United Kingdom Infrared Telescope a British Success Story

The Project and the early years

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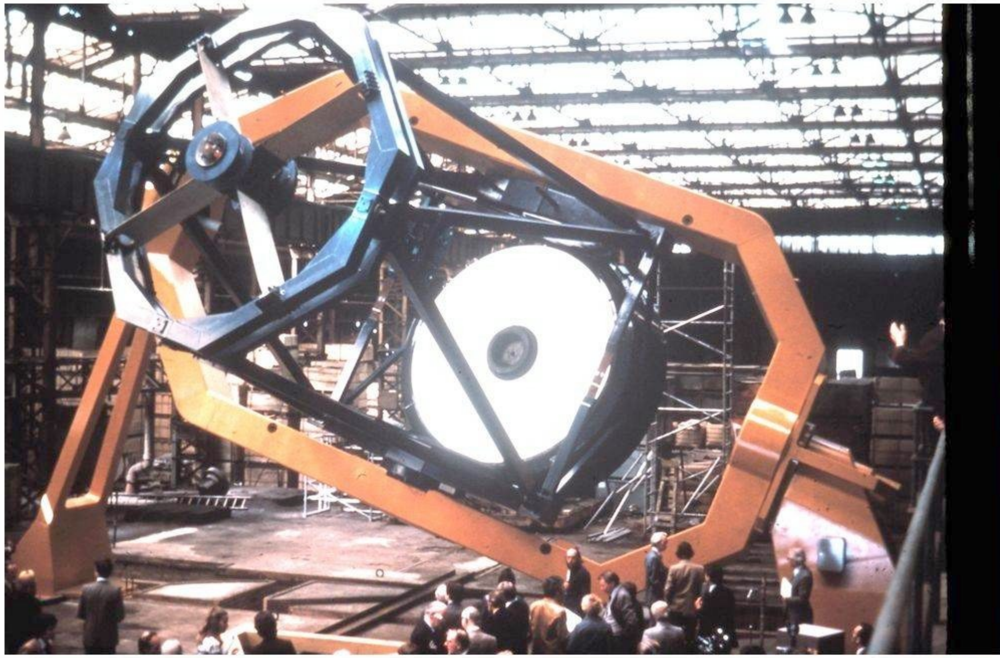
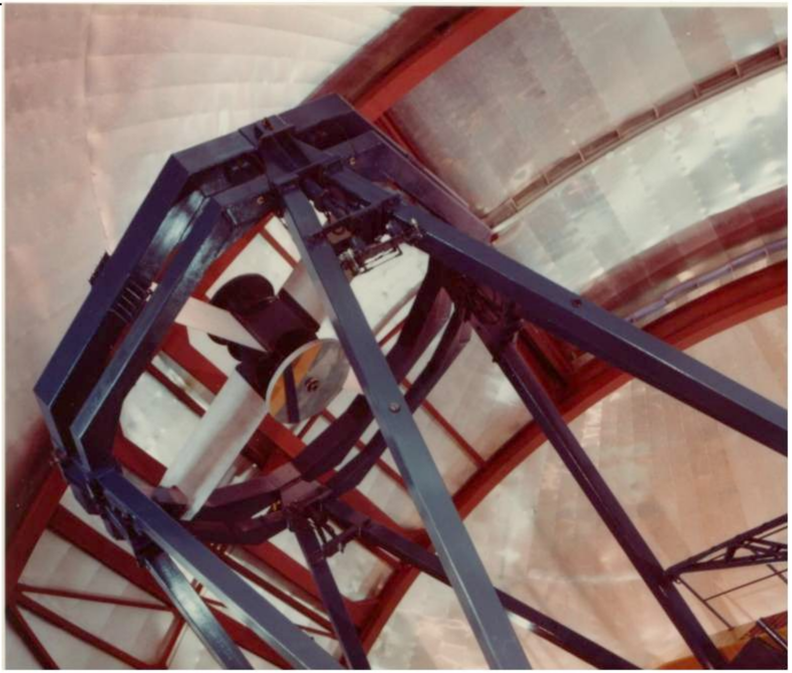
Proposal

