FMOS Overview

Oxford, 22nd June 2009

FMOS: Fibre Multi-Object Spectrograph

- Logical successor to 2dF
  - Wide-Field IR spectroscopy on 8m telescope, high throughput and ultra-low background (OH Airglow-Suppressed) for low resolution survey spectroscopy
- Formal discussions began 1997 →NAOJ funded concept study (Oxford, IoA, RGO, Durham, AAO)
- Key science goals included 'Galaxy Evolution' and the 'Evolution of Large-Scale Structure'
- Design phase began 2001 (Oxford, RAL, Durham, Kyoto, AAO)
- Many challenges of design and implementation
  - International Collaboration
  - Fibre Positioner, Cold VPH Gratings, Articulated Camera, OH Suppression Mask, Mosaiced Gratings
- Will be the world-leading IR survey spectrograph

Fibre Multi Object Spectrograph

★ *400 fibres on the prime focus (= 30 arcmin ϕ FoV)*

- *Each fibre (100 μm core) subtends 1".2ϕ on the sky.*
- *~13 minutes for fibre configuration (~15 μm/0".12 accuracy)*

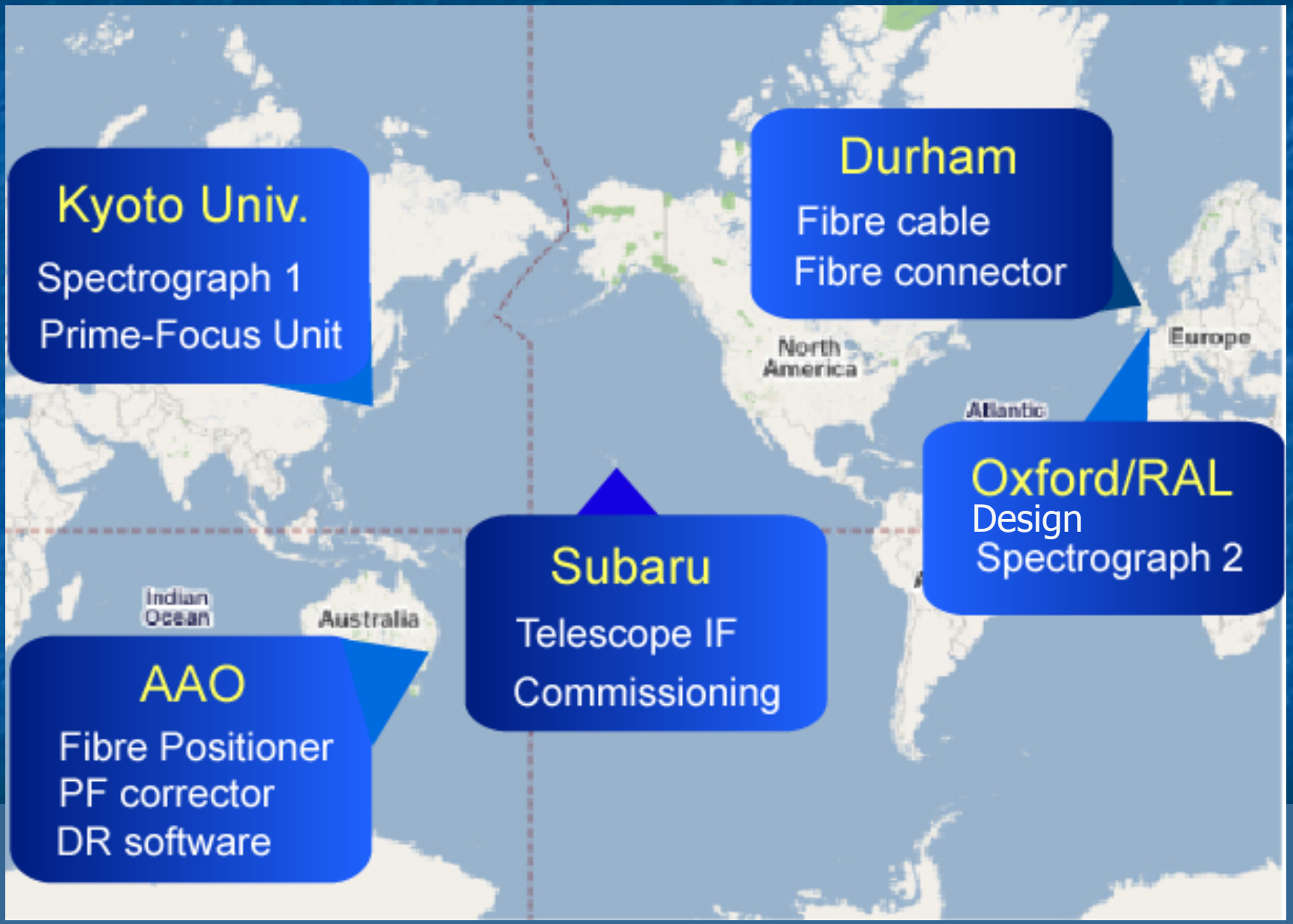
★ *NIR spectroscopy: 0.9 - 1.8 μm*

- *2 spectrographs (200 spectra x 2) operated at T ~ – 55 deg.*
- *OH airglow Suppression (OHS) with a mask mirror.*

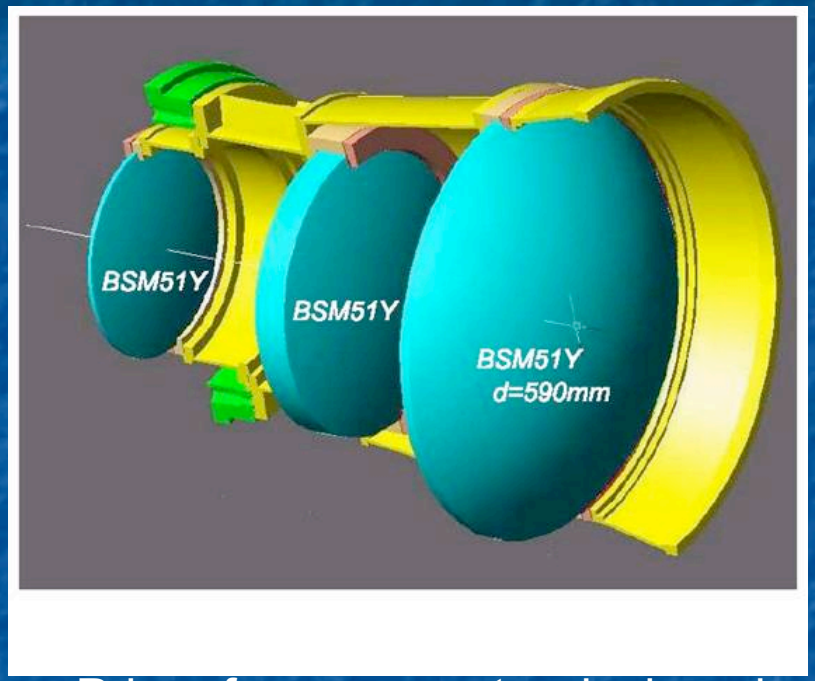
★ *Two observing modes: Low Res. & High Res.*

