Progress on Target Design

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2nd August 2004

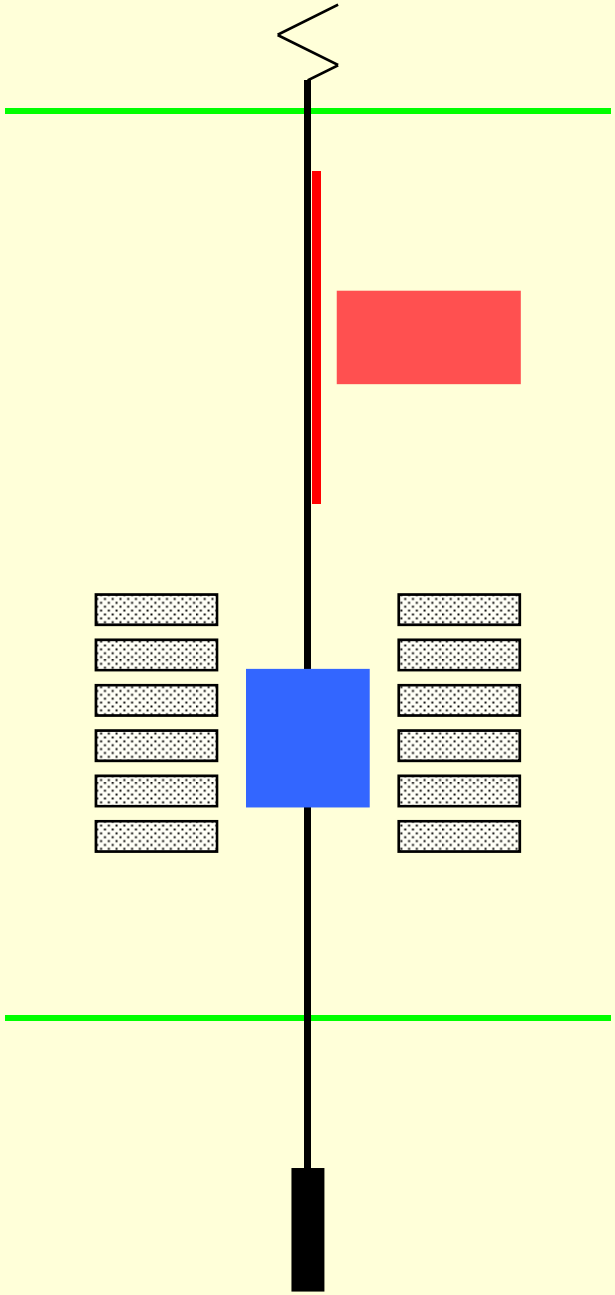
Components

- Linear Drive
- Diaphragm Spring suspension
- Position measurement system
- Drive waveform
- Feedback and control

Operating environment concerns

- Radiation
- Beam heating

Schematic design



Diaphragm spring

Position measurement

Array of coils

Magnet(s)