- 1968 Jim Ring Professor at ICST
- Passive design limits
- Challenge cost diameter ratio barrier
- 1972 1.5 m precursor at Izania
- 1973 Jim Ring and Gordon Carpenter
- 1974 Astronomy Committee (Stibbs)
- 1974 June DES approve 3.8mFC Hawaii
- Gordon Carpenter appointed Project Manager
- Steering Committee formed





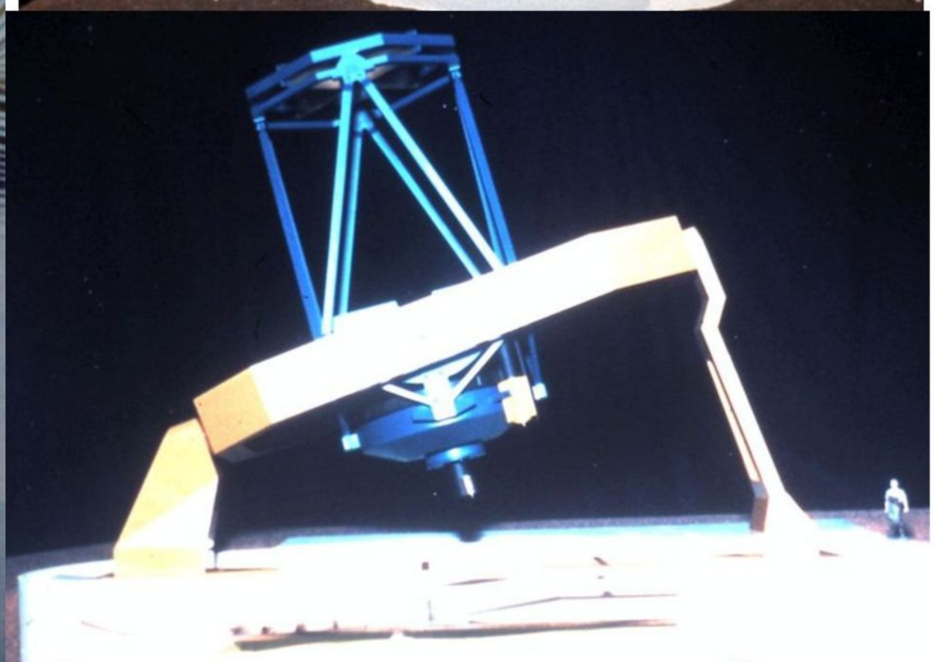
Key elements

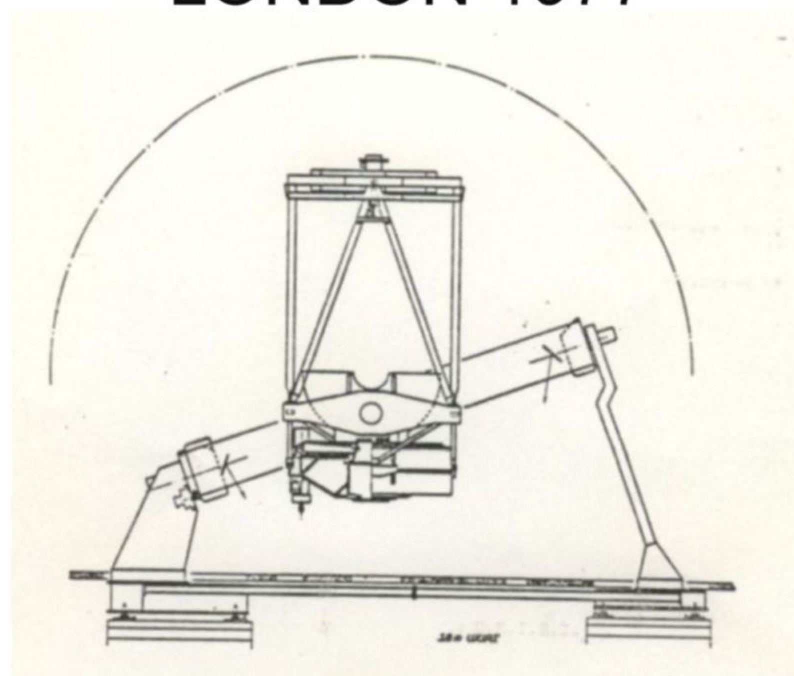
- Lightweight primary
- Fast primary (2.5)
- Clean structure
- Light structure, no central box
- Large diameter gears
- Position control loop closed in computer
- No control system independent of computer
- Keyboard input supplemented by a few buttons

