

PPAP Community Meeting 2015

24-25 September 2015 Imperial College Europe/London timezone

Introduction and Welcome

Paul Newman (Birmingham)

- PPAP Terms of Reference, Membership & Activities
- 2015 PPAP Roadmap
- Plans for this meeting

Panel Terms of Reference

"The purpose of the Panel is to provide a link between Science Board and the community and to represent the needs of the Community to STFC.

The Advisory Panel is tasked to

- Maintain an overview of activities within particle physics
- Develop and maintain a science vision and long term strategy / roadmap by assessing the merit of current and future science opportunities
- Develop and maintain a technology roadmap
- Consult and interact with the community to ensure its views are canvassed and there is an appropriate and effective route for communication with STFC on strategic programmatic issues
- Provide advice to Science Board on specific questions as requested
- Liaise with other Advisory Panels when appropriate

The remit of the panel includes Technology Development, Theory, High performance Computing and Data Curation issues."

We welcome contact on matters of interest / concern and news of new initiatives at any time (to the panel as a whole or any of us as individuals).

Panel Membership

• Mark Thomson stood down Autumn 2014

• Yorck Ramachers and Morgan Wascko joined, adding expertise in neutrino physics

Current Panel Composition

Rob Appleby (Manchester) Christine Davies (Glasgow) Victoria Martin (Edinburgh) Paul Newman (Birmingham, chair) Jonas Rademacker (Bristol) Yorck Ramachers (Warwick) Claire Shepherd-Themistocleous (RAL, deputy-chair) Bill Spence (QMUL) Morgan Wascko (Imperial) Matthew Wing (UCL) + Sarah Verth (STFC)

Further membership rotation expected this autumn.

PPAP Activities

Panel meets usually ~ every 2 months

- Phone meetings (1-2 hours) to exchange and review news
- Annual face-to-face panel meeting (23/10/14, Birmingham)
- Annual community meeting

Ad hoc Activities

- Pl's for a when there is a need
- Input to / presentation at ECFA Country visit (7/11/14)
- Input to STFC Computing Consultation, Nurse review, House of Commons Science & Technology Inquiry on Science Budget

PPAP Roadmap

- Last 2 day community meeting was 21-22/7/14, RAL)
- Updated roadmap for UK Particle Physics (28/4/15)

2015 Roadmap Update Document

Pitched as an update to 2012 document rather than a rewrite:
1) Compilation of info on particle physics projects with UK involvement, summarising science goals, size of UK involvement, leadership roles, main responsibilities and opportunities, indicative timescales and funding sources (STFC & otherwise).
2) Series of PPAP recommendations, reiterating, expanding upon or replacing those in 2012 version
3) Clear statements of size of UK theory activities pointing out

3) Clear statements of size of UK theory activities, pointing out connections with experiments where they are strongest.

- Community consultation:
 - July 14 community meeting
 - Panel discussion
 - Sub-panel community consultations
 - Circulation for comments to group / project leaders
 - Circulation for comments to entire community ... 5

Roadmap Update

Update to the UK Particle Physics Roadmap

The Particle Physics Advisory Panel to STFC

> R.B. Appleby (University of Manchester), C.T.H. Davies (University of Glasgow), V.J. Martin (University of Edinburgh), P.R. Newman* (University of Birmingham), J.H. Rademacker (University of Bristol), Y.A. Ramachers (University of Warwick), C. H. Shepherd-Themistocleous (RAL), W.J. Spence (QMUL), M. O. Wascko (Imperial College) M. Wing (UCL)

> > 28 April 2015

* Contact p.r.newman@bham.ac.u

"[Internationally, since the last roadmap in 2012], the updated CERN Council Strategy Document for European Particle Physics and the HEP Prioritisation Panel P5 document in the US both placed their highest priority on the full exploitation of the LHC."