Linear Drive

Target

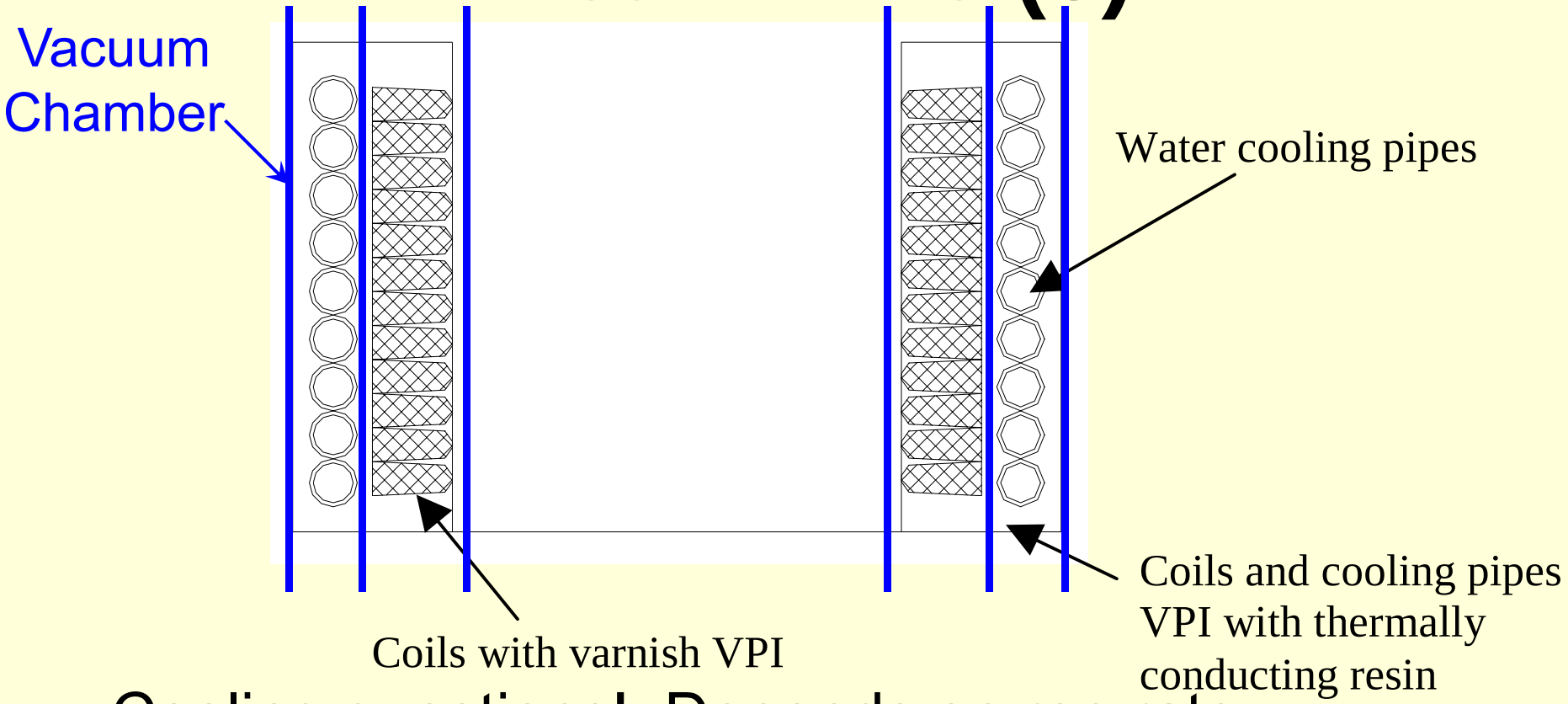
Linear Drive (1)

- Work with Electrical Engineering Dept.
- Pre-prototype constructed
  - Moving magnet shuttle (2 magnets)
  - Static double coil excitation
  - No commutator
- Does not provide required acceleration (or control)
- Measurements taken to measure and optimise flux-linkage
  - Overheated & destroyed during measurements!

Linear Drive (2)

- Multi-phase design in progress
  - 6 coils in 3 circuits
  - commutator
  - Design complete end August?
- Coil cooling test module under construction
  - Need for water cooling pipe in final device?
  - Study possibility of cooling coils outside vacuum chamber

Linear Drive (3)