Specification

- Primary diameter 3.8m
- f/9 Cassegrain, f/20 coudé
- Primary image quality 98% EED 2.4 arcsec
- Short nod time (2seconds)
- Tracking (5 arc sec per hour)
- Pointing 30 arc sec circle rms
- Dome building to be as small as possible

BATTERSEA PARK
LONDON 1977





Steering Committee - changes

- Increase the maximum payload on the instrument rotator from 100Kg to 200Kg
- Increase the dome size to enable a chopping secondary to be accommodated
- Consider possibility of improving image quality to 90% in 1 arc sec

PDP 11/40

28K of 16 bit memory

20Mb disks

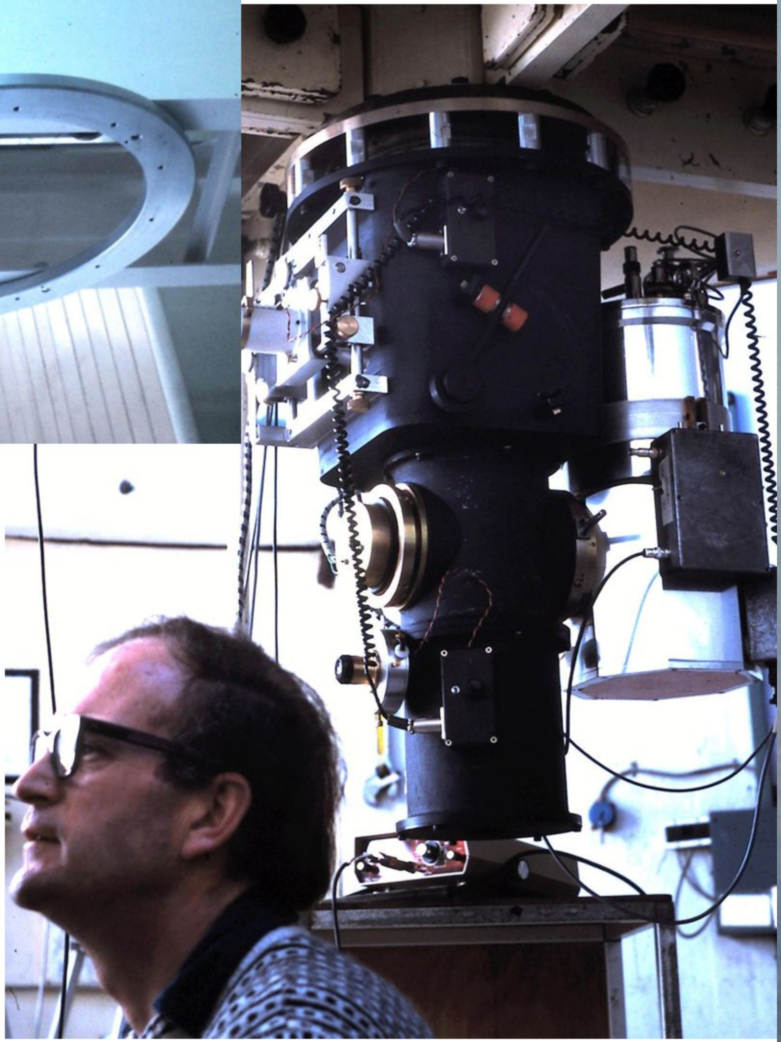
Instrumentation Project

- Tenerife experience

+ Input from experienced UK & US

+ Working group

- Chopping secondary
- InSb detector optimisation
- Common user instruments
- Computer system for instruments
- Intensified TV A&G on main beam
- Simulation and Test facilities at ROE



