UK Astronomy Technology Centre

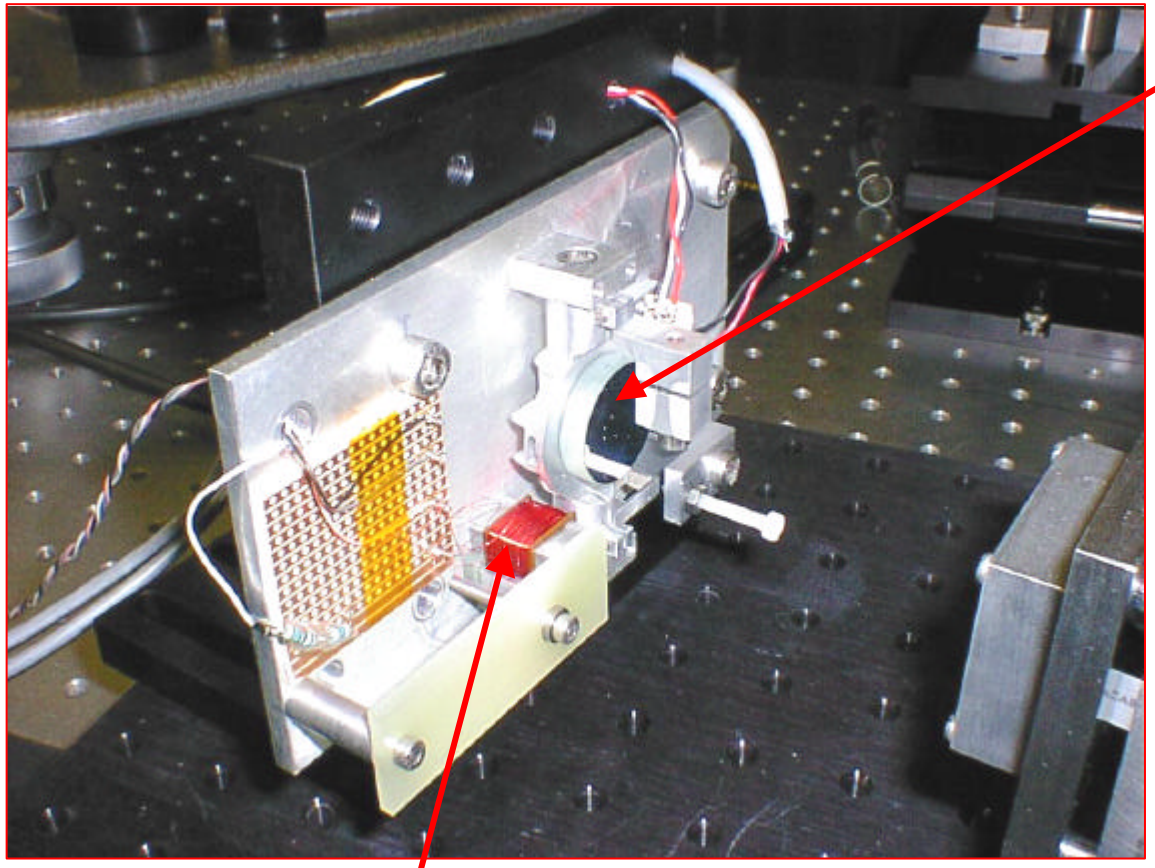
Prototype Results and Test Plan

Gillian Wright

Proto-types and tests

- **Tests to be carried out on proto-types, DM and other models set out in BSM development plan**
  - **Section 9 of document pack, starting page 26**
- **Current Status**
  - **Single axis proto-type tests complete**
  - **Have "brought forward" some tests from two-axis to single axis proto-type**
  - **Two axis proto-type construction being completed this week**
- **Single Axis proto-type (section 5 appendices 8 and 9)**
  - **manufacture and assembly OK**
  - **confirmed basic design assumptions - position sensors, motors, control loop, D-Space, Simulink etc.**
  - **experience with & tests of CDL position measuring device**
  - **cooling rate test**
  - **basic cryogenic functionality of sensors and motors**

