# Helical Undulator Status

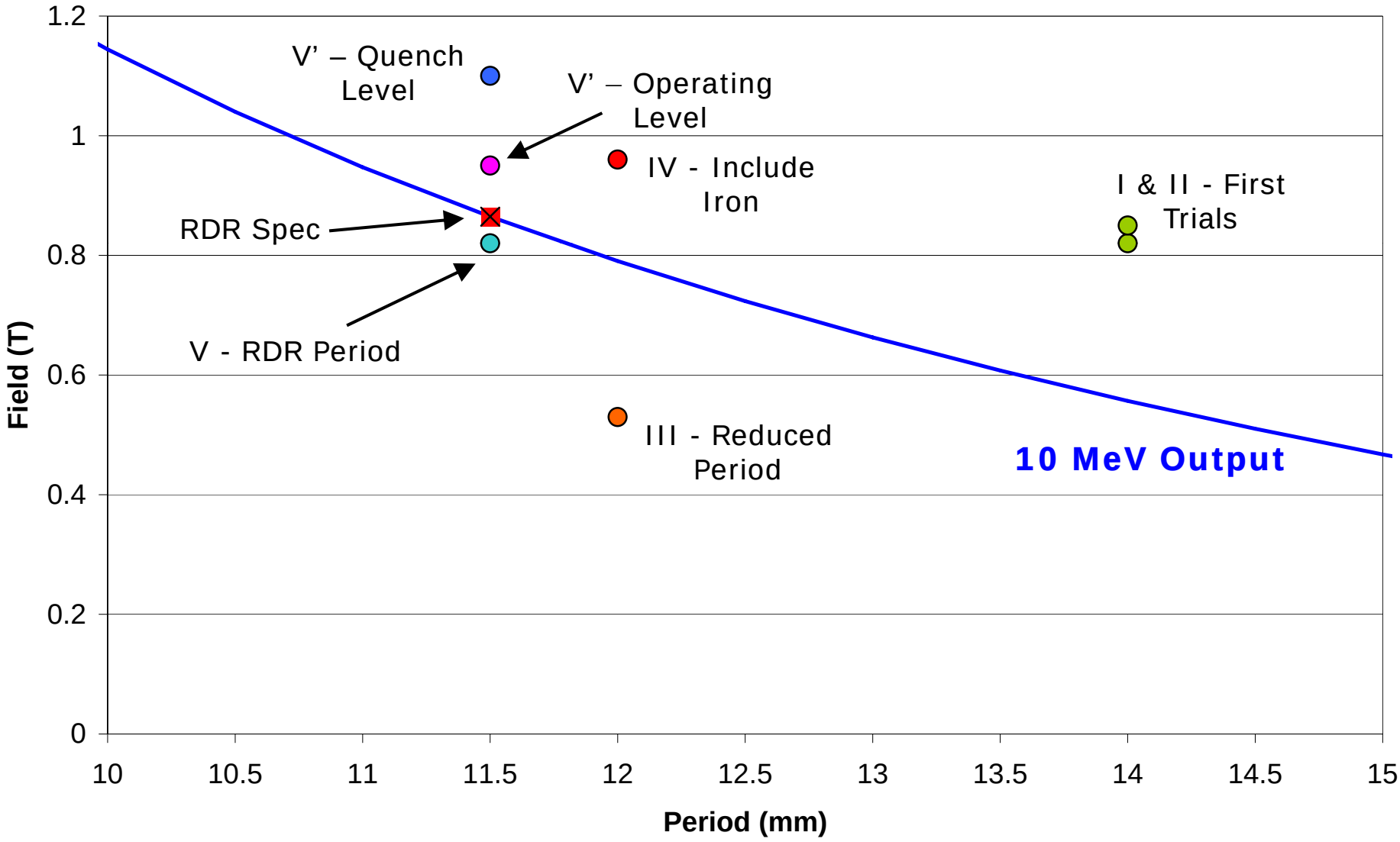
Jim Clarke

ASTeC, STFC Daresbury Laboratory

# Recap

- STFC are building a full scale 4m undulator module which is needed for the positron source
  - ➔ 2 x 1.75m undulators
  - ➔ RDR parameters
  - ➔ Stand-alone cryosystem
- Previously several short prototypes were completed and focus is now on manufacture and testing of 4m cryomodule.

