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Undulator Measurements

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on
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Undulator Measurements

Test setup

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Undulator field strength

Trajectories

Quench data

Measurement setup

2m 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)

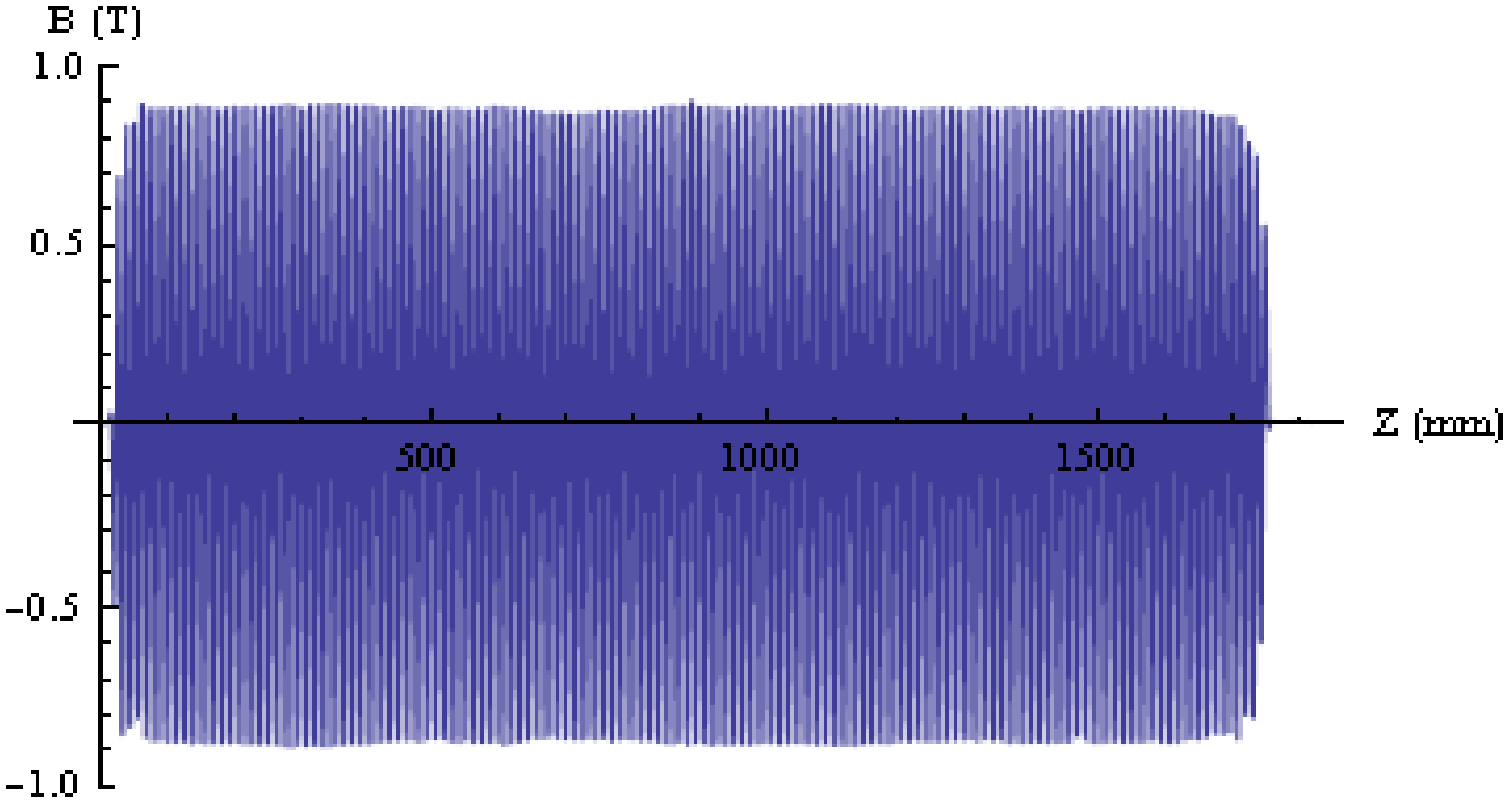
Measurements Taken - Magnet 1

Have repeated measurements 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

Measurements Taken - Magnet 1



Example fieldmap

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Undulator Period

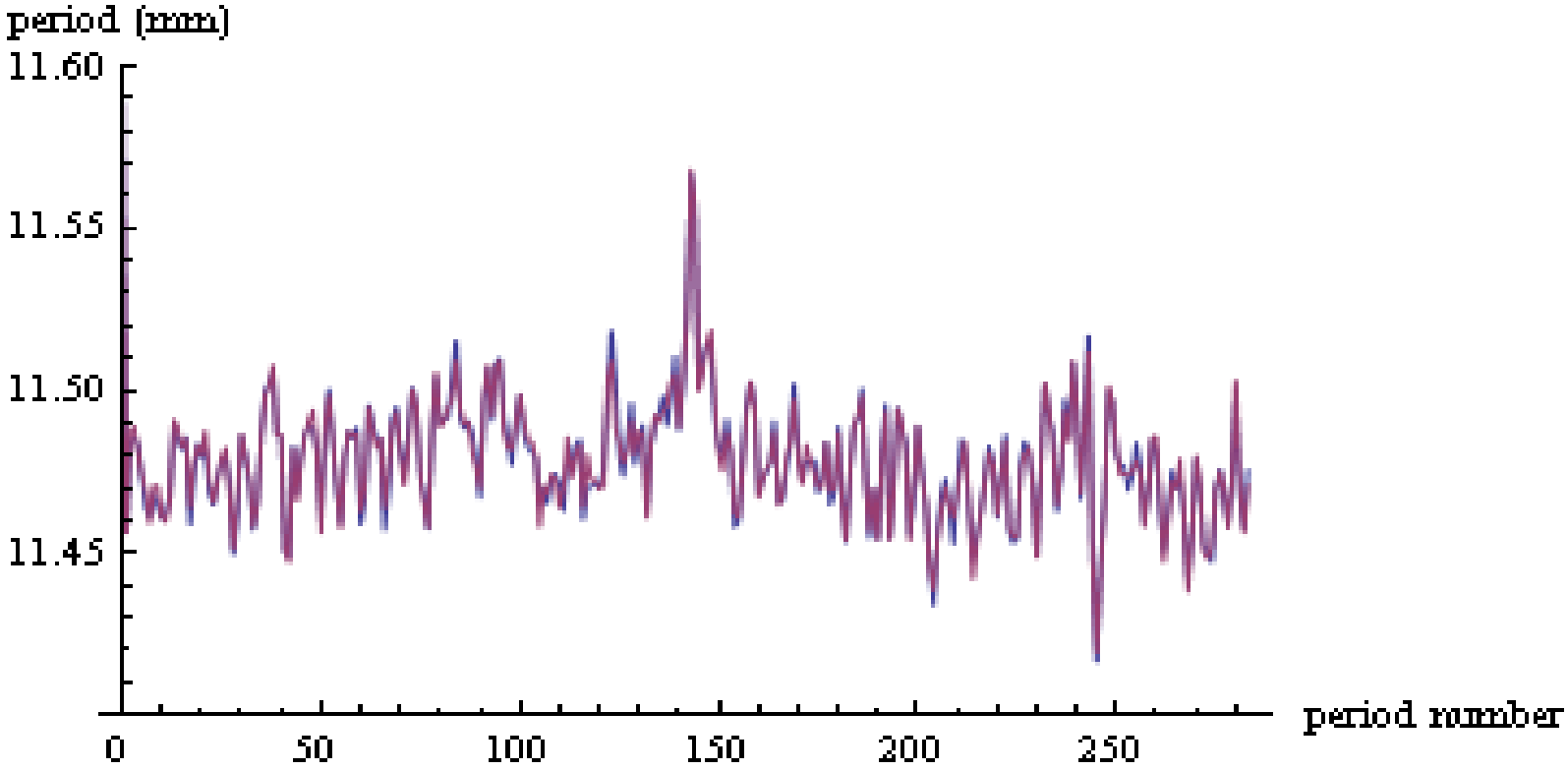
Undulator periods measured by identifying positions in fieldmap where B=0T