Single Axis Prototype

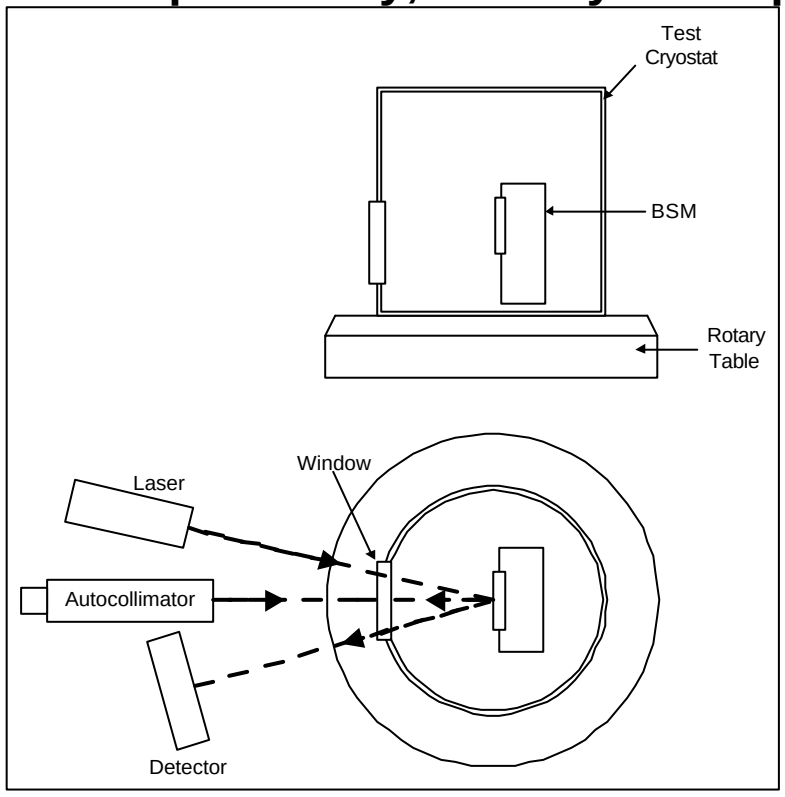


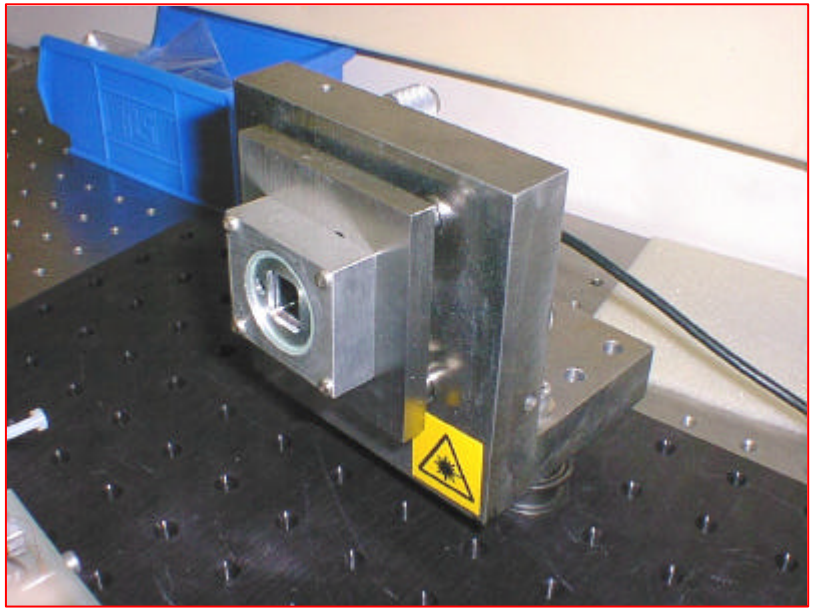
Test Equipment

- **Position measuring device to allow optical measurement and monitoring of the BSM mirror position.**
- **Used for the warm motor torque tests on the single axis proto-type**
- **Performance has also been checked against stable plane mirror.**

Tilt Measuring Device

- To verify optically that mirror is performing within spec
  - calibrate angle of tilt
  - repeatability, stability of chop, jiggle etc.





Tilt Measuring Device - tests

- **Tests of TMA with a fixed mirror, not the BSM indicate its working extremely well.**
  - **ie detector and laser stability are fine.**
  - **expect to achieve required measurement accuracy**
  - **cf. BSM stability requirement to be measured is 0.02 degrees rms**
- **Can also measure stability of BSM position hold interferometrically.**
  - **by taking repeated measurements over period of hours.**

