

# PPAP report + Sol status

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**Philip Burrows**

*John Adams Institute*

*Oxford University*

# The PPAP

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**Philip Burrows (Oxford) *chair***

**Cinzia Da Via (Manchester)**

**Tim Gershon (Warwick)**

**Nigel Glover (Durham)**

**Claire Shepherd-Themistocleous (RAL) *deputy chair***

**Mark Thomson (Cambridge)**

**Dan Tovey (Sheffield)**

***Rachel Boning (STFC)***

**<http://www.hep.phy.cam.ac.uk/~thomson/ppap.html>**

# Terms of Reference

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**‘Draft and maintain a roadmap describing current and future research opportunities in their areas, for presentation and approval by PPAN**

**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**

**Make an independent presentation to PPAN on the relevant panel area in years in which an STFC Programmatic Review takes place, thereby providing community input to the programmatic review process**

**Respond to other specific requests from PPAN for advice as the need arises’**

# Possible Workplan I: Future Opportunities

*(Walter Gear 6/3/09)*

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- identify what facilities will be needed in order for the UK make significant contributions to these areas;**

# Possible Workplan I: Future Opportunities

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**‘identify the top major scientific challenges to be solved in the future (in 20 – 30 years) in this field world wide;**

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**identify what facilities will be needed in order for the UK make significant contributions to these areas;**

**based on b) understand which of a) and / or c) are the top priorities.’**

# Possible Workplan II: Matching Current Programme to Roadmap priorities

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- a) What are the science drivers for each of the activities e.g. how does x help the UK reach the identified challenge?**
  
- b) What is the UK expertise for each activity e.g. is the UK world-leading, if not, what specific activities are the UK involved in that will contribute to this?**

# Possible Workplan II: Matching Current Programme to Roadmap priorities

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- c) What are the technological needs for each activity and what is the UK expertise in such technology (both academia and industry)?**
  
- d) In a fixed budget, what are the top priorities e.g. what really must be done in order to meet the challenge?'**

# Additional considerations

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- **First-pass roadmap due September 11 2009**
  - **Pay attention to ‘flavour physics’:**
- ‘PPAN asked that a review of the funding requirements for ‘flavour physics’ be undertaken by the newly established Particle Physics advisory panel. In particular, the advisory panel should provide recommendations on the optimal methods and experiments.’ [PPAN minutes]**
- **Roadmap will be used to guide 2010/11 budget plans**

# Roadmap process

13,14,15 July 2009: PP reviews (Birmingham)  
c. 200 community members attended!



# Roadmap process

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**13,14,15 July: PP reviews (Birmingham)**

**c. 200 community members attended!**

**suggestion to make this (2-yearly?) event**

**29 July: ‘findings’ and ‘summary of discussion’ reports posted – several comments received**

**11 Sept: draft recommendations discussed with exp. group leaders**

**16 Sept: draft report released – many (largely detailed) comments**

**21 Sept: report submitted to PPAN**

**28 Sept: Chair (PNB) to present report at PPAN meeting**

# Report outline

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**Requirement: < 20 pages (!)**

- **Introduction**
- **Major scientific challenges**
- **List of facilities**
- **Recommendations**
  - framework**
  - short discussion of each area/facility**
  - summary/synthesis**
- **Appendices: detailed discussion of each area (for final version of report)**

# Major scientific challenges (1)

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- 1. How do elementary particles acquire mass? Does the Higgs boson exist, or are new laws of physics required?**
- 2. What is the new physics that solves the problems of the Standard Model? Are there new particles or new principles? Are there as-yet undiscovered symmetries of nature such as SUSY? Are there extra dimensions of space or time? Are leptons and quarks really distinct, or simply separate manifestations of a single type of matter?**
- 3. Can we understand the phenomena produced by strongly interacting systems?**

# Major scientific challenges (2)

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- 4. How many generations of elementary particles are there? What principle determines this number?**
- 5. Does new physics introduce new sources of flavour- and CP-violation beyond those of the quark sector of the Standard Model? If not, what principle explains the uniqueness of the Standard Model couplings?**
- 6. Is charged lepton flavour violated? If so, what new physics causes charged lepton flavour violation?**

# Major scientific challenges (3)

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- 7. What are the masses and properties of neutrinos and what role did they play in the evolution of the Universe?**
- 8. Is the neutrino its own antiparticle?**
- 9. Is CP violation realised in the neutrino sector? How are neutrinos connected to the matter-antimatter asymmetry?**
- 10. What is the dark matter that makes up about one quarter of the contents of the universe? Can we make and study it in the laboratory?**