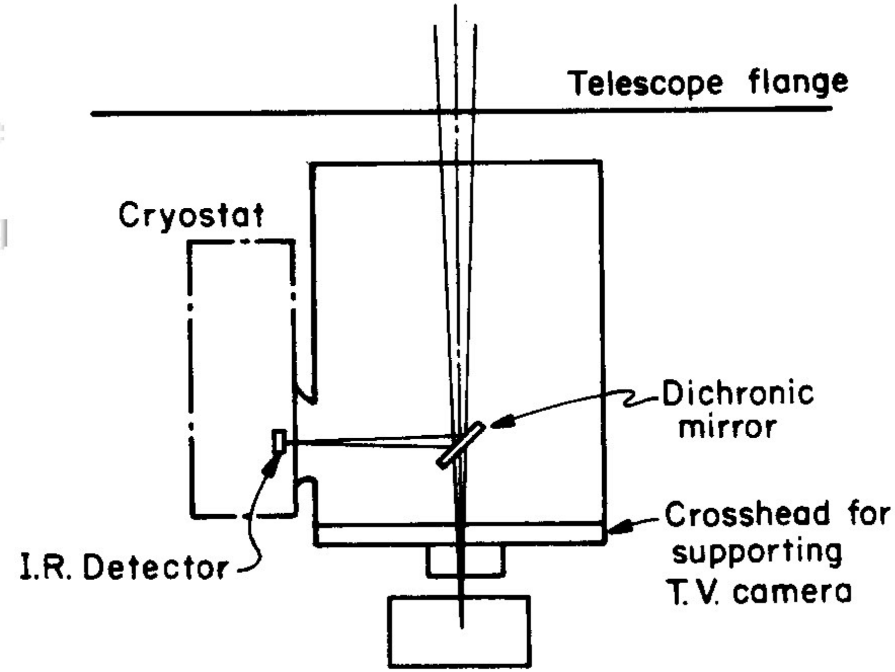
Simulators

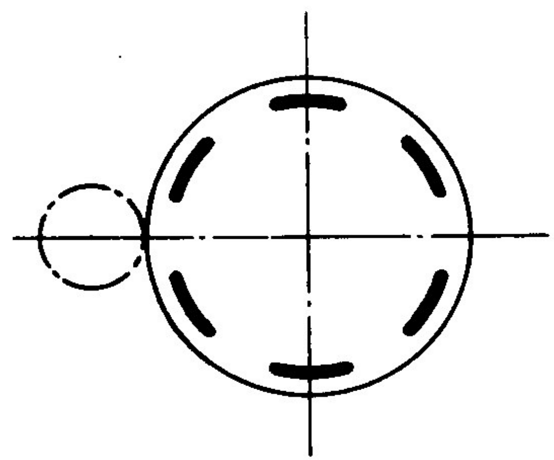
Common user instruments

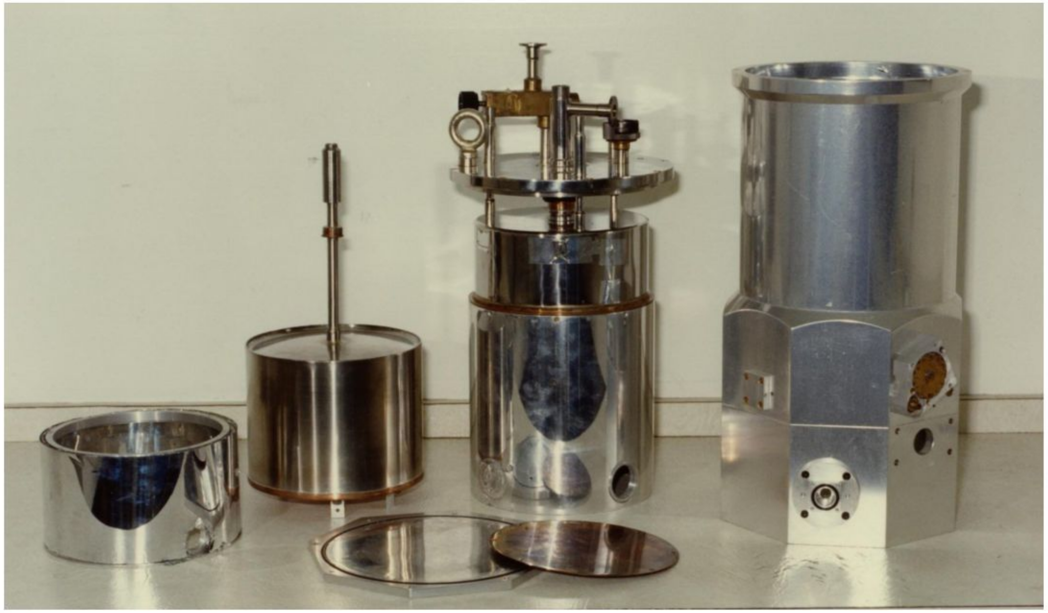
- Focal plane choppers for f/9 (1 ROE 1 ICST)
- Photometer for f/9 Cass two cryostats with InSb detectors, bandpass filters and CVFs covering 1 to 5.6 microns
- Photometer for f/35 Cass two cryostats with InSb detectors, bandpass filters CVFs covering 1 to 5.6 microns
- Cryostat with bolometer detector, filters covering 3.8 to 40 microns
- Cryostat with bolometer or doped Si detector, filters covering 8 to 40 microns, CVF 8 to 14
- Polarimeter insert icw Hatfield
- Fast photometry
- Visible photometer (UBVRI)
- Cooled grating spectrometer

