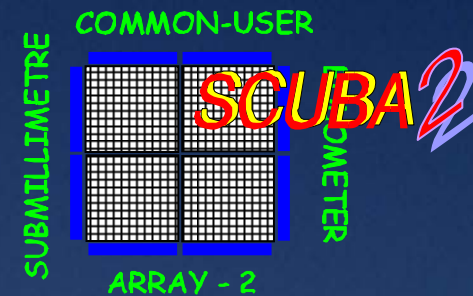


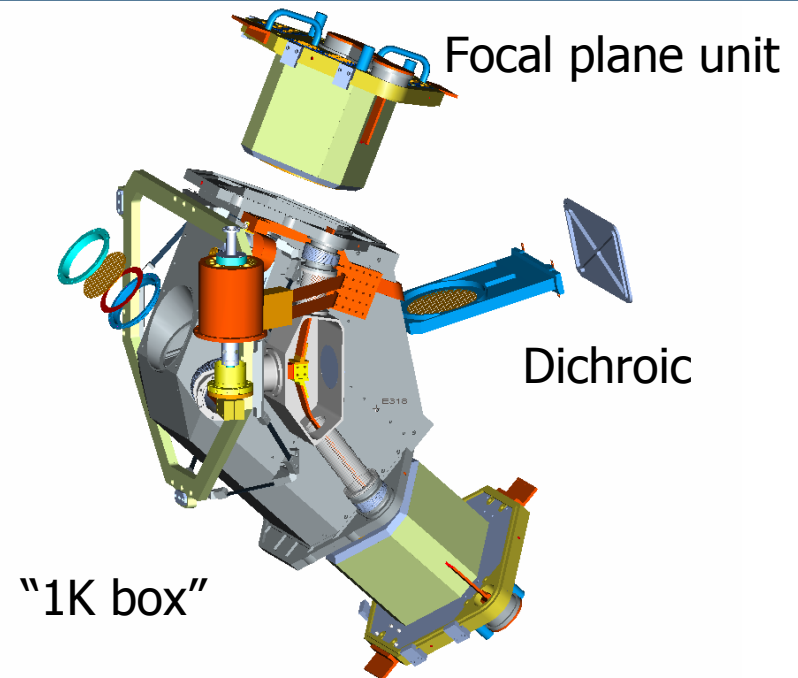
# SCUBA-2 on CCAT



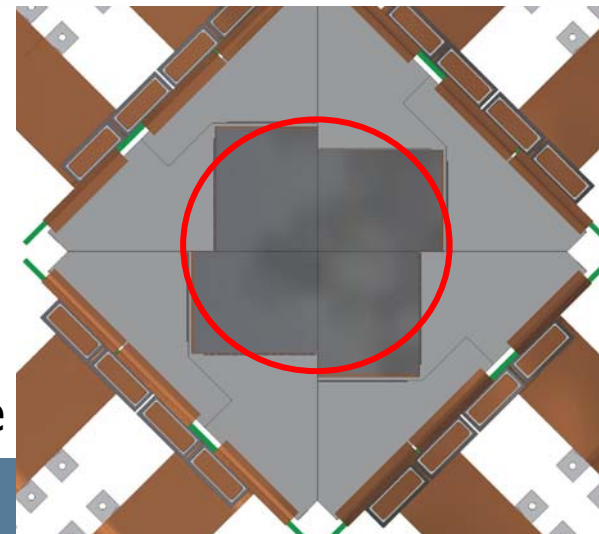
Wayne Holland  
UK ATC, Royal Observatory Edinburgh