# Prototype Field levels achieved



# Present Status

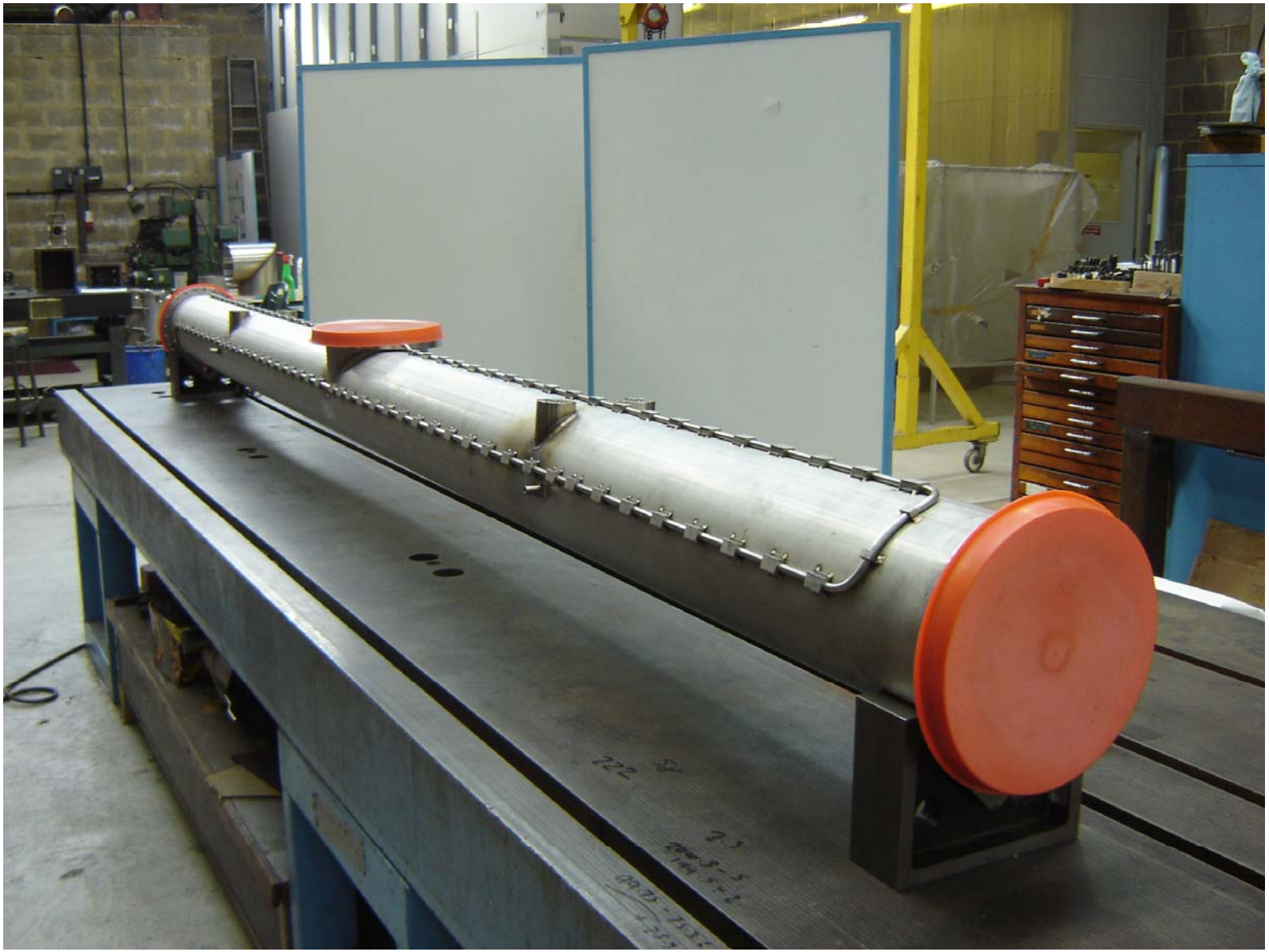
- Undulator I
  - ➔ Manufactured and fully (vertically) tested
  - ➔ Now being e-beam welded to bellows
- Undulator II
  - ➔ Manufactured and magnet tests have started
- Cryomodule
  - ➔ All major components and tooling at RAL except helium bath (delivery 2 to 3 weeks)
  - ➔ Turret undergoing trial assembly
  - ➔ Module trial assembly to start when bath delivered
- Plan
  - ➔ Complete end June – bath and Und II tests on critical path

