



# Target Wheel Prototype Progress

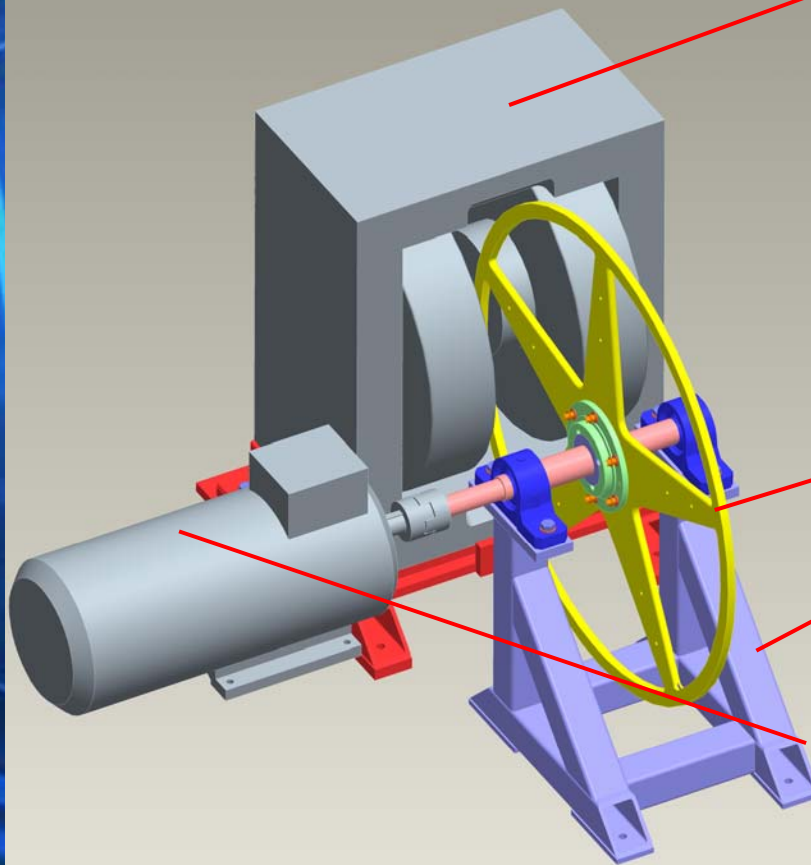


- Zeuthen meeting – Apr 7-9
- Leo Jenner & Ian Bailey
- Cockcroft Institute @ Daresbury Laboratory

# Prototype Design

## Prototype I - eddy current and mechanical stability

Ken Davies - Daresbury Laboratory



- Model 3474-140 GMW water-cooled electromagnet
- Variable pole gap (0mm to 160mm)

▪ Ti alloy wheel.

▪ Wheel support stand.

▪ 15 kW drive motor (Control Techniques)

# Progress Since ANL Meeting (Sep '07)

- Electricity and water rerouted to caged area.
- Ti alloy wheel manufactured and installed.
- Torque transducer delivered (late) and installed.
- Motor power supply and interlocks complete.
- Magnet support stand manufactured.
- Torque transducer stand manufactured.
- Magnet guarding designed and manufactured.
- Preliminary local guarding design complete.
  - Awaiting quotes.
- DAQ design still being finalised.
  - Calibration underway.
- Cooling system not yet fully designed.
  - Main cooling fan ordered.



# DAQ Overview

- Transducers interfaced to PC / LabView
- Torque transducer
  - Coupled to motor and drive shaft
    - Moduflex coupling
  - 0.1% accuracy
  - Sampling at ~3 kHz  $\Rightarrow$  at least one reading per spoke per revolution at 2000 rpm
- Accelerometers (one per bearing)
  - Require  $1 \times 10^{-3}$  m" g" sensitivity at ~1 kHz
- Temperature transducers
  - Thermocouples (pole caps?, exhaust air, support structures)
  - IR sensors (pole caps?, shaft, wheel rim)
  - Black paint to reduce emissivity of metal surfaces?
  - Tests underway...
- Hall probe

A photograph of a laboratory workstation. In the foreground, a wooden desk holds two computer monitors, a keyboard, and a mouse. The monitor on the left displays a software interface with a blue header. The monitor on the right shows a similar interface with a grid of data points. Behind the desk is a black tower PC. In the background, a large white control panel is mounted on a wall, featuring several indicator lights (red, yellow, green) and a small window. The entire setup is within a room enclosed by a metal safety fence. The image has a blue, glowing, grid-like overlay on the left side.

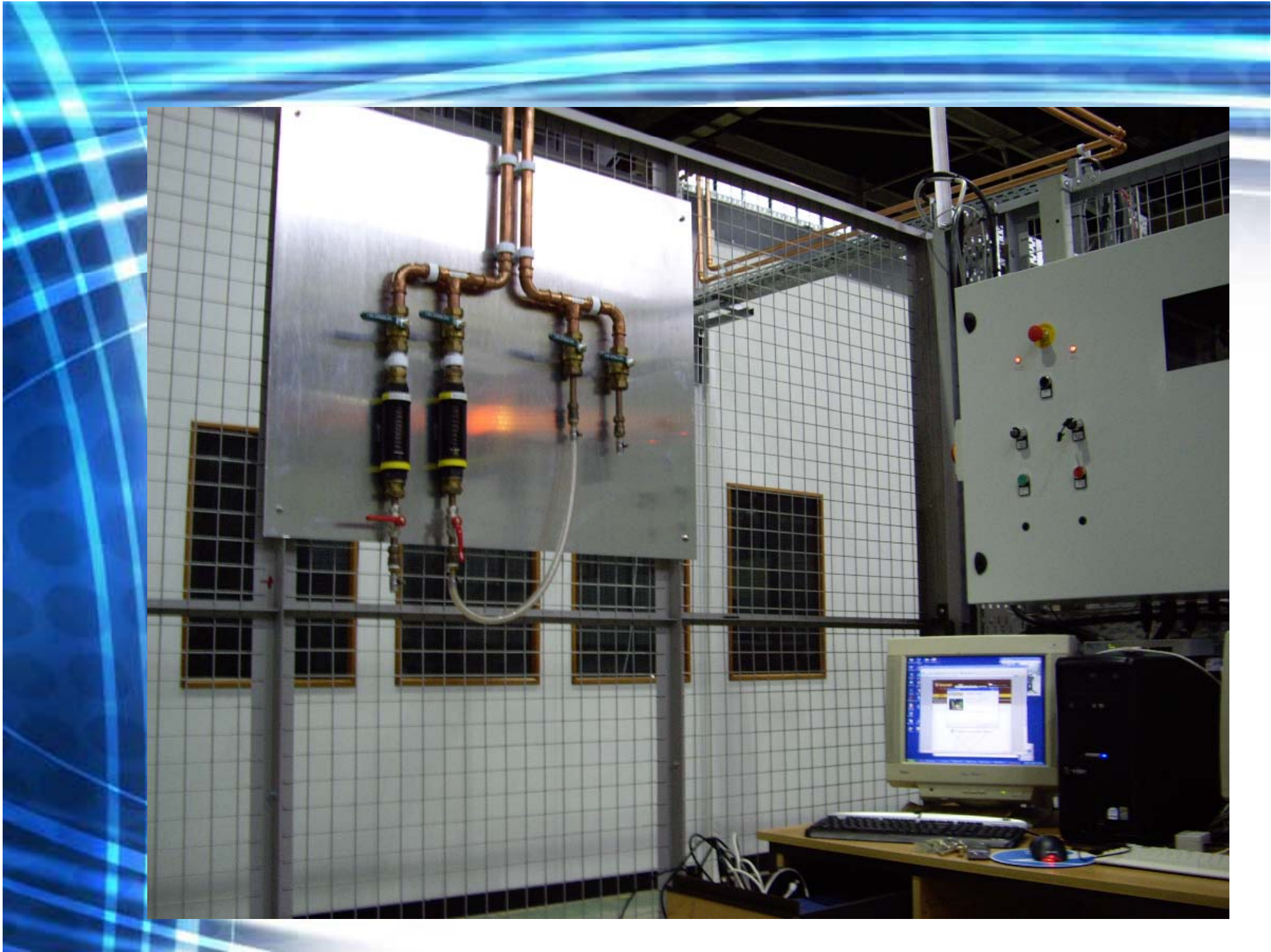
### Labview master:

- Motor Control
- Accelerometers (Safety)
- Torque transducer
- Webcams

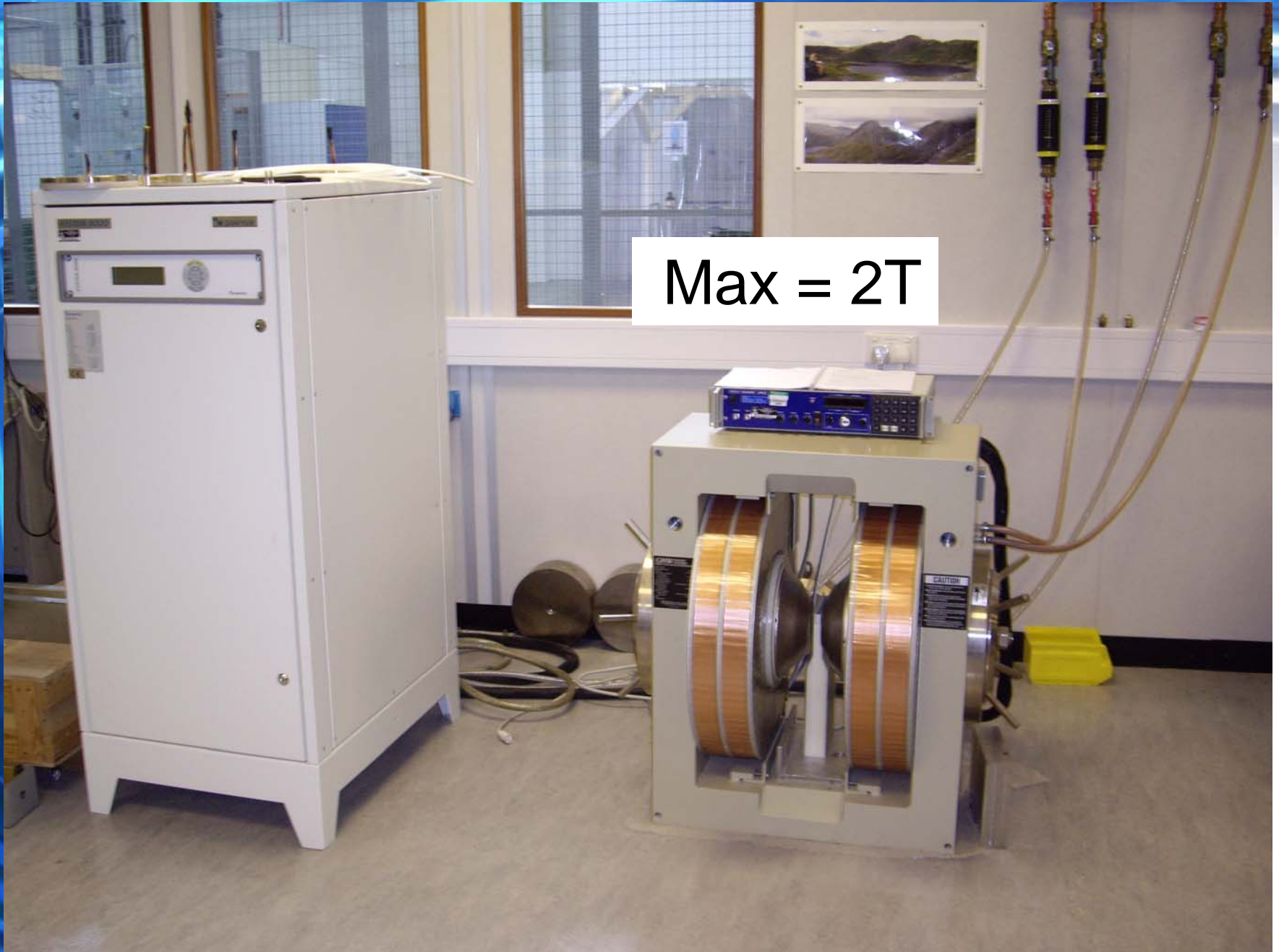
### Labview server:

- Temperature
- Field
- Magnet control

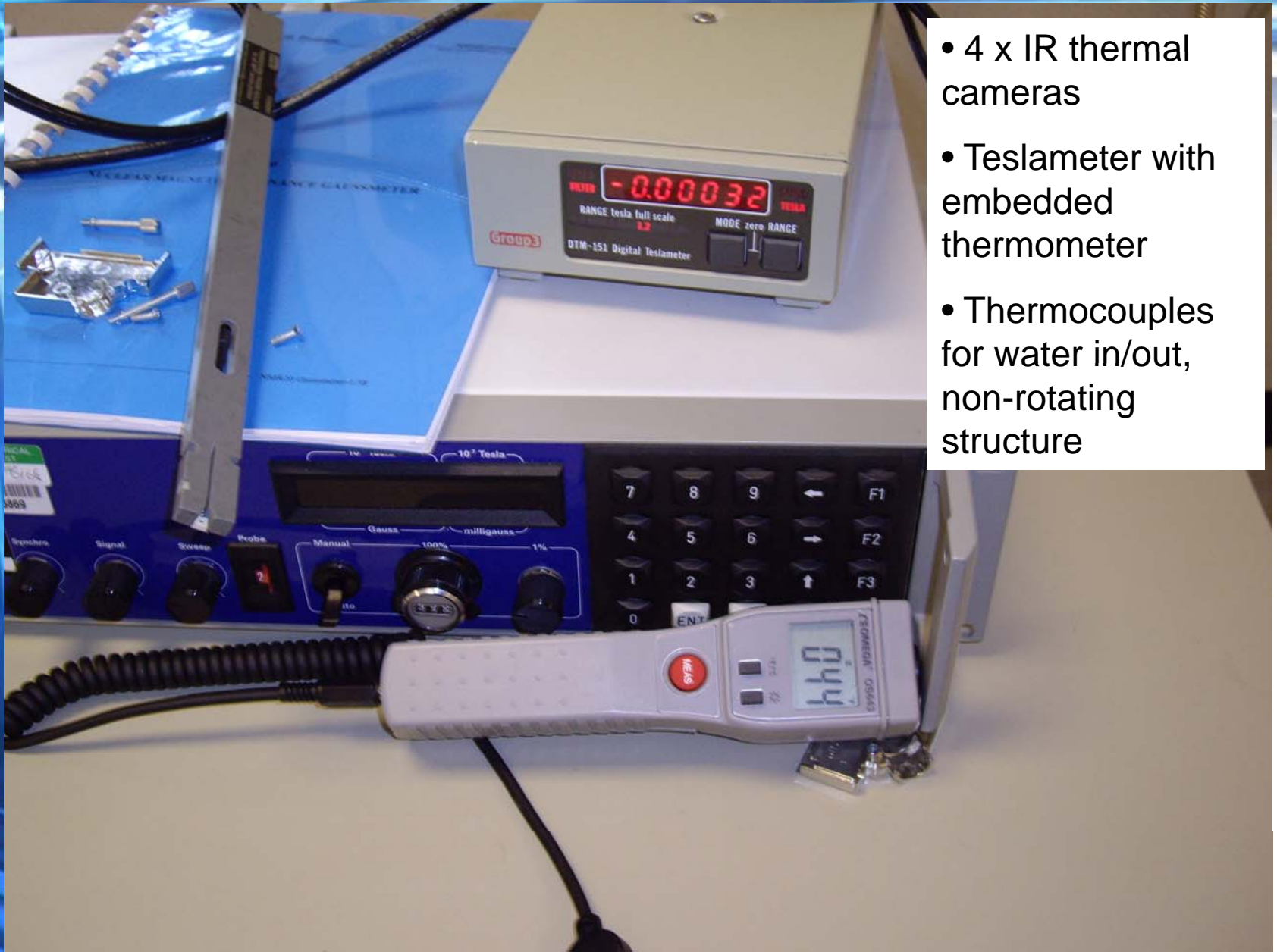




Max = 2T

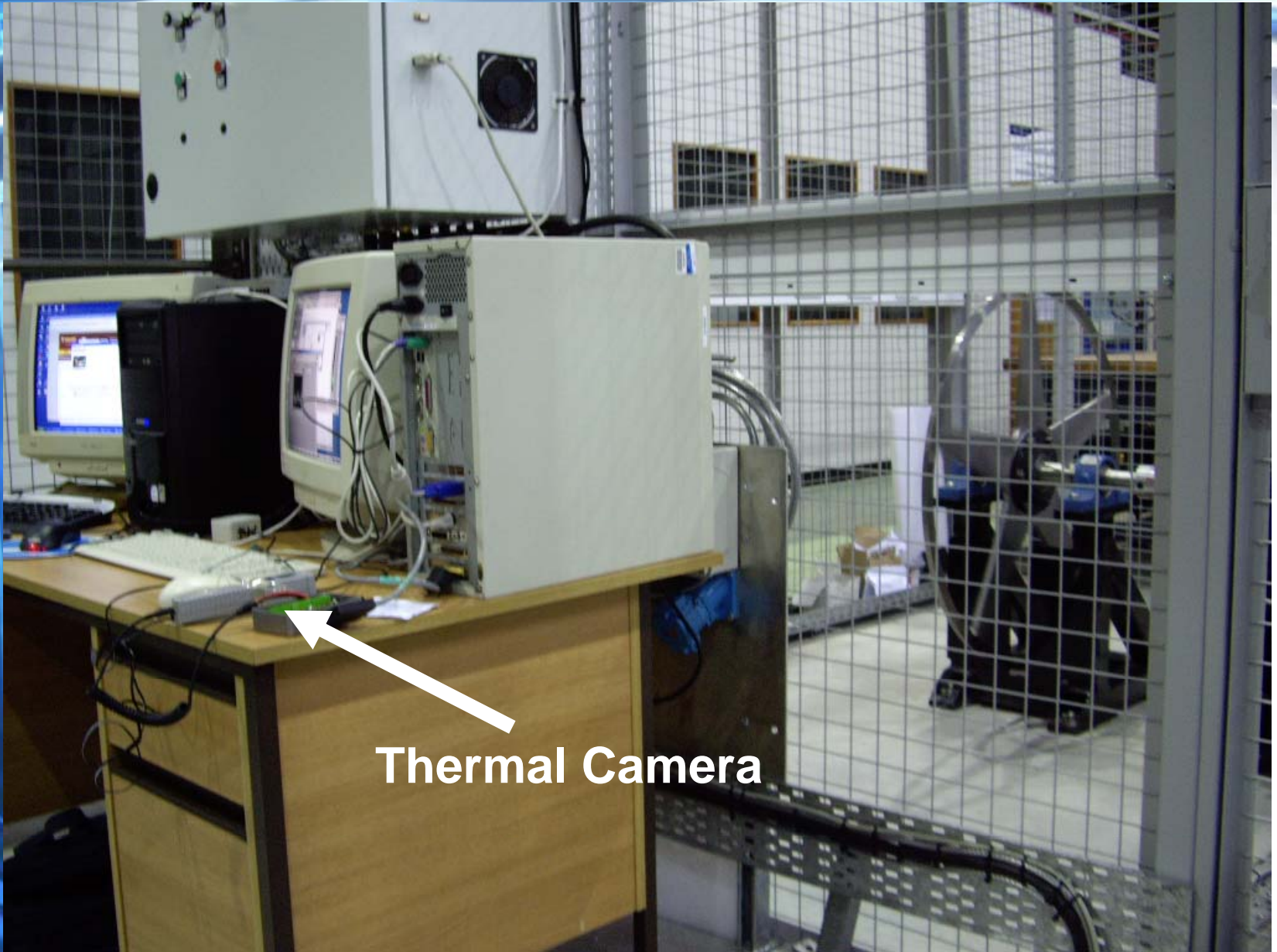