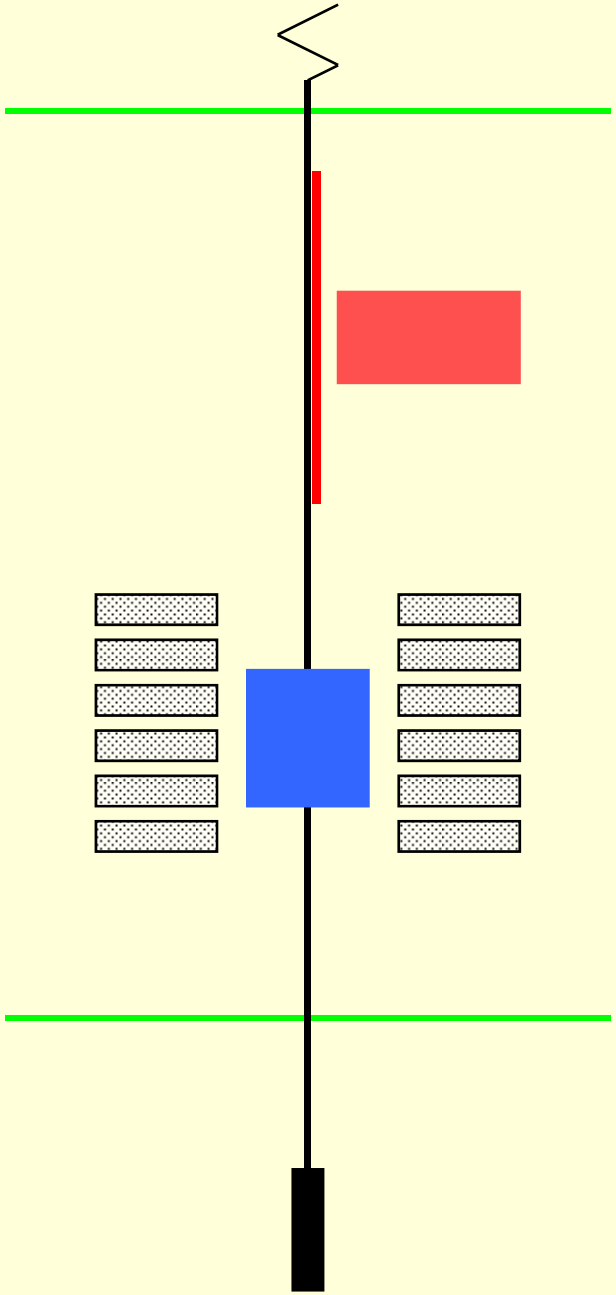


- Cooling questions! Depends on rep rate:
  - All inside vacuum chamber? (Allowed by ISIS?)
  - All outside vac. Chamber? (Screening currents?)
  - Heatsink through chamber? (ok for lower power only?)

Linear Drive (4)

- High repetition rate may have serious cooling implications! (Also see later.)
- We must design for what is absolutely necessary for MICE
- Extend to what “would be nice if possible” if possible!!!