# High-energy e+e- collider (1)

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- ‘... has been internationally recognised as the highest-priority next global major particle physics facility.**
- ... likely that it will be the facility for exploitation and extension of the LHC physics discoveries.**
- ... complementary to the LHC, bringing incisive precision and significant additional discovery potential.**

# High-energy e+e- collider (2)

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**Early LHC results will guide the design energy range ...**

**... ILC is the most mature technical design (TDR in 2012) and addresses the energy range 0.5 – 1 TeV.**

**... CLIC concept aims to address the energy scales up to several TeV, but requires significant further R&D (TDR expected in 2015).**

**... in the past 18 months a formal collaboration has been launched between ILC and CLIC for a coherent strategy to realise a linear collider.**

**This naturally extends CERN's role in the global planning process for the linear collider.**

# High-energy e+e- collider (3)

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**The UK has made significant investments in R&D on both the accelerator and detector technologies and key systems, and continues to hold positions of international leadership and responsibility.**

**All of the UK investment was deliberately targeted at areas that are applicable to both the ILC and CLIC designs.'**

# High-energy $e^+e^-$ collider (4)

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## Recommendation:

**It is essential that the UK should pursue both accelerator and focussed detector R&D through to a decision point on the future direction for the linear collider.**

# High-energy e+e- collider (5)

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## Milestones:

**2012: ILC TDR**

**2012/2013: future project direction based on LHC results**

**2015: CLIC TDR**

**2015-20: possible start of construction**

**2022-27: possible start of operation**

# High-energy e+e- collider (6)

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## Impacts of non-participation:

- i) loss of UK influence/opportunity in the world's next forefront particle physics project;**
- ii) failure to engage in world-leading detector and accelerator R&D, with loss of related KE opportunity;**
- iii) failure to capitalise on previous investment, and loss of international leadership;**
- iv) further damage to the UK's international reputation.**

# World-leading / highest priority

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- LHC GPDs exploitation and upgrades
- LHCb exploitation
- Neutron and electron EDM search experiments
- Theoretical physics programme
- T2K

**MANDATORY to exploit world leadership and investment**

# World-leading / UK involvement essential

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- **Direct dark matter search experiments**
- **LHCb upgrade R&D**
- **Linear collider accelerator & detector R&D**
- **Long-baseline neutrino physics detector R&D / neutrino factory accelerator R&D**
- **Neutrinoless double-beta decay experiments**
- **Tevatron experiments**

**ESSENTIAL to participate in ALL above**

# World-leading / significant UK scientific opportunity

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- **High-precision muon experiments**
- **MINOS**
- **NA62**

**Limited investment HIGHLY RECOMMENDED**

# Significant future opportunity

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- **High-luminosity B factory**
- **Future high-precision kaon experiments**
- **LHeC**
- **Muon collider**

