ILC positron source
Helical Undulator update

Alison Birch

On behalf of the Helical collaboration

Science & Technology Facilities Council

helical

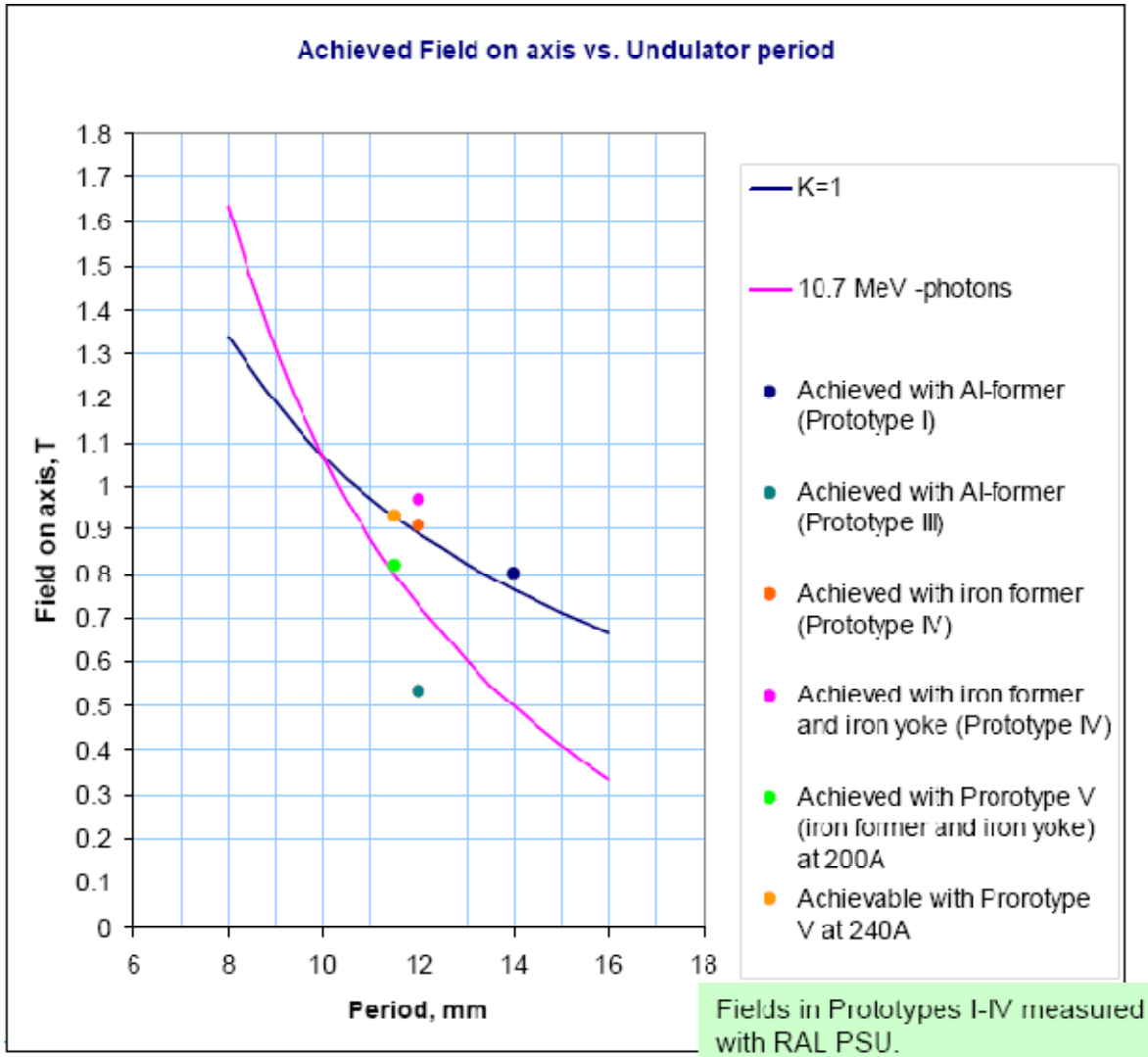
Introduction

- UK funding update
- Undulator update
  - Prototype testing
  - 2K operation
  - 4m module
  - Taper Wakefields
  - Radiation from multiple modules

