# Target Design Status

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# Overview

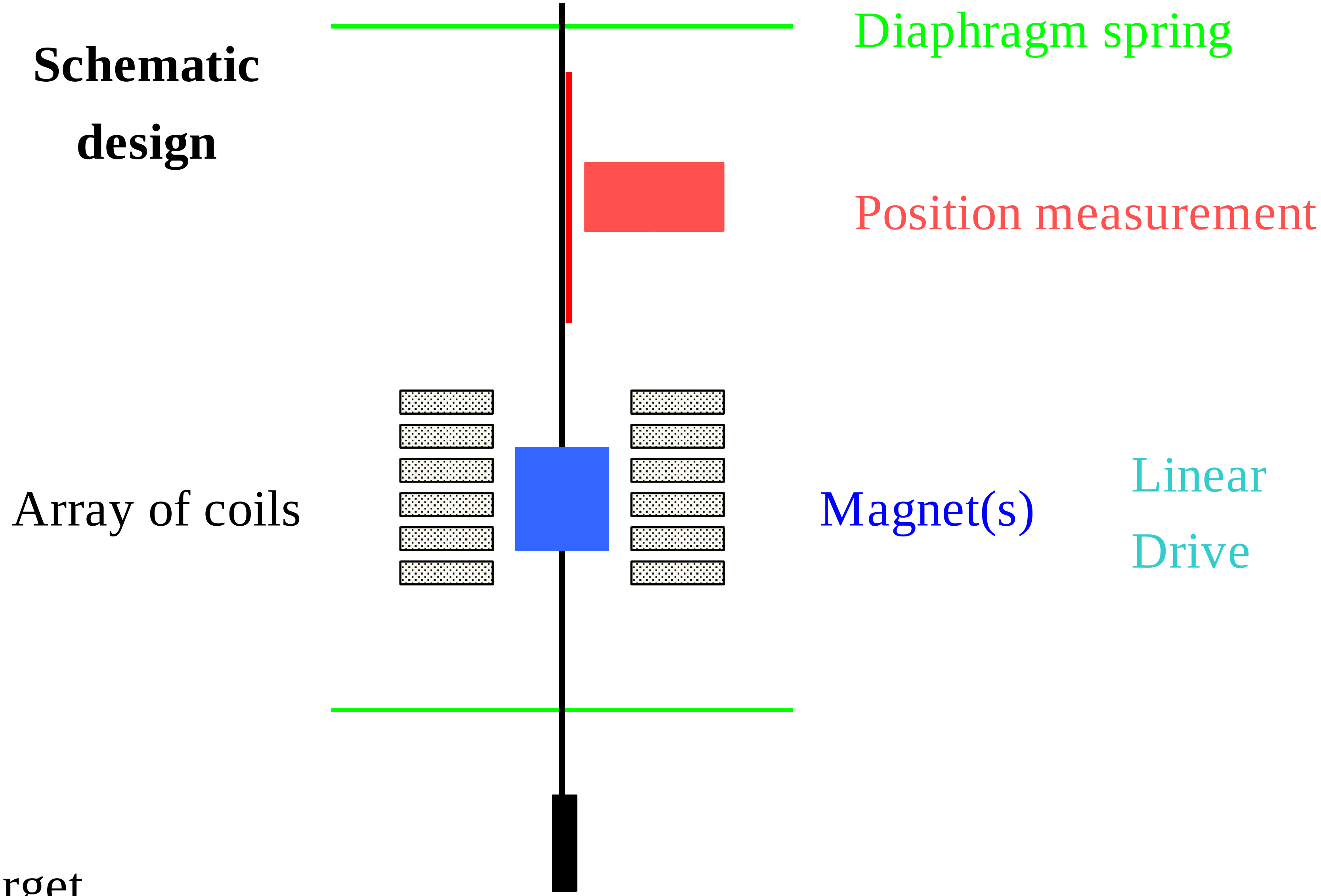
- Current prototype and status of testing
- Design of full prototype
- Concerns about radiation levels, vacuum conditions and heating of target
- Schedule

# Reminder of specs

- Target travel of 40mm
- Positioning accuracy < 0.5mm
- Frequency 1-3 Hz (higher if possible) on demand
- Maximum proton rate $1.4x10^{12}$
- The mechanism must not disturb the vacuum

