



# CTF3 Probe Beam



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CTF3 Meeting, CERN

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- Introduction – UK Context
- Draft Proposal
- Future prospects

# UK funding for accelerator science for particle physics 2004 - 2007

UK funding agency, PPARC, secured from Govt. £11M for  
'accelerator science' for particle physics, spend period April  
04 – March 07

Bids peer-reviewed and preliminary new allocations made Oct  
21 2003:

ILC-Beam Delivery      £7.2M from PPARC +  
   £1.5M from CCLRC

2 university-based accelerator institutes

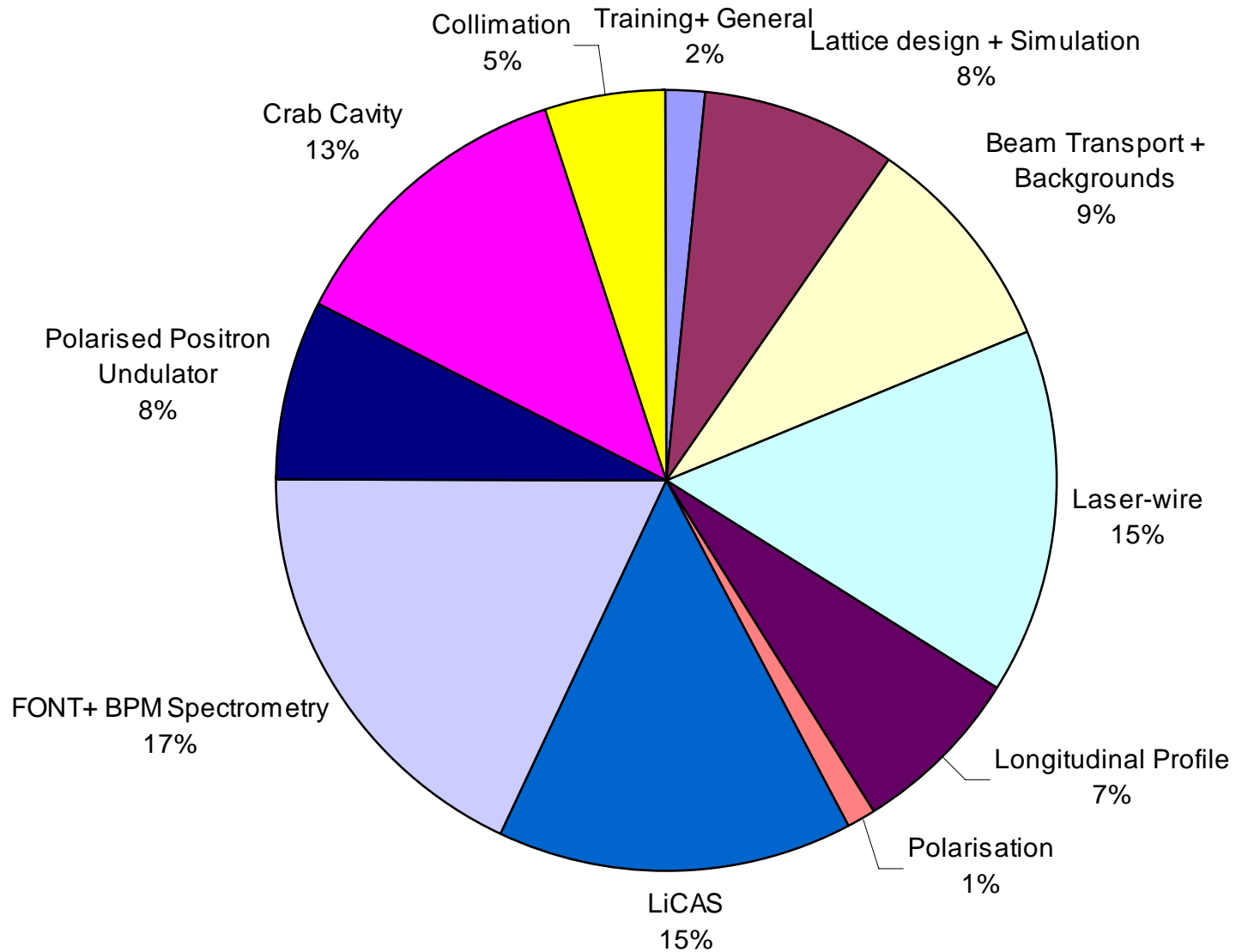
# Accelerator Institutes

2 New institutes for Accelerator science:

Cockcroft: **Lancaster, Liverpool, Manchester**  
