

UK LC-ABD Collaboration

UK Beam Delivery System Plans

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UK funding for accelerator science for particle physics 2004 - 2007

- UK funding agency, PPARC, secured from Govt. 15MEuro for 'accelerator science' for particle physics, spend period April 04 – March 07
- Called for bids from universities and national labs; large consortia were explicitly encouraged
- 5 bids received:
A total in excess of 30MEuro was requested!
- Bids peer-reviewed and preliminary allocations made Oct 21 2003:
LC-Beam Delivery recommended to receive 10MEuro
UKNF received 2.4MEuro
2.6MEuro for national university-based accelerator institute

LC-ABD Collaboration

- Abertay
- Bristol
- Birmingham
- Cambridge
- Durham
- Lancaster
- Liverpool
- Manchester
- Oxford
- Queen Mary, Univ. London
- Royal Holloway, Univ. Of London
- University College, London
- Daresbury and Rutherford-Appleton Labs;
spokespersons: Blair, Burrows
- 41 post-doctoral physicists (faculty, staff, research associates) + technical staff + graduate students

1. BDS Lattice Design and Beam Simulations

Bristol, B'ham, Daresbury, Lancaster, Liverpool, Manchester, Oxford QMUL, RAL, RHUL, UCL

- **1.1 BDS Lattice design:**

Understand design issues, contribute to global development + optimisation:

working with Saclay on latest TESLA IR optics
very interested in: collimation system, extraction line,
diagnostics layout...

- **1.2 Beam transport simulations, backgrounds + collimation:**

Cradle-to-grave simulations; database of TESLA train Xings, pairs, FB
64 cpu Grid cluster at QMUL for production jobs (30-40 cpu-hours)

Halo production and tracking through BDS

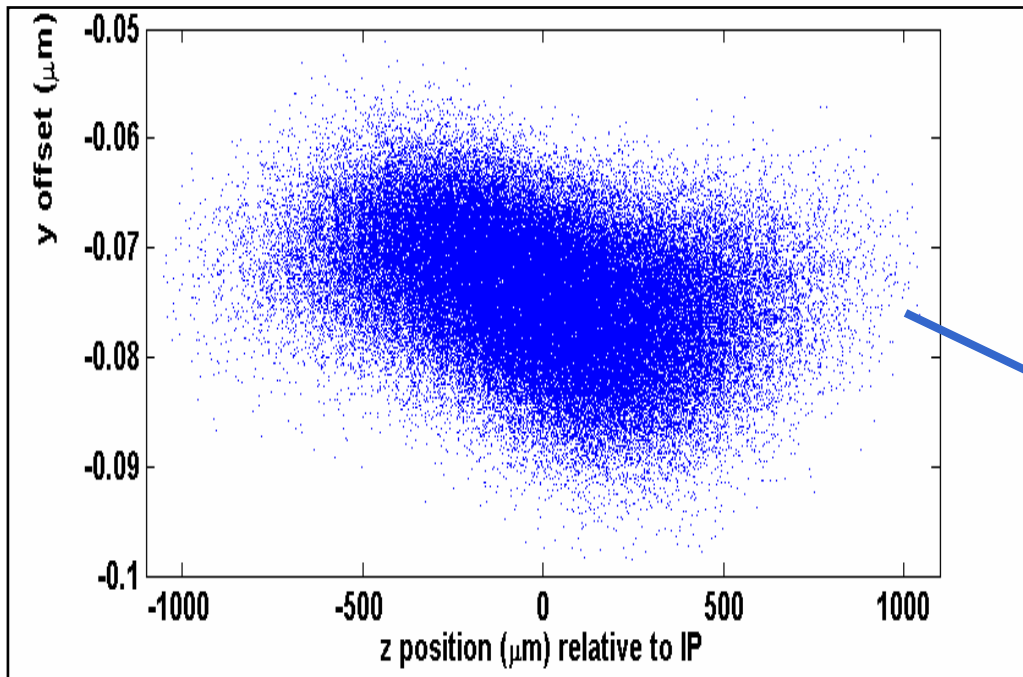
Collimator wakefields

Backgrounds in IR: pairs, gammas, n: -> VXD, calorimetry, FB system ...

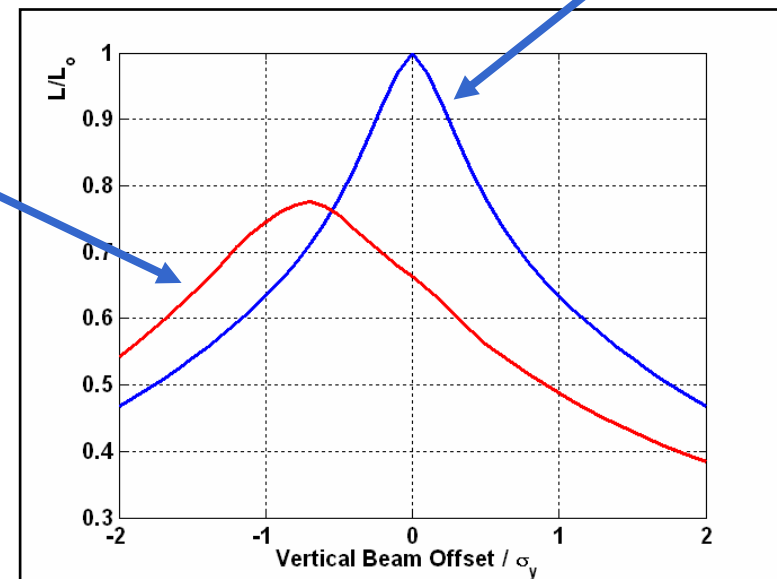
We welcome your guidance, suggestions + input