Schematic design



Diaphragm spring

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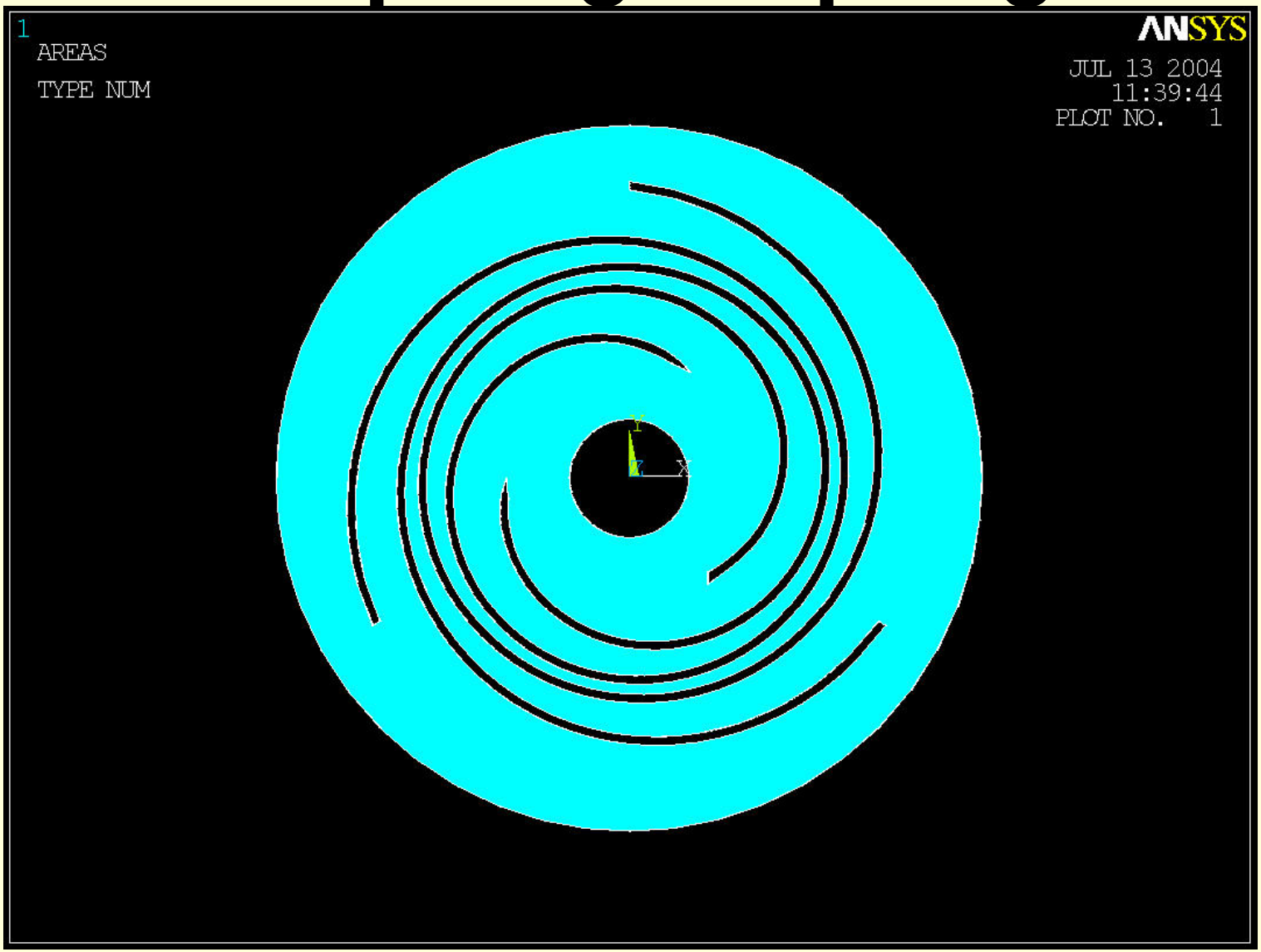
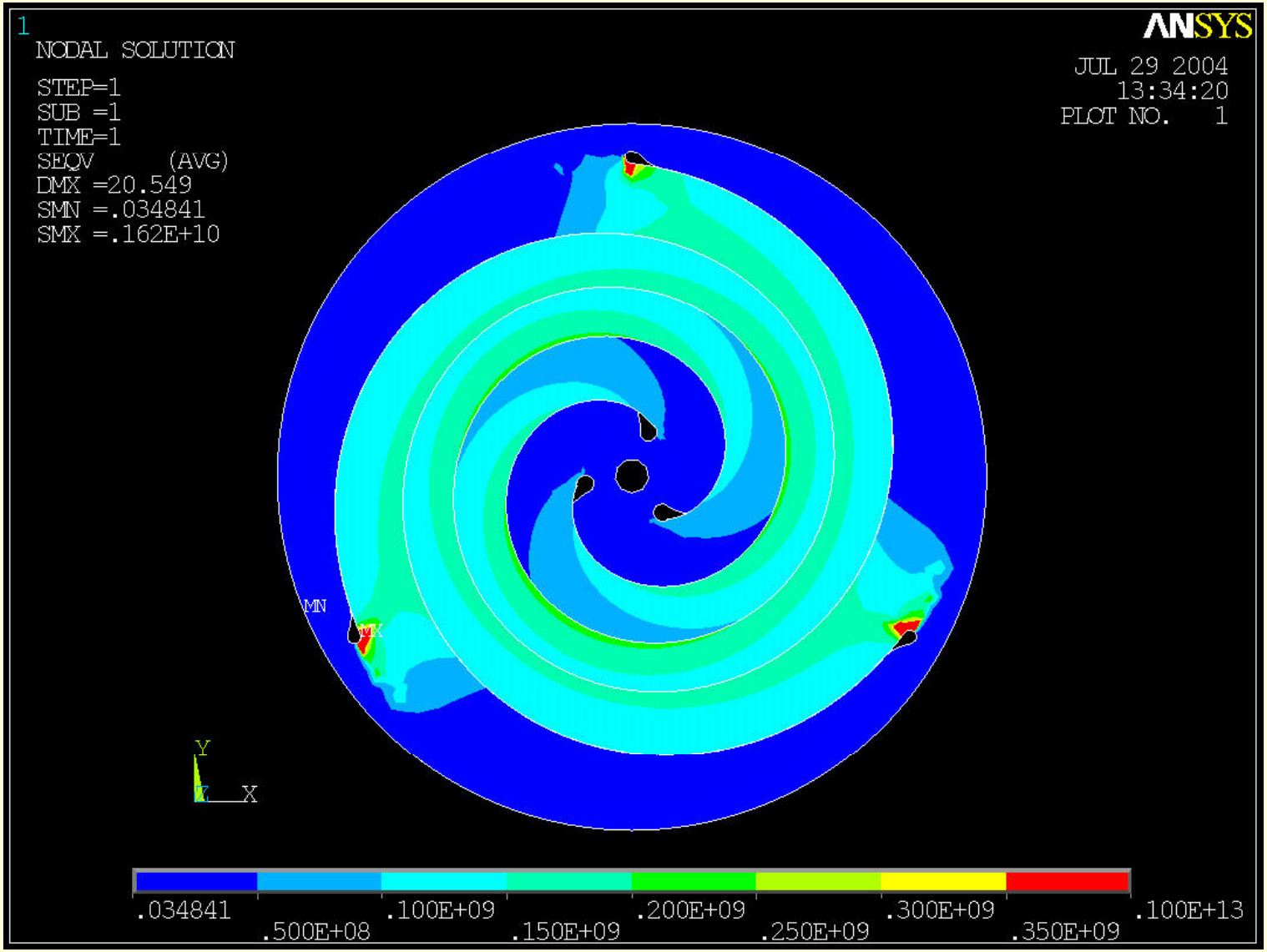
Diaphragm Spring