# Vac Vessel, Turret, Und II

# Vertical test stand

# Helium Bath at Manufacturers

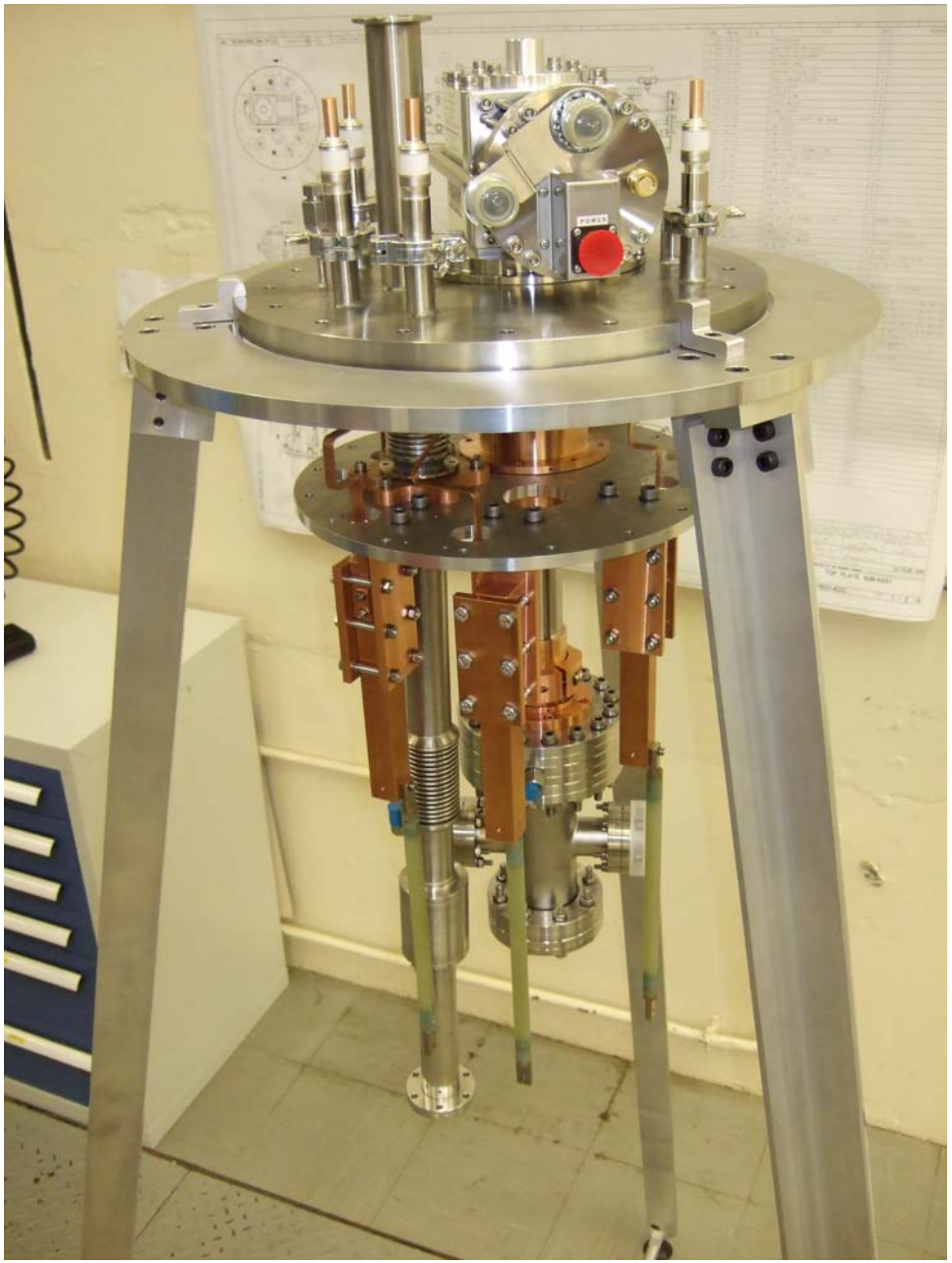




# Thermal Radiation Shield



# Turret (trial assembly)



# Undulator Measurements



- 1.75m module mounted vertically in liquid helium bath
- 2m carbon fibre rod with two hall probes mounted orthogonally to each other and undulator axis
- Logging system controls a stepper motor to move the probe through the undulator and then take voltage readings from the two hall probes
- Probes can be orientated in 8 directions (0, 45, 90, 135, 180, 225, 270, 315 deg)