Example: banana bunches, impact on FB

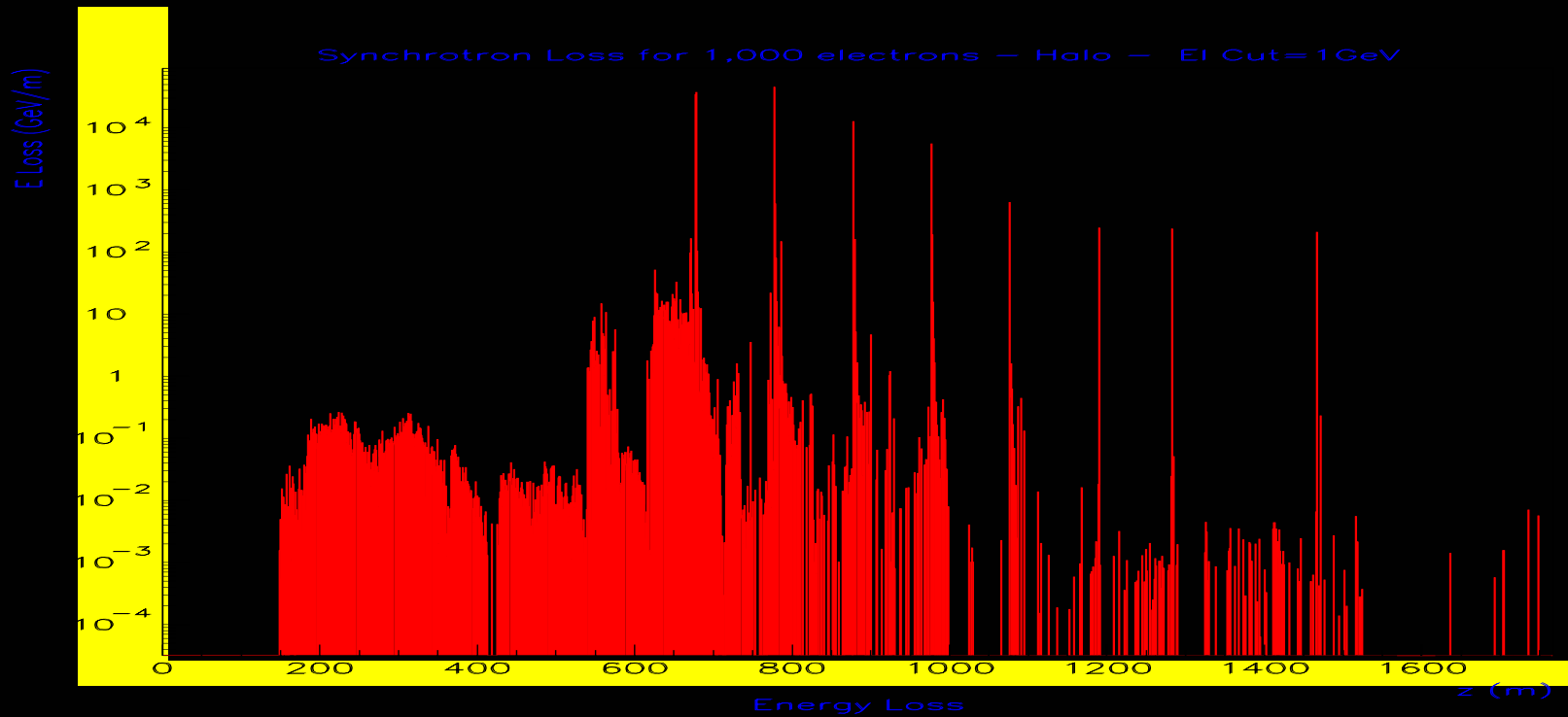
'Banana' bunch (PLACET/MERLIN)



Gaussian bunch



Tracking of halo energy deposition (BDSIM)



2. Beam Diagnostics

- **2.1 Laserwire (RHUL, UCL, Oxford):**

Ongoing collaboration on PETRA laserwire project
UK building laser scanning system (multidirection)
Simulations: halo backgrounds, diagnostics layout