- based at DL campus.  
**12 New academic positions.**

John Adams Institute: **Oxford, RHUL:**  
- based at both institutes  
**6 new academic positions.**

# Overview of Projects



# UK LC-ABD Work Packages

1. Lattice design and beam simulations (D. Angal-Kalinin)
2. Advanced beam diagnostics (G. Blair)
3. Alignment and survey (A. Reichold)
4. Final focus luminosity stabilisation and spectrometry (P. Burrows)
5. e+ undulator, crab cavity system, wakefields/collimators (M. Poole)

Major programme of beam-based work ongoing at ESA (SLAC), ATF (KEK).  
Time to investigate possibilities of next funding round, including CTF3

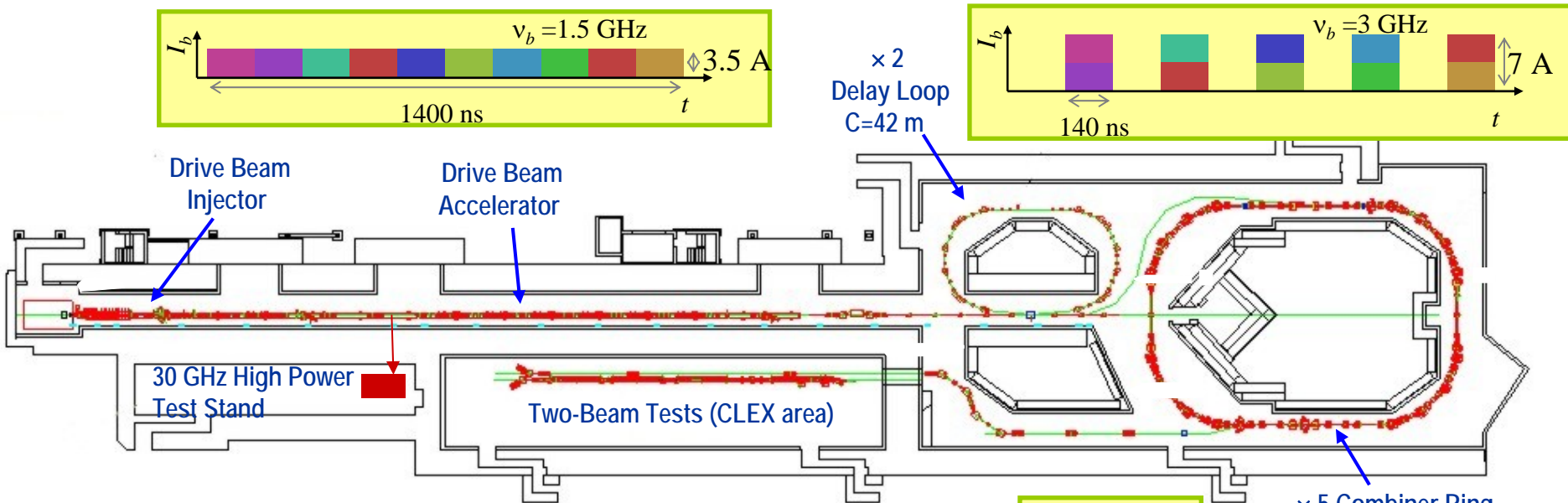
**A Conceptual Proposal for a Diagnostics Line at the CTF3 Probe Beam  
Draft 2.0  
17th September 2005.**