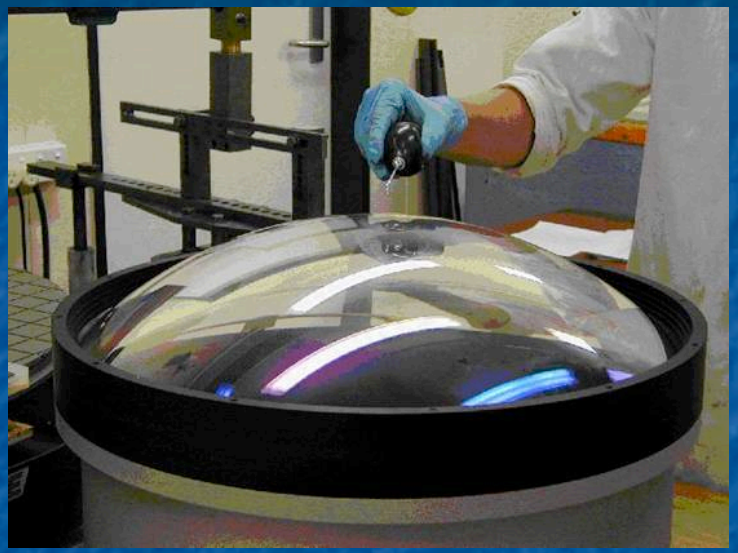
- *Low R: 0.9 - 1.8 μm is observed at one exposure with R~500.*
- *High R: Any ~ 0.2 μm region is observed with R ~ 2200.*

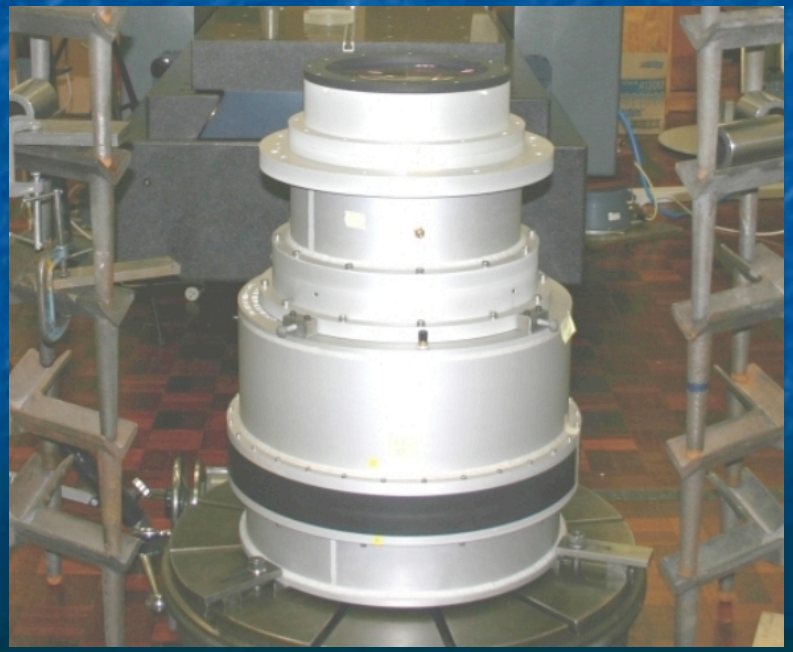
FMOS Project Overview



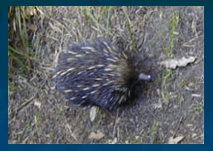
FMOS: prime-focus corrector







- Prime-focus corrector designed and fabricated by AAO
- Three BSM51Y design with F/2.0 and 30arcmin diameter FoV.
- Image quality optimized between 0.9-1.8micron



FMOS:Echidna

- 2dF pick'n'place solution doesn't scale to FMOS focal plane size…
- Need a radically different concept (Gillingham, Dalton et al., 1998)
- Tiling the focal plane with 400 of them = 7mm x 7mm each