- **2.2 Bunch length/profile measurement (Abertay, DL, Oxford):**

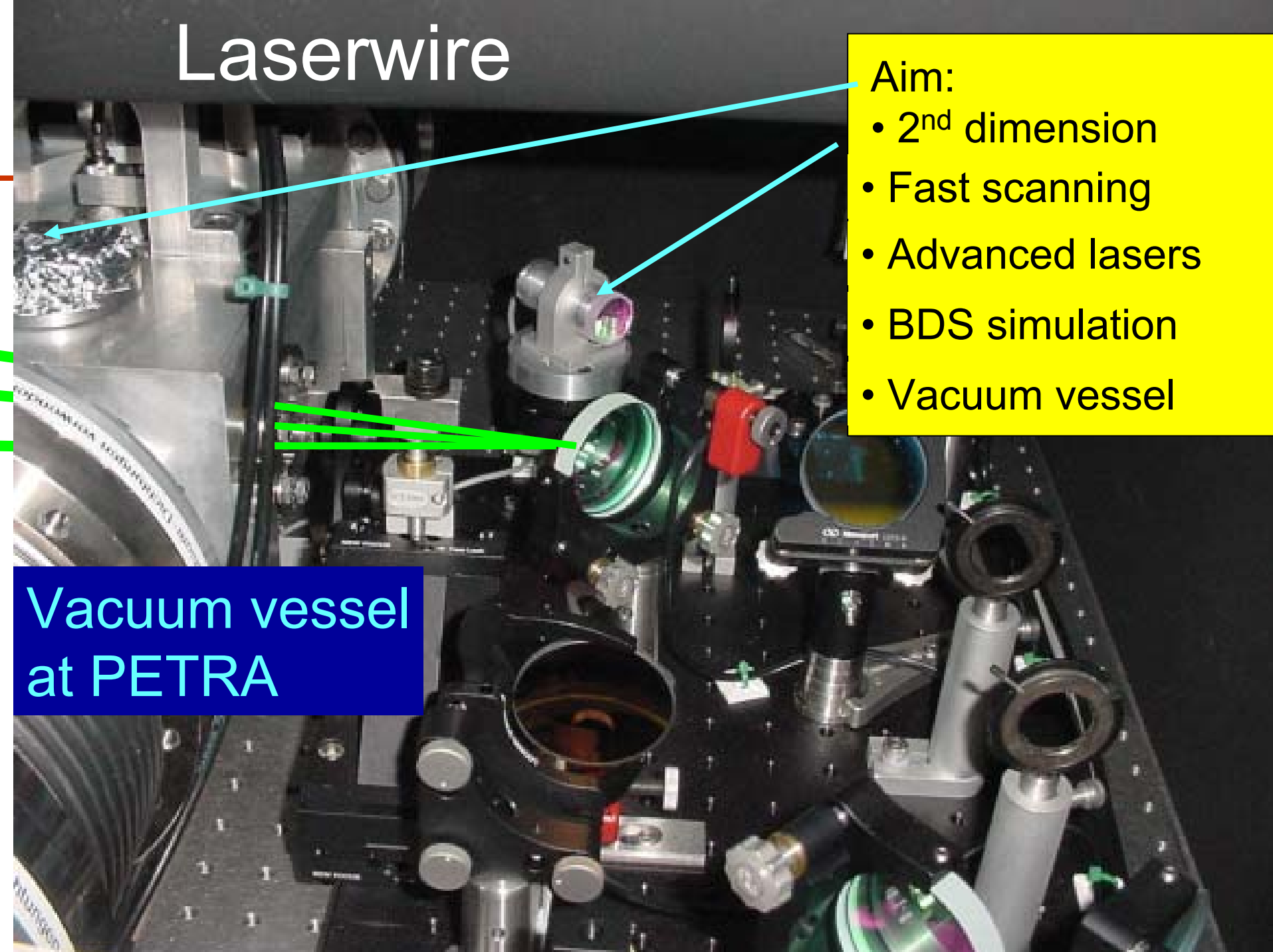
Very successful electro-optic bunch length expt. at FELIX
600fs achieved; aiming for 200fs
R&D on Smith-Purcell radiation bunch profile monitor (Frascati)
possible deployment at FELIX

Laserwire

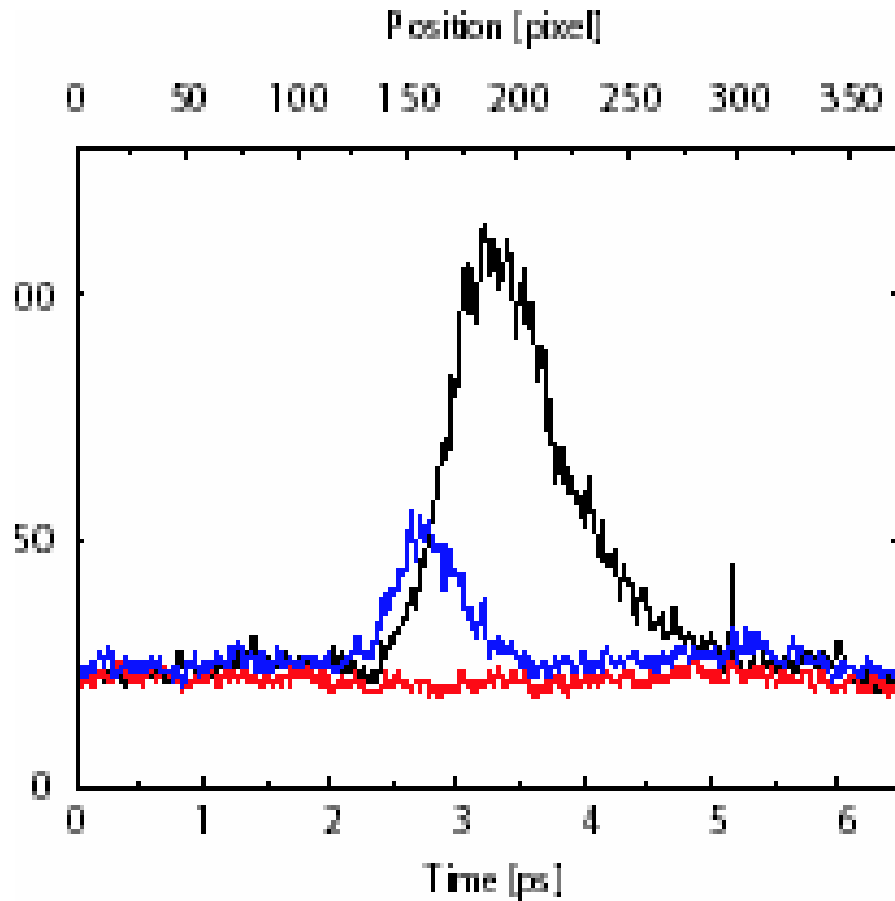
Aim:

- 2nd dimension
- Fast scanning
- Advanced lasers
- BDS simulation
- Vacuum vessel