UK funding update

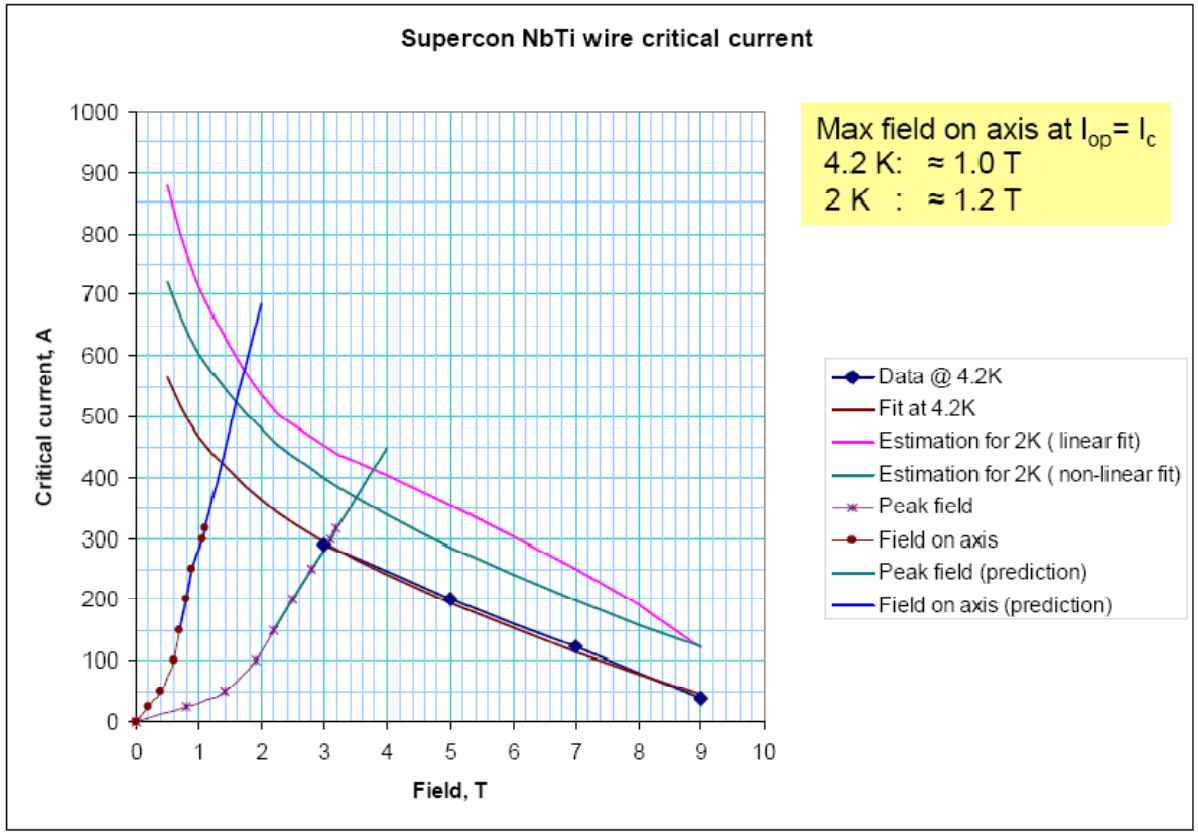
- Funding for the next financial year (April 08) leftover from LC-ABD1 and Eurotev
- LC-ABD2 got one year's worth of funding, split between the different work packages
  - however undulator work package got (virtually) no funding
- PPARC and CCLRC merged to form STFC, over the next year there will be a comprehensive review of all projects
- Will have to wait and see

Undulator Prototypes



Fields in Prototypes I-IV measured at 200A with RAL PSU.