"A healthy particle physics programme should include both a sizeable commitment to the largest scale worldwide 'flagship' projects such as the LHC and a portfolio of 'high risk, high reward' projects ... where a paradigm changing result is possible"

No detailed recommendations on relative funding strategies

2.1 ATLAS and CMS ('LHC GPDs') and their upgrades

The 2012 roadmap document followed quickly after the discovery of the Higgs boson. Since then, the LHC General Purpose Detectors (GPDs) have begun work on determining the properties of the Higgs. It is almost certainly spin-parity 0⁺ and its couplings to ZZ, $\gamma\gamma$ and WW are in line with Standard Model expectations to current precision. There is also now strong direct evidence, through the $\tau\tau$ channel, for Higgs boson decays to fermions. GPD searches for physics beyond the Standard Model have excluded a wide range of possibilities up to new physics scales of typically 1-2 TeV. The restart of data taking with a higher centreof-mass energy of 13 TeV (compared with 8 TeV previously) is eagerly awaited in 2015. This increase in energy will substantially enhance the sensitivity of the GPDs to new phenomena beyond the Standard Model.

The first LHC run obtained approximately 1% of the total target integrated luminosity at around half the design energy. The current detectors are performing well at luminosities and multiple-event pile-ups beyond their original specification, but have a limited lifetime and will certainly not cope with the ultra-demanding environment of the high luminosity LHC (HL-LHC, expected from mid-2020s). The detector upgrades in the present long shutdown (LS1) were relatively modest. UK work is well underway towards the more extensive upgrades during LS2 (~2018-19) and the very major upgrade programme planned for LS3 (~2024 - for HL-LHC). The instrumentation requirements to meet the severe technological challenges of the HL-LHC (radiation dose, data rates and pile-up) motivate significant international R&D activities.

By the start of the HL-LHC data taking period a number of scenarios are possible: direct evidence for new physics may have been discovered in the form of new particles or missing energy signatures; deviations from Standard Model expectations may have been observed - for example in Higgs branching ratios; or no deviations from Standard Model expectations may yet have been made manifest. In all of these scenarios the HL-LHC will provide critical information, enabling the disentangling of possible origins of observed new physics or providing a major increase in sensitivity in the search for its evidence. The UK involvement in ATLAS and CMS is funded mainly by STFC through Consolidated Grants and Experiment Grants.

Scientific Goals:

Broad exploration of the multi-TeV energy frontier using pp collisions, including characterisation of the Higgs boson and searches for new physics in uniquely accessed new kinematic domains. Also precision studies and tests of the Standard Model, often in areas, such as top quark production and multiple weak boson production, where there has been little or no previous exploration.

UK Leadership (ATLAS):

The current spokesperson (ex deputy-spokesperson and physics coordinator) and recently retired physics and upgrade coordinators are from UK institutes, as well as the incoming physics coordinator. In addition the UK provides multiple leaders of physics analysis working groups and sub-groups, and of many operational aspects of the experiment, including the coordinators of both the current and upgrade Inner Detector projects and of Data Preparation.

UK Responsibilities (ATLAS):

ATLAS is the largest UK particle physics activity by some distance, with 300 authors (about 10% of the collaboration). The UK performs a wide range of pivotal roles and delivered substantial components of the tracking, triggers, DAQ, computing resources and software for Run 1. The main UK involvements in the upgrade programmes are a substantial part of the ITk (new all-silicon inner tracker for installation at LS3), the LS2 and LS3 phases of the first

e.g: ATLAS / CMS entry

level calorimeter trigger (L1Calo), a new first level track trigger (L1Track) for LS3, plus computing, software and Higher Level Trigger upgrades.

UK Institutes (ATLAS):

Birmingham, Cambridge, Edinburgh, Glasgow, Lancaster, Liverpool, QMUL, RHUL, UCL, Manchester, Oxford, RAL, Sheffield, Sussex, Warwick.

UK Leadership (CMS):

The UK has provided the spokesperson, deputy spokeperson, deputy tracker project manager, upgrade coordinator, ECAL endcaps project manager and will be providing the next project leader for the ECAL (starting 2015). In addition the UK has and is providing various leaders of physics coordination and analysis groups.