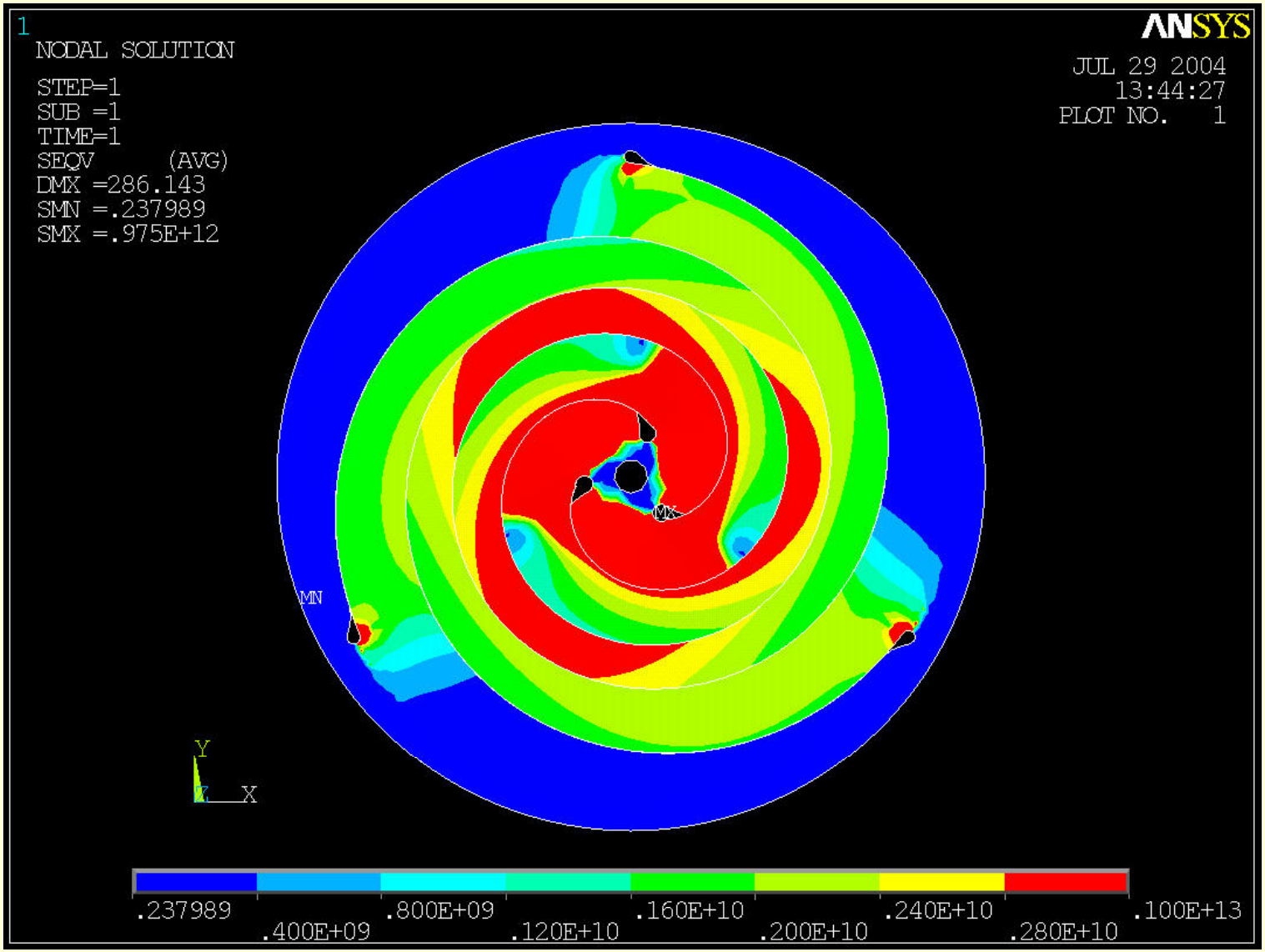
Diaphragm Spring suspension

- Frictionless “bearing” allowing vertical movement
- Must keep armature on axis to $\pm$0.2 mm (for magnet and position monitor)
- Design of small spring obtained from Tom Bradshaw (RAL)
- Scaled up to allow ≥40 mm travel
- Finite element studies to check stress and lifetime issues (Lara Howlett)
  - Outer radius → 57.5 mm