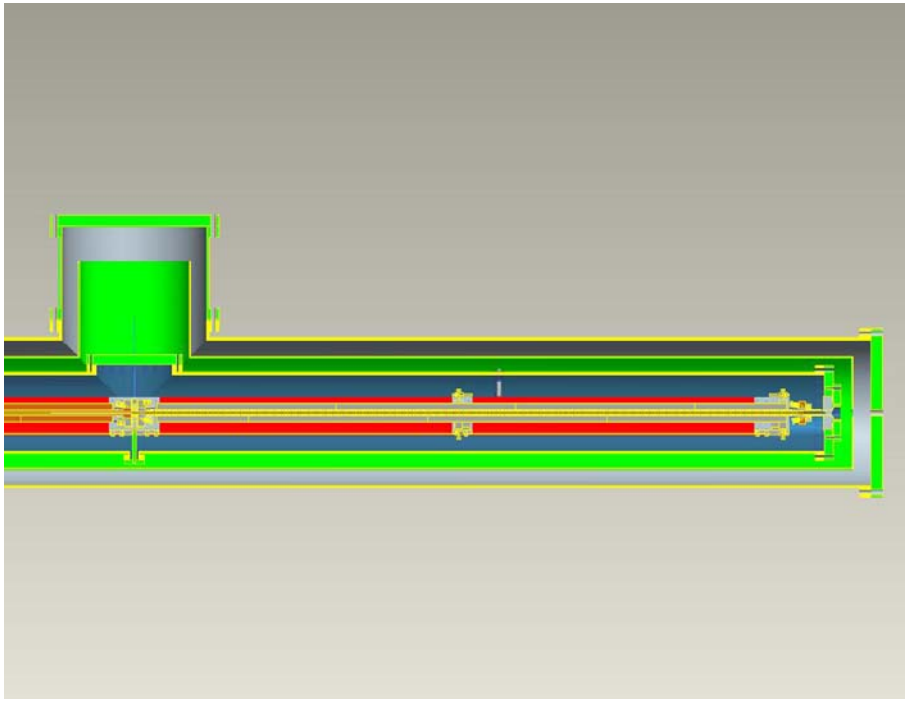
Undulator Field at 2K



- Lowering undulator working temp from 4 to 2K gives about 20% gain in the field on axis

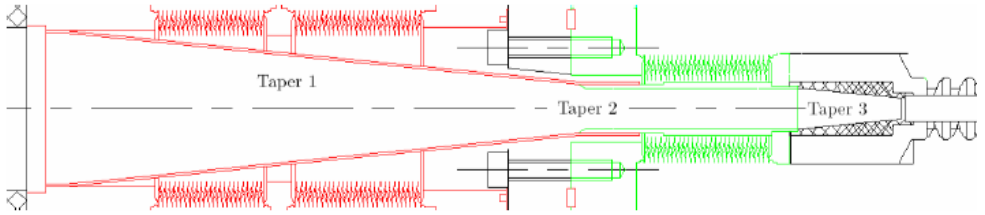
4m module

- Complete testing of Magnet 1 –August 2007
- Complete testing of Magnet 2 –September 2007
- Complete Magnet/Cryostat assembly –November 2007
- Complete Testing of 4m Module –December 2007

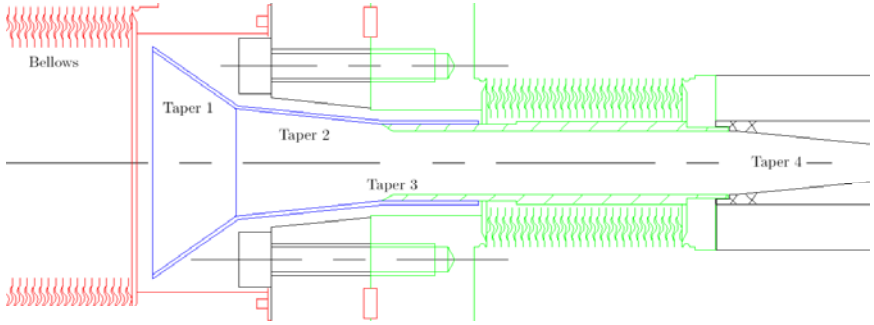


Taper Wakefields

- There are two designs for the tapers
  - Shielded
    - result in trapped volumes of air
    - Would need holes in taper, for ILC parameters this is unsolved problem
    - LHC has holes, but a bunch length of 7cm, ILC is 150 microns