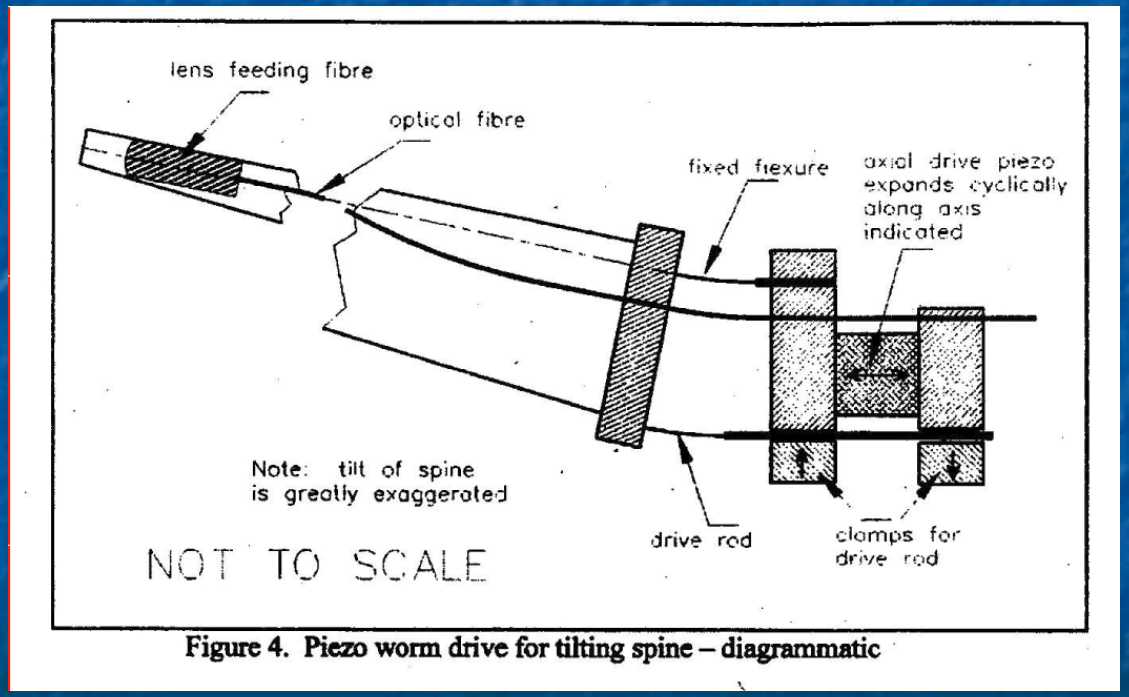
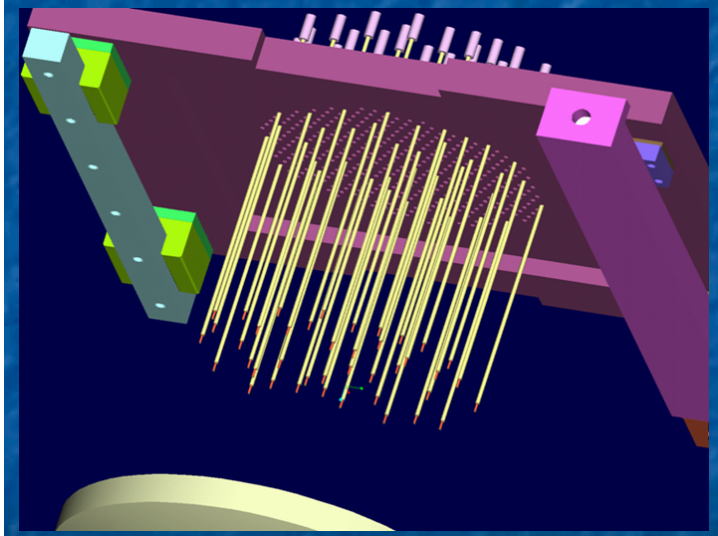
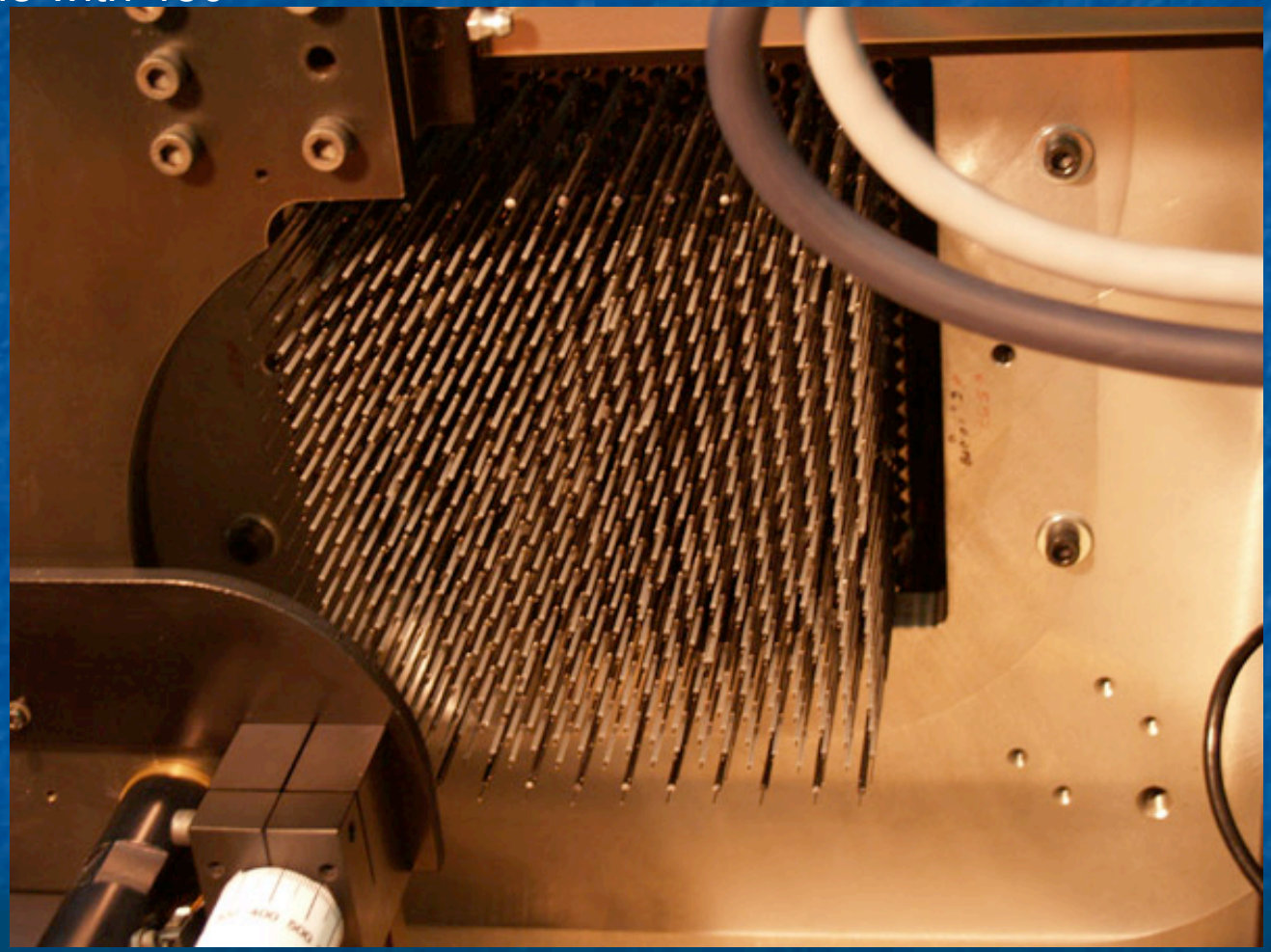