UK Responsibilities (CMS):

The UK provides about 4% of CMS authors. The UK led the design and delivery of the ECAL end-caps, the front-end readout of the Silicon Tracker (including the readout ASIC used for both the tracker and the ECAL) and the calorimeter trigger. The UK provides significant computing resource to the experiment. It also has a major and leading role in the calorimeter trigger upgrade for installation at LS2 and is performing R&D towards LS3 upgrades in the trigger and tracker.

UK Institutes (CMS):

Bristol, Brunel, Imperial College, RAL.

Milestones:

2015: LHC restart at 13 TeV. 2016-2017: ATLAS and CMS TDRs for HL-LHC Upgrades. 2018-2019: LHC LS2. 2023-2025: LHC LS3, leading to HL-LHC.

The LHC is the world's flagship energy frontier facility. With only around 1% of the planned total data sample collected to date, it has already yielded a major, Nobel prize-recognised, discovery. With the expected future programme of energy and luminosity upgrades, further significant discoveries are likely.

Recommendation 3: The UK must fully exploit its investment in ATLAS and CMS by maintaining a leading role in the science exploitation of the current detectors at the 13/14 TeV design energy.

Recommendation 4: The UK must invest in the ATLAS and CMS upgrades so as to maximise the science output over the entire LHC lifetime, including the high luminosity phase.

2.1 ATLAS and CMS ('LHC GPDs') and their upgrades

The 2012 roadmap document followed quickly after the discovery of the Higgs boson. Since then, the LHC General Purpose Detectors (GPDs) have begun work on determining the properties of the Higgs. It is almost certainly spin-parity 0⁺ and its couplings to ZZ, yy and

The LHC is the world's flagship energy frontier facility. With only around 1% of the planned total data sample collected to date, it has already yielded a major, Nobel prize-recognised, discovery. With the expected future programme of energy and luminosity upgrades, further significant discoveries are likely.

Recommendation 3: The UK must fully exploit its investment in ATLAS and CMS by maintaining a leading role in the science exploitation of the current detectors at the 13/14 TeV design energy.

Recommendation 4: The UK must invest in the ATLAS and CMS upgrades so as to maximise the science output over the entire LHC lifetime, including the high luminosity phase.

ATLAS and CMS is funded mainly by STFC through Consolidated Grants and Experiment Grants.

Scientific Goals:

Broad exploration of the multi-TeV energy frontier using pp collisions, including characterisation of the Higgs boson and searches for new physics in uniquely accessed new kinematic domains. Also precision studies and tests of the Standard Model, often in areas, such as top quark production and multiple weak boson production, where there has been little or no previous exploration.

UK Leadership (ATLAS):

The current spokesperson (ex deputy-spokesperson and physics coordinator) and recently retired physics and upgrade coordinators are from UK institutes, as well as the incoming physics coordinator. In addition the UK provides multiple leaders of physics analysis working groups and sub-groups, and of many operational aspects of the experiment, including the coordinators of both the current and upgrade Inner Detector projects and of Data Preparation.

UK Responsibilities (ATLAS):

ATLAS is the largest UK particle physics activity by some distance, with 300 authors (about 10% of the collaboration). The UK performs a wide range of pivotal roles and delivered substantial components of the tracking, triggers, DAQ, computing resources and software for Run 1. The main UK involvements in the upgrade programmes are a substantial part of the ITk (new all-silicon inner tracker for installation at LS3), the LS2 and LS3 phases of the first

K Institutes (CMS):

Bristo, Brunel, Imperial College, RAL.

Milestones:

2015: LHC restort at 13 TeV. 2016-2017: ATLAS and CMS TDRs for HL-LHC Upgrades. 2018-2019: LHC LS2. 2023-2025: LHC LS3, leading to HL-LHC.

The LHC is the world's flagship energy frontier facility. With only around 1% of the planned total data sample collected to date, it has already yielded a major, Nobel prize-recognised, discovery. With the expected future programme of energy and uminosity upgrades, further significant discoveries are likely.