Diaphragm Spring – best parameters



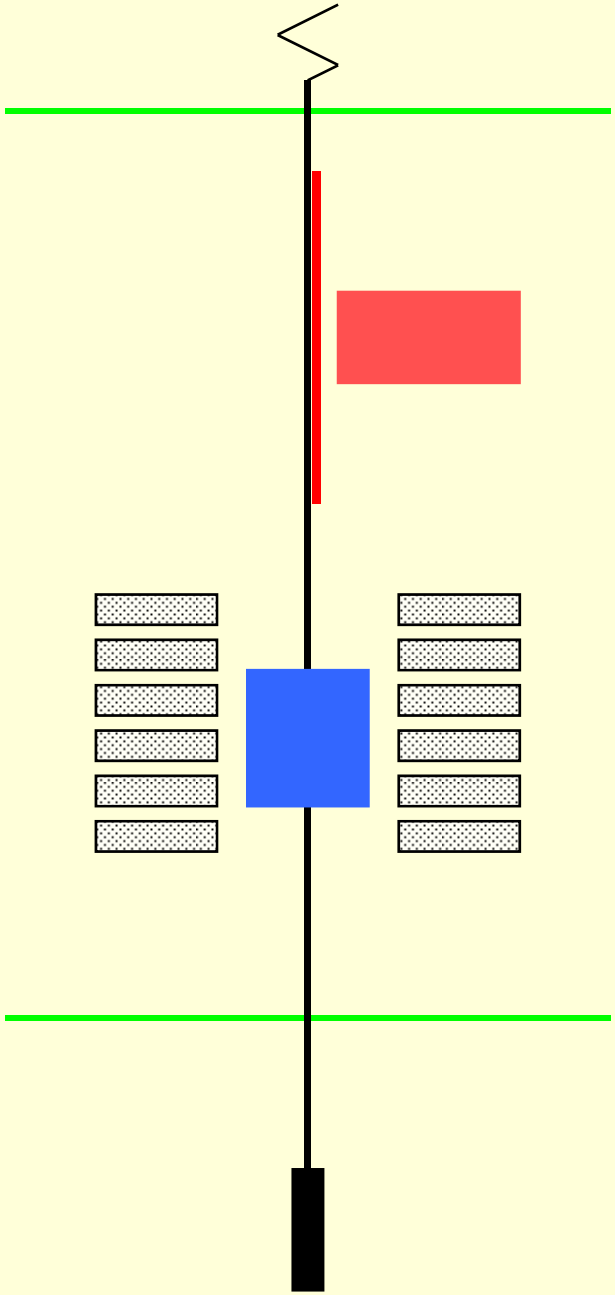
Diaphragm Spring – bad spiral ratio



Diaphragm Spring suspension

- Be-Cu sheet procured
- Wire-erosion arranged in Eng. Dept. workshop
- Produce first batch this week
  - Range of thicknesses
  - Also phosphor bronze?
- Lateral stability tests
- Possible further optimisation

Schematic design



Diaphragm spring

Position measurement

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Position measuring system

- Inductive linear measuring system (Hengstler)
- Low mass moving scale
- Fixed magnetic read head
- Contact-free
- Resolution 50μm
- PCI-card readout
- Bench tests in progress, software under development

Electronic Drive & Control

- PC-controlled arbitrary function generator
- High power audio amplifier (1000 W) ordered
- Feedback & control system (to be developed)
  - Operator request (time & depth)
  - Position measurement samples (0.1 ms)
  - Load modified drive waveform into function generator

Environment – Radiation

- What is radiation level at drive motor?
  - Problem for Nd-Fe-B magnets?
- Radiation level at position monitor?
  - Problem for electronics?
  - Radiation profile? Advantage in moving sensor or electronics out?
  - Possibility of shielding?
- Programme of measurements proposed for autumn ISIS run – radiation monitors plus sample magnets, electronic components etc.

Beam heating

- Tom Roberts' presentation to collaboration meeting (30th March): "1.4E12 protons on target" to deliver 300 – 500 good muons to MICE
- Implies ionisation heating of 1.9 kW in 1 ms
  - Mean power 1.9 W @ 1 Hz, 95 W @ 50 Hz
  - Radiation from 2 cm^2? 860K @ 1 Hz, 2300K @ 50 Hz!!
- Fins to improve thermal radiation? Thicker shaft to improve conduction? (but Curie point of magnets?) Effect on overall mass?
- Need better estimate of beam flux
- Model, plus tests with heating element in vacuum

Timetable (as presented 30/3/04)

• First prototype	Summer 04
• Develop control	Autumn 04
• System tests	Winter 04-05
• Cooling, stability tests	Spring-Summer 05
• Rad-hard components	Spring-Summer 05
• Interfaces with ISIS	Spring-Summer 05
• Implement improvements	Summer 05
• Final device construct/test	Autumn-Winter 05
• Install	Winter-Spring 06