Figure 4. Piezo worm drive for tilting spine – diagrammatic



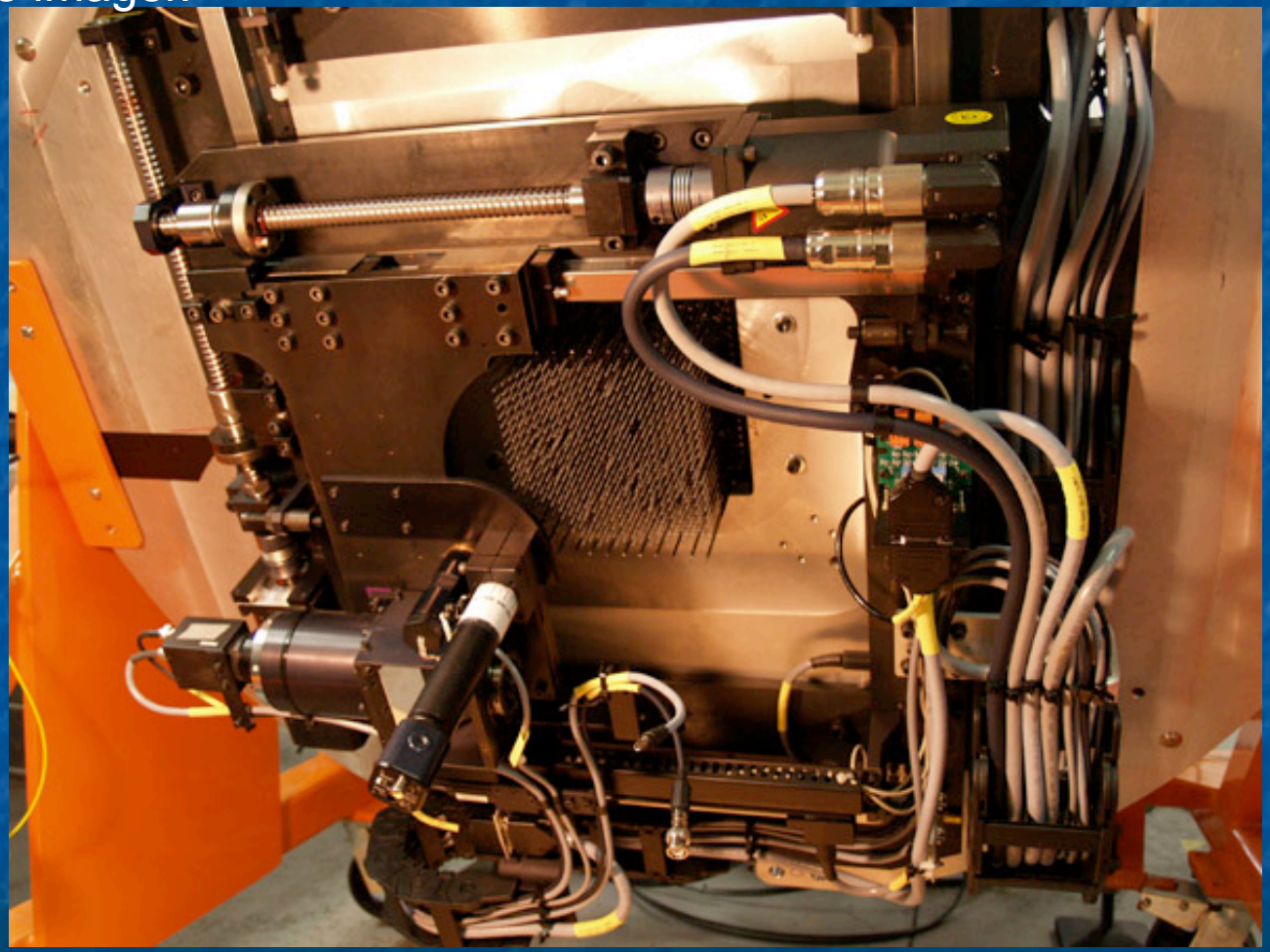
FMOS:Echidna: Under testing in Hilo

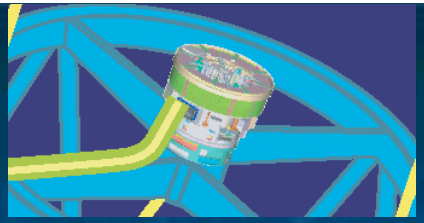
- Focal plane with 480 spines.



FMOS:Echidna: Under testing in Hilo

- Focal plane imager.

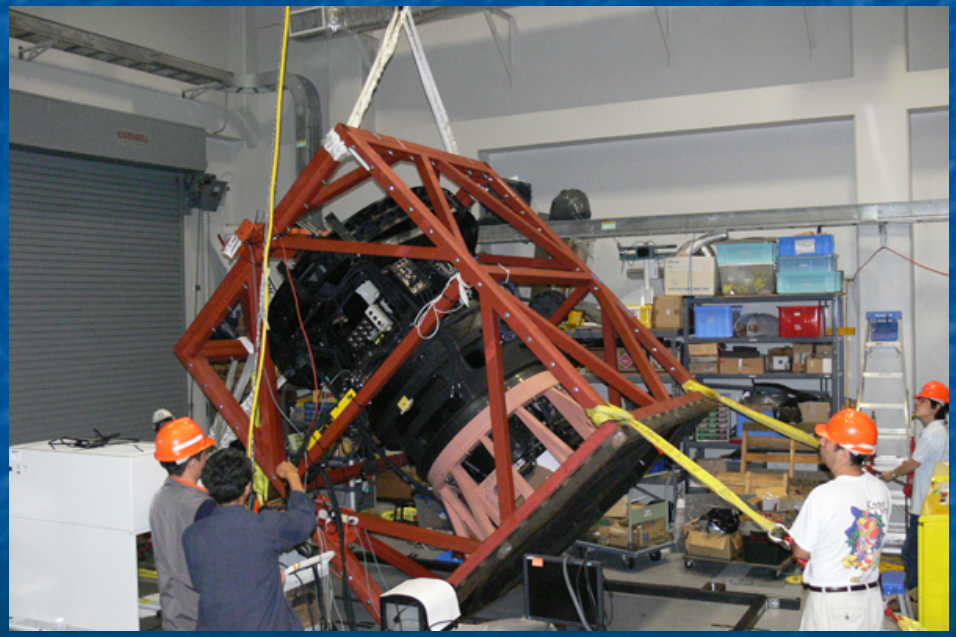




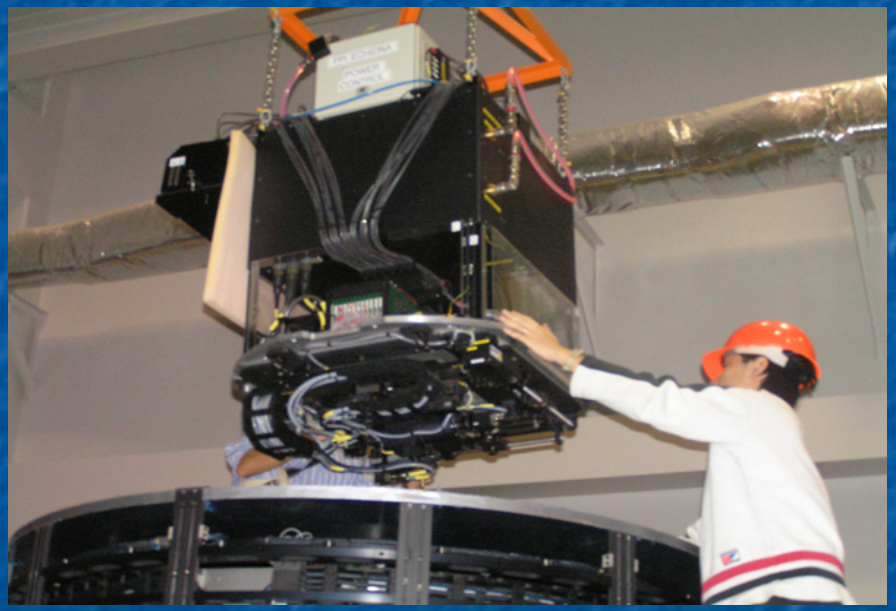
FMOS: prime-focus unit (PIR)