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## **1. Executive Summary**

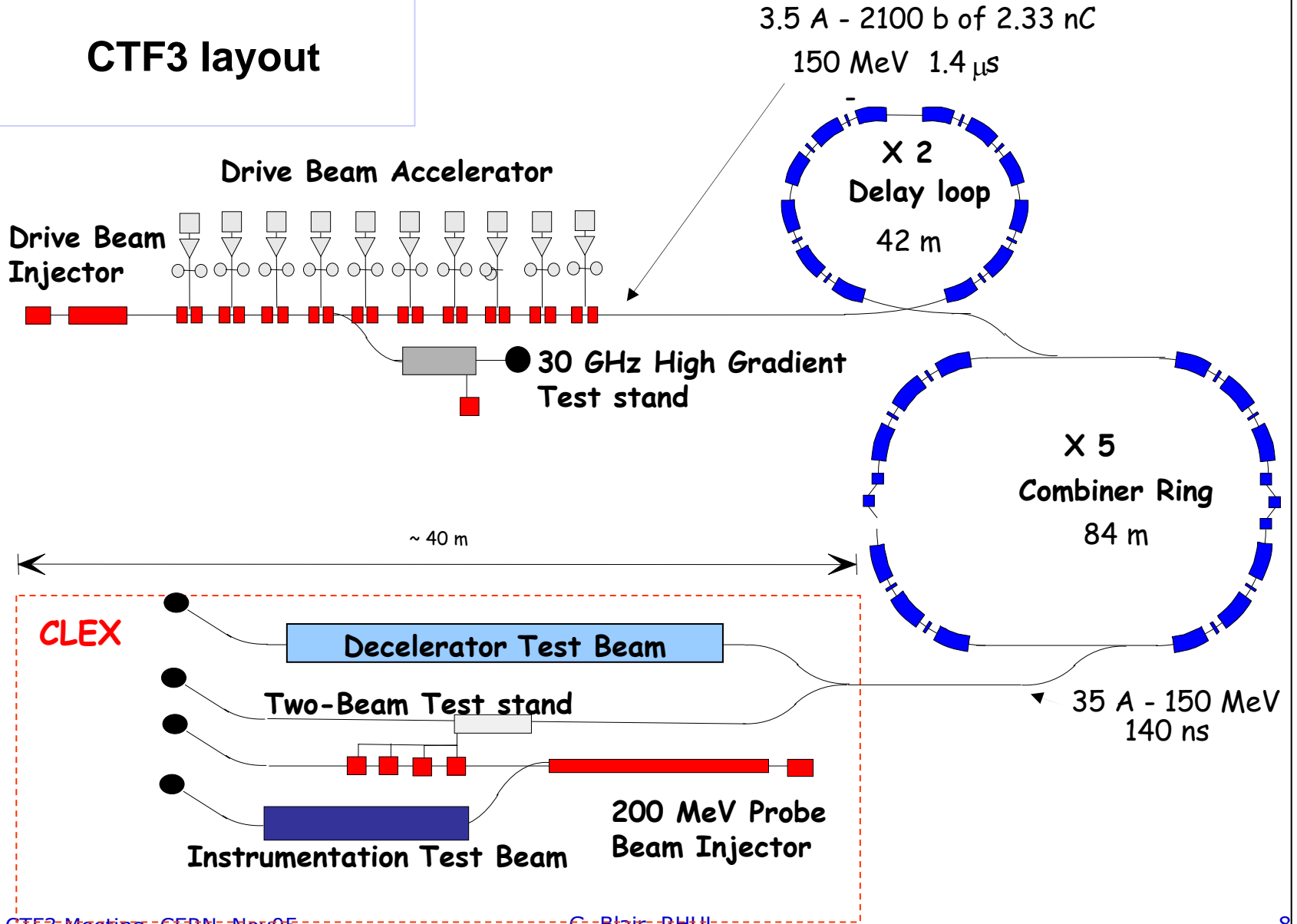
The current planning phase of the CLEX area at CTF3 has revealed an excellent opportunity to build a flexible Instrumentation Test Beam (ITB), at a time when such an international facility is in high demand and short supply, to address both ILC and CLIC instrumentation issues. This proposal addresses some preliminary baseline requirements of the ITB, presents initial cost estimates and timelines, and identifies some key diagnostics tests that could be addressed.