# Measurements Taken - Magnet 1

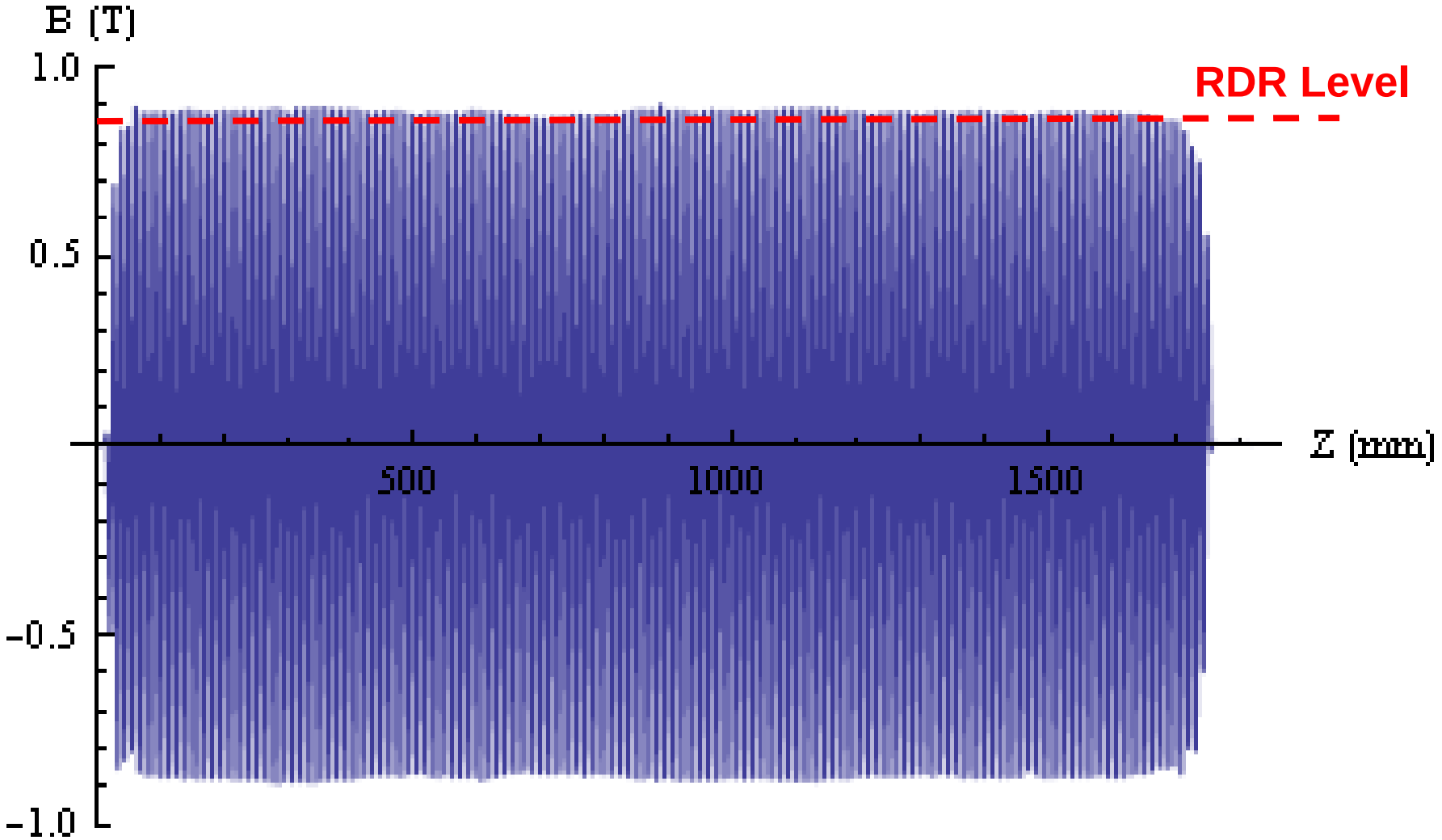
- Have taken two measurements (at least) of whole undulator in each of 4 probe directions (0, 90, 180, 270), each measurement is with two probes so we therefore have at least 4 sets of data in each direction.