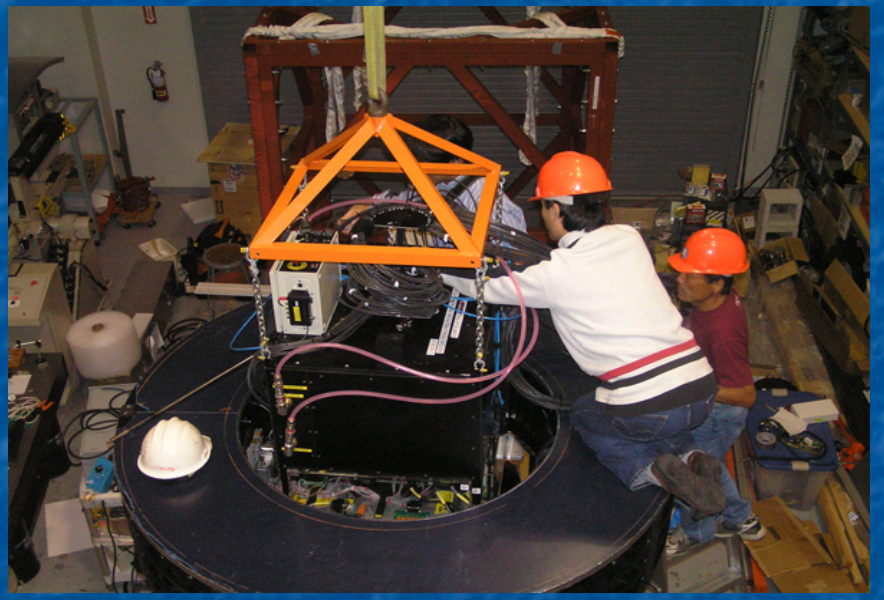
- New prime focus unit with
  - instrument focusing unit (Z-movement)
  - corrector lens adjustment mechanism (XY-movement)
  - cable wrapping unit

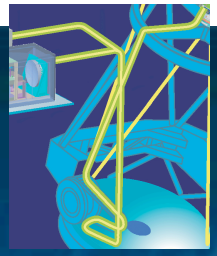
  for FMOS is constructed by Kyoto Univ. and Mitsubishi.



FMOS:PIR+Echidna



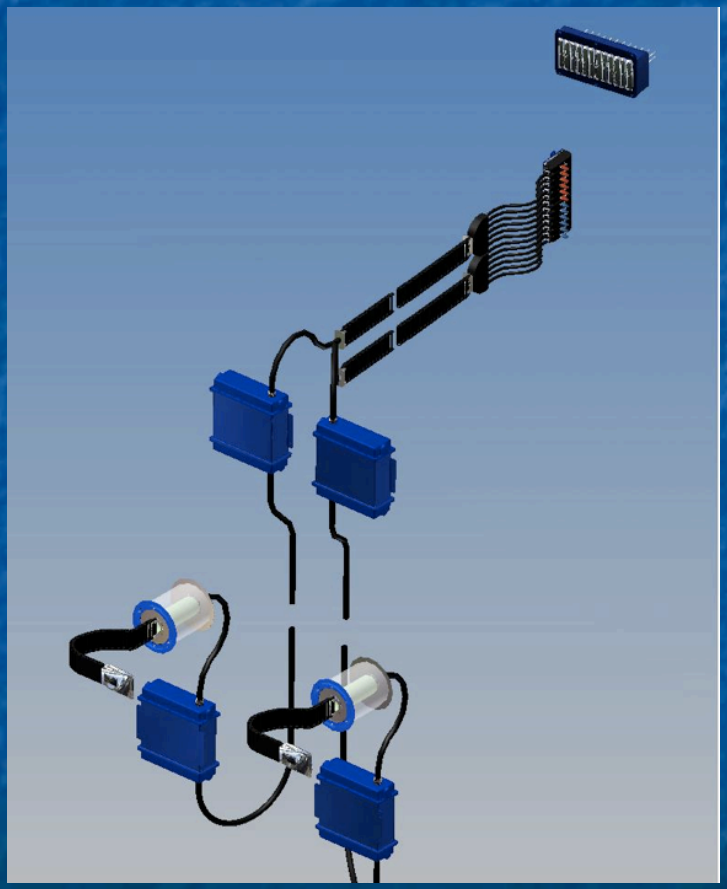




FMOS: fibre train with connector

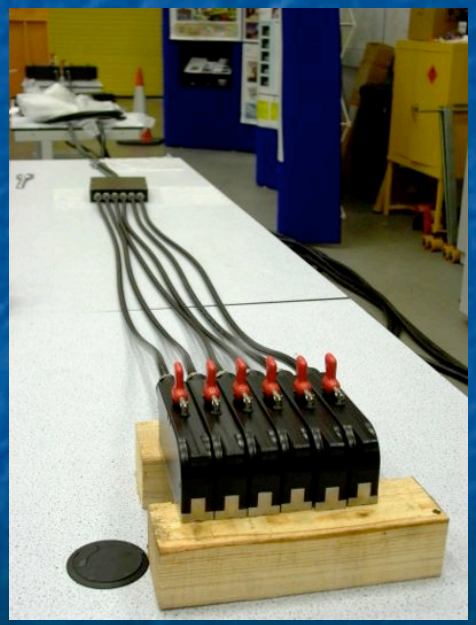
- Fibre trains with
  - 120mm 200 fibres/slit
  - strain relief boxes
  - F2/F5 conversion air connector
  - fibre back illumination system

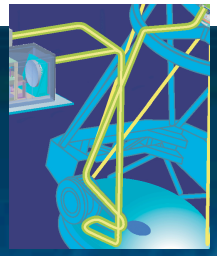
was designed and fabricated in Durham.