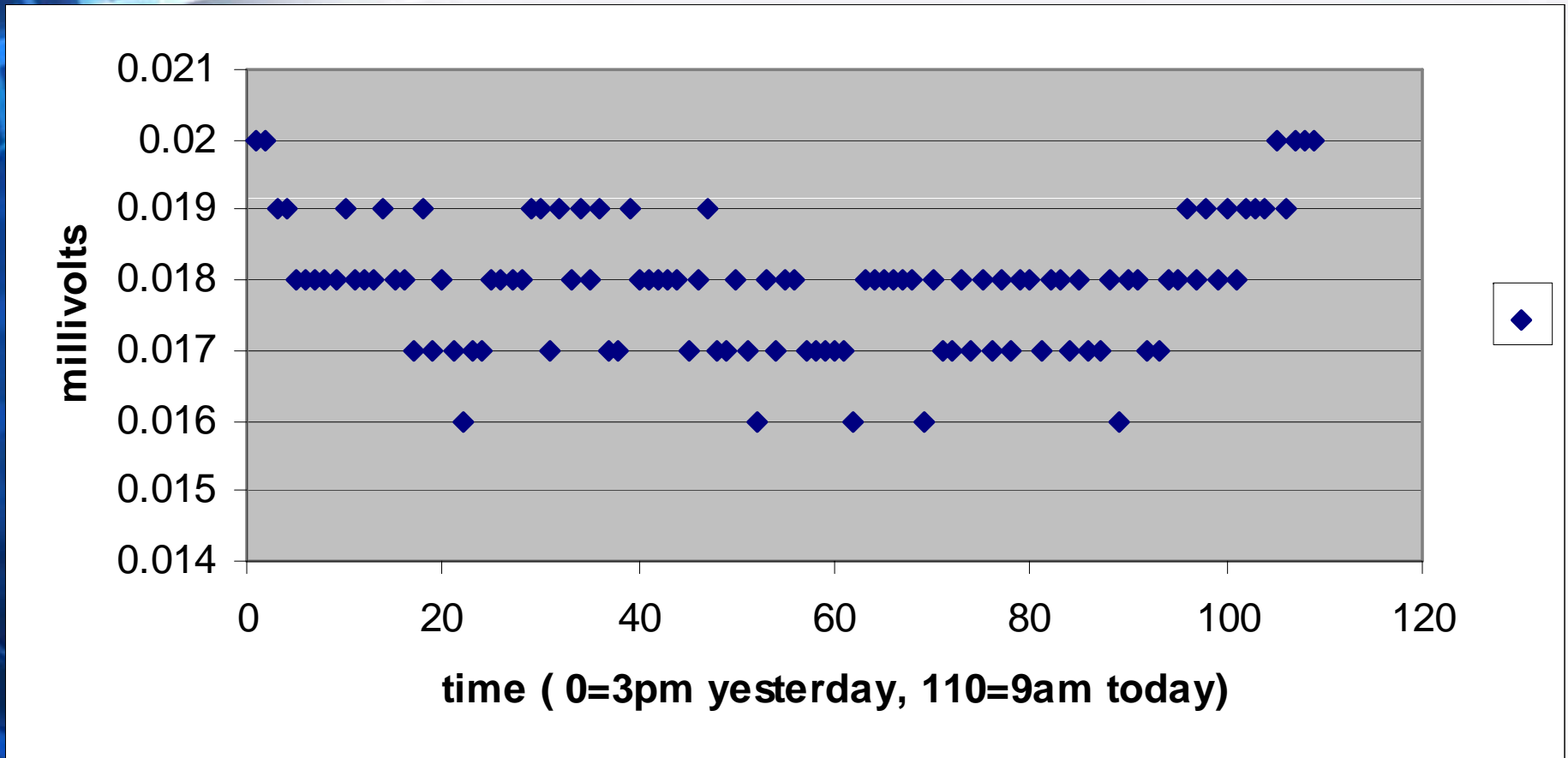
- 4 x IR thermal cameras
- Teslameter with embedded thermometer
- Thermocouples for water in/out, non-rotating structure