# Proposed Target Scheme

**Schematic design**

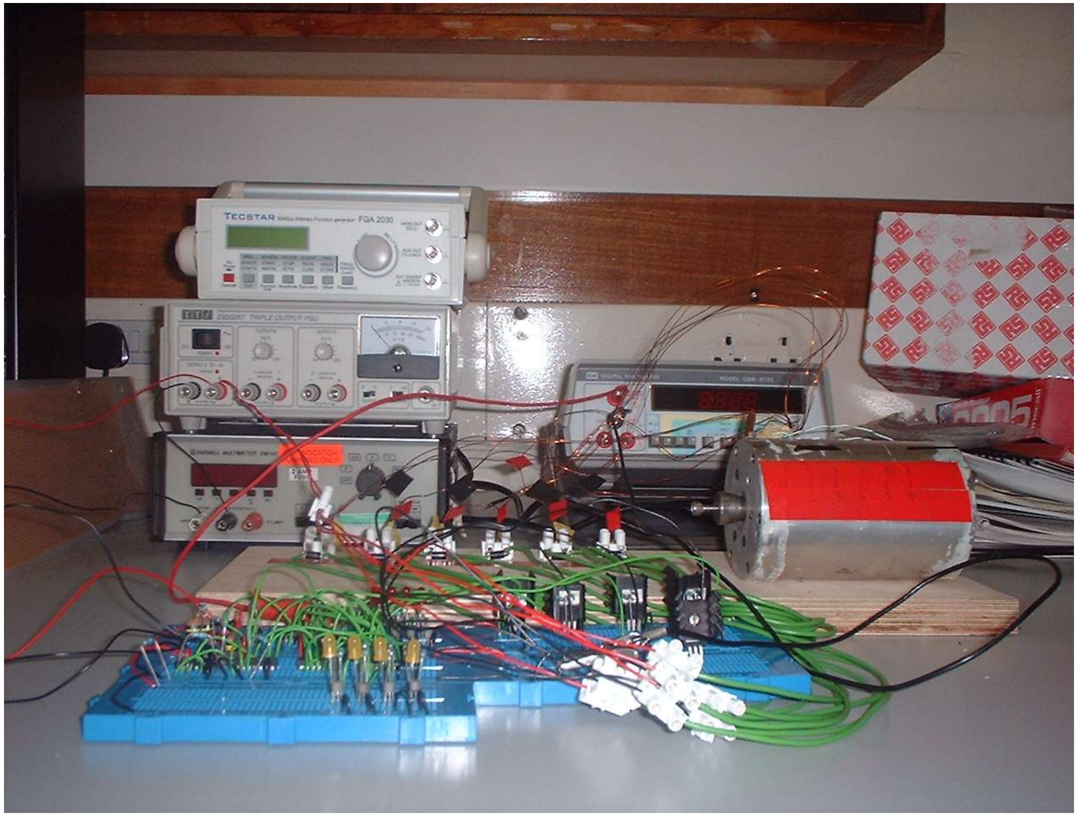


# Pre-prototype

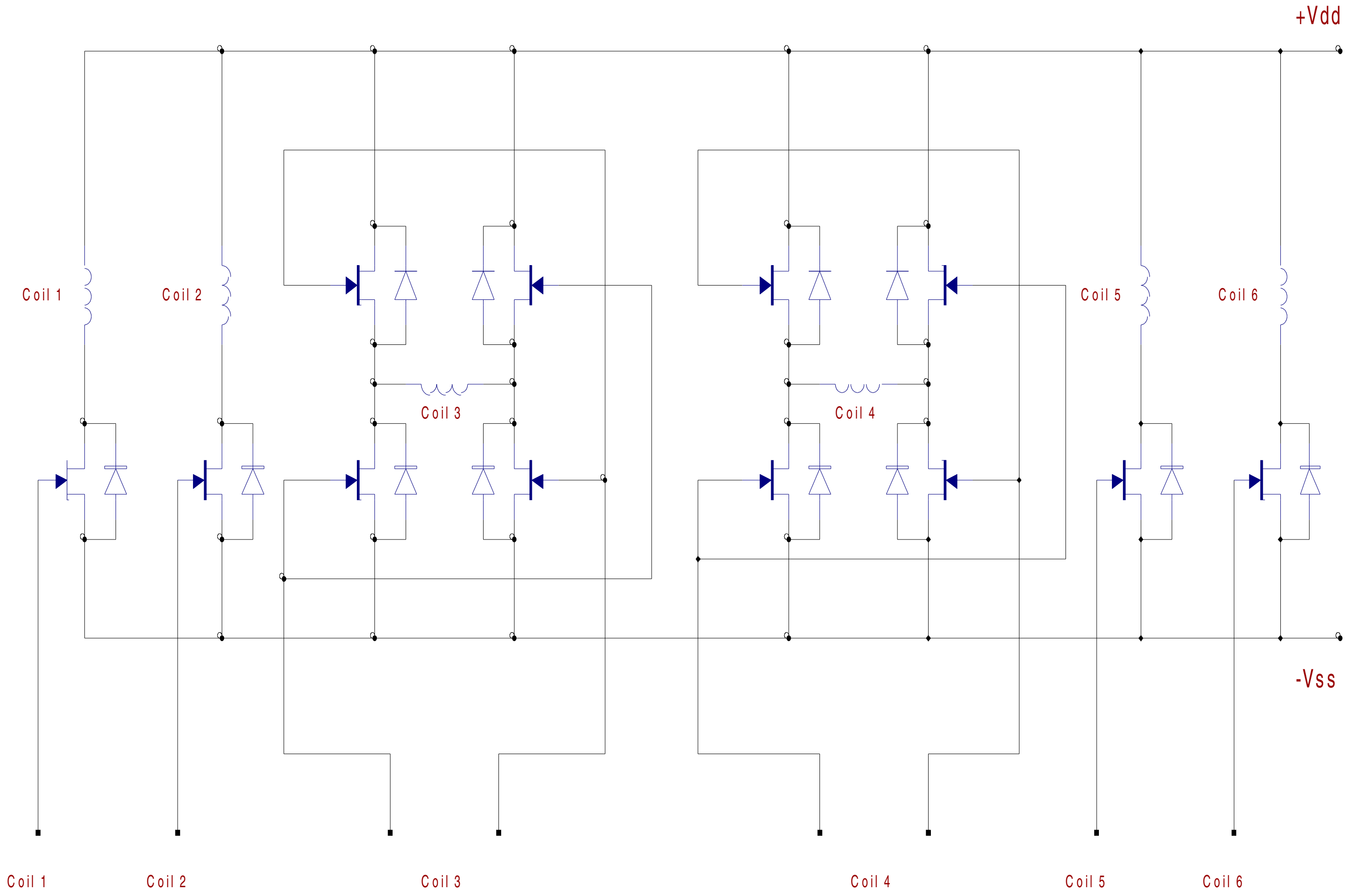
- A pre-prototype was produced late last year
- This prototype was never supposed to work to specs it was a tool to understanding the heating of coils etc
- However this prototype has been used by the Sheffield group to gain experience in:
  - Electronics
  - Mounting the system with diaphragm spring
  - Position readout

# Electronics

- The current pre-prototype has 6 coils
- The coils are activated in pairs
- A timing circuit has been developed to control the actuation
- This uses MOSFET h-bridges to switch the coils