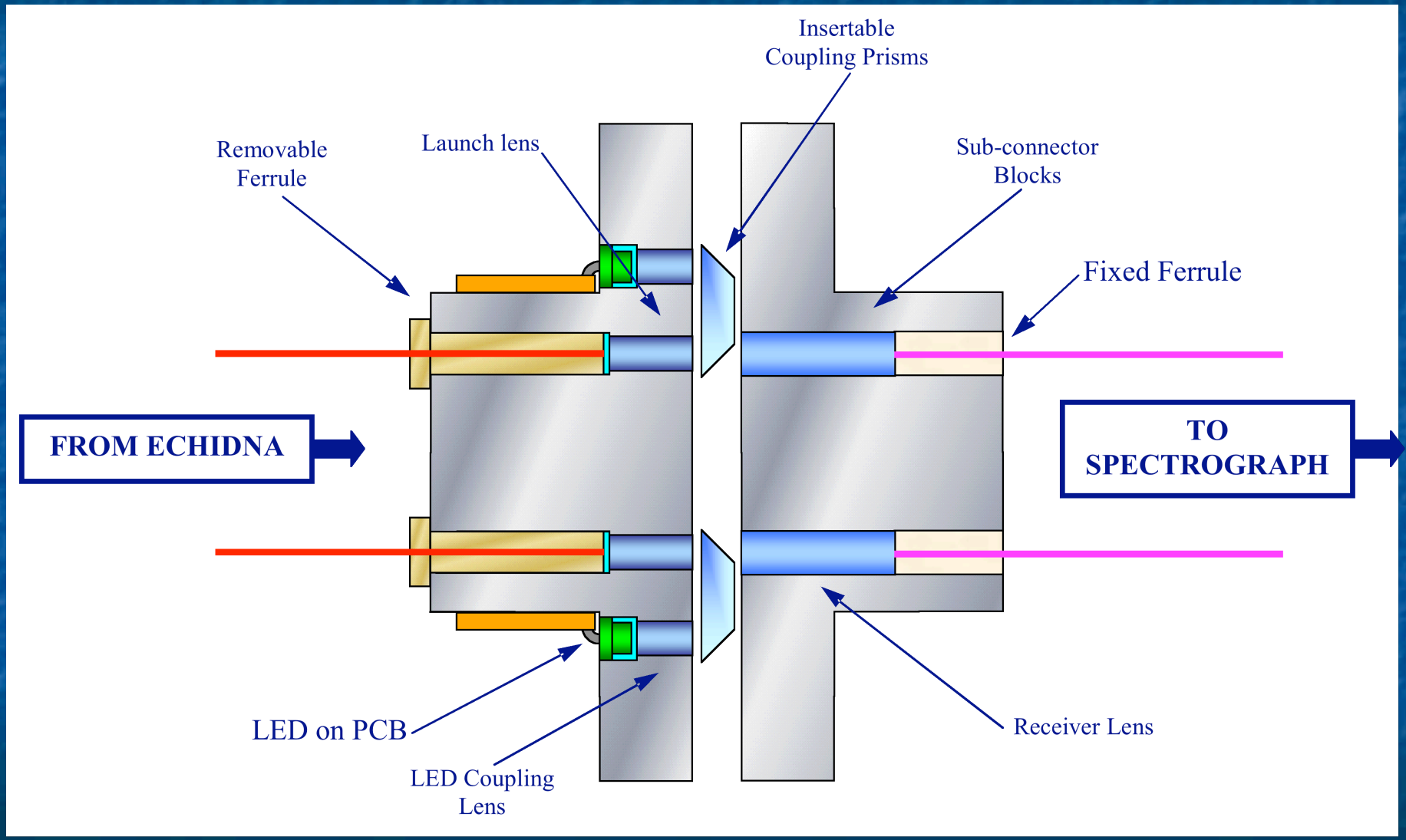
- F2-side fibre

- F5-side fibre

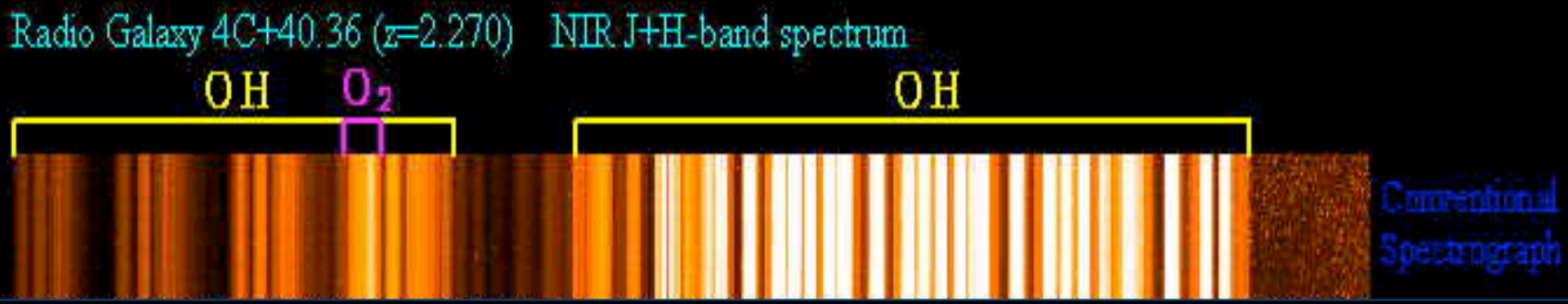




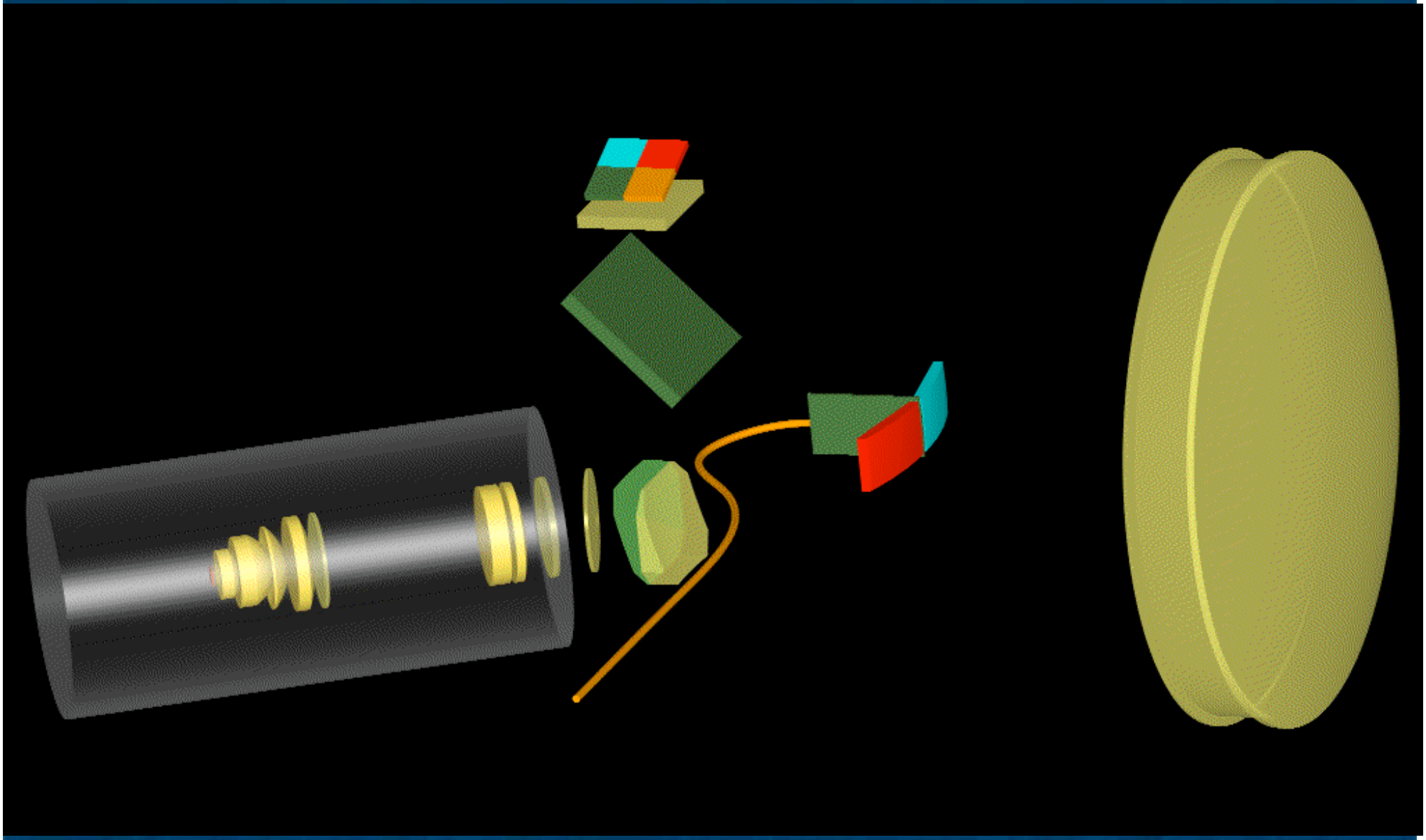
FMOS: fibre train with connector



Spectrograph: Why OH Suppression?