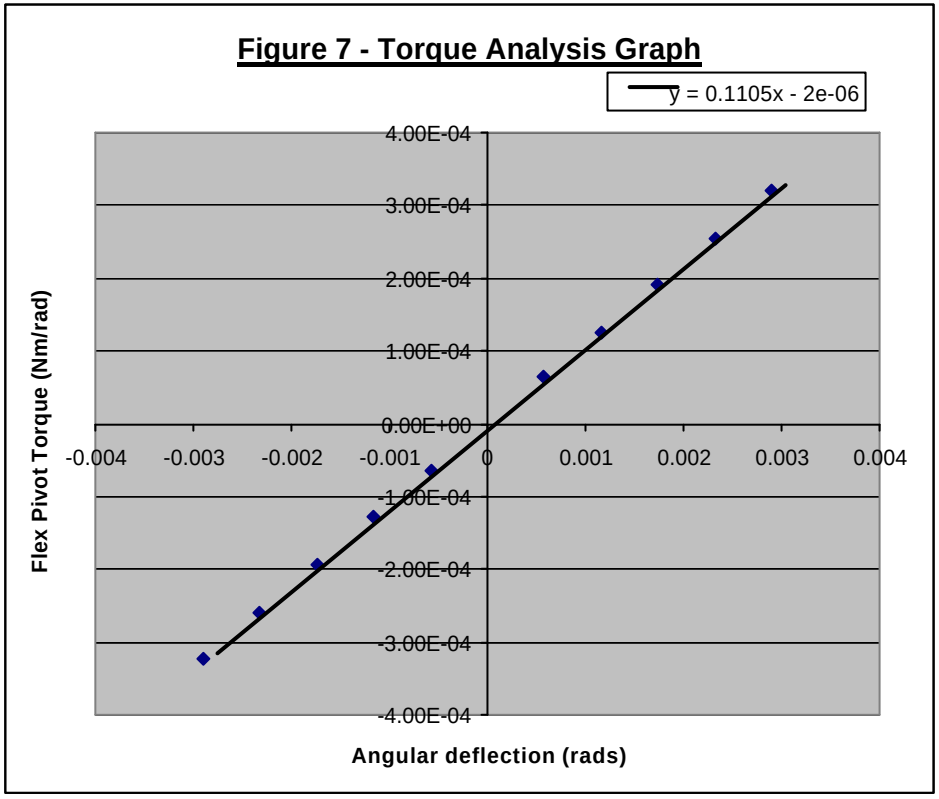
Position Sensor Noise

- **Allowing 25% of the maximum mirror position error to be due to positions sensors and electronics**
  - **~ 9.5mV maximum tolerable noise**
- **Output from position sensor + preamp captured when operating open loop**
  - **noise amplitude ~ 10mV rms**
  - **frequency analysis - some large peaks at > 50 kHz**
  - **low frequency noise peaks**
- **Conclusions**
  - **need high frequency filter**
  - **need to ensure pre-amp is shielded**
  - **should easily meet requirements**

Motor Torque

- **Apply several different voltages to the motor on the single axis and measure angular movement of the mirror using the tilt measuring device.**

- **Flex pivots have known spring constant**
  - **angular movement => equivalent force => torque constant**

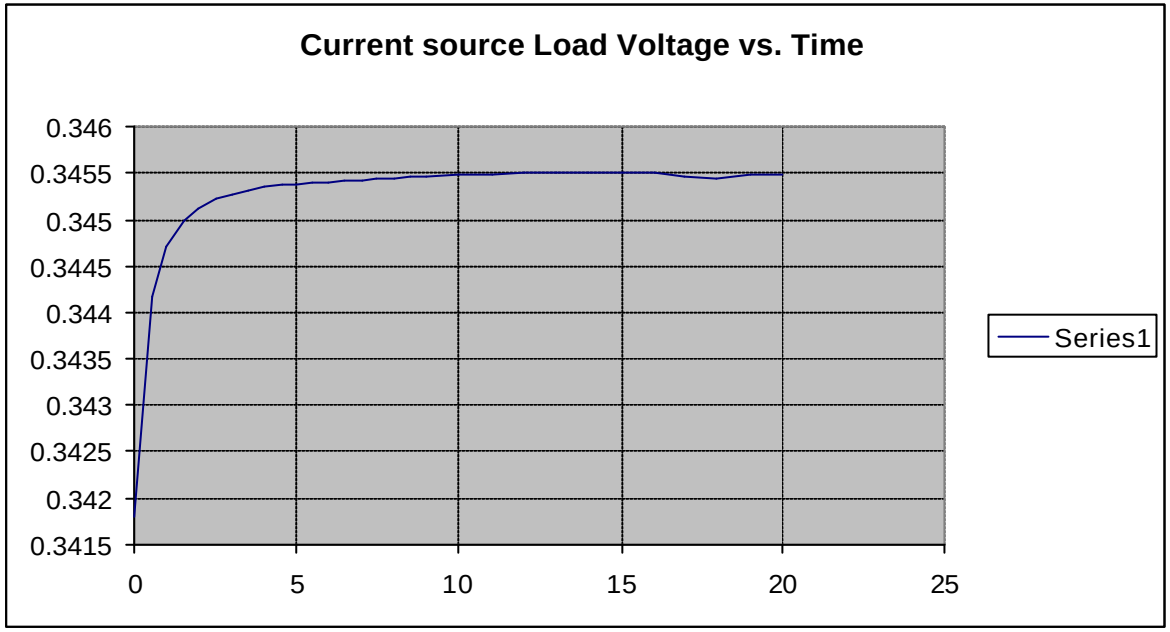


Motor Torque cont.