# Electronics – Current Scheme




+ 0 – 0 0 0

0 + 0 – 0 0

0 0 + 0 – 0

0 0 0 + 0 -

0 0 + 0 – 0

0 + 0 – 0 0

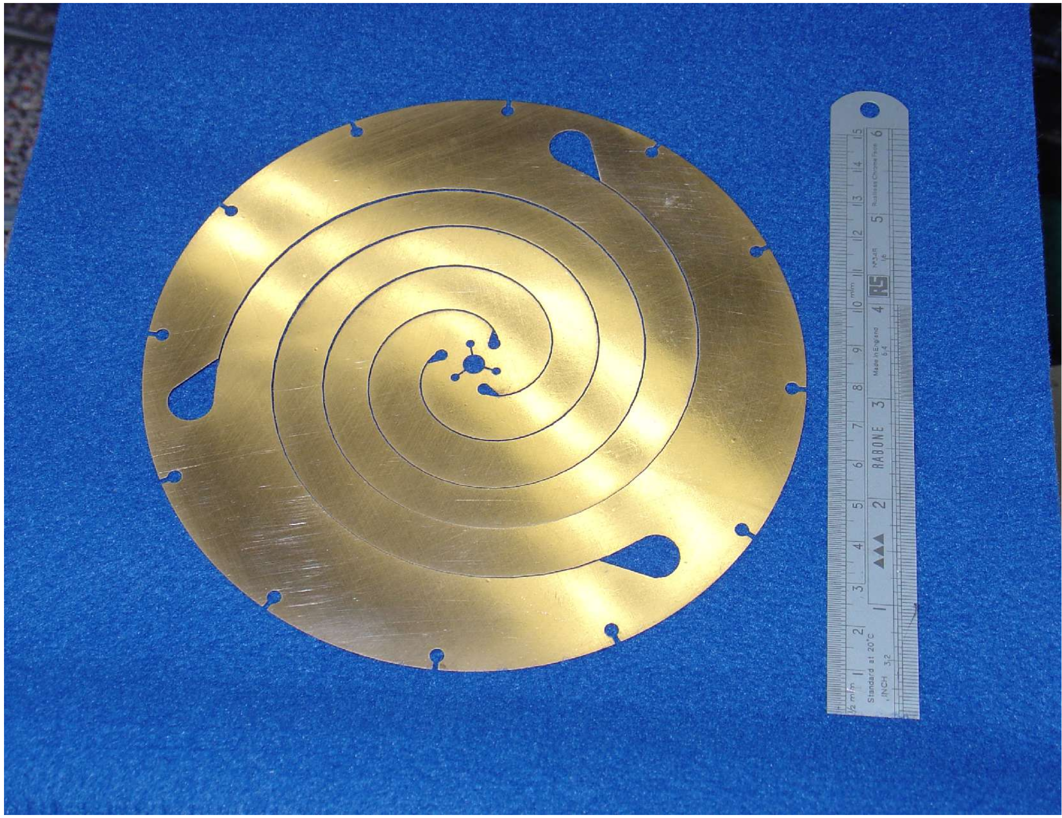
+ 0 – 0 0 0

# Electronics – Future Plans

- Work has now started on a circuit suitable for the full prototype
- This will be controlled by a microprocessor allowing:
  - Variable timing in the coils
  - Feedback from position sensing
- The Full prototype will need much higher voltages and currents than currently used and this will require several modifications

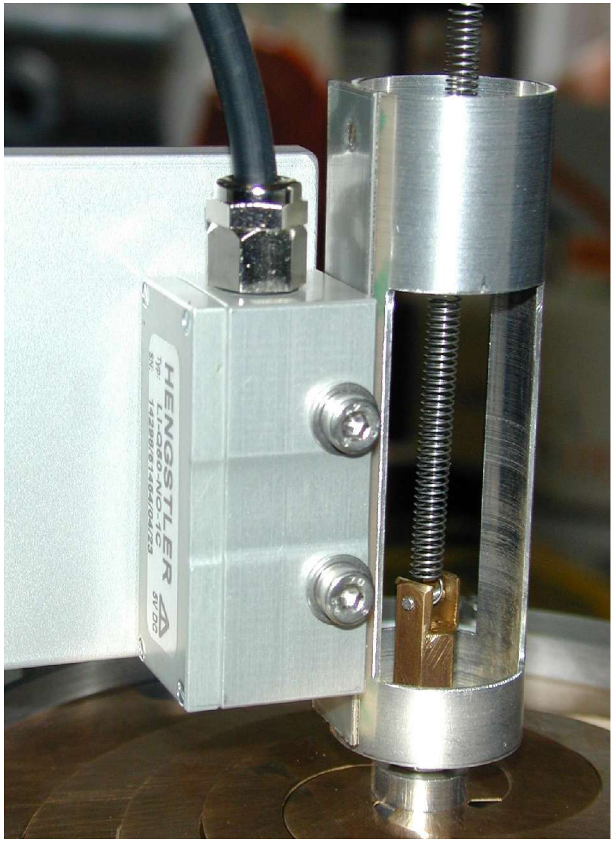
# Diaphragm Springs

- Diaphragm springs are required to hold the shuttle on axis
- Springs have been designed using an initial design provided by Tom Bradshaw
- FEA have been done to check the stresses on the spring
- The springs have been cut by wire erosion



# Position sensing

- Position sensing is provided by an inductive linear measurement system
- The system consists of an etched metal scale and readhead containing sensors
- The metal scale has 8cm spaced index markers to allow absolute position to be obtained
- The sensor has been mounted on the pre-prototype and first results obtained