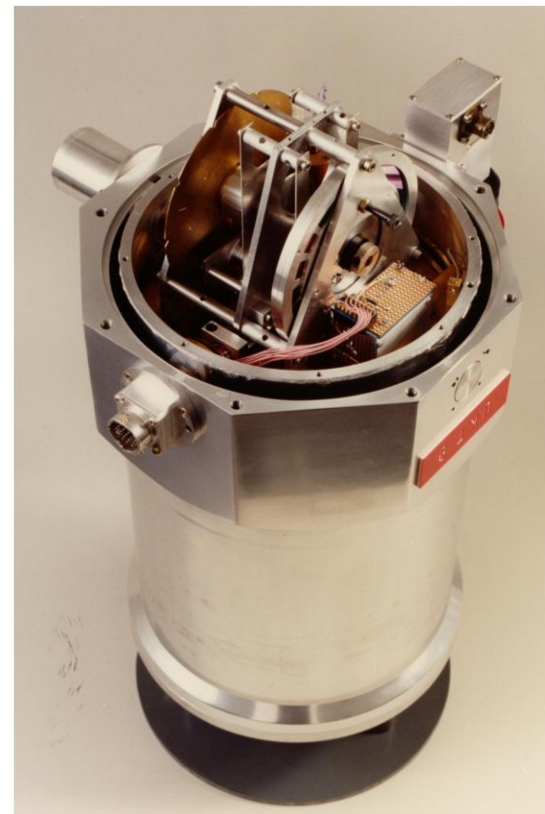
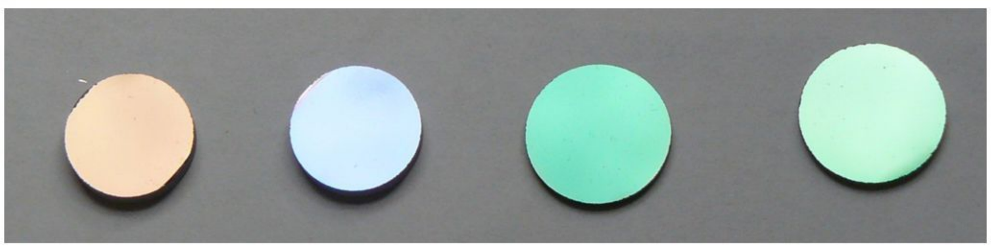
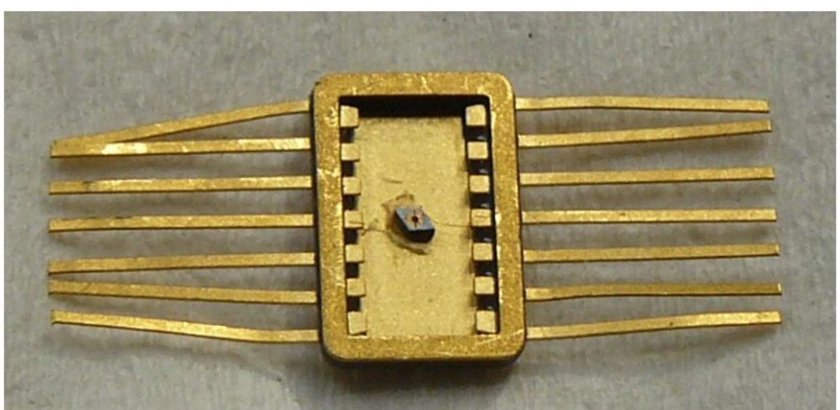
For
Allows A _G through dichroic
Simpler for cryogenic service
Simpler for build
Enables instrument switching