Mean period length found to be 11.48mm with std dev 0.02mm

Have identified one slightly larger period near the midpoint of magnet 1

RDR period length is 11.5mm

Undulator Period



Example plot of period lengths for two measurements of magnet 1

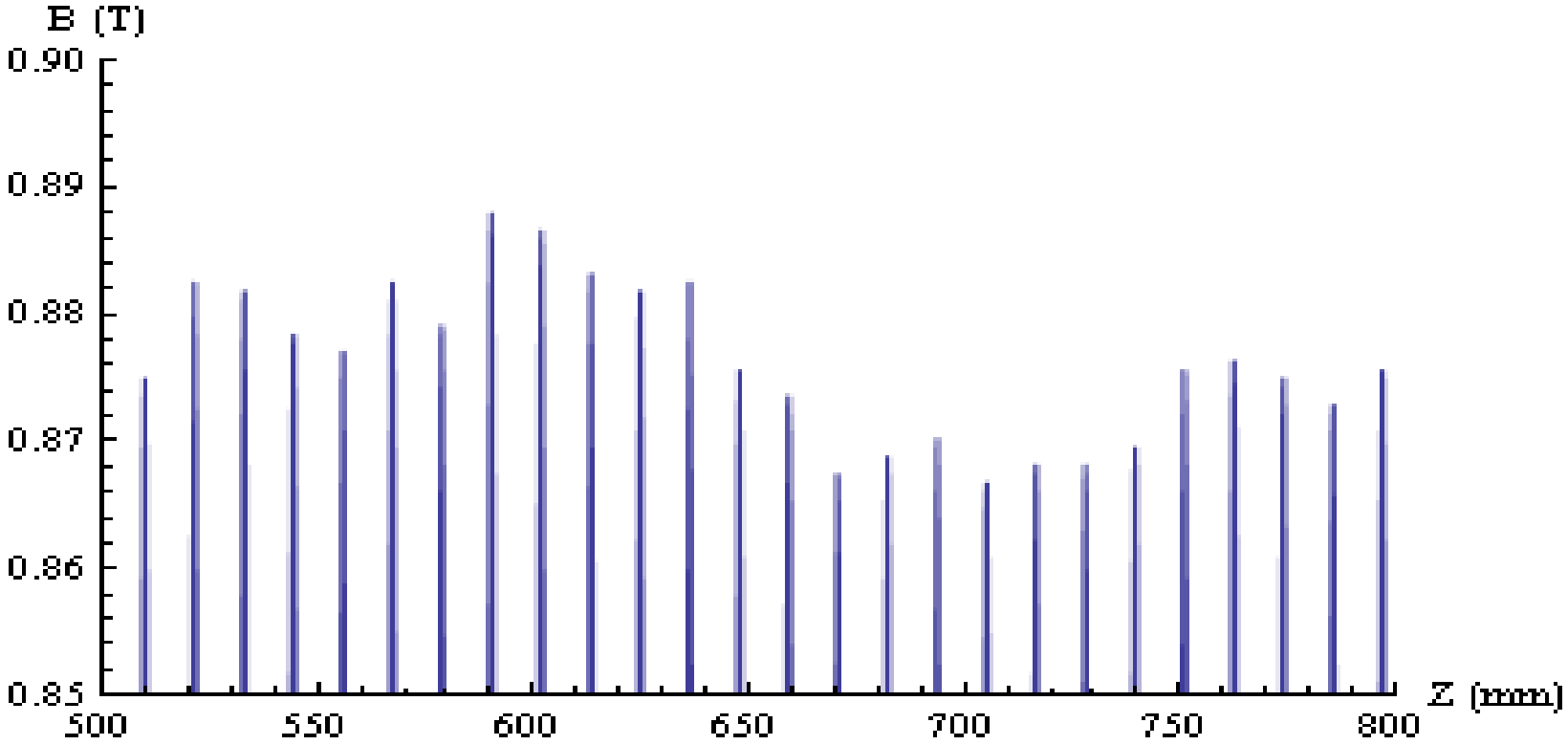
Undulator Field Strength

Have identified field strength by taking the peak values of the fieldmaps, having converted hall probe voltages into field strengths