Vacuum vessel
at PETRA

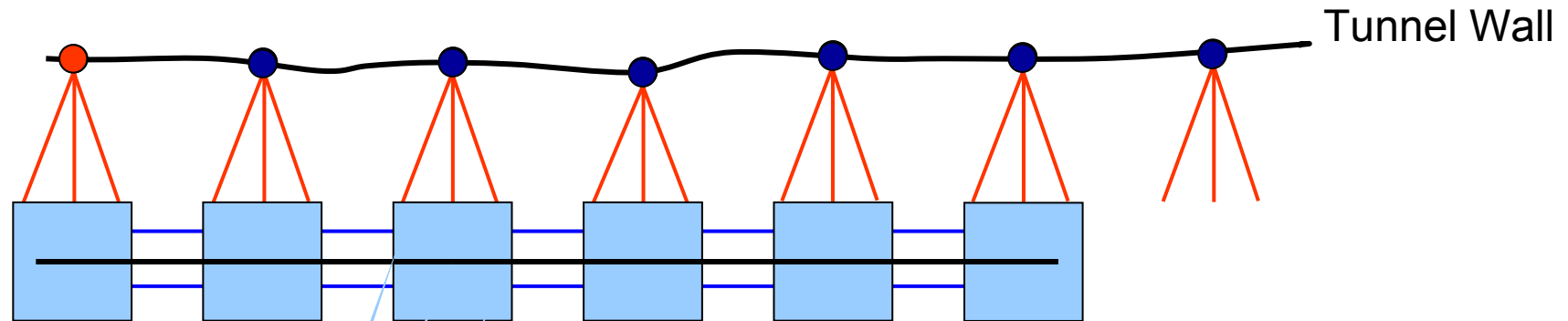


Sub-ps bunch length measurement (EO)



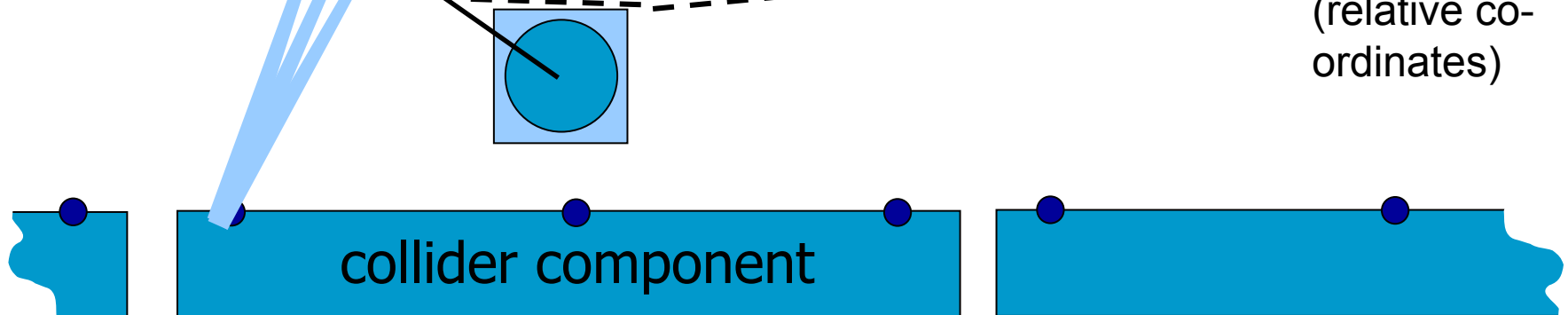
600 fs achieved.
Ongoing project
at FELIX;
aiming for 200 fs

3. Alignment + Survey: LiCAS (Oxford)



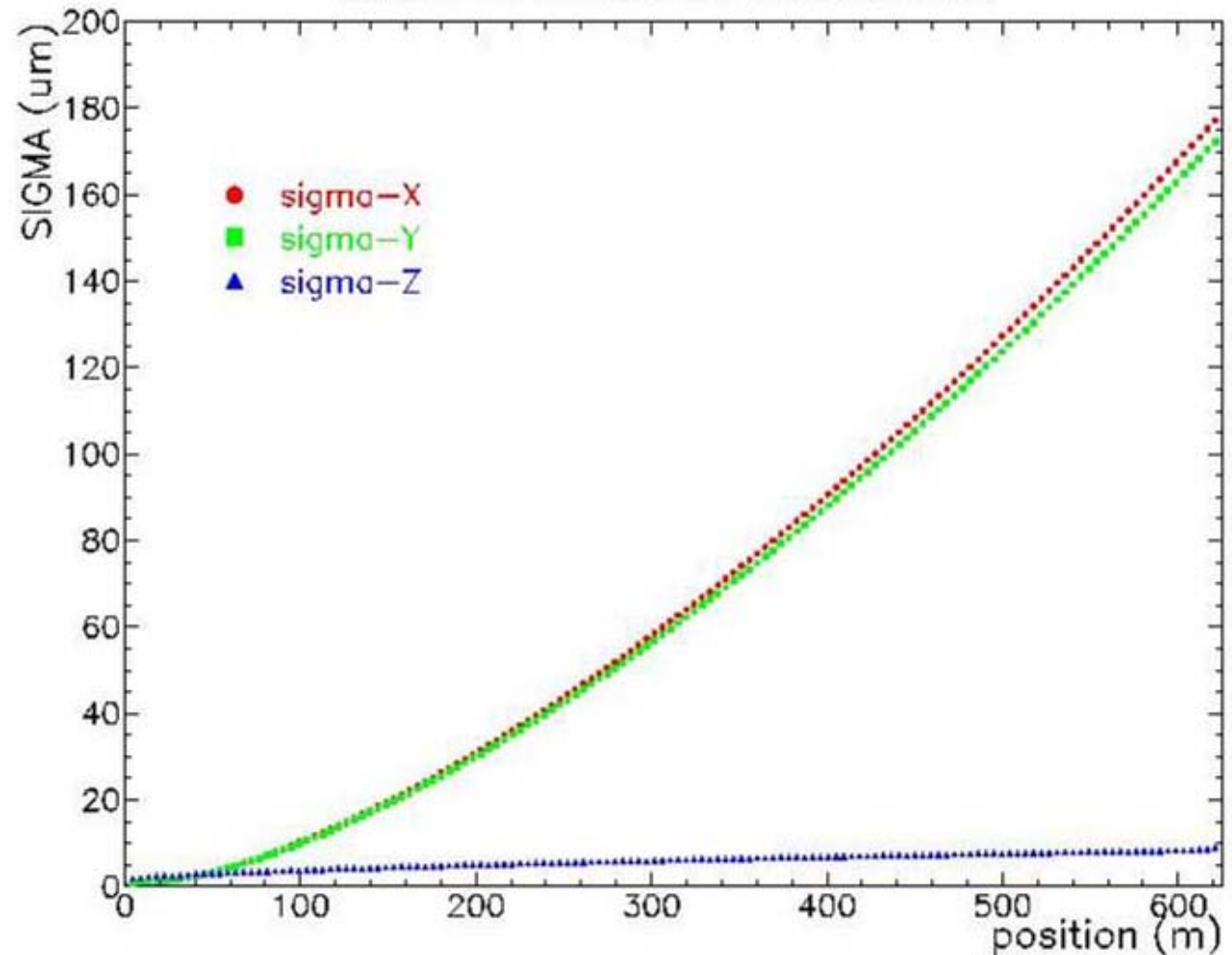
LiCAS technology
for automated
stake-out process