**Modest funds ... to allow UK leadership ... in design studies**

# UK engagement not foreseen at this time

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**CNGS**

**Dedicated high-precision charm experiments**

**g-2**

**Belle**

**MEG**

**Mu2e**

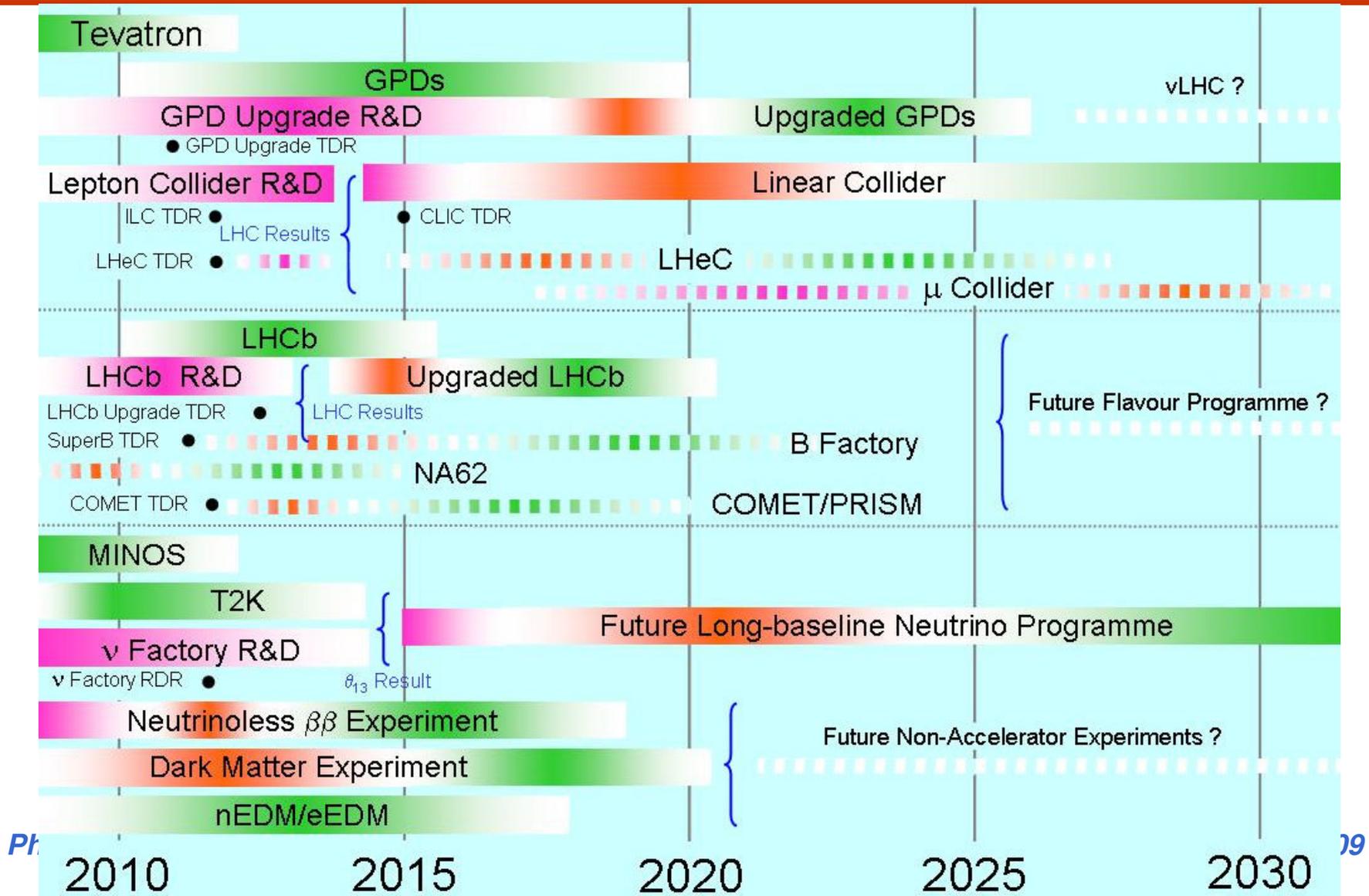
**Nova**

**Precision neutrino mass experiments**

**Reactor neutrino experiments**

**...**

# Draft Roadmap



# LC-ABD Collaboration

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- **Abertay**
  - **Birmingham**
  - **Cambridge**
  - **Durham**
  - **Liverpool**
  - **Oxford**
  - **Royal Holloway**
- Daresbury Lab.**
  - Dundee**
  - Lancaster**
  - Manchester**
  - University College London**
  - Rutherford-Appleton Lab.**

# LCABD history

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## **First project phase:**

**1/4/04 – 31/3/07**

**PPARC + CCLRC**

## **Second project phase:**

**1/4/07 – 31/3/10 approved via PPRP**

**year 1 funding issued by STFC**

**ramp-down after 'Delivery Plan' (Dec 07)**

## **Third phase:**

**1/4/09 – 31/3/11**

**STFC c. £1M /an + EuCARD**

# Positioning the UK for involvement in a high-energy electron-positron collider (11/5/09)

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**The new and evolving European approach to collaboration on linear colliders presents an opportunity for the UK to:**

- Apply and develop our expertise gained from five years of significant investment in the R&D phase of the ILC project.**
- Maximise our strategic benefit by investing in linear collider work at CERN, via EuCARD, and contribute to the CLIC design study and CLIC Test Facility (CTF3). This will gain us both valuable experience and a seat at the table when technology decisions are taken.**

# Positioning the UK for involvement in a high-energy electron-positron collider (11/5/09)

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**Capitalise on our investment, and the facilities available, at CERN, and maximise return on our CERN subscription. This will allow us to take a leading role in the emerging European effort.**

**Further strengthen our generic electron-accelerator knowledge base and capabilities. This has obvious applications to future electron-based high brightness light sources that will adopt similar technological solutions.**

**CERN plans to prepare a CLIC Conceptual Design Report (CDR) in 2010 and a Technical Design Report (TDR) in 2015. The EuCARD start-up funds allow us to make a modest contribution to the CDR. Increased investment by the UK starting in 2010 would allow us to engage with the R&D for the TDR, do first-rate accelerator science, and develop leadership in CLIC.**