# CLIC key technology issues addressed in CLIC Test Facility (CTF3)



- CTF 3**
- Demonstration of CLIC drive beam generation
  - 30 GHz power for 30 GHz structure testing
  - Two beam acceleration
  - Test bed for CLIC technology developments

# CTF3 layout

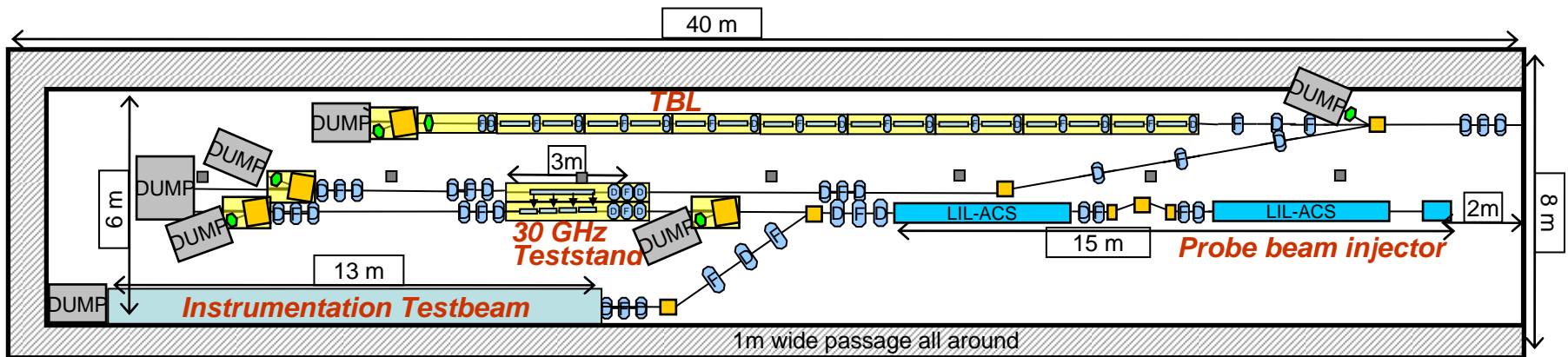




| <b>Parameters CTF3 Drive beam accelerator</b> |                       |                         |                  |
|---|-----------------------|-------------------------|------------------|
| Operation mode                                | Drive beam generation | 30 GHz power production | Single bunch     |
| Bunch charge                                  | 2.35 nC               | 1.66 nC                 | 3 nC             |
| Bunch spacing                                 | 0.666 ns              | 0.333 ns                | -                |
| Bunches/ Pulse                                | 2300                  | 1200                    | 1                |
| Rep. rate                                     | 1-5 Hz                | 1-50 Hz                 | 1-50 Hz          |
| Energy  | 150 MeV               | 210 MeV                 | 300 MeV          |
| Norm. Emittance                               | 100 $\mu\text{m}$     | 100 $\mu\text{m}$       | 20 $\mu\text{m}$ |
| Bunch length                                  | 4 ps                  | 2 ps                    | 1-10 ps          |
| Available                                     | From 2006             | Now                     | From 2007        |