Mean field strength is found to be 0.88T with std dev 0.014T

RDR field strength is 0.86T

Undulator Field Strength



Plot of magnetic field in one plane showing the variation in the peak field value

Trajectories

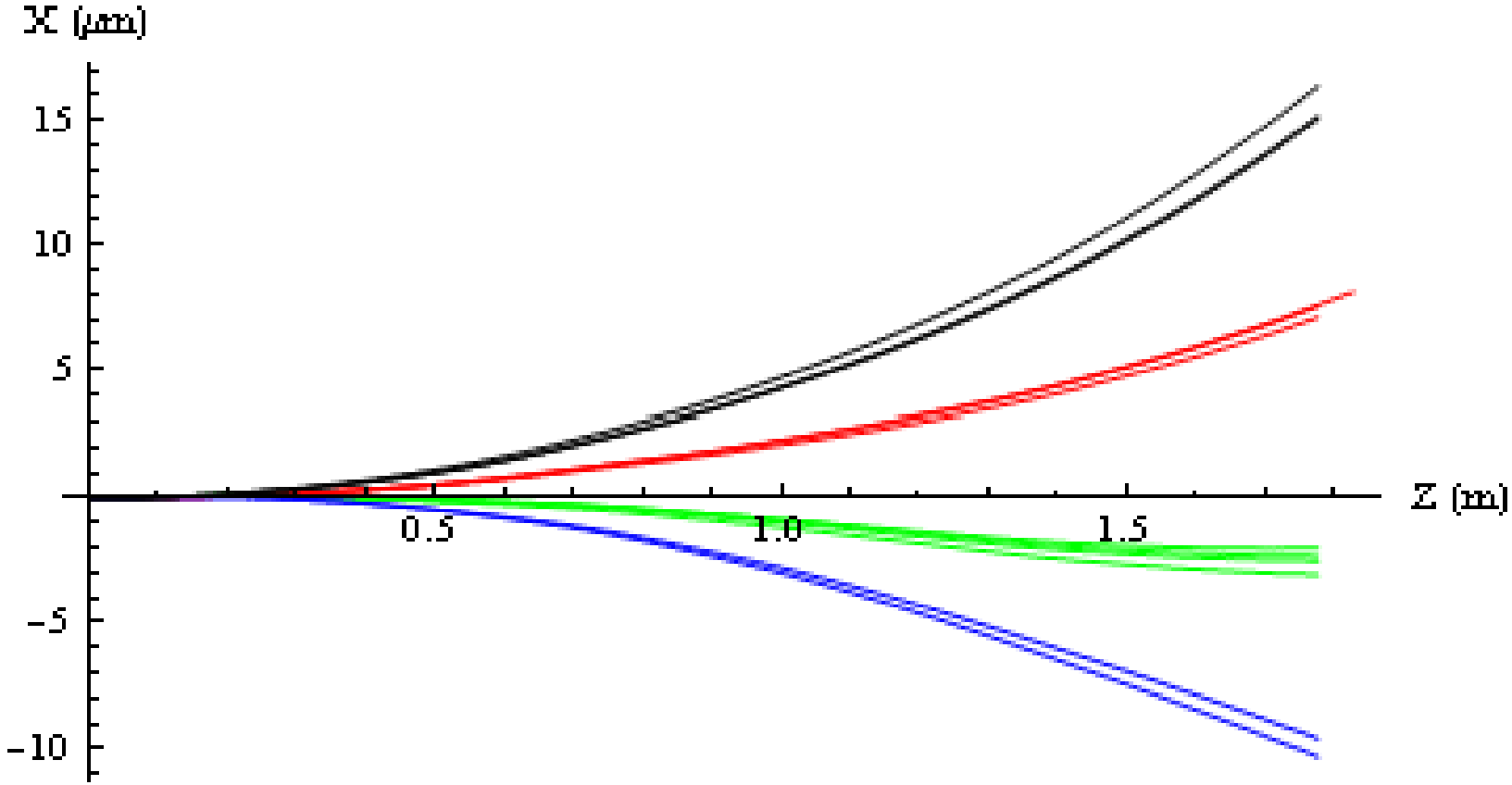
Trajectories were modelled using SPECTRA