- Average motor torque constant of 0.11 Nm/A
- By extrapolation at the maximum required angular deflection of 0.042 radians motor will ???
- Adequate to drive system
- Need to say what motor torque is for what assumptions and how that compares to the requirement ! Please, Brian ?

Current Source Stability

Current source stability directly affects long term stability of mirror position



Current source stable to about 30 ppm after warmup period
Should not be significant contribution to the required position stability which corresponds to 0.16% over 4 hours.

Preliminary Cross talk test

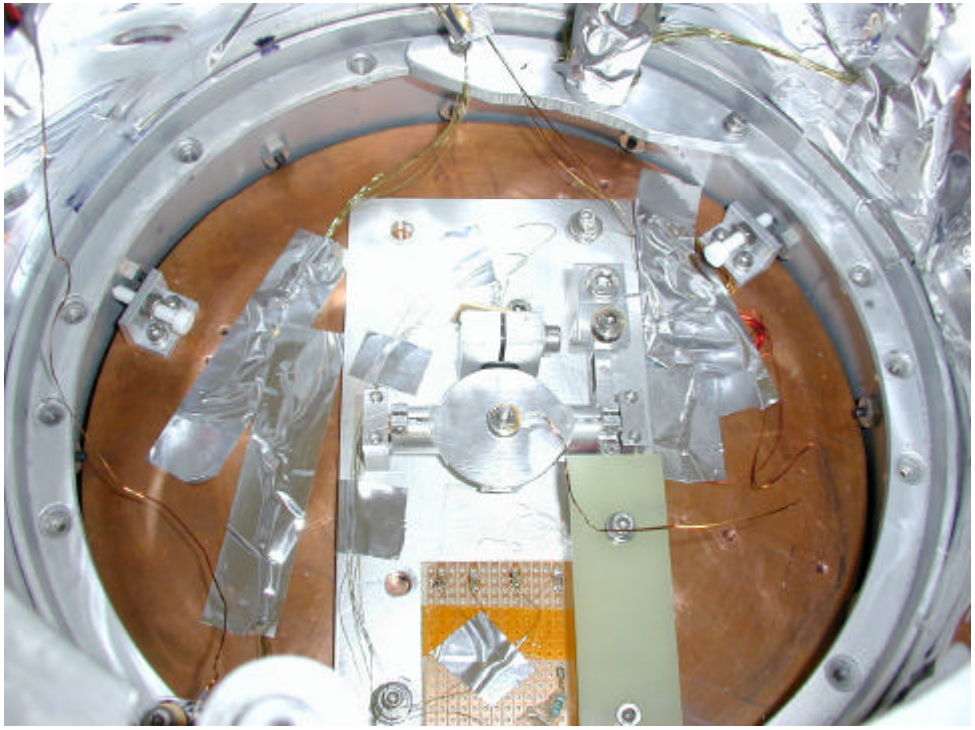
- **Sensor placed in position of jiggle axis sensor whilst chop motor running**
  - **output showed only the noise on the sensor circuit at same 10mV level as when power is off.**
  - **moved as close to motor as possible and still no signal**
  - **replaced in chop axis position and confirmed still working.**

- **Unlikely to be electrical cross talk between the axes**
  - **tbc with tests of 2-axis proto-type.**

Single axis cold power dissipation

- This section was mistakenly included.
- Not clear what type of copper windings we have
  - suspect not pure, since this was a proto-type motor
- Measurements include disipation in our temporary harness in cryostat
  - also not clear wiring type, since this was a test rig constructed just to verify basic function, not make measurements.
- 330 O to 50 O resistance drop is not consistent with PACs measurements.
- Primary goal of cooldown was to determine cool rate of mirror .....

Cooling test



- **Shown mounted on baseplate of liquid He test cryostat.**
  - **baseplate cooled to 4.6K**
- **Mirror reached temperature of 5.2 K after 9 hours**
- **Basic functionality confirmed by examining position sensor output on oscilloscope.**

Conclusions

- **Several design assumptions verified by performance of the single axis proto-type**
- **Some small changes for two axis proto-type.**
- **test procedures verified**