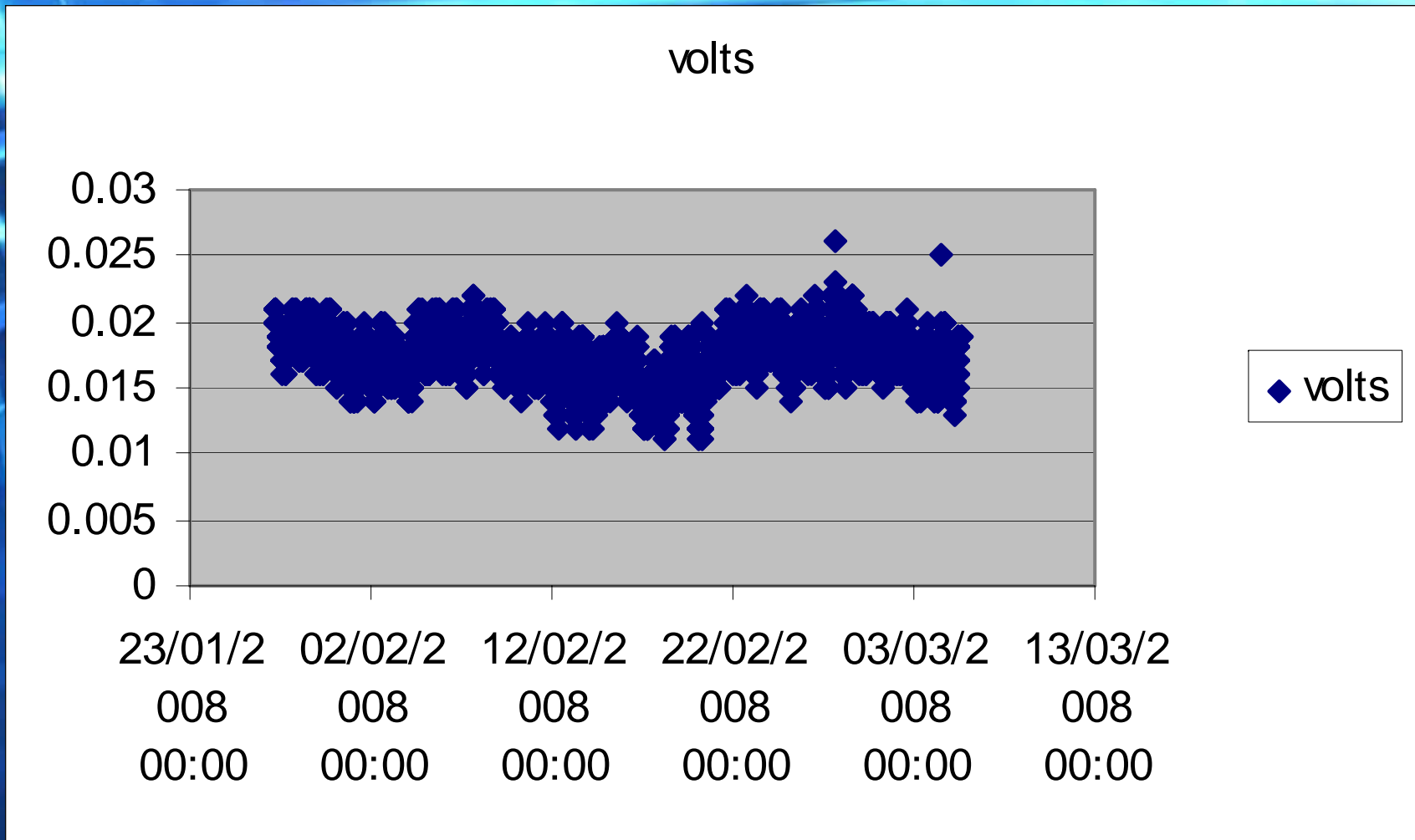
Thermal Camera

# Data...



Wheel may reach 200 degrees...





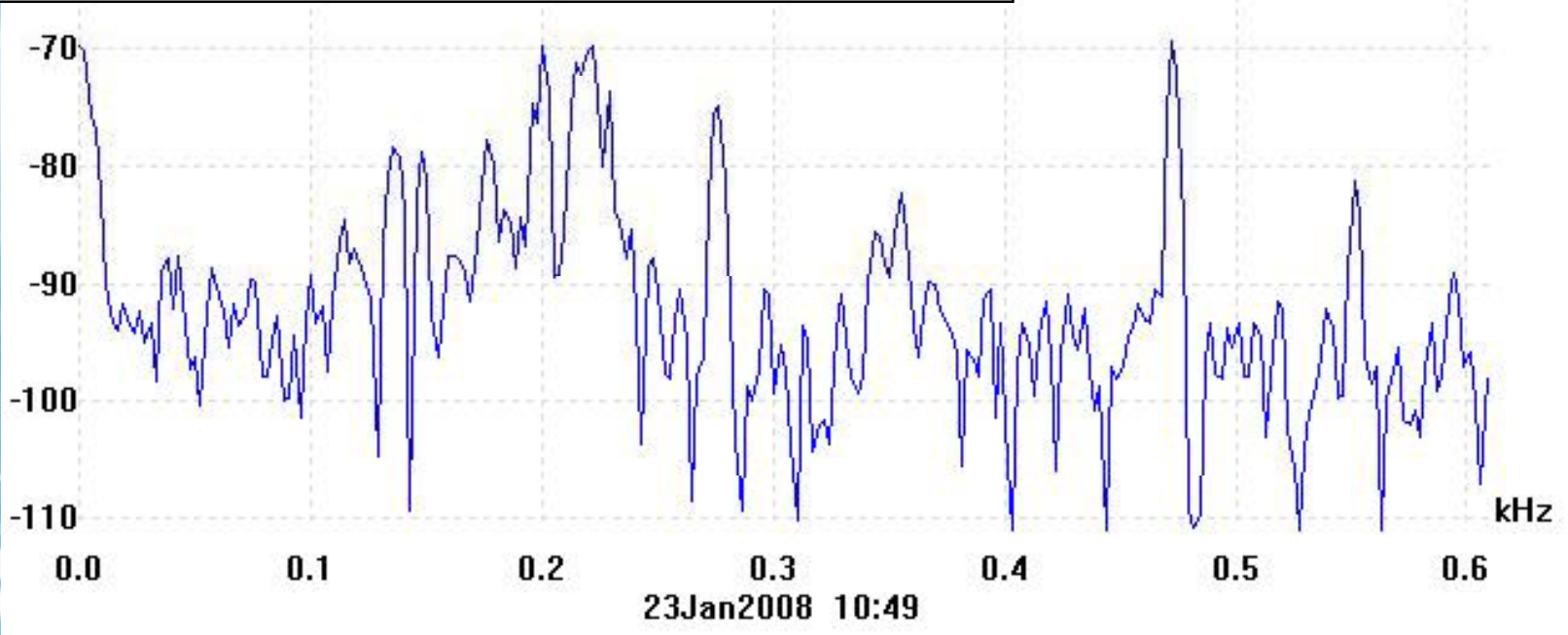
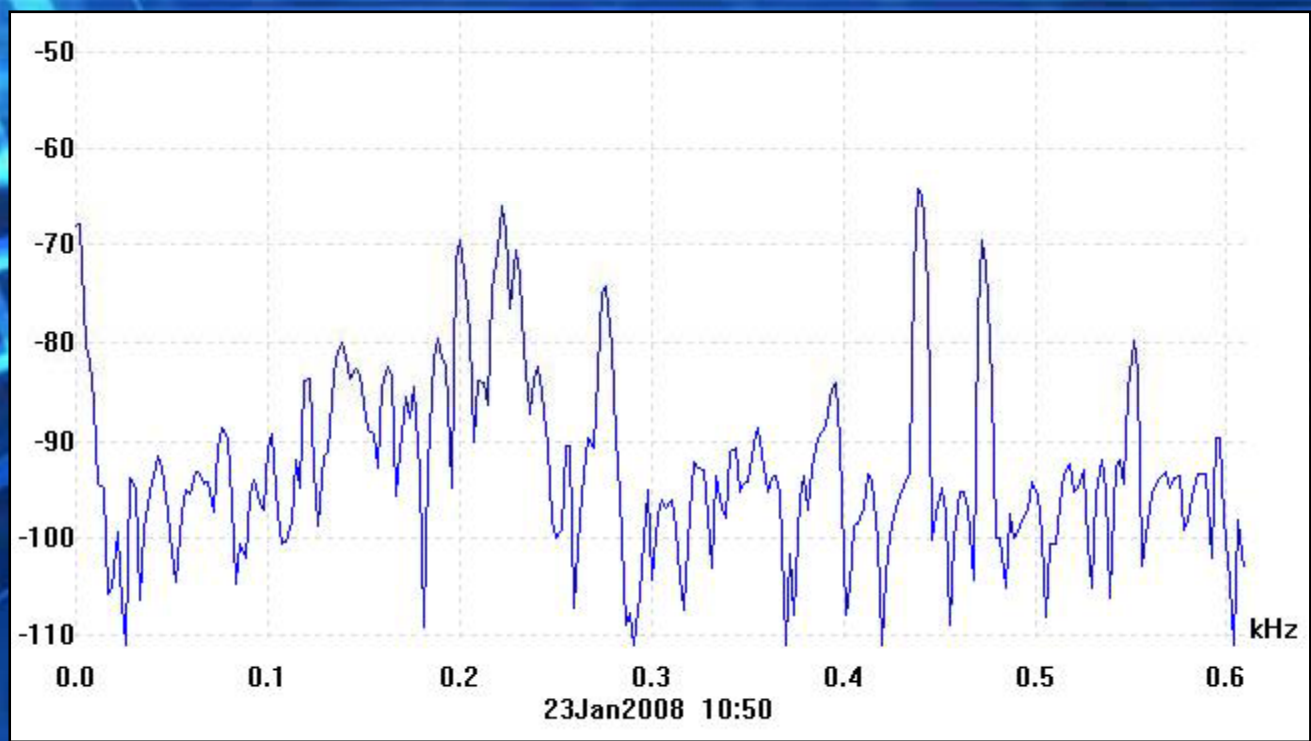
**Ice and oven ready: calibration coming very soon...!**