- Also have repeated measurements of each end (50mm long, top and bottom) in each of the 8 directions.

- Have also quench tested the magnet.

# Example Field Map



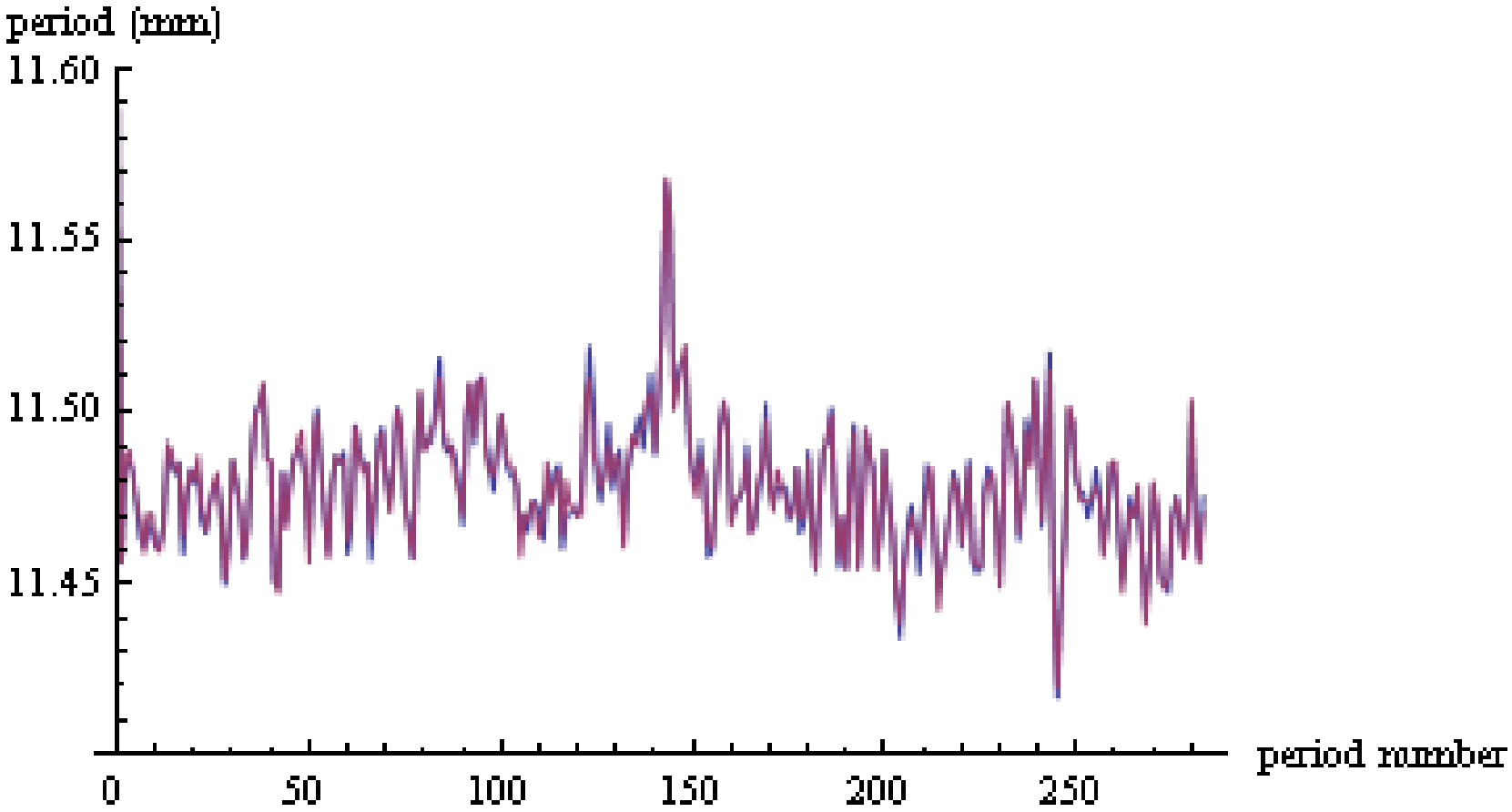



Field measured at nominal current of 215 A

RDR Field level (0.86 T) achieved for the first time in a full length magnet (peak field is 0.88 ± 0.014 T)