# Positioning the UK for involvement in a high-energy electron-positron collider (11/5/09)

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**Two key areas in which the UK can make significant contributions:**

**Design of the CLIC high-energy machine. This is primarily through simulation work on beam dynamics, wakefields, beam tracking, and beam transport, as well as relevant engineering and prototyping work on radiofrequency systems, magnets and vacuum.**

**Key beam instrumentation systems for CTF3, including beam position monitors, emittance measuring devices, and feedback/control systems.**

**We estimate that additional resources at the level of 6 FTEs (RA and technical staff), plus c. £100k p.a. for consumables and travel to CERN, are required for a 3-4 year period starting in 2010 in order for the UK to make a significant contribution to the CLIC TDR.**



ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE  
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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Ref.: DG-PRJ-CLS/JPD/aab

**Professor John Womersley**  
Director of Science Programmes  
Science and Technology Facilities Council  
Polaris House  
North Star Avenue  
Swindon, SN2 1 SZ  
United Kingdom

Geneva, 8th May 2009

Dear Professor Womersley,

At CERN we have noted the outcome of the recent STFC programmatic review, in which work on accelerator and detector R&D for the International Linear Collider was rated low priority.

Like ICFA, the CERN Council Strategy Group and a large majority of the particle physics community, we consider linear collider R&D to be essential for the future of accelerator-based particle physics. We recognize that the new accelerator science infrastructure established in the United Kingdom during the past five years with the John Adams Institute and the Cockcroft Institute enables your country to provide scientific leadership in many areas of linear collider R&D.

We therefore hope that you continue to encourage and nurture a viable programme of generic linear collider R&D in the United Kingdom. In this connection, I believe the long-planned closer collaboration between the ILC and CLIC teams represents an excellent opportunity for generic LC R&D. In particular, CERN offers many excellent opportunities for the UK linear collider groups to pursue their generic R&D programmes, and we are very open to discuss collaboration possibilities further with you and your colleagues.

Yours faithfully

Jean-Pierre Delahaye

CLIC Study Leader  
ILC European Deputy Director

# STFC response 13/7/09

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Professor Phil Burrows  
Department of Physics  
University of Oxford  
Denys Wilkinson Building  
Keble Road  
Oxford OX1 3RH

13 July 2009

Dear Professor Burrows

**Statement of Interest: Positioning the UK for Involvement in a High-Energy Electron-Positron Collider**

The Statement of Interest (SoI) for Positioning the UK for Involvement in a High-Energy Electron-Positron Collider was considered by the Particle Physics, Astronomy and Nuclear Physics Science Committee (PPAN) at the meeting held on 30 June and 1 July 2009.

The proposal aimed to integrate linear collider research and development with CERN activities. PPAN agreed that linking linear collider research and development with developments at CERN (including CLIC) was the most appropriate strategic direction for future funding of linear collider research and development.

# STFC response 13/7/09

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PPAN endorsed the principle that the UK should be involved in future developments relating to a linear collider and that such involvement was of high strategic importance. However, PPAN could not recommend the submission of a full proposal at this stage as a number of further clarifications were required. PPAN asked that a further SoI should be submitted to contain the following additional information:

- i. more specific information on the precise research and development that would be undertaken;
- ii. clarification of timescales;
- iii. further detail relating to the linkage between this project and the UK accelerator institutes;
- iv. clarification of the relationship between the proposed research and the work currently being undertaken as a continuation of the LCABD project.

# STFC response 13/7/09

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The applicants were asked to note that STFC's budget is severely constrained at present and it cannot be assumed that the level of funding currently requested in the SoI would be available. The applicants were asked to explore whether some of the funding could be found from the core funding of the accelerator institutes.

Further details relating to the deadlines for submission of SoIs can be found at:  
<http://www.stfc.ac.uk/SciProg/Plan/Plandocs/SOIGuidelinesiii.aspx>.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Trish Mullins', written in a cursive style.

Trish Mullins

Secretary, Particle Physics, Astronomy and Nuclear Physics Science Committee

# Next steps

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- **PMC drafted + submitted (7/9/09) response to STFC's pro forma questionnaire**
- **PPAN will 'grade' and 'rank' projects at its 28-29/9/09 meeting, and compare them against the Advisory Panel roadmaps ...**
- **Assuming LC R&D programme survives:**
  - LCABD could draft + submit further Sol for LC accelerator R&D > March 2011: dovetail ongoing LCABD with new CERN-oriented approach**
  - New proposal to STFC Spring 2010 (?)**