Trajectory models show good repeatability when probes are in the same orientation

Using uncorrected raw data trajectories show bending due to biases in the hall probes

Uncorrected trajectories leave 2m long undulator up to ~ 15 microns off axis

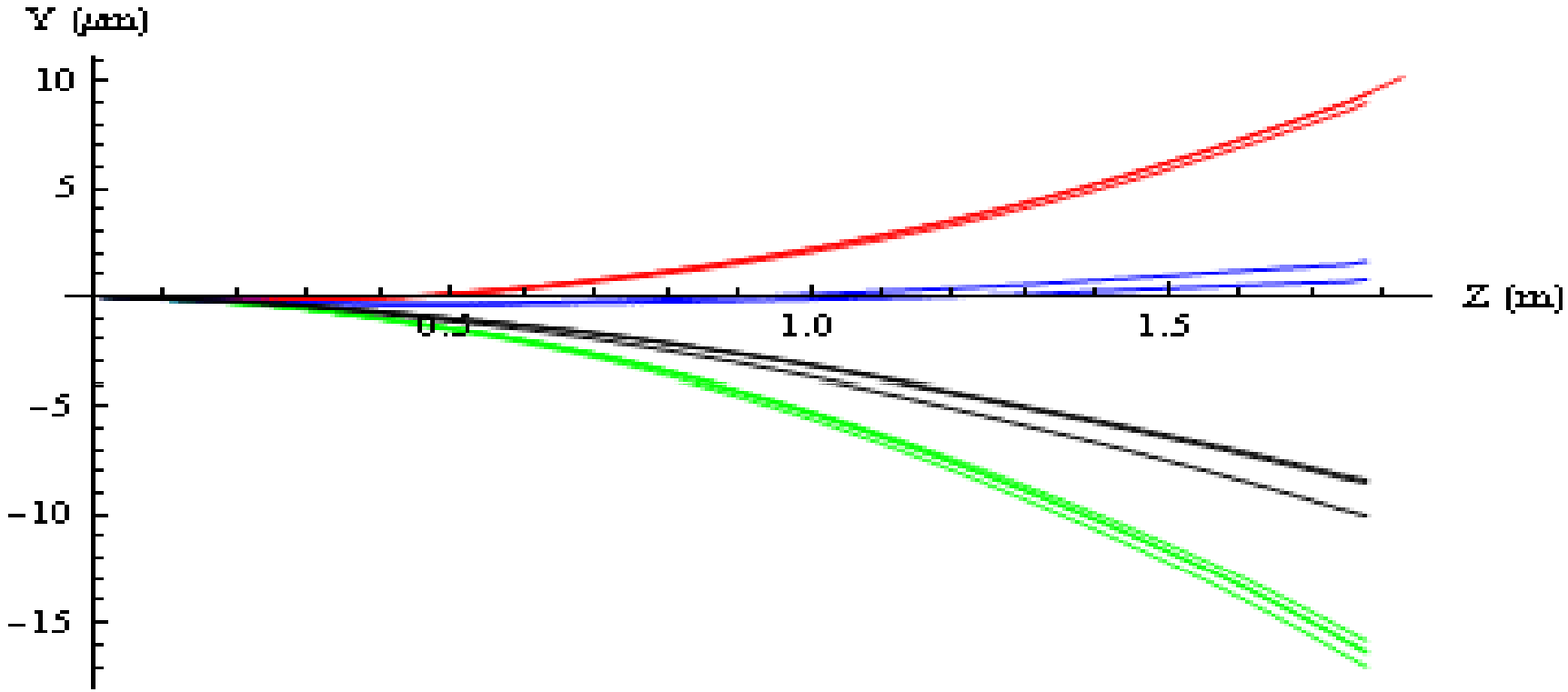
Trajectories



Plot of uncorrected trajectories in X-plane

Each colour corresponds to a different probe orientation

Trajectories



Plot of uncorrected trajectories in Y-plane