Reconstructed
tunnel shapes
(relative co-
ordinates)



LiCAS Simulation Results (TESLA)

Achieves goal
for TESLA of
200 micron
transverse
alignment over
600m



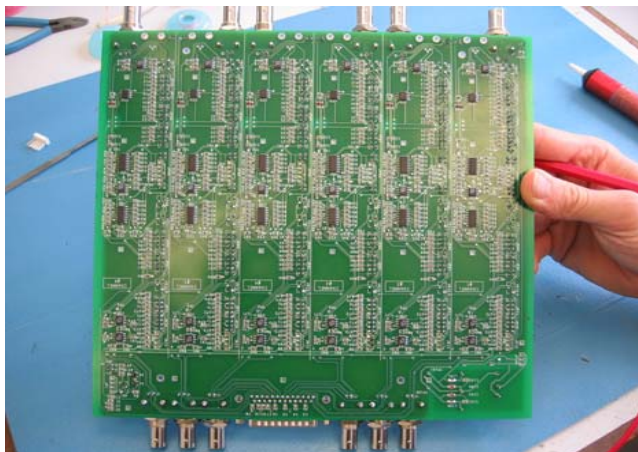
LiCAS Development

Prototype survey car:

2004: Single-car sensor

2005: 3-car prototype
deployed in dedicated 70m
tunnel at DESY

2007: 5-car prototype
available for use in TESLA
XFEL tunnel

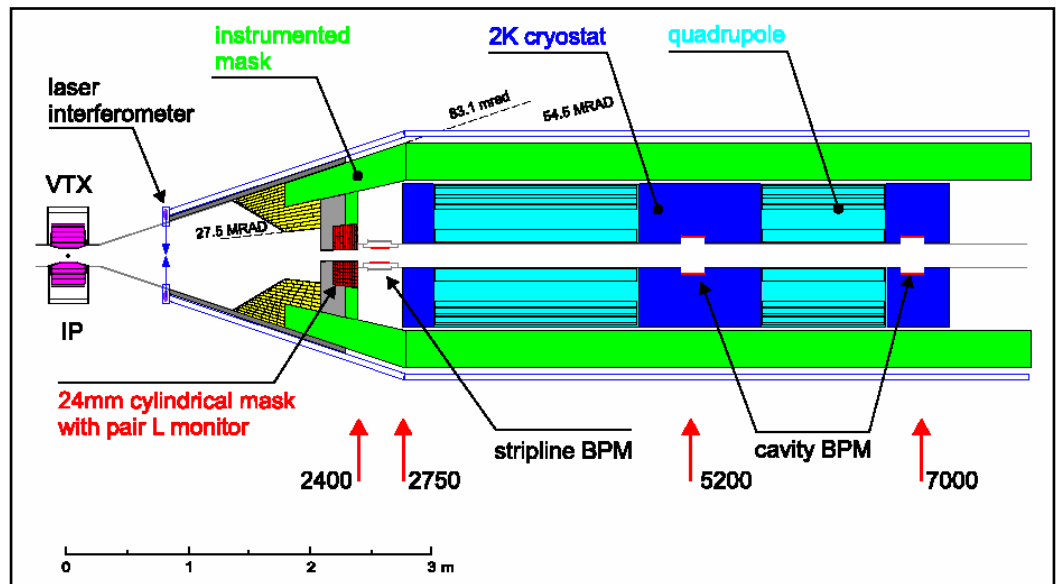


Prototype readout board

4. Final-focus Luminosity Stabilisation (QMUL, Oxford, Daresbury)

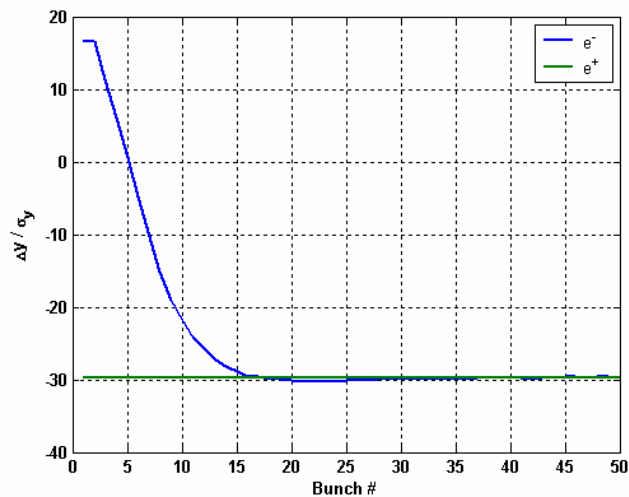
- **Beam-based feedback:**
Worked primarily on intra-train FB as complement to 'IP FB' (train-train) + active mech. stabilisation schemes (warm design)
- **Simulated intra-train FB for J/NLC, TESLA, CLIC**