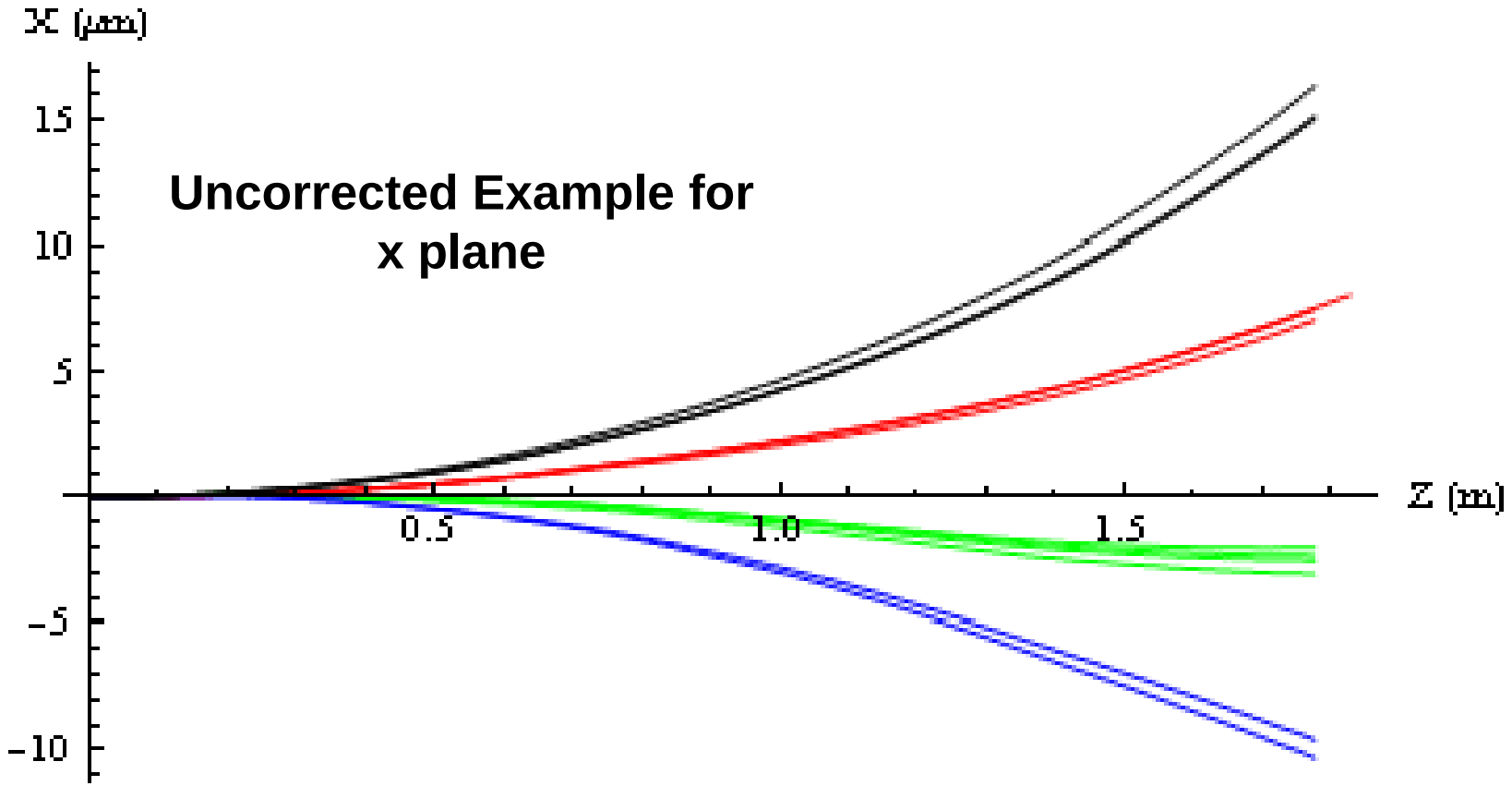
# Undulator Period

- Undulator periods measured by identifying positions in fieldmap where B=0T
- Mean period length found to be 11.48mm with std dev 0.02mm
- RDR period length is 11.5mm