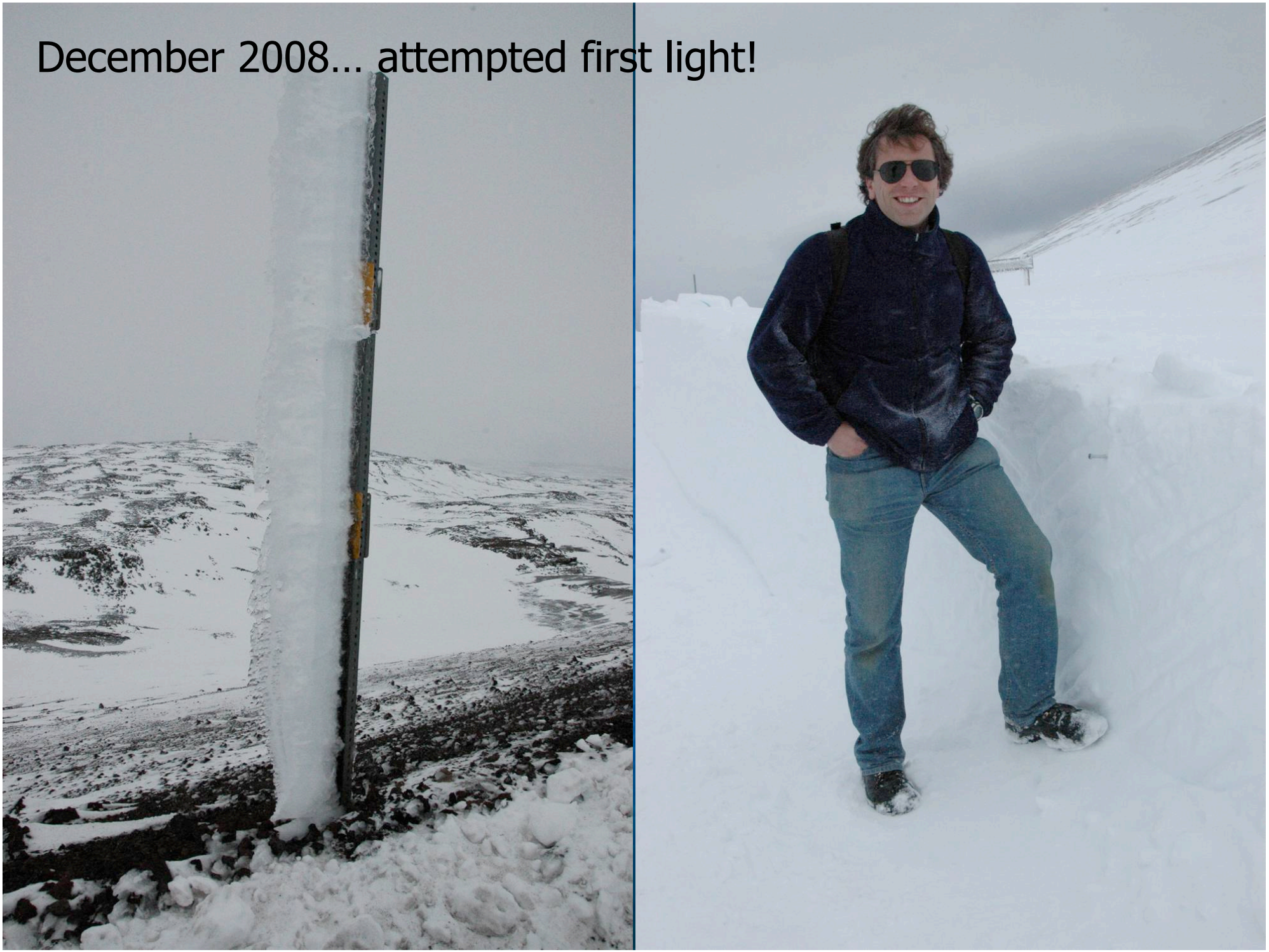


Spectrograph Design

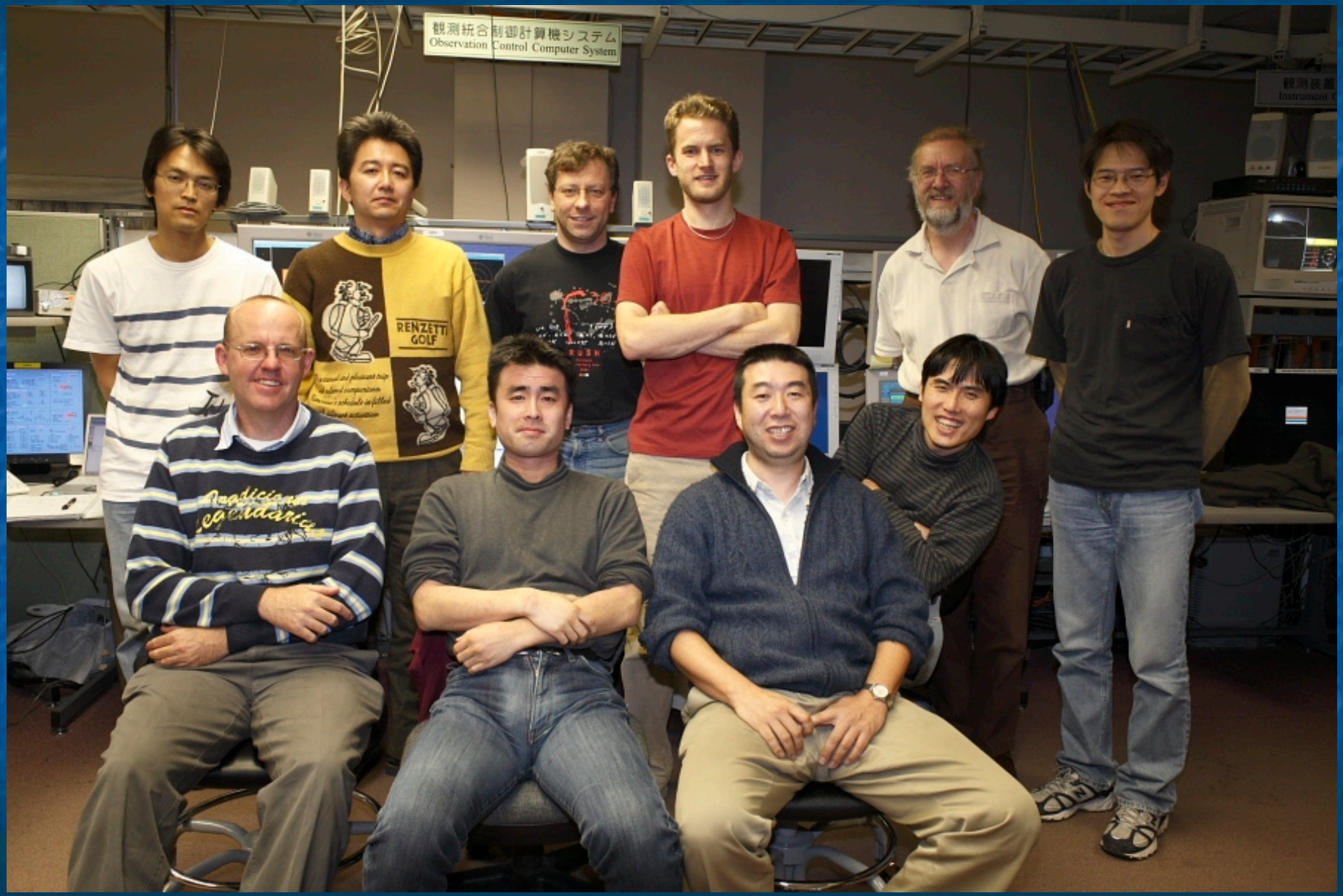


VPH grating at spectrograph exit pupil provides low cost/high efficiency solution for simultaneous coverage of Y, J and H bands

December 2008… attempted first light!



First Light… January 2008



Engineering First Light @May 14, 2008

Target: 48 bright stars (V < 15) in Mel 111 (Galactic open cluster)

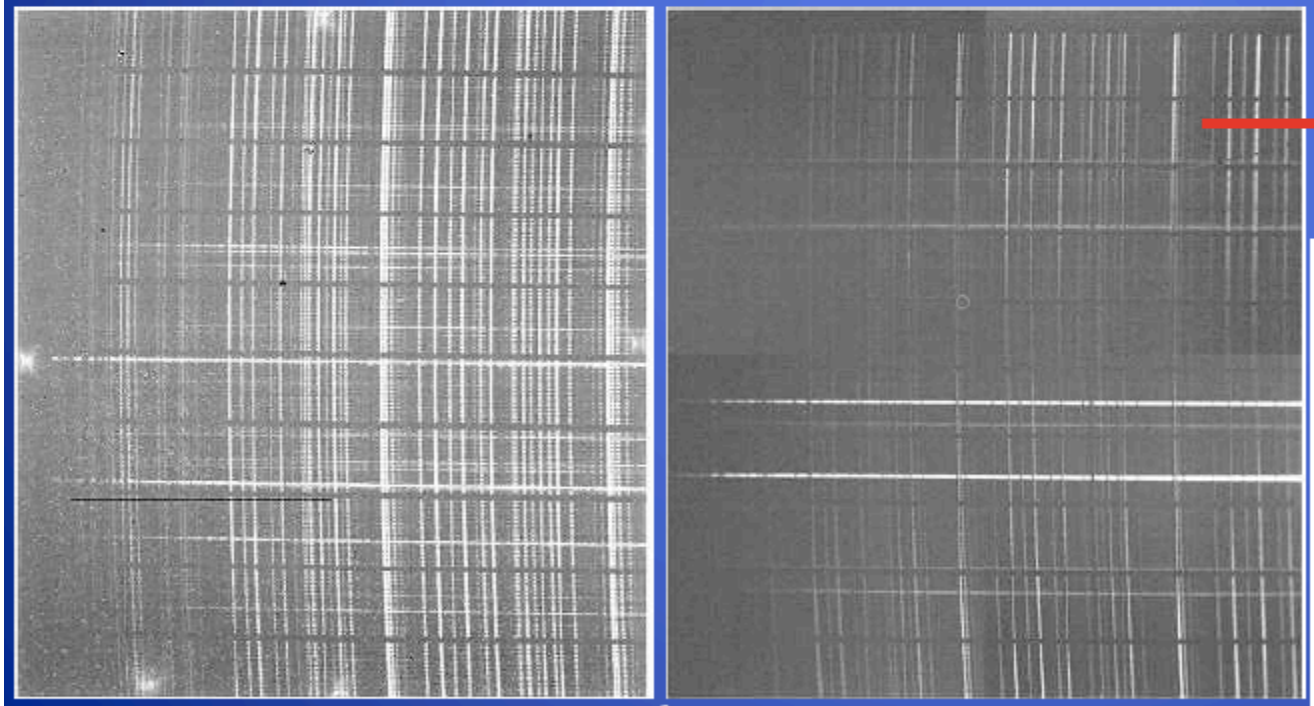
- •33 stars were immediately visible after 1 min exposure!!

Note(1): The fibre positioning accuracy was ~ 0".4 in rms (now ~ 0".2)