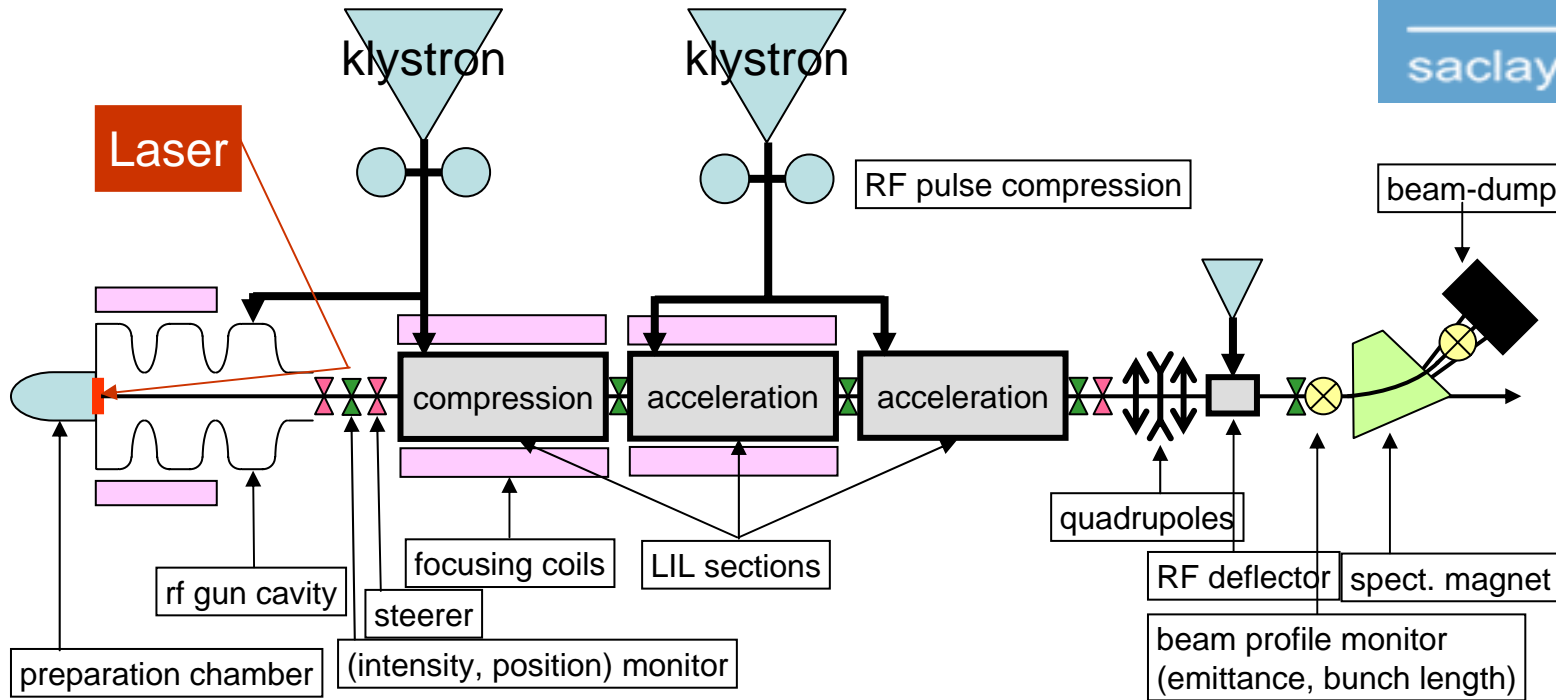
## CLIC experimental area (=CLEX), construction of new building in 2006

- Test beam line (TBL) to study drive beam decelerator dynamics, stability and losses
- Two beam test stand