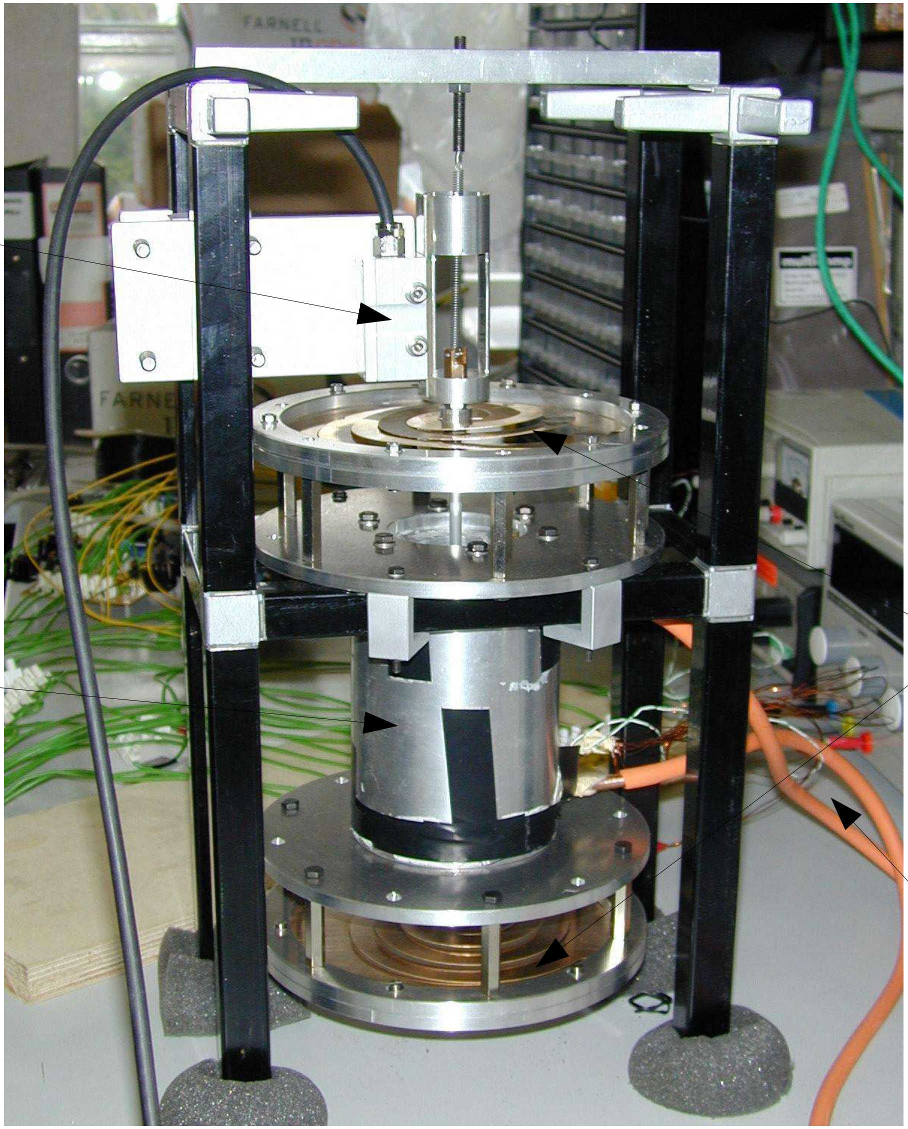


# DAQ for position sensor

- The encoder signal is fed into PCI-QUAD 04 board
- Libraries are provided with the board in C++ and Visual Basic
- Software has been developed in visual basic to:
  - Look at information on screen for monitoring purposes
  - Write to file for later analysis

