for Dynamical Gravity	24-28 March 2014	Cambridge		£6,000	£6,000
BEACH 2014	21-26 Jul 2014	Birmingham	£3,000	£1,000	£4,000
The Pre-SUSY School	15-18 Jul 2014	Manchester		£3,000	£3,000
IOP 2014 HEPP and APP joint Meeting	7-9 Apr 2014	RHUL	£3,000	£1,000	£4,000
Supersymmetry Breaking in String Theory	10-14 Mar 2014	KCL		£4,000	£4,000
Permutations & Gauge-String Duality	21-25 Jul 2014	QMUL		£2,000	£2,000
IPA 2014: Interplay between Particle Physics & Astroparticle Physics	18-22 Aug 14	QMUL	£750	£250	£1,000
UK Particle Cosmology Workshop @ NAM	Tuesday, 24 June 14	Nottingham		£2,000	£2,000
Beauty 2014	14-18 Jul 2014	Edinburgh	£2,000	£500	£2,500
ESF HoloGrav	3 years 2014/15			£4,000	£4,000
NuPhys 2014 - IPPP workshop Meeting: Future Neutrino Experiments	15-17 Dec 14	QMUL	£1,500	£1,000	£2,500

Conferences supported 2013/14

Summary

UK PPT continuing to deliver world class science in an unfriendly funding environment

Consolidated Grant mechanism:

- focuses on projects rather than groups
- favours clear timelines/deliverables
- able to exploit developments (LHC, DiRAC, Planck…)

Concern about decline in support for formal theory?

Commitment to preserve funding, in difficult times, of leading science at expense of important and competitive

we need to argue more forcefully than ever about opportunity cost of funding decline

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Merry Christmas!