Note(2): The OHS masks were not well aligned with the actual OH lines.

IRS1 (25 stars)

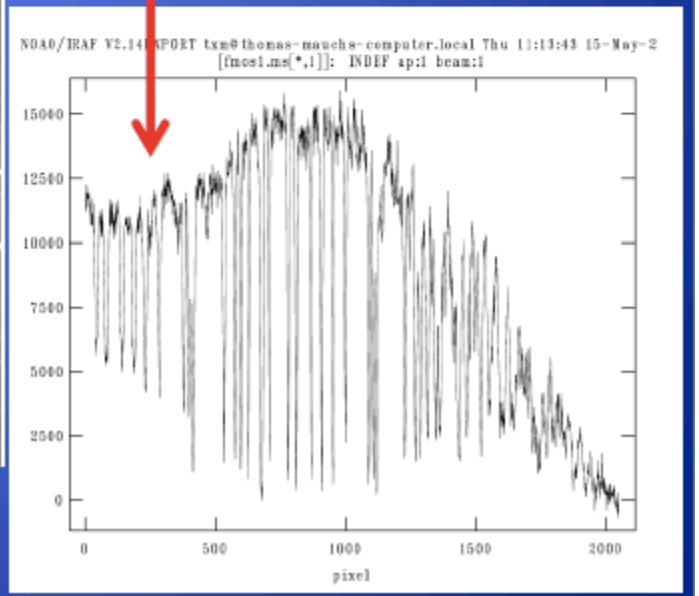
IRS2 (8 stars)



λ

HR mode, J long (1.1-1.3 μm), 1 min exp.

A stellar spectrum is extracted.



This Workshop

- Outline of timescale for open use and requirements for large programs
- Discuss current key science areas in the context of upcoming FMOS open use
- Consider options for a large collaborative program for galaxy evolution or BAO
- Lay ground for open use proposal submissions in September