# Fully mounted pre-prototype

Position sensor

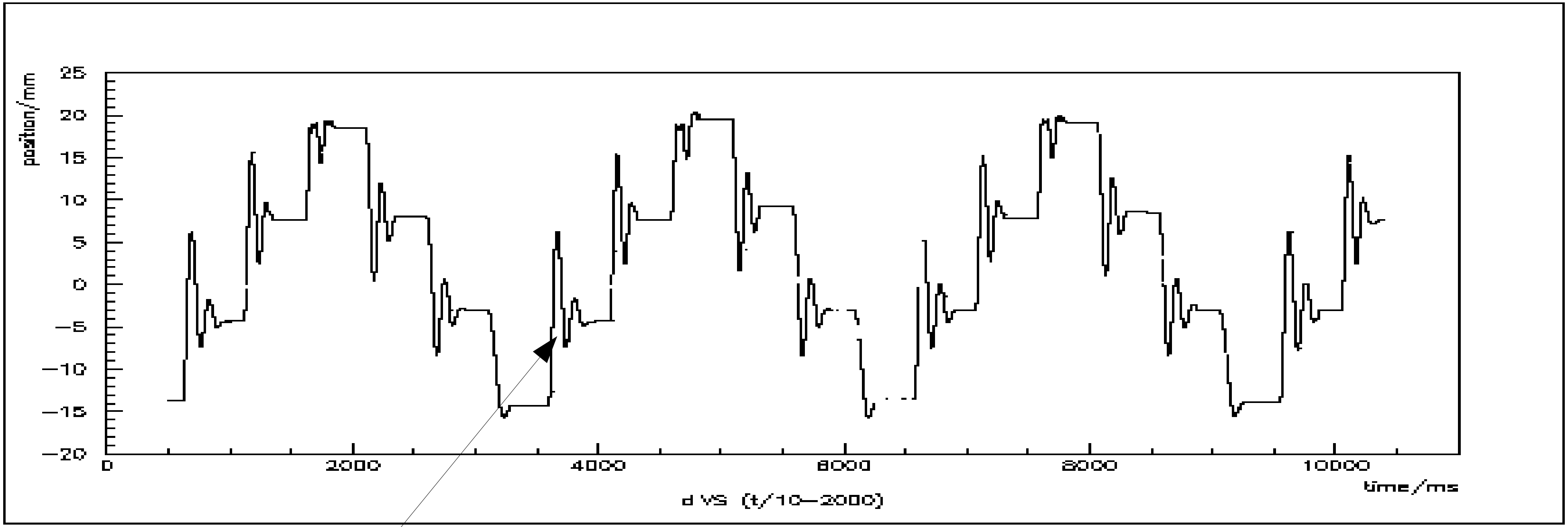


Coil Assembly

Diaphragm Springs

Water Cooling

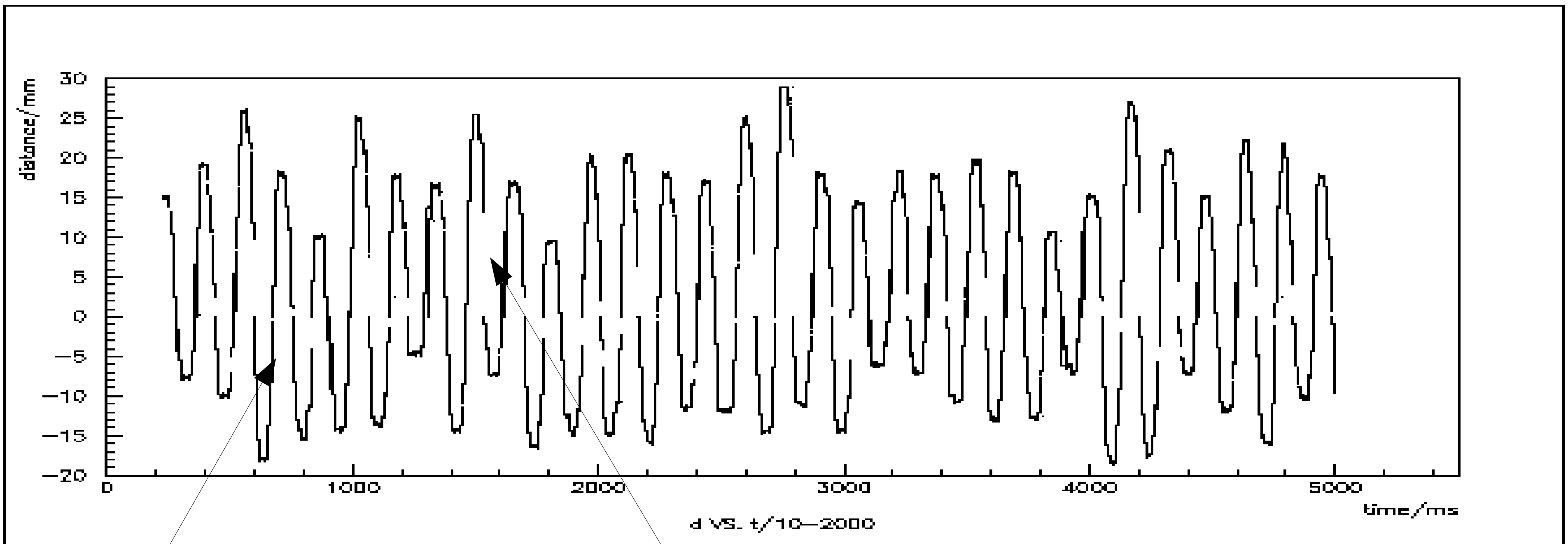
# First results




Position is oscillating once the shuttle reaches the correct value

Frequency = 0.3Hz

# First Results




Much smoother motion

Gaps when sensor passes marker index. Missing counts?