Against
Transmission loss
Thermal noise







Telescope realisation

- 1977 primary figured - weighs 6.5 tons
- 1978 telescope arrives in Hawaii - weighs 60 tons
- First light July 31 03:23
- 2 arc sec circular
- Dome seeing
- Encoder scale variance elongates image
- **Jim Ring’s telescope concept demonstrated!**

Telescope Tests

- Pointing within spec (30 arc sec rms)
- Tracking within spec but oscillation not acceptable for observing
- Nod performance poor, typically about 5 seconds for small nods.
- Guide telescope flexes too much wrt to main
- Crosshead for autoguider drives has errors.
- Dome drive marginal
- **Dome crane not safe to lift top end**

First IR

1979 January

Lee and Beattie

with Becklin

Opening Ceremony 1979 October 10

Operations – How we observed

- Acquisition, no intensified TV camera yet,
- Limiting magnitude 13, FOV 90 arc sec diagonal inadequate for guide stars
- Guide telescope issues meant that not fruitful solution
- No secondary chopper therefore f/9 Cass.
- Convert the F/35 gold dustbin to f/9 use by mounting a focal plane chopper on the end of an arm fixed in one of the 6 ports.
- Detector cryostat mounted opposite
- The TV was mounted on the X-Y stage field of +or-13 arc minutes
- Image motion while tracking still about 3 to 5 arc sec due to fine code error.
- Inject small signals to the RA and Dec amplifiers to drive the telescope in fine motions

Operations – Observing team

- The size of the observing team would depend on the scientific programme but might need:

one to operate telescope and guider

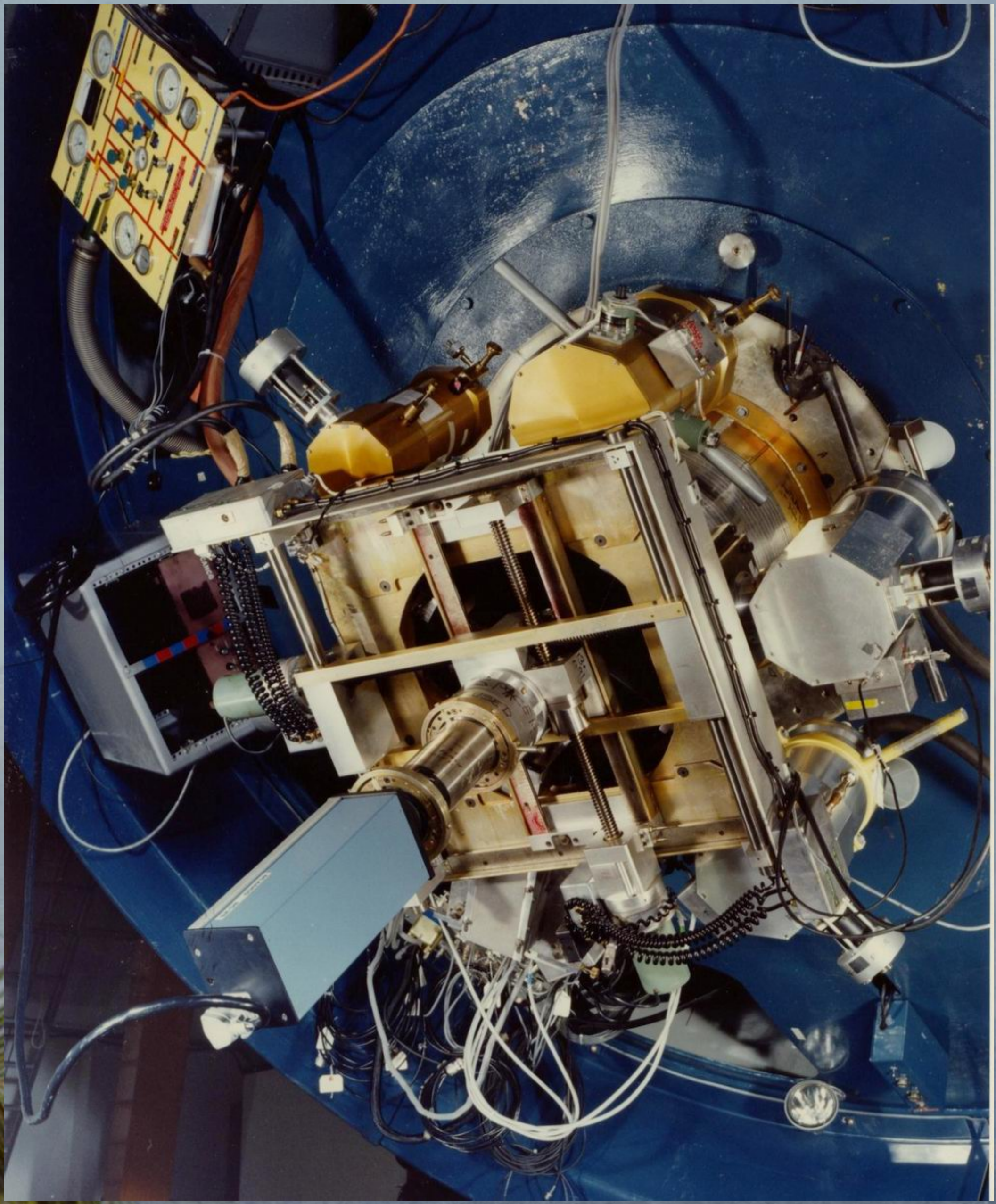
+one to operate instrument

+one to review data

+one to compute guide star and guider offsets

+at times one quality control, backup, make coffee.