**Location of
FB BPM:**

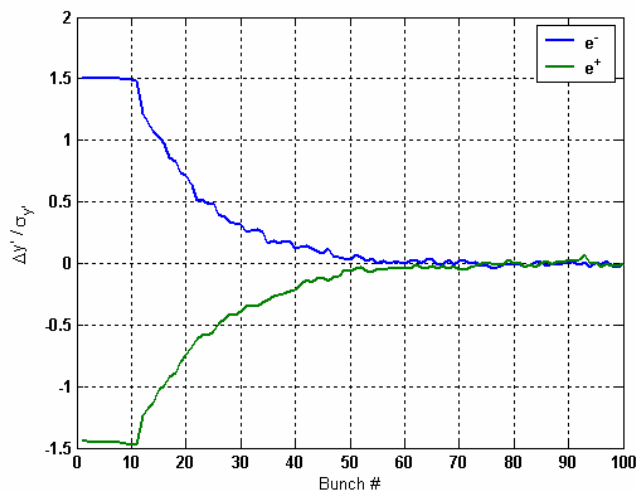


FONT Luminosity Recovery (TESLA)

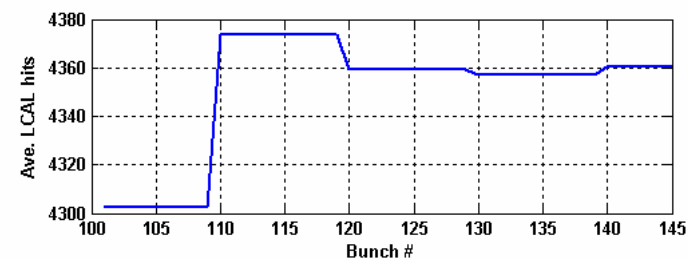
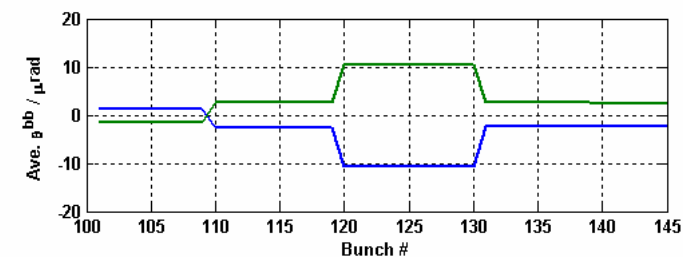
Posn. FB