Recommendation 3: The UK must fully exploit its investment in ATLAS and CMS by maintaining a leading role in the science exploitation of the current detectors at the 13/14 TeV design energy.

Recommendation 4: The UK must invest in the ATLAS and CMS upgrades so as to maximise the science output over the entire LHC lifetime, including the high luminosity phase.

e.g: ATLAS / CMS entry

1Track) for LS3, plus

QMUL, RHUL, UCL,

eputy tracker project will be providing the has and is providing

d delivery of the ECAL eadout ASIC used for K provides significant role in the calorimeter LS3 upgrades in the

Summary Table

	Exploitation Phase	Upgrade Phase	Medium-term Construction	Design stage	R&D for longer term projects
	[Operational now]	[in ${\sim}5$ years]	[in ${\sim}10$ years]	[awaiting decision]	$[\stackrel{>}{_{\sim}} 15$ years]
_	ATLAS & CMS	ATLAS & CMS	ATLAS & CMS	ILC	FCC / SppC
Energy		phase 1 upgrades	phase 2 upgrades	LHeC	CLIC
Frontier	Characterisation of Higgs Boson Searches for Direct Production of new massive particles				
	LHCb	LHCb		SHIP	
	NA62	phase 1 upgrade			
Flavour	g-2, C	COME I			
Physics	Searches for evidence of new particles through quantum loops				
	Understanding matter / antimatter asymmetry in quark sector Understanding lepton flavour quantum number violation				
	T2K			DUNE / Hyper-K	Neutrino Factory
Noutrino	MINOS+, NO ν A				
Physics	SNO+, SUPERNEMO Characterisation of Neutrino Mass Spectrum				
Filysics	Neutrino contribution to matter / antimatter asymmetry				
Non-	e, n EDN	searches			
Accelerator		LUX-Z	EPLIN		
Experiments	Direct searches for dark matter particles				
Searcnes for new physics via anomalous electric dipole moments					

- Primary science drivers in blue
- `Flagship elements' in bold font
- Experiments receiving STFC experiment grants in red

+ World-leading theory programme in support of all activities



Since 2015 Roadmap ...

- Among smaller scale expeirments:
 - NA62 started data taking (kaons at CERN)
 - SNO+ & Super-NEMO will improve $0\nu\beta\beta$ sensitivity



BNL ring now in new building at FNAL for g-2

- g-2 (anomalous μ magnetic moment), Lux-Zeplin (direct dark matter) entering construction phase
- Full exploitation of past experiments: e.g. 'final' proton structure results from H1, ZEUS at HERA.

• Keen engagement with studies towards future energy-frontier facilities (ILC, CLIC, FCC, CEPC/SppC, LHeC ...)





PPAP Community Meeting 2015

24-25 September 2015 Imperial College Europe/London timezone

Introduction / Programme Overview Thu 24/9

10:00	Registration & Coffee	
	Sherfield Building, Imperial College	10:00 - 11:00
11:00	Welcome to Imperial and Housekeeping	Dr. Morgan WASCKO
	Pippard Lecture Theatre, Sherfield Building, Imperial College	11:00 - 11:05
	Intro to PPAP and the Commnunity Meeting	Paul NEWMAN
	Pippard Lecture Theatre, Sherfield Building, Imperial College	11:05 - 11:20
	News from STFC	Prof. Grahame BLAIR
	Pippard Lecture Theatre, Sherfield Building, Imperial College	11:20 - 11:40
	Overview Discussion	
	Pippard Lecture Theatre, Sherfield Building, Imperial College	11:40 - 12:00