Instrument
Cluster
at f/35



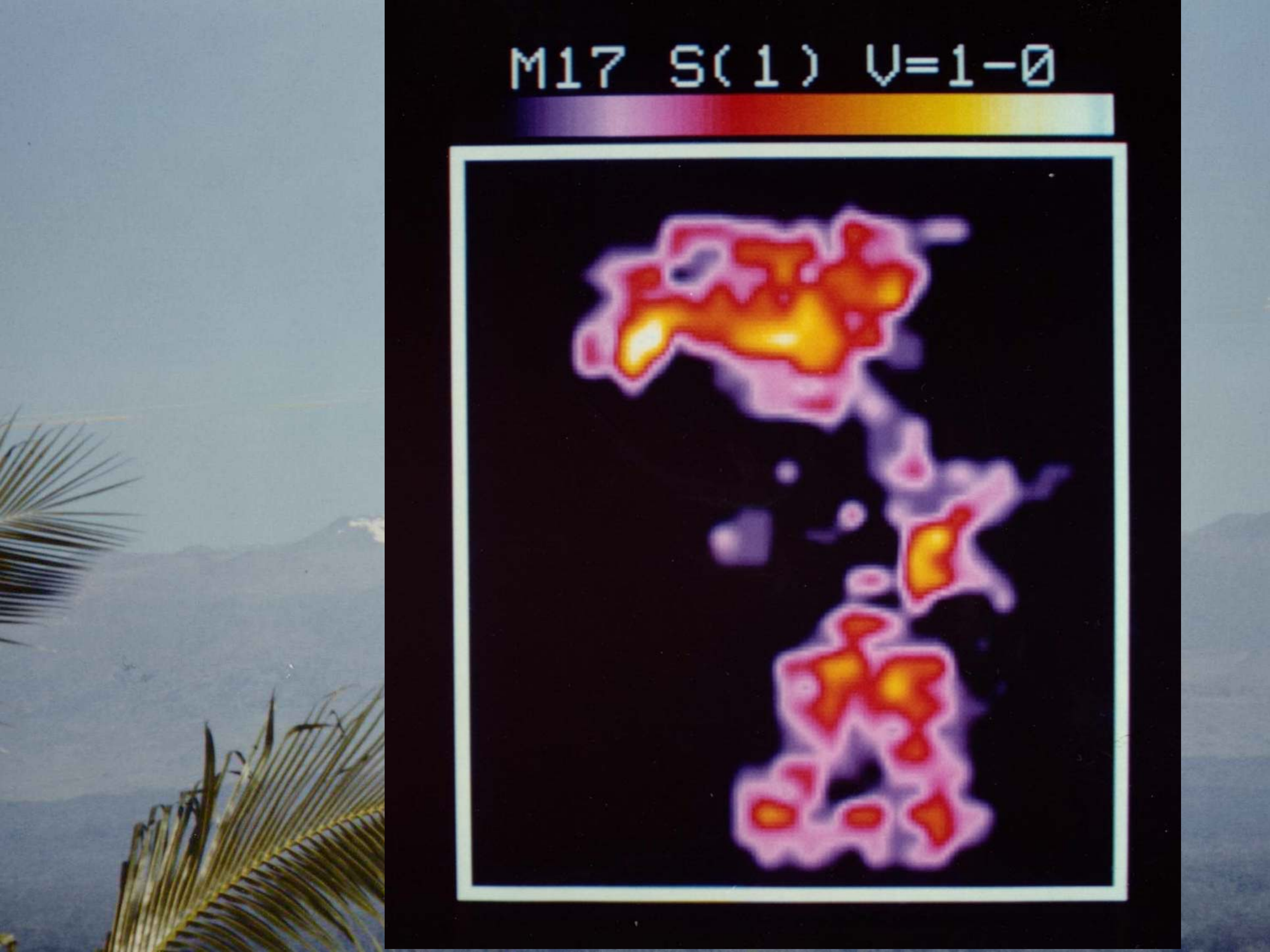
Operations - USERS

- Own Instruments
- Visible spectroscopy (U of H)
- 10 micron spectroscopy Roche/Aitken
- Heterodyne spectrometers mm and submm
- Submillimeter photometers, Chicago, Oregon/QMW

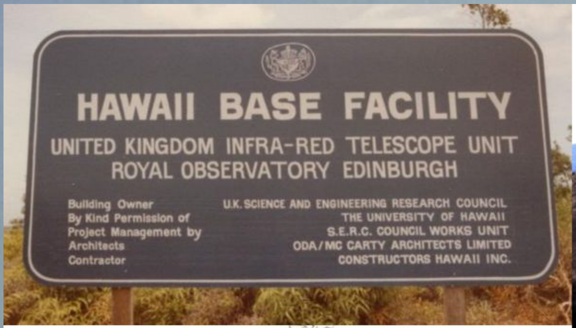
- Facility instruments
- Experienced observers, UK, Hawaii, Japan, US
- Observers new to IR, UK, Netherlands, Japan

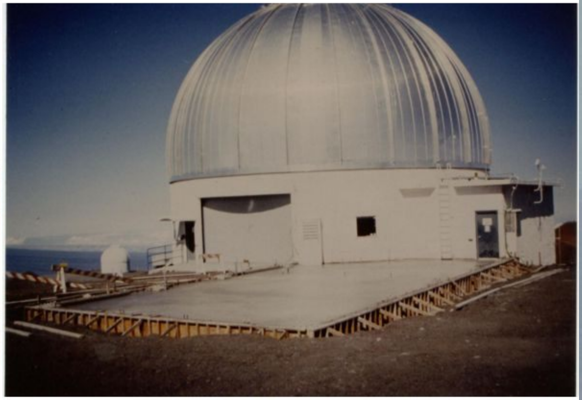
Evolution

- **UKIRT low budget telescope**
- **High expectation of performance and service**
- continual programme of improvments.
- Pointing accuracy increased to 4 arcsec rms.
- Nod time reduced by running conrol feedback through computer enabled dynamic tuning.
- 24 bit encoders in place of 20 bit
- The user interface was improved
- Phone capacity at summit greatly increased so we could network from Hilo Base to summit and also back to Edinburgh.
- Malcolm Stewart first demonstrated remote observing.
- Later a remote observing room was set up in Edinburgh


M17 S(1) V=1-0

Parallel Developments





Hale Pohaku

Summit extension

Signs of success

- Oversubscription: people wanted to come back
- Papers based on UKIRT data published
- External recognition:
- Japan wanting to emulate and asking for advice on how to do so
- Santa Barbara Research Corporation choosing UKIRT as one of their two IR array partners