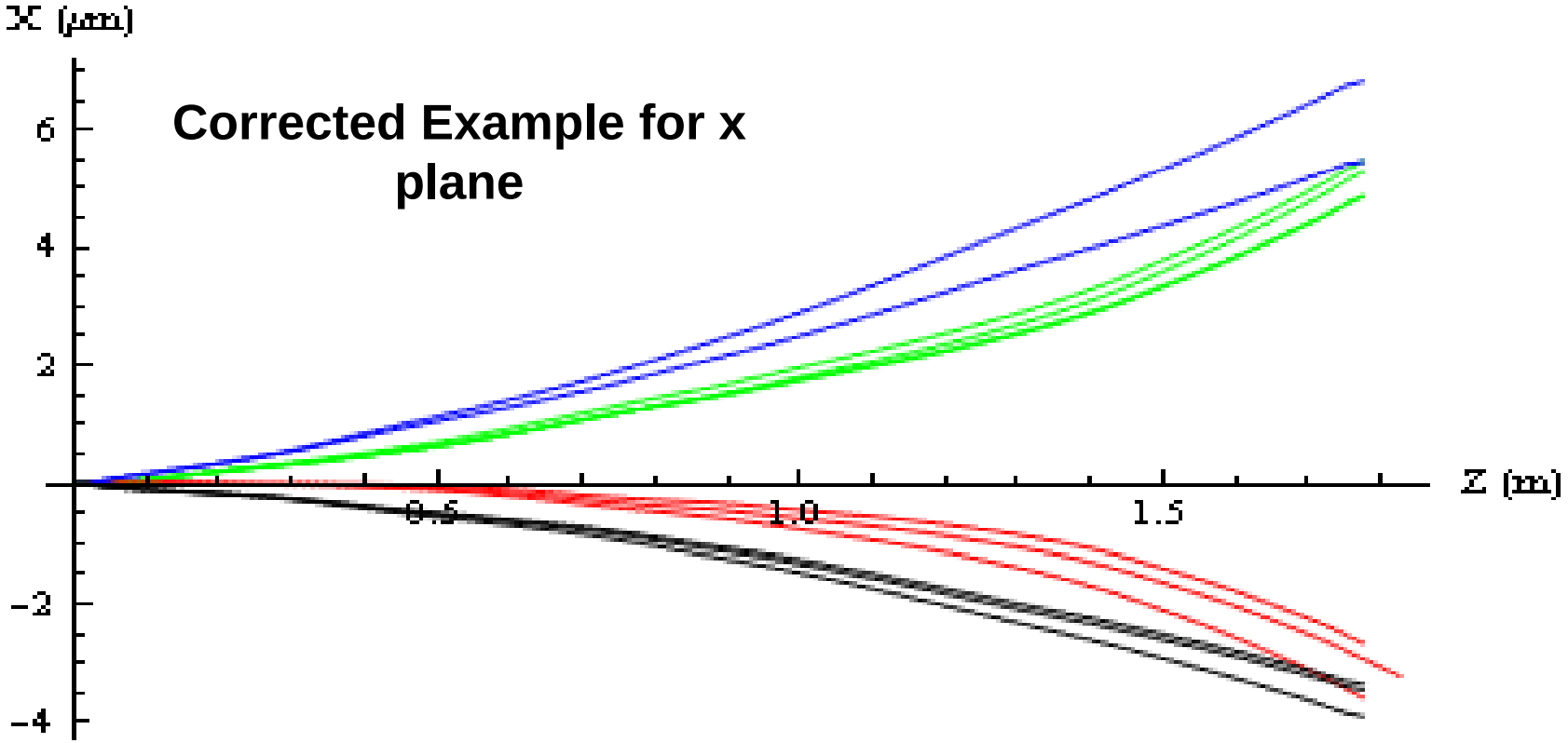
# Trajectories

- Trajectories were modelled using SPECTRA
- Trajectory models show good repeatability when probes are in the same orientation
- Using uncorrected raw data trajectories see curvature due to biases in the hall probes