The Energy Frontier

12:00	ATLAS and LHC status	Craig BUTTAR
	Imperial College	12:00 - 12:40
	Lunch	
13:00		
	Queens Tower Rooms B, Sherfield Building, Imperial College	12:40 - 13:40
	CMS	Prof. Newbold DAVE
14:00	Pippard Lecture Theatre, Sherfield Building, Imperial College	13:40 - 14:10
	GridPP	Prof. Dave BRITTON
	Pippard Lecture Theatre, Sherfield Building, Imperial College	14:10 - 14:25
	Future e+e- colliders	Dr. Aidan ROBSON
	Pippard Lecture Theatre, Sherfield Building, Imperial College	14:25 - 14:50
	LHeC and FCC	Uta KLEIN
15:00	Pippard Lecture Theatre, Sherfield Building, Imperial College	14:50 - 15:15
	Теа	
	Queens Tower Rooms B, Sherfield Building	15:15 - 15:45
	Novel accelerator technologies	Dr. Graeme BURT
	Pippard Lecture Theatre, Sherfield Building, Imperial College	15:45 - 16:00
16:00	Energy Frontier Dicussion	
	Pippard Lecture Theatre, Sherfield Building, Imperial College	16:00 - 16:25

Flavour Physics

	LHCb	Greig COWAN
	Pippard Lecture Theatre, Sherfield Building, Imperial College	16:25 - 16:55
17:00	NA62	Dr. Cristina LAZZERONI
	Pippard Lecture Theatre, Sherfield Building, Imperial College	16:55 - 17:10
	SHiP	Mitesh PATEL
	Pippard Lecture Theatre, Sherfield Building, Imperial College	17:10 - 17:25

Fri 25/9

09:00	COMET/PRISM/cLFV	Dr. Yoshi UCHIDA
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	09:00 - 09:15
	g-2	Prof. Mark LANCASTER
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	09:15 - 09:30
	Future charged lepton experiments and involvements	Prof. Themis BOWCOCK
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	09:30 - 09:45
	Flavour Physics Discussion	
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	09:45 - 10:00

Special Session on 2015 Experimental Particle Physics Consolidated Grant Round

10:00	Report of Behalf of the PPGP	Prof. Joel GOLDSTEIN
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	10:00 - 10:20
	Discussion	
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	10:20 - 10:40
	Coffee	
	Outside Physics Lecture Theatre 1, Blackett Lab, Imperial College	10:40 - 11:00

Neutrinos and Non-Accelerator Experiments

11:00	Long Baseline Neutrino Experiments	Dr. Helen O'KEEFFE
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	11:00 - 11:30
	Short Baseline Neutrino Experiments	Dr. Roxanne GUENETTE
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	11:30 - 11:45
	Neutrinoless Double Beta Decay	Dr. Jeanne WILSON
12:00	Physics Lecture Theatre 1, Blackett Lab, Imperial College	11:45 - 12:05
	Direct Dark Matter Searches	Prof. Jocelyn MONROE
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	12:05 - 12:25
	Electric Dipole Moments (electron, neutron and proton)	Dr. Ben SAUER 📄
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	12:25 - 12:40
	Lunch	
13:00		
10100		
	Outside Physics Lecture Theatre 1, Blackett Lab, Imperial College	12:40 - 13:30
	LSST	Prof. Ian SHIPSEY
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	13:30 - 13:45
	GridPP for non-LHC experiments	Prof. Peter CLARKE
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	13:45 - 14:00
14:00	Neutrino and non-Accelerator Dicussion	
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	14:00 - 14:15

Theoretical Physics

	Phenomenology	Prof. Valentin V KHOZE
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	14:15 - 14:35
	Astro-Particle Theory	Dr. Anne GREEN
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	14:35 - 14:55
15:00	Formal Theory	Dr. Toby WISEMAN
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	14:55 - 15:15
	Lattice QCD	Prof. Christine DAVIES
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	15:15 - 15:35
	Theory Dicsussion	
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	15:35 - 15:45
	Теа	
16:00	Outside Physics Lecture Theatre 1, Blackett Lab, Imperial College	15:45 - 16:05
	Discussion	
	Prof. Claire Shepherd-Themistocleous	
	Physics Lecture Theatre 1, Blackett Lab, Imperial College	16:05 - 16:50

- Many thanks to attendees, speakers & Imperial College
- Looking forward to interesting and constructive discussion of the whole programme ...