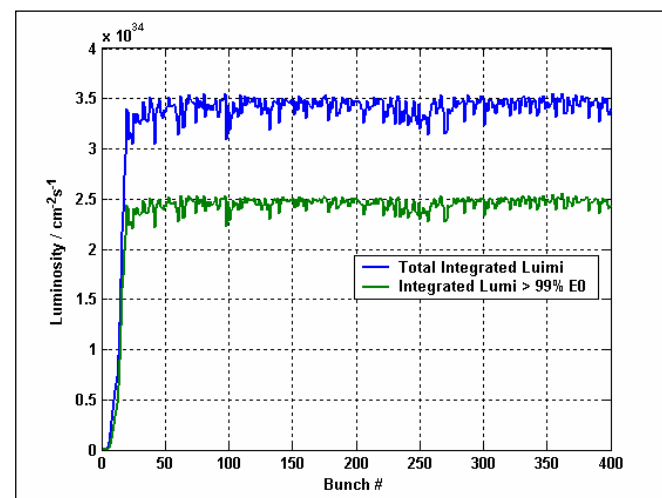
Angle FB



Lumi scan

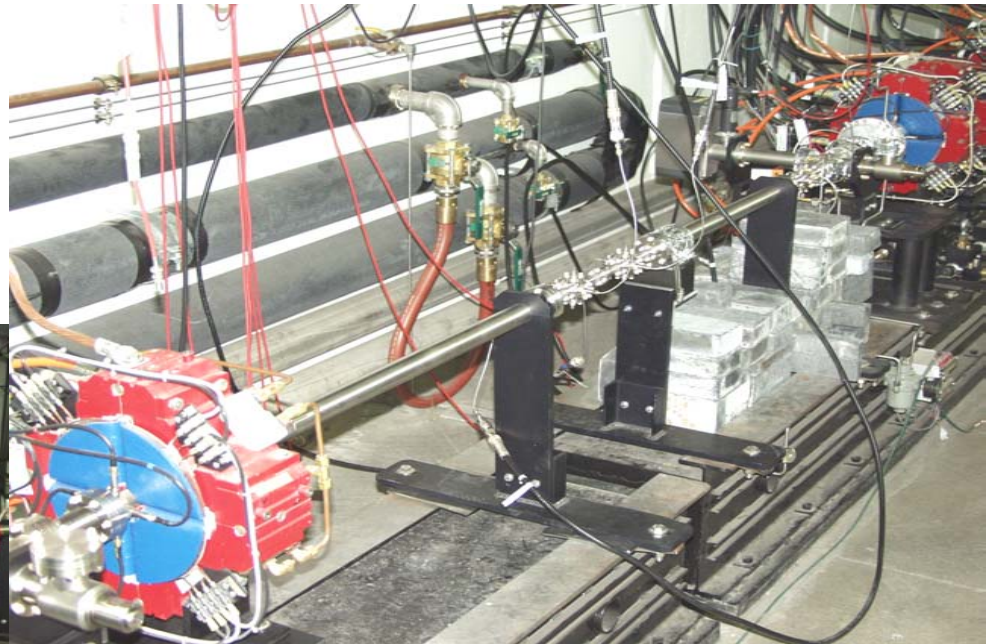


Optimised Lumi

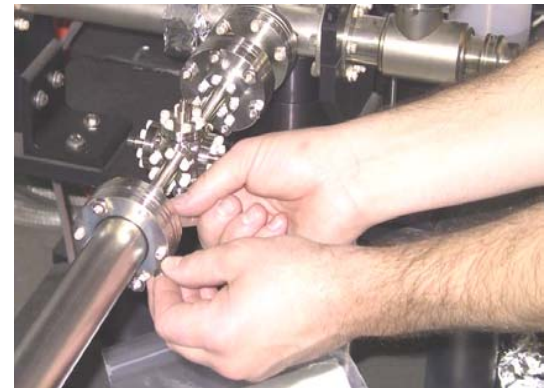


FONT prototype at SLAC NLCTA

Dipole and kickers

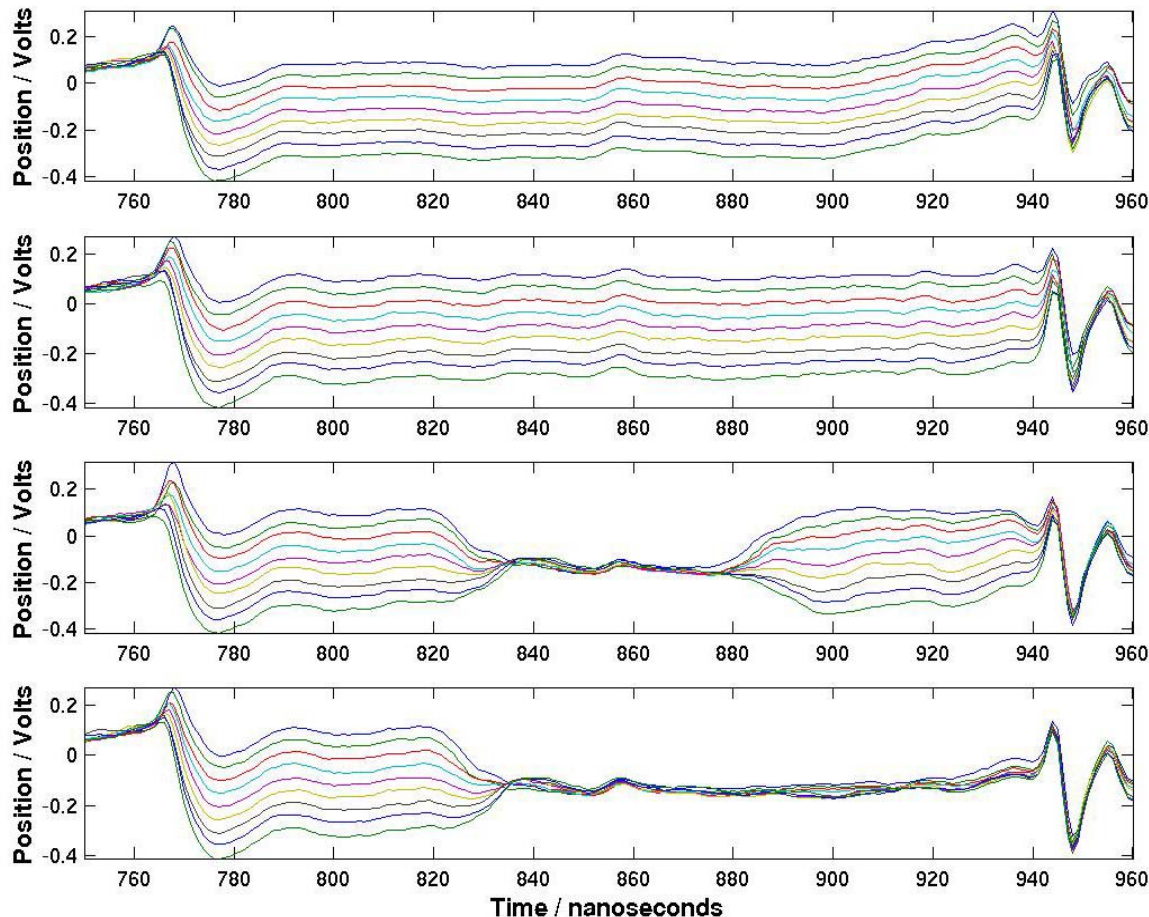


Advanced
BPMs



FONT2 initial results: feedback mode

Jan 19th: BPM 2: First run



Beam starting positions

Beam flattener on

Feed forward on

Feedback on

Integration of Stabilisation and Feedbacks

Survey + alignment:

Beam-based alignment:

Slow-orbit beam feedbacks:

Active stabilisation schemes:

Pulse-pulse beam feedbacks:

Intra-train beam feedbacks:

Timescales/frequencies:

year (complete), weeks (local)

weeks – days

hours – minutes

seconds – milliseconds

milliseconds

microseconds (TESLA)

nanoseconds (J/NLC, CLIC)