Frequency = 6.4 Hz

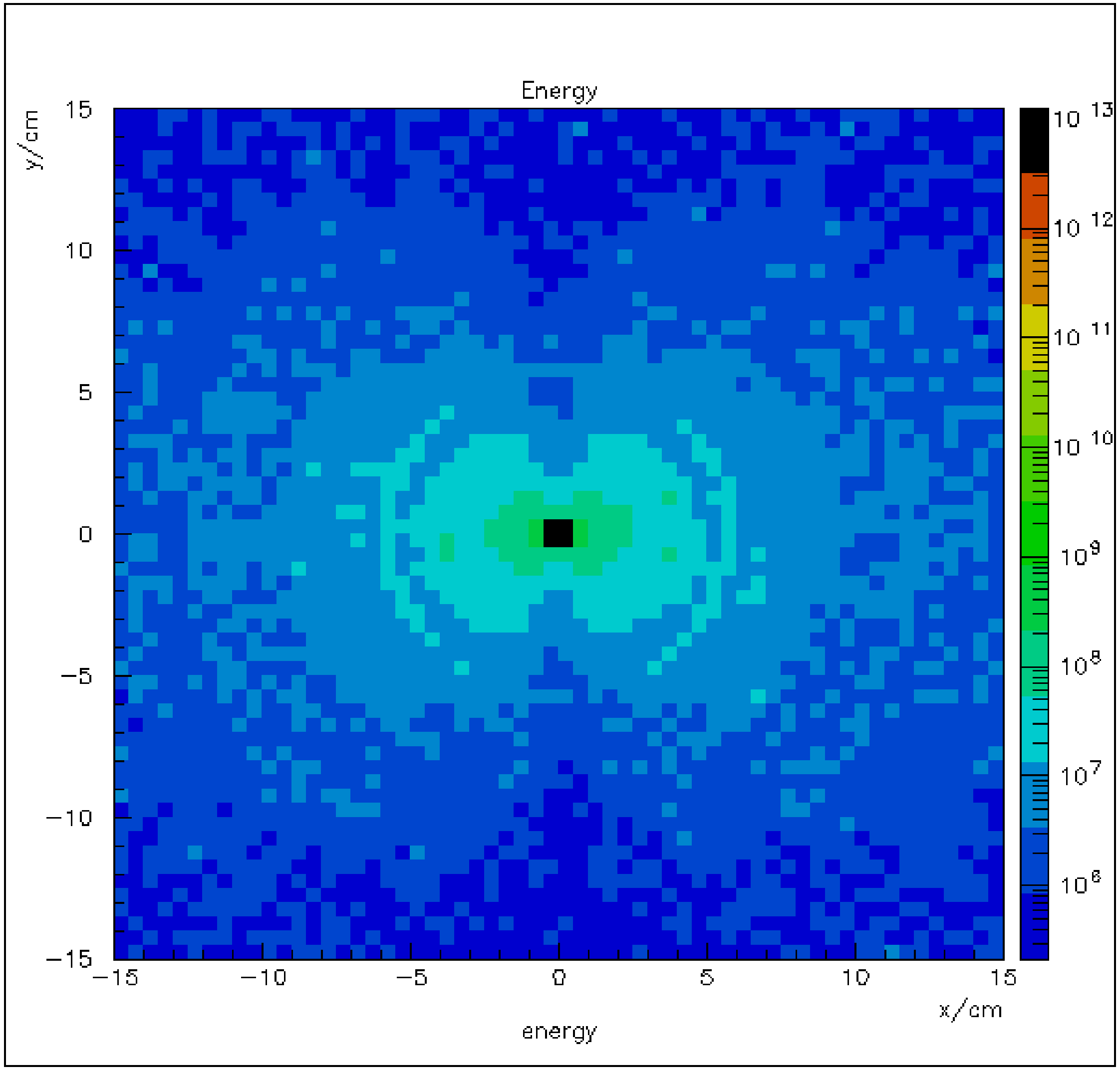
# Full Prototype design

- Design of the new prototype is almost complete
- This has new magnet layout to give better flux linkage
- Will use higher current to give bigger forces and acceleration
- More coils in three phase to give better control

# Radiation concerns

- Concerns on how radiation levels will affect the magnets and electronics have previously been expressed
- To this end a first simulation has been done with FLUKA to try to assess what we can expect radiation levels to be around the target
- The simulation consists of 800 MeV protons on a $10x10x1mm^3$ titanium target

# Simulation results




Grays/year

# What does this mean

- A brief scan of the literature reveals that:
  - NdFeB magnets are unaffected by radiation levels of $1.2 \times 10^5$ Gray
  - Electronics start to show affects at around $10^2$ Grays
- Results still need to be carefully analysed and cross checked, but it looks like this is an issue that needs careful study and thought