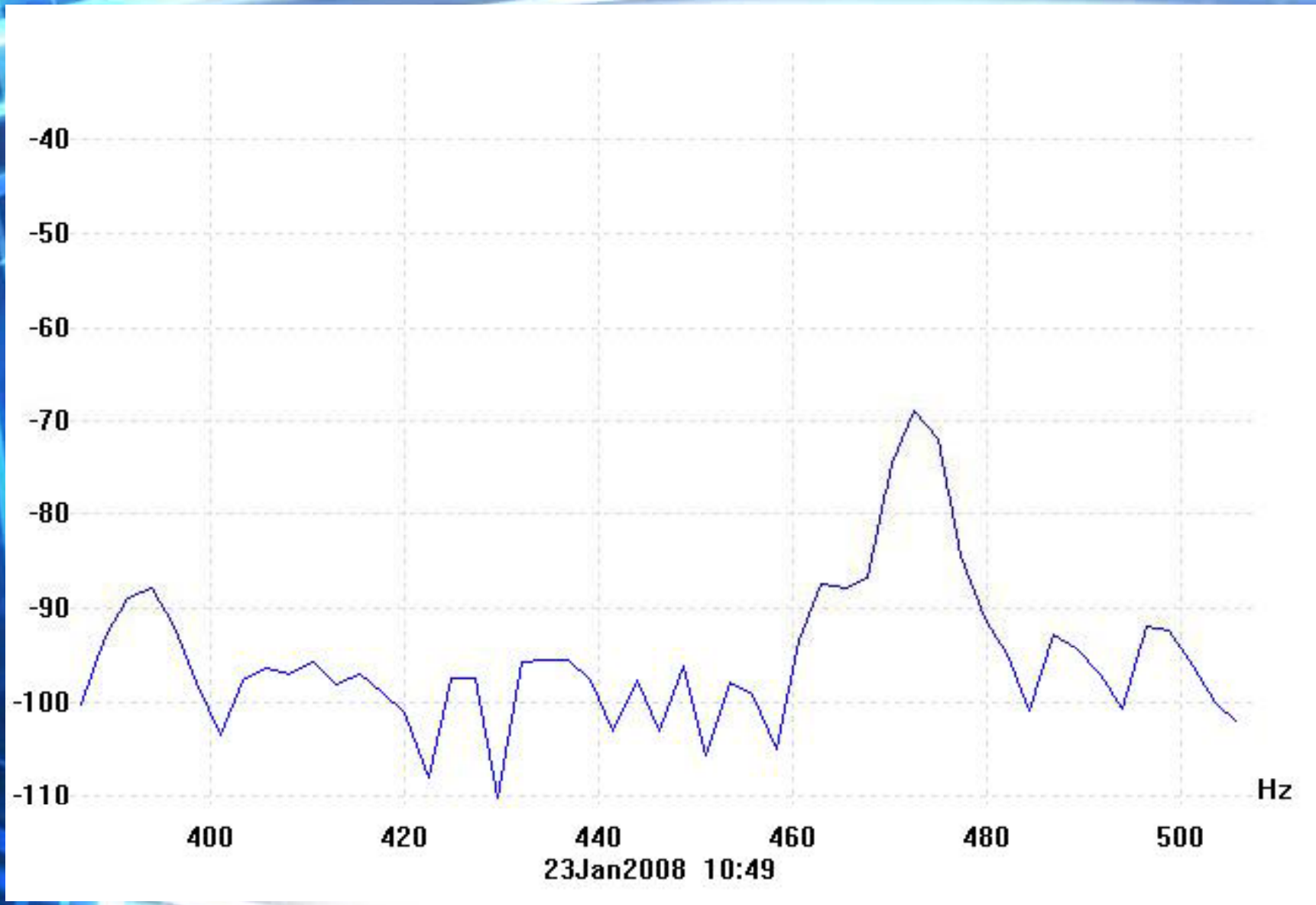


Slow – bearing wear

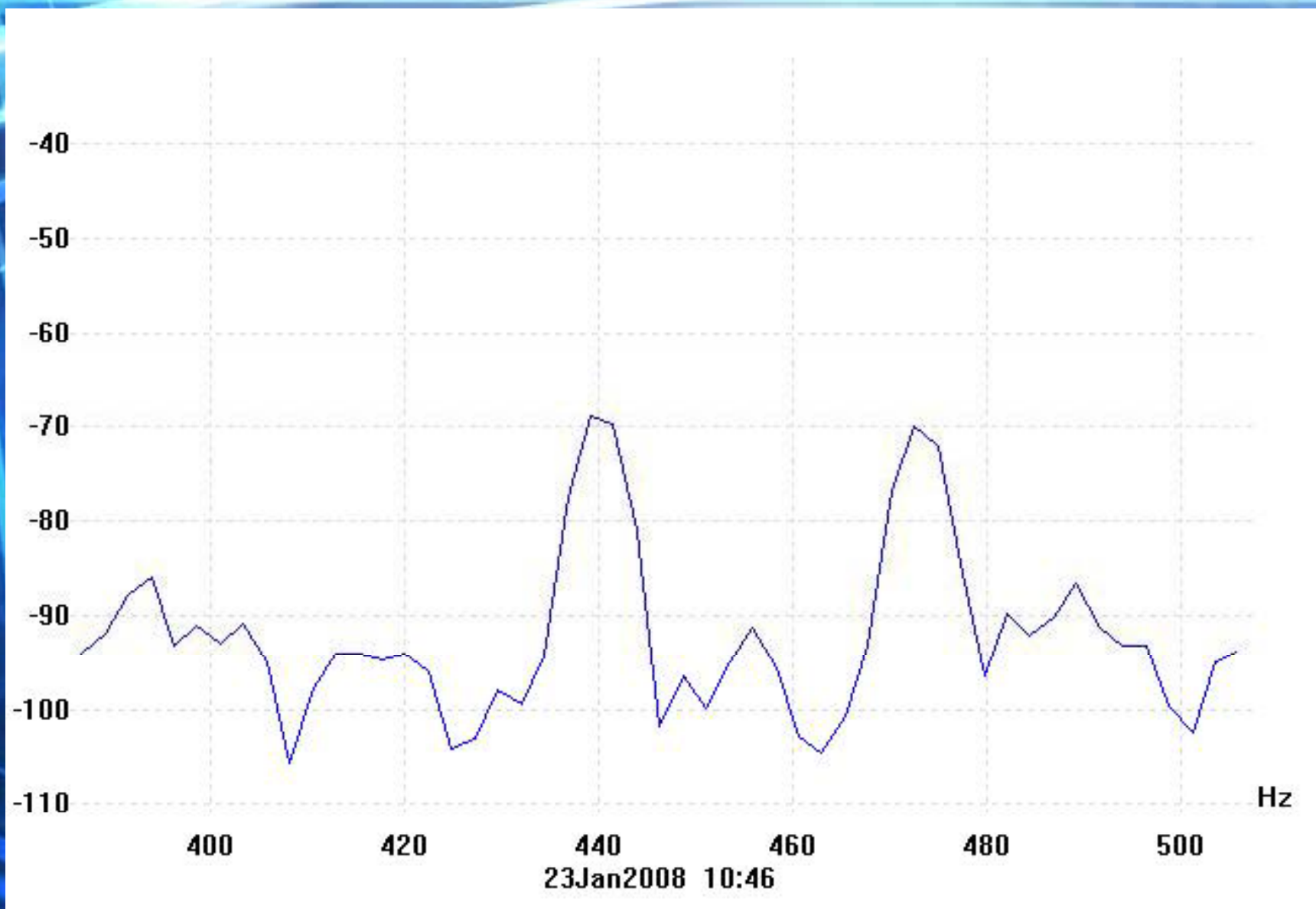
Fast – failure



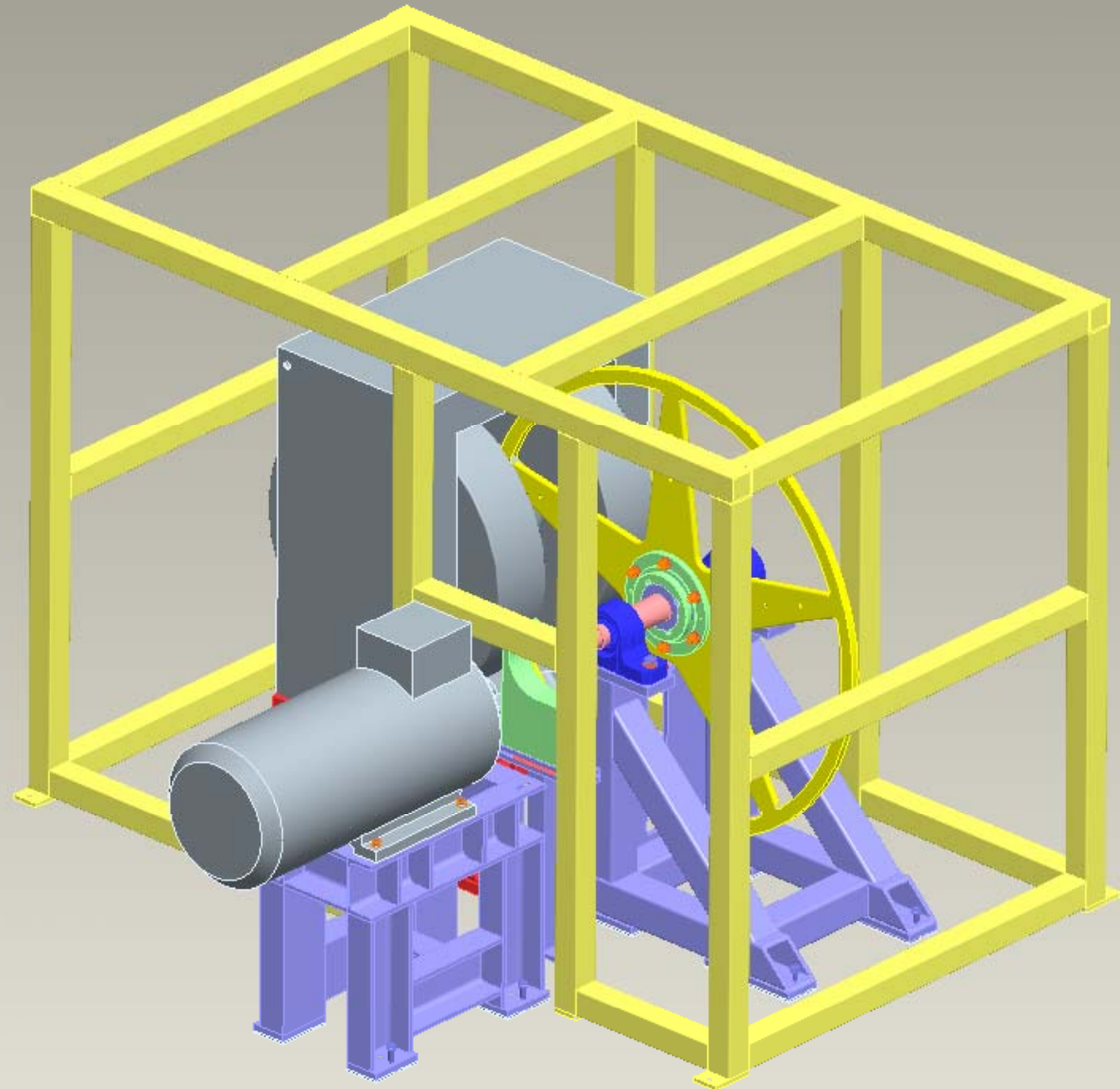






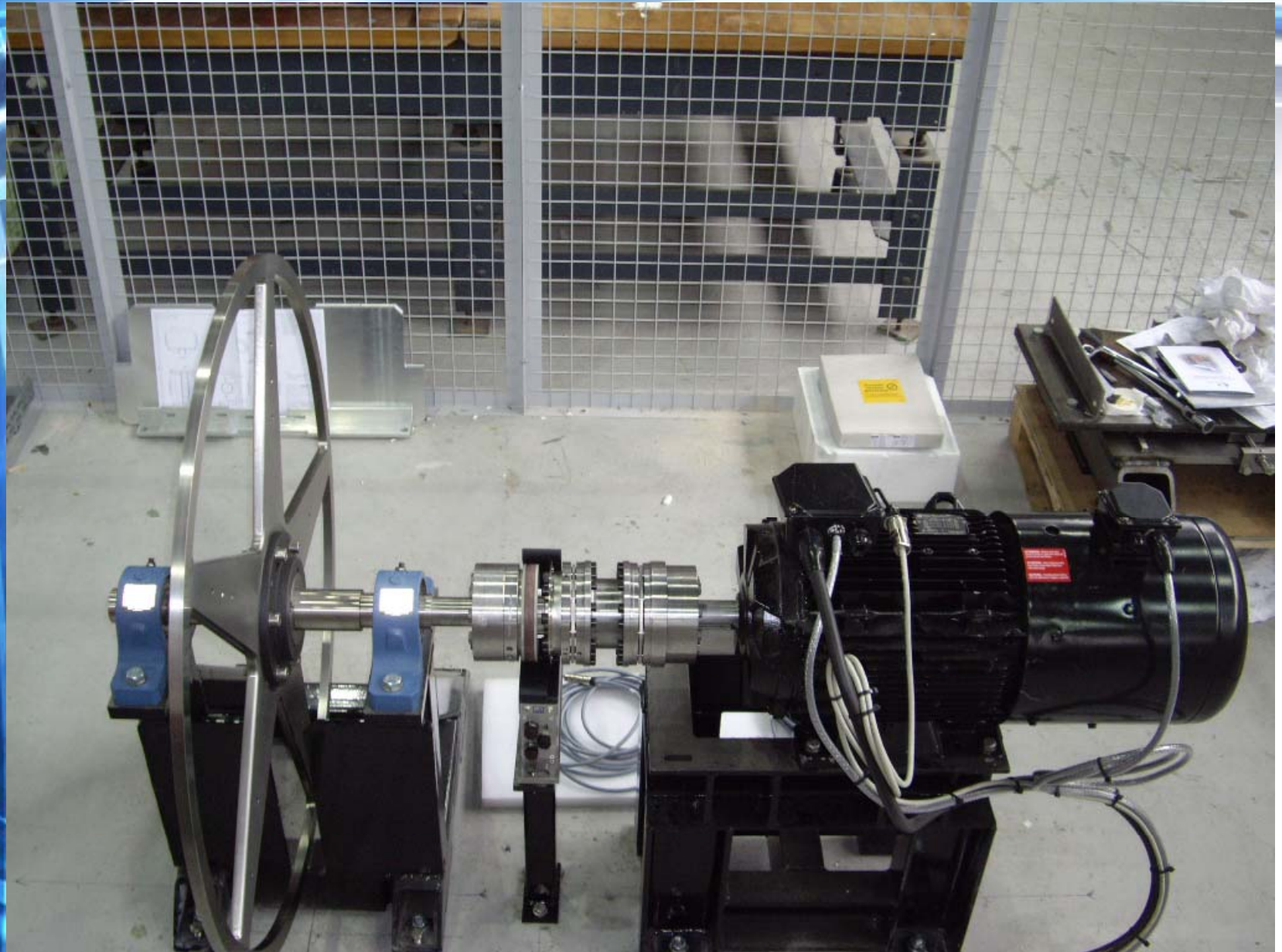


- **Wheel can't be sped up until safety cage is in place**
- **Mechanical design gone out to tender**





Torque Transducer has now been installed...



# Remote Desktop and Webcam...





# Experimental Programme

- Balancing and initial commissioning ~Nov 07
- Operation of wheel without magnet ~Dec 07 onwards
  - Calibrating transducers and DAQ
- Operation of wheel in magnetic field ~May to Jul 08
  - Was scheduled to start in Jan 08.
  - Systematic scan of field strength (0T to 1T in 0.2T steps)
  - Systematic scan of ang. vel. (0rpm to 2000rpm in 50rpm steps) avoiding critical speeds.
  - Torque and temperature readings to be compared with the predictions of computer simulations.
  - Immersion depths?
- Long-term operation of wheel to monitor stability ~Aug 08
- Additional investigations using aluminium wheel or modifying conductivity of wheel rim also possible.
  - Very unlikely due to lack of funding.
- Experiment complete by Nov 08.

# Remaining Work

- Eddy current simulations
  - Need simulations to compare with data
  - Effects of spokes in field (~1% torque increase?)
  - Varying rim immersion
  - Hopefully from LLNL(?)
- Thermal and fatigue calculations
  - LLNL already provided.
  - Crosschecks ongoing at RAL
- Material tests
  - Hardness tests to gauge stress state of wheel
  - Was happening at LLNL...
- Finalise DAQ
  - Ongoing at DL/CI
- Guarding simulations
  - MoU between DL and LLNL being drafted
  - Also crosscheck at RAL
- Finalise guarding design and integrate with cooling fan.
  - Ongoing at DL



# ILC Newsline