Layout for CLEX floor space

# Probe beam linac with rf photo gun and velocity bunching



| Parameters          |                    | Motivation                              |
|---------------------|--------------------|---|
| Energy              | $\sim 200$ MeV     | Avoid beam disruption in high RF fields |
| norm. rms Emittance | $< 20 \pi$ mm mrad | Fit in 30 GHz structure acceptance      |
| Energy spread       | $< \pm 2\%$        | Measurement resolution                  |
| Bunch charge        | 0.5 nC             | CLIC parameters                         |
| Bunch spacing       | 0.333 ns           |   |
| Number of bunches   | 1 - 64             | Measure 30 GHz structure transients     |
| rms bunchlength     | $< 0.75$ ps        | Acceleration with 30 GHz                |

## CTF3 Schedule

|  | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|--|------|------|------|------|------|------|
| <b>Drive Beam Accelerator</b>                                  |      |      |      |      |      |      |
| <b>30 GHz power test stand in Drive Beam accelerator</b>       |      |      |      |      |      |      |
| <b>30 GHz power testing (4 months per year)</b>                |      |      |      |      |      |      |
| <b>R1.1 feasibility test of CLIC structure</b>                 |      |      |      |      |      |      |
| <b>Delay Loop</b>  |      |      |      |      |      |      |
| <b>Combiner Ring</b>   |      |      |      |      |      |      |
| <b>R1.2 feasibility test of Drive beam generation</b>          |      |      |      |      |      |      |
| <b>CLIC Experimental Area (CLEX)</b>                           |      |      |      |      |      |      |
| <b>R1.3 feasibility test PETS</b>                              |      |      |      |      |      |      |
| <b>Probe Beam</b>  |      |      |      |      |      |      |
| <b>R2.3 feasibility test representative CLIC linac section</b> |      |      |      |      |      |      |
| <b>Test beam line</b>  |      |      |      |      |      |      |
| <b>R2.2 Beam stability bench mark tests</b>                    |      |      |      |      |      |      |

# Representative Probe Beam Parameters

|                     |                      |
|---------------------|----------------------|
| Energy              | $\sim 200$ MeV       |
| Rep Rate            | 5 Hz                 |
| Norm. rms Emittance | $< 20$ $\pi$ mm mrad |
| Energy Spread       | $< \pm 2\%$          |
| Bunch Charge        | 0.5 nC               |
| Bunch Spacing       | 0.333 ns             |
| Number of Bunches   | 1-64                 |
| RMS Bunch Length    | $< 0.75$ ps          |

# Possible activities at the Instrumentation Test Beam

- Robust and reliable BPM-based energy spectrometry for the purposes of ILC/CLIC fast extraction schemes.
- Hardware development and tests of fast extraction kicker and extraction line.
- Deflecting cavity R&D for beam diagnostics; this will require additional RF provision, possibly derived from the probe beam klystrons.
- Beam phase space measurement with electron bunch longitudinal sizes similar to that of the ILC.
- Collimator wakefield studies.
- High performance BPM R&D.
- Tests of engineering prototypes of a wide range of instrumentation developed for ILC/CLIC over the coming years.

## FUTURE FUNDING OF LC-ABD

Current PPARC support ends in March 2007

Future proposed programme will need to be peer reviewed by the end of 2006 to ensure continuity.

The proposal for the next phase will need to take into account overall international status, UK role/responsibilities and timescales for TDR etc.

Funding for accelerator R&D awarded in SR2002 has been built into the PPARC baseline.

Linear collider R&D is given high priority by PPARC. There are long term commitments to the two accelerator R&D centres.

## LARGE CAPITAL FACILITIES FUND

Linear collider is a bid from PPARC to the OST Large Capital Facilities Fund – separate funding line retained by OST for capital construction projects.

Prioritisation exercise currently underway of bids from all Research Councils – outcome not yet known but if given high priority, any funding could be for the construction phase only. Discussions with OST continue.

PPARC will have to balance the need to maintain momentum, with the funds available and other calls on the PPARC budget.



## Summary

The CLEX beam area provides an opportunity to develop a new European test facility.

Funding is uncertain at present.

UK industry and academic institutions are currently being consulted.

Please input new ideas for instrumentation and collaboration.