  - Unshielded
    - Pumping holes can be avoided

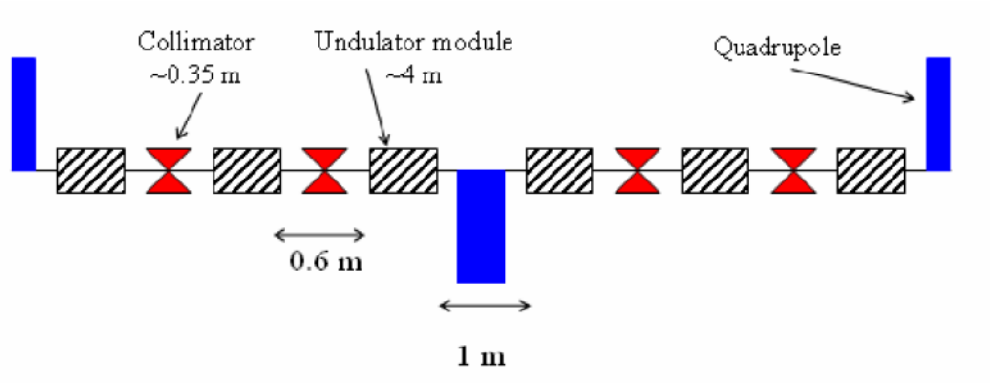


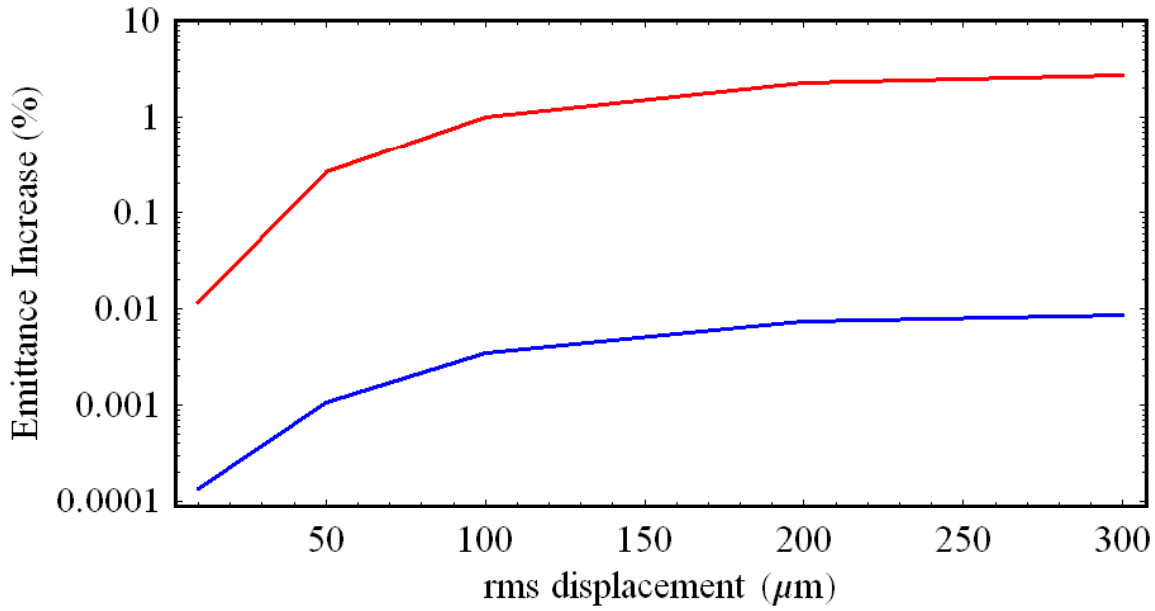
Model	Unit	K
Analytic, Shielded Layout	V pC^{-1} mm^{-1}	1.34
ECHO, Shielded Layout	V pC^{-1} mm^{-1}	0.93
ECHO, Unshielded Layout	V pC^{-1} mm^{-1}	0.96