**Need to understand, through performance simulation, hand-over
between these systems:**

**avoid: feedback ‘competition’
frequency ‘shuffling’**

5. Positron Source Undulator + Crab Cavity

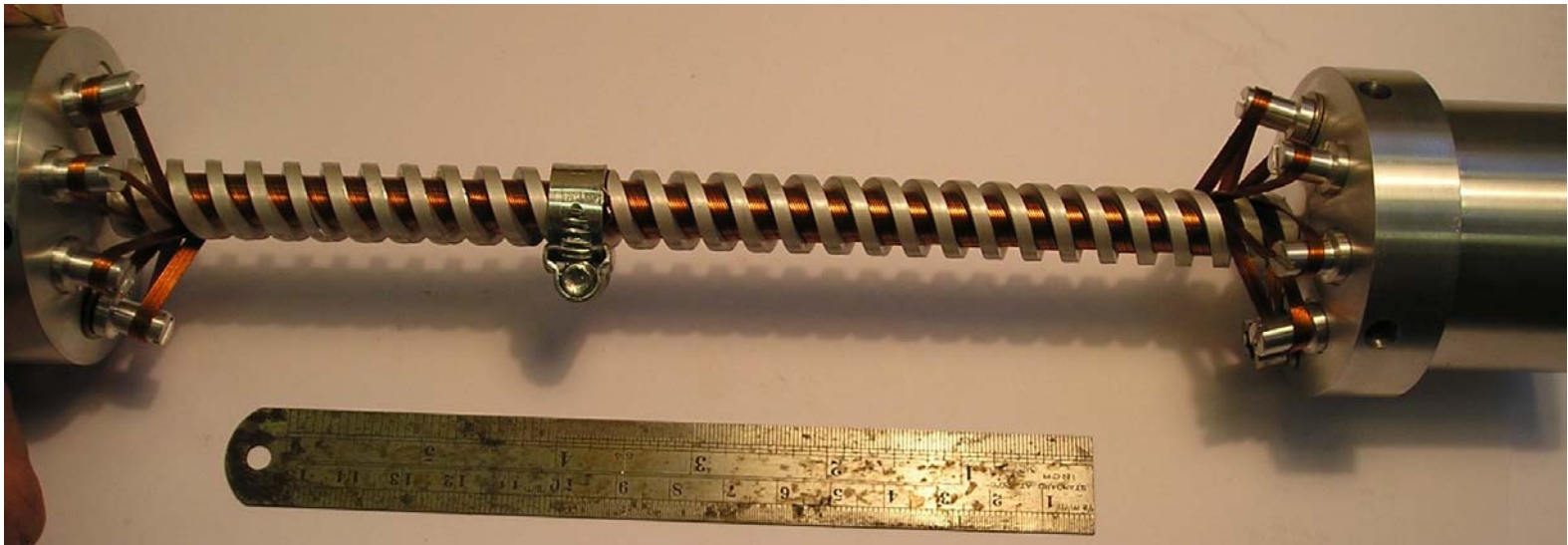
(Daresbury, Durham, Liverpool)

- 5.1 e⁺ source undulator design:

Baseline method for TESLA, in consideration for NLC

Polarised e⁺ -> helical undulator (E166 expt)

Design work for TESLA helical undulator in progress:



Detailed engineering design, prototyping, test with beam

- 5.2 Crab cavity design (for IR with crossing angle):

Overlap of interest with angle FB systems; UK RF company interest

6. Machine Detector Interface

(Bristol, Cambridge, Lancaster, UCL)

6.1 Measurement of Luminosity

Energy Spectrum (MOLES):

Absolute E (survey, alignment)

E jitter (fast BPMs)

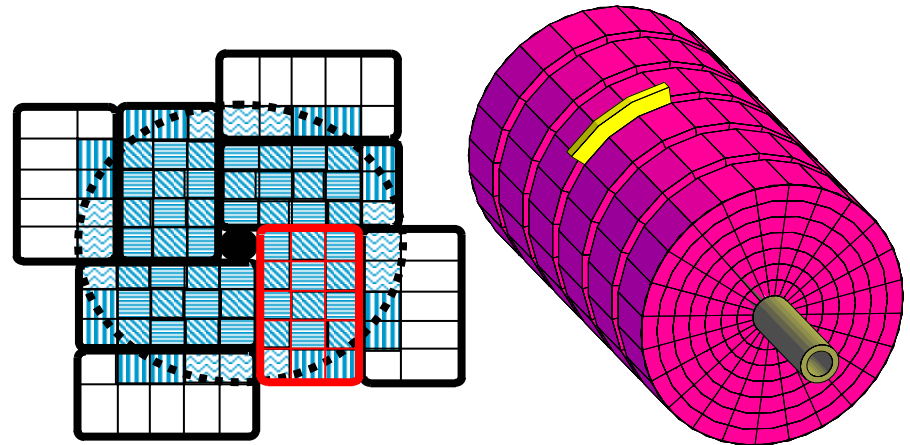
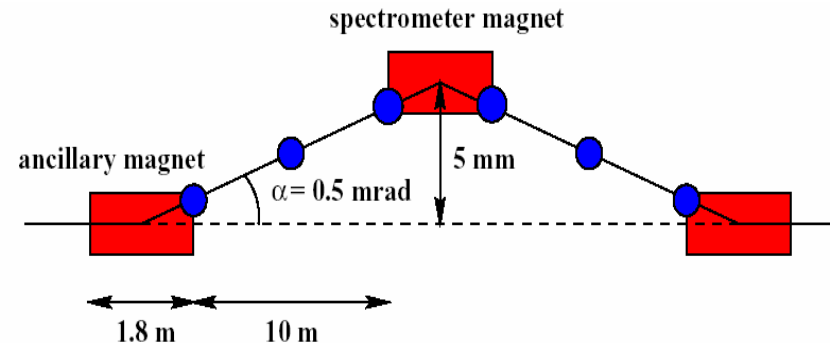
E dispersion (laserwire?)

6.2 Small-angle fast calorimetry:

PbWO₄ + vac photodiodes:

Rad hard + fast (no local amp)

6.3 IR layout + integration



Extremely important but not funded!

Summary and Outlook

- Embarked on a substantial UK LC BDS work programme
- Have expertise in some areas, learning in many others
- Aiming to build a strong, coherent design team:
intellectually interested in BDS
aim to prepare UK funding agencies for a UK LC contribution
- Collaborating w. European partners via 'Framework 6' programme:
EU funded LC 'network' to facilitate interactions
Drafting 'design study' proposal for LC design work
- **We look forward to working with you all!**