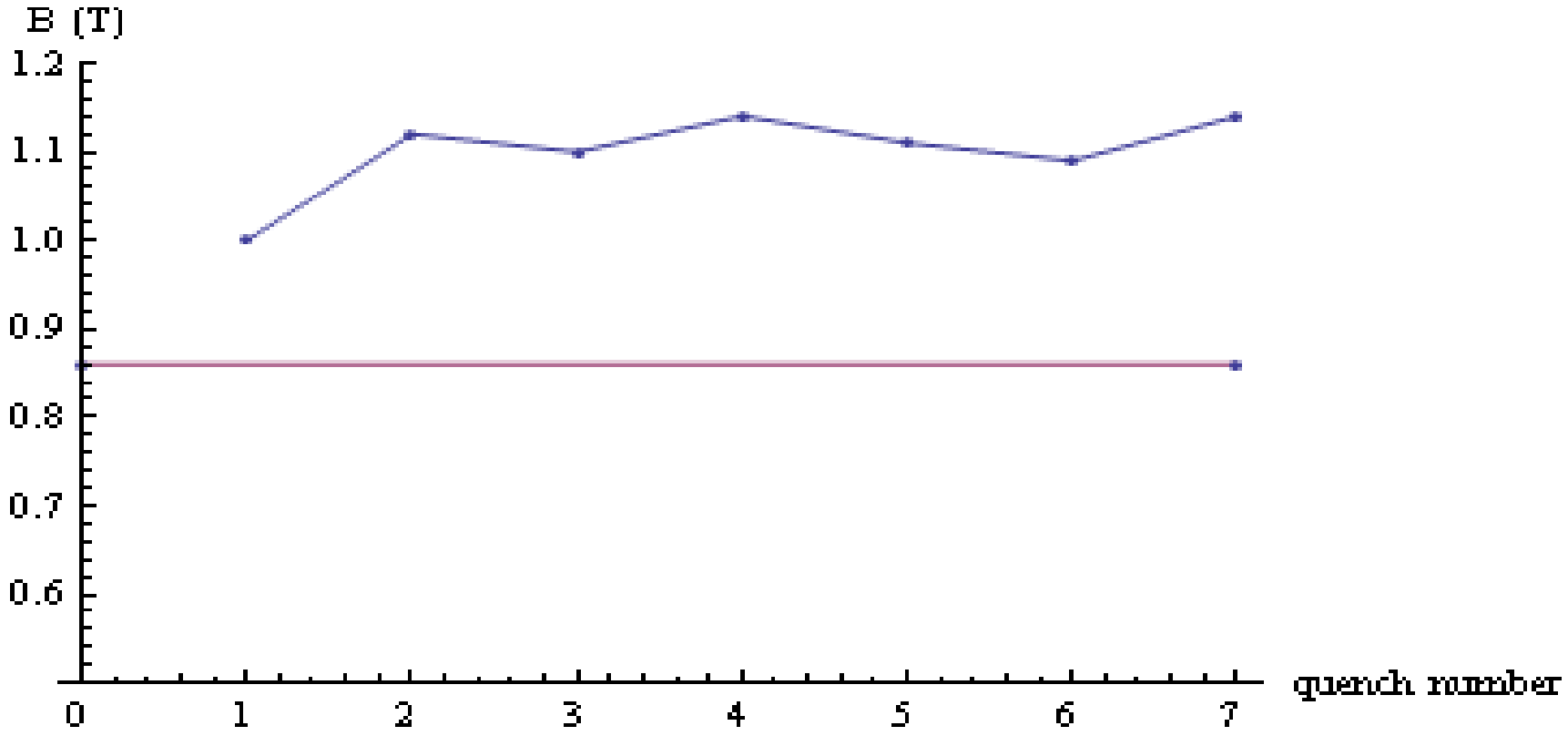


# Trajectories

- Have corrected for voltage offset by looking at average voltage values in zero field regions before the probe enters and after it exits the undulator's field
- Assumed linear variation in offset along undulator's length
- This correction improves the trajectories, however further improvements are expected after taking measurements with no magnet in the cryostat



# Quench Tests




- Peak field strength when magnet quenched during training shows that the superconductor is stable up to ~1.1T
- Also shown is the RDR field specification (0.86T)
- Good safety margin for long term operation of ILC

# Summary

- The 4m full scale cryomodule is in the final stages of manufacture
- It will be completed this summer
- The vertical magnet tests for the first ever 1.75m undulator are excellent