Emittance increase

-Elements of the lattice being misaligned is equivalent to beam being off axis, and causes a kick

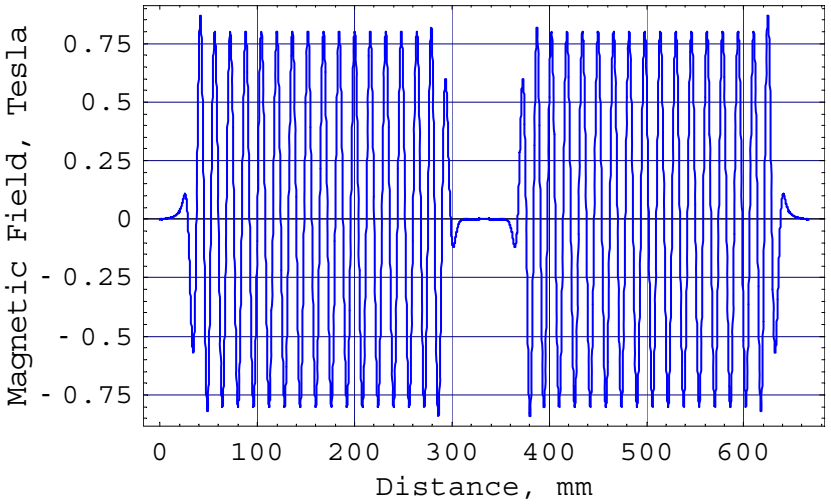
-The emittance increase was calculated, from the mean of 10,000 lattices with different misalignments

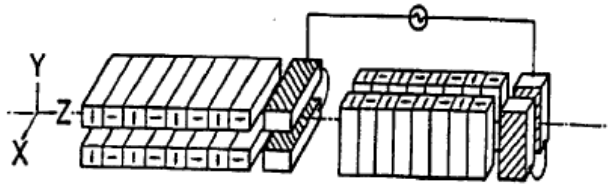




Undulator Modules

- ILC positron source undulator requires small gaps between each undulator module
- interference effects occurring between the radiation from the different modules may effect the polarisation of photons
- Using programme SPECTRA to model these effects in two helical undulators with a gap between them