Each colour corresponds to a different probe orientation

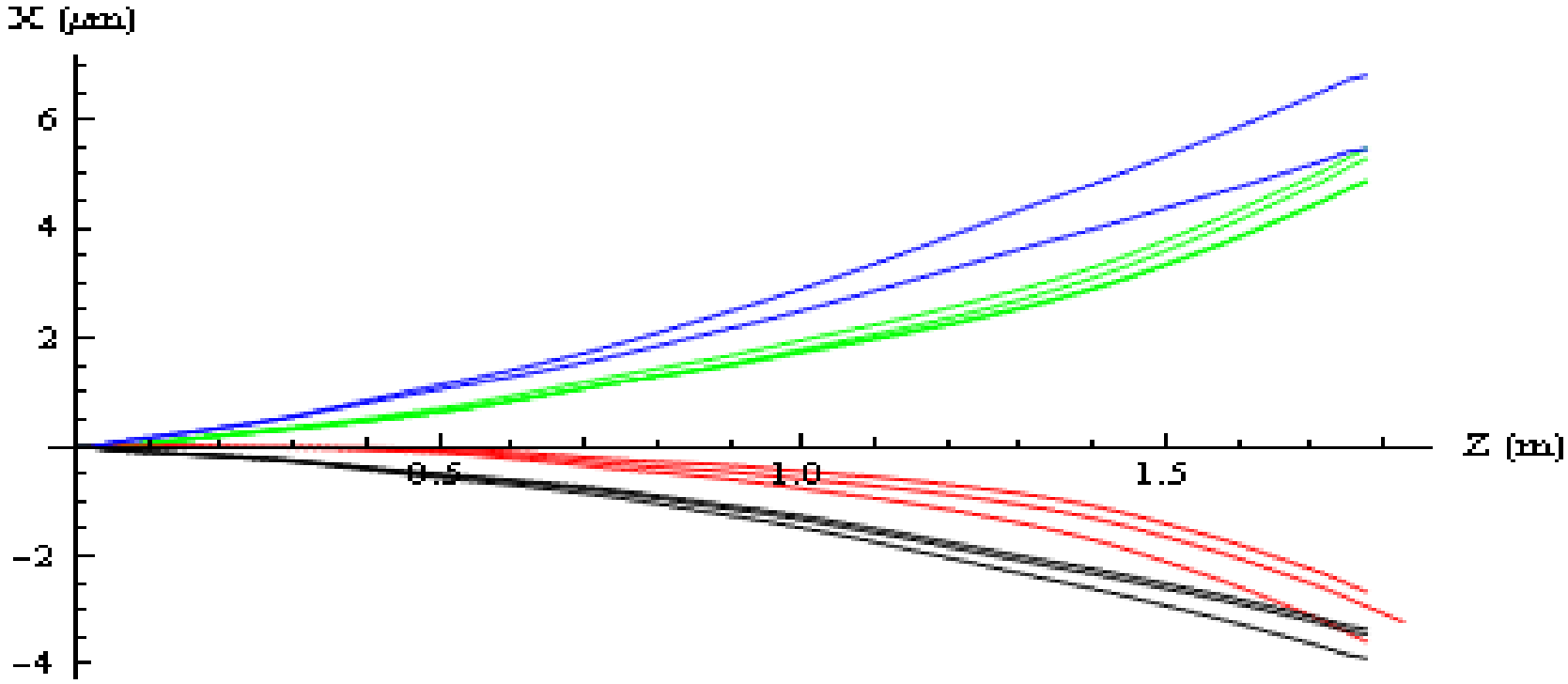
Trajectories

Have attempted to correct for bias voltages by looking at average voltage values before the probe enters and after it exits the undulator's field

Assumed linear variation in bias along undulator's length

This correction improves the trajectories, however improvements to the method are expected after taking measurements with no magnet in the cryostat