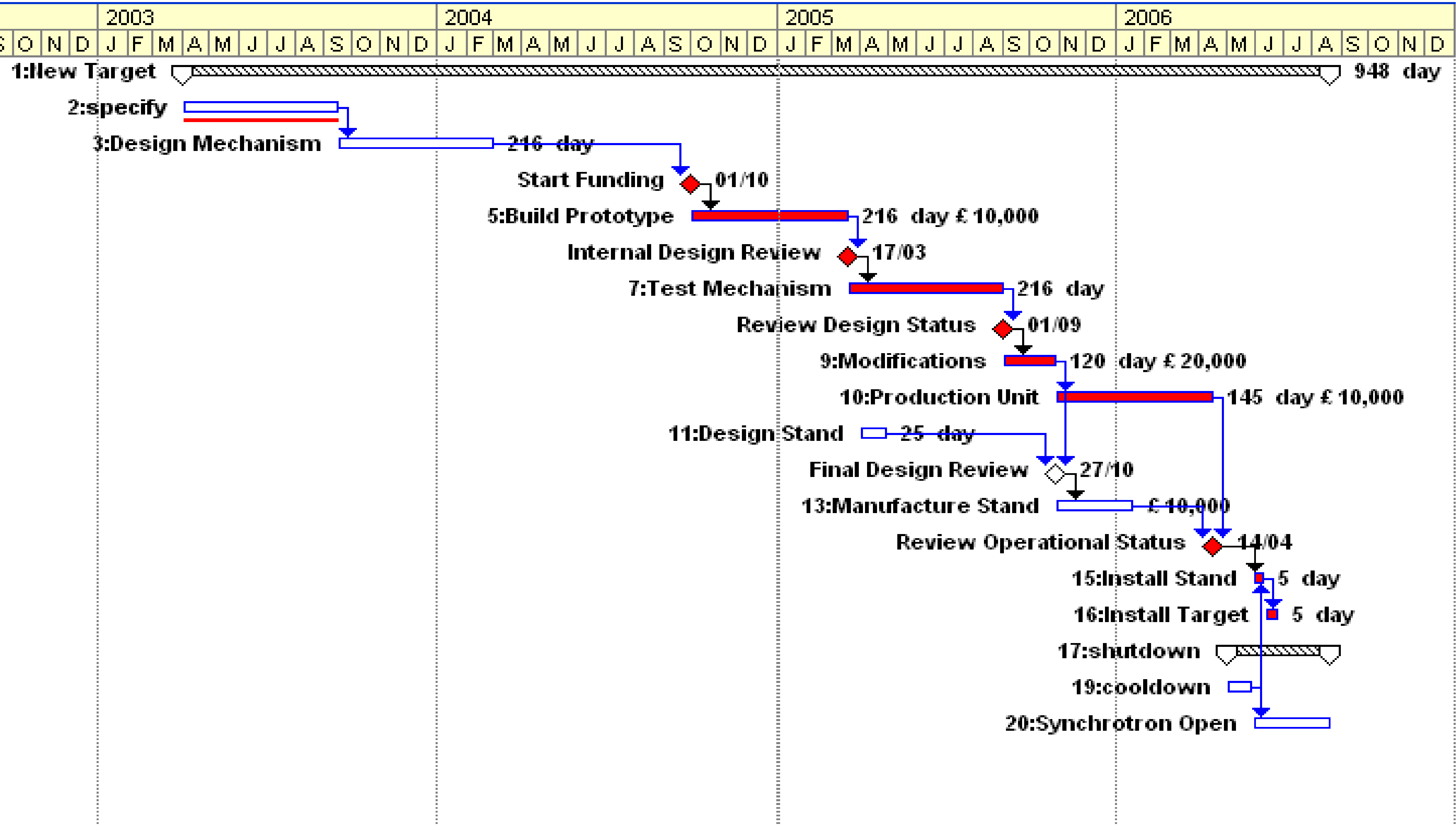
# Heating concerns

- Concerns have also been expressed about heating both
  - Heating of the target from proton collisions
  - Heating of the coils from high currents
- These issues need to be studied further

# Vacuum concerns

- Concerns have also been expressed about whether all the materials used are suitable for use in a vacuum
- There is also of the issue of how the water cooling should be implemented
- It is vital that we get the input of ISIS engineers before the design progresses too far

# Schedule



2003
2004
2005
2006
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1:New Target
948 day
2:specify
3:Design Mechanism
216 day
Start Funding
01/10
5:Build Prototype
216 day £ 10,000
Internal Design Review
17/03
7:Test Mechanism
216 day
Review Design Status
01/09
9:Modifications
120 day £ 20,000
10:Production Unit
145 day £ 10,000
11:Design Stand
25 day
Final Design Review
27/10
13:Manufacture Stand
£ 10,000
Review Operational Status
14/04
15:Install Stand
5 day
16:Install Target
5 day
17:shutdown
19:cooldown
20:Synchrotron Open

# Conclusions

- Progress has been made in development of electronics and readout technology
- First full prototype is expected at the end of Febuary
- Problems with radiation levels, heating and vacuum conditions remain a concern and should be studied carefully
- The involvement of ISIS engineers is needed for the design