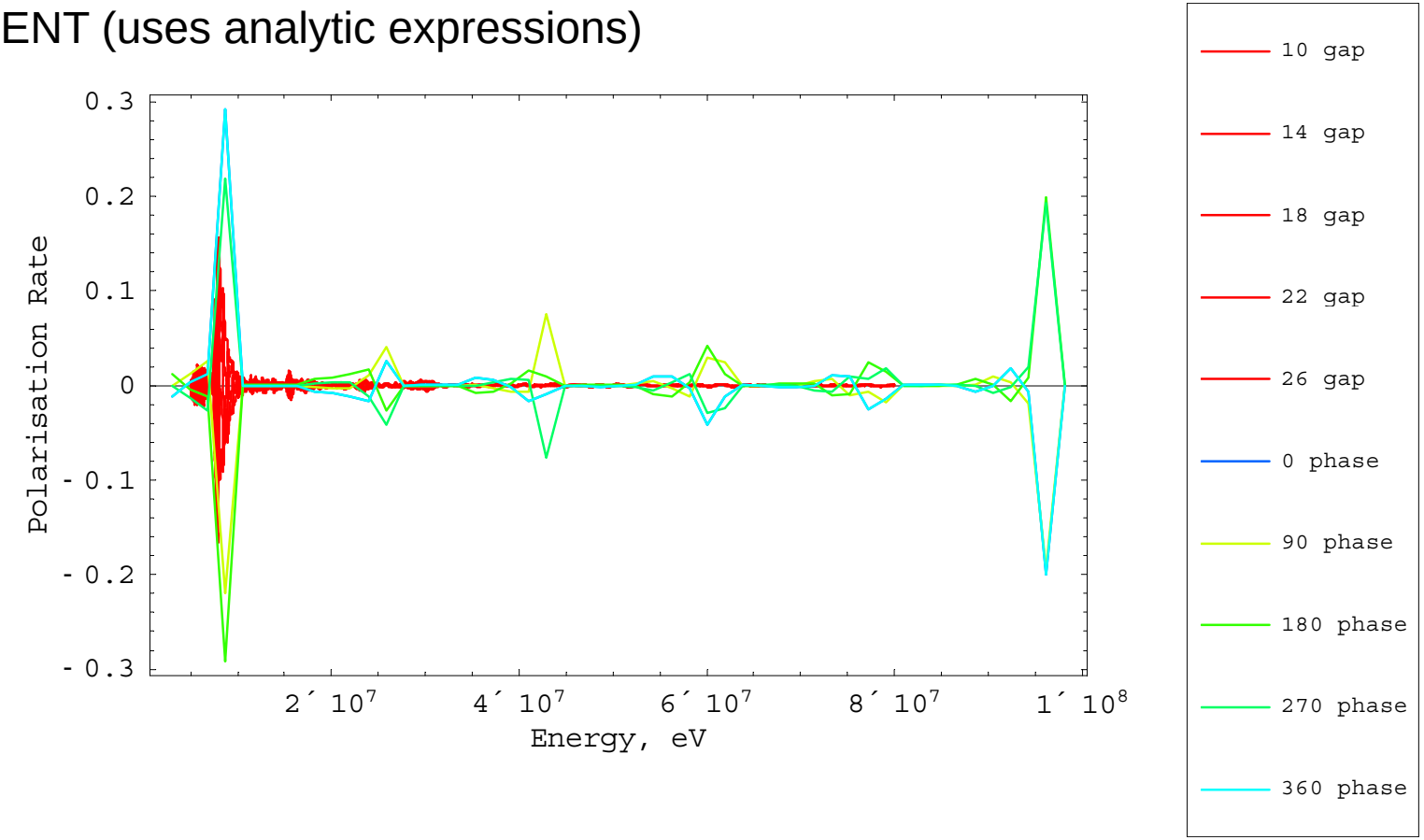




- There is no easy way to check results from SPECTRA for an arbitrary magnetic field
- Can compare results for a crossed undulator in URGENT to the results for a crossed undulator in SPECTRA

Undulator Modules

Circular polarisation rate of radiation emitted from 2 crossed undulators, calculated in SPECTRA (user defined magnetic field) and URGENT (uses analytic expressions)



Undulator Modules

- SPECTRA does not agree with the crossed undulator results from URGENT
- URGENT may be calculating the polarisation after a monochromator
- The radiation from an electron passing through two crossed undulators consists of a linearly polarised oscillation in the x plane followed by a linearly polarised oscillation in the y plane
- “These two linear oscillations combine to give rise to an elliptical oscillation in the frequency domain, because the dispersive elements of a monochromator mixes signals arriving at different times” Kwang Je Kim, NIM 219 (1984) p425
- Possible SPECTRA does not consider a monochromator after the undulators
- Does the positron target act as a monochromator?
- Understanding what happens to the polarisation is not intuitive
- 4m test module could be used for an experiment to test this

Next Steps

- Concerns from the MAC about the photon heating in the undulator module
  - Initial calculations were done (EPAC 2004), more detailed calculations yet to be published, but things seem okay
- How trajectory/Jitter errors effect the polarisation of the positrons needs to be calculated in more detail
- How important is it to reach the baseline spec of 10mm period?
  - Operate at 2K
  - Decrease operating margins
  - ‘Better’ iron for poles