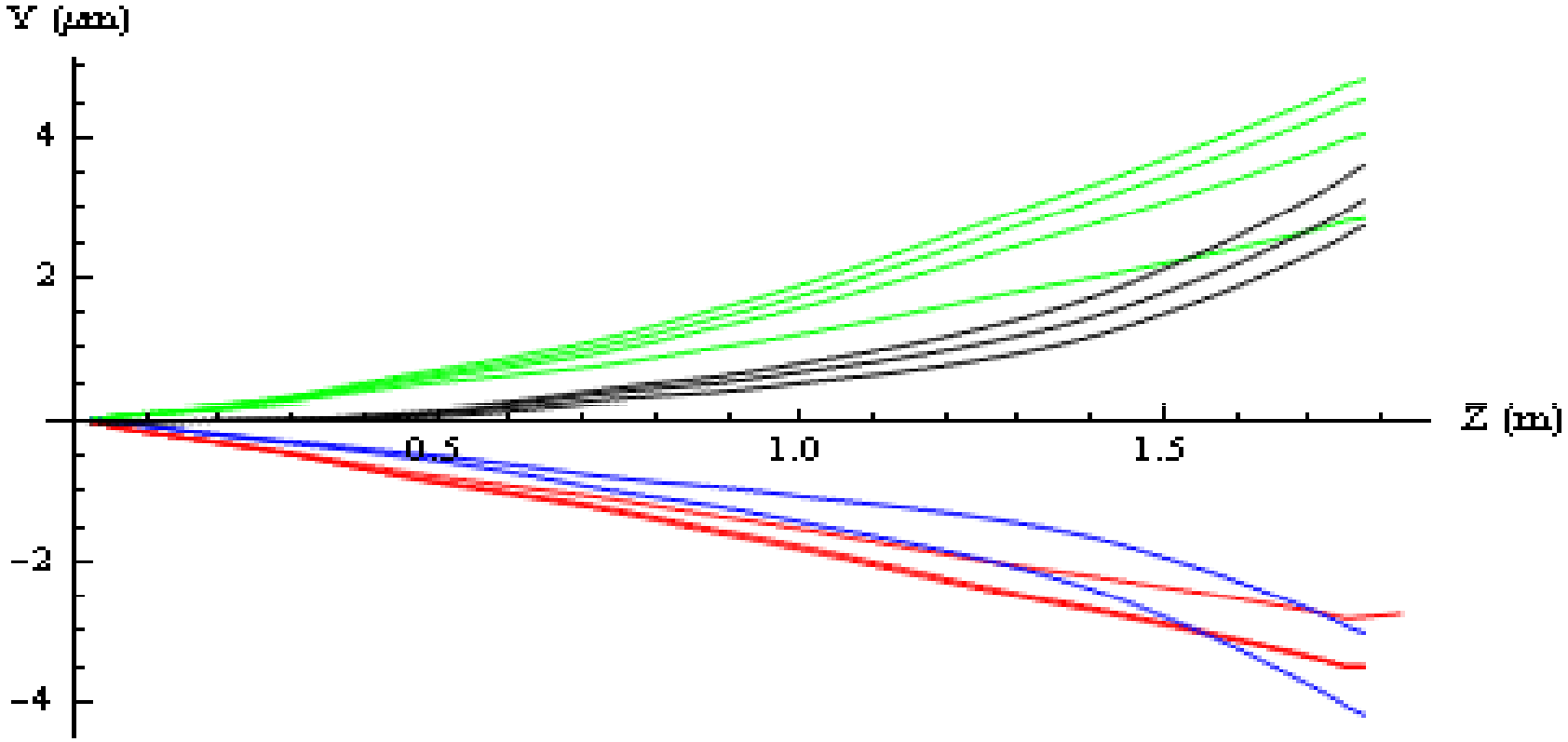
Trajectories



Plot of corrected trajectories in X-plane

Each colour corresponds to a different probe orientation

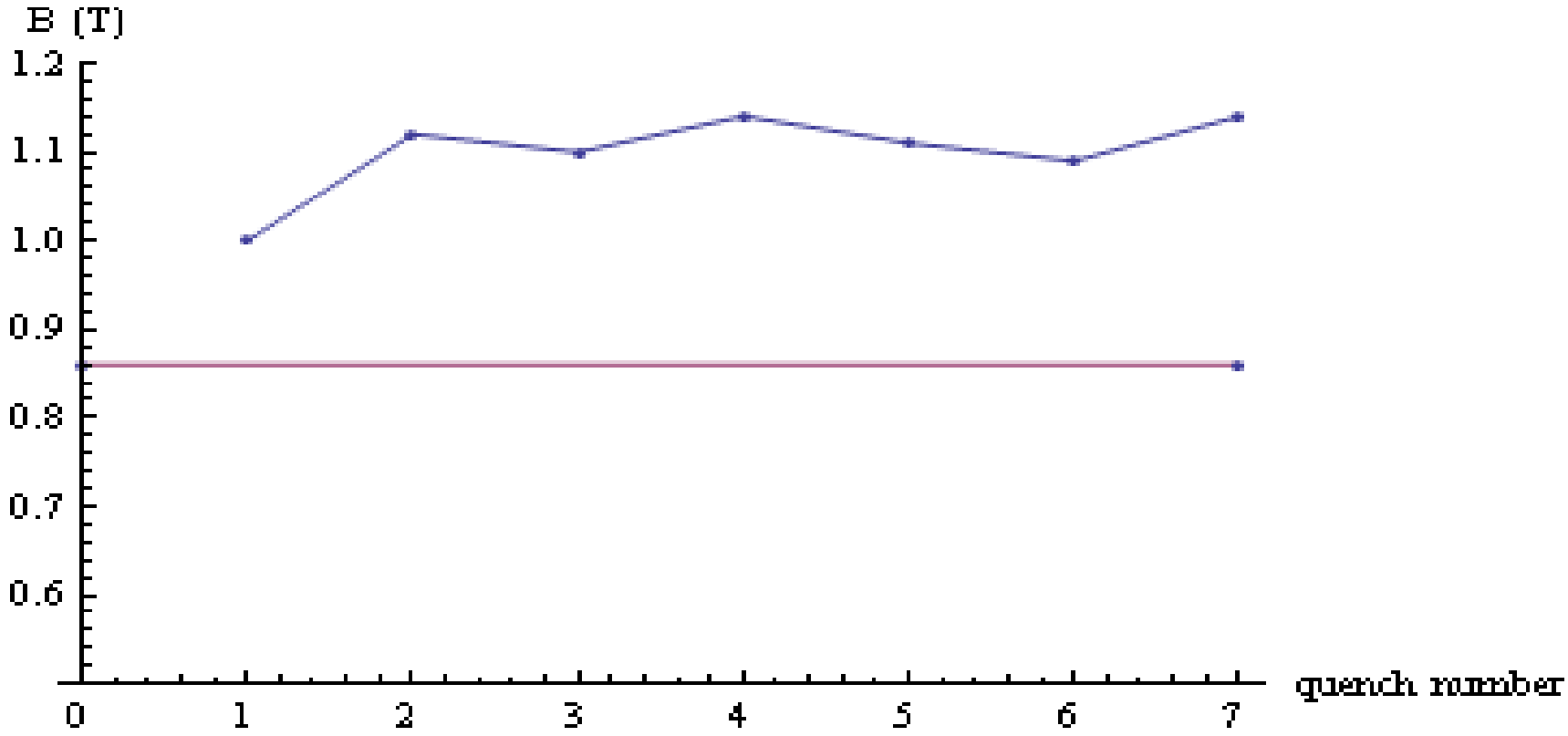
Trajectories



Plot of corrected trajectories in Y-plane

Each colour corresponds to a different probe orientation

Quench Tests



Peak field strength when magnet quenched during quench testing shows that the superconductor is stable up to ~1.1T

Also shown is the RDR field specification (0.86T)

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Summary

Magnet 1 meets RDR specification in terms of period length and axis field strength

Magnet 1 is stable up to fields 25% higher than RDR specification

Some work still needs to be done to understand and correct for hall probe biases

Magnet 2 tests will be conducted in the next few weeks