# SCUBA-2 in a nutshell

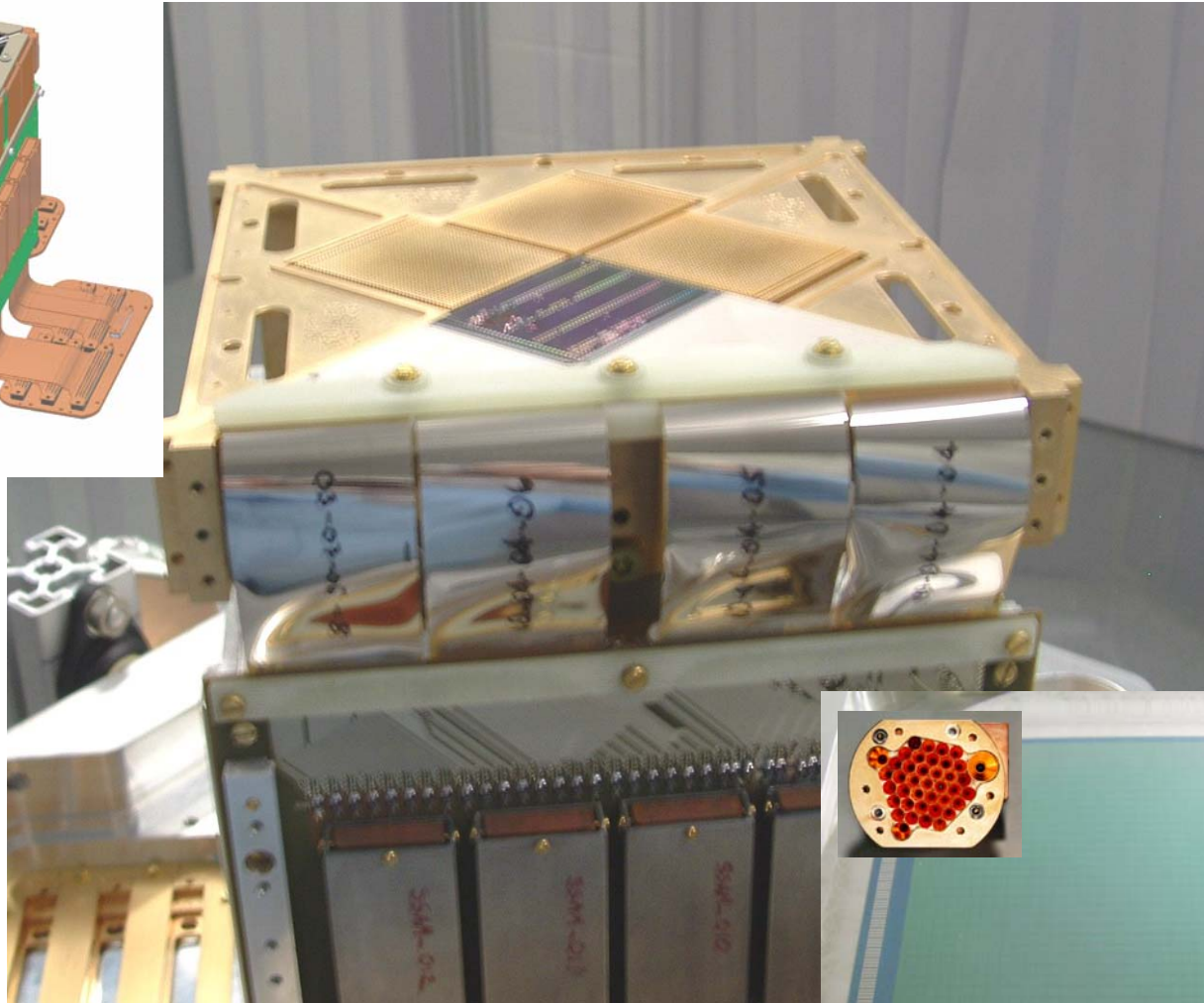
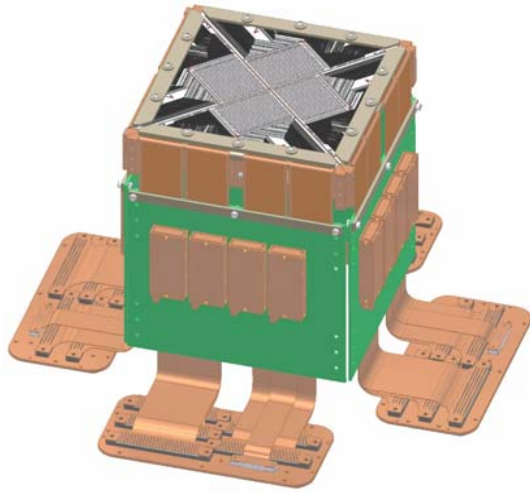
- Two focal planes, working simultaneously at 450 and 850 $\mu$ m
- Each focal plane has  $\sim$ 5000 pixels in 4 sub-arrays (TES with in-focal plane MUX)
- 850 fully-samples the sky; 450 under-samples by a factor of 2
- Field-of-view on sky is  $\sim$  50 sq-arcmin at both wavebands
- Mapping speeds some 1000 times faster than SCUBA...



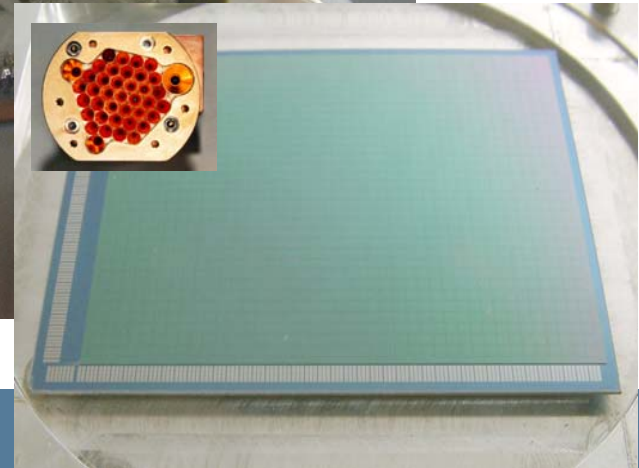
Focal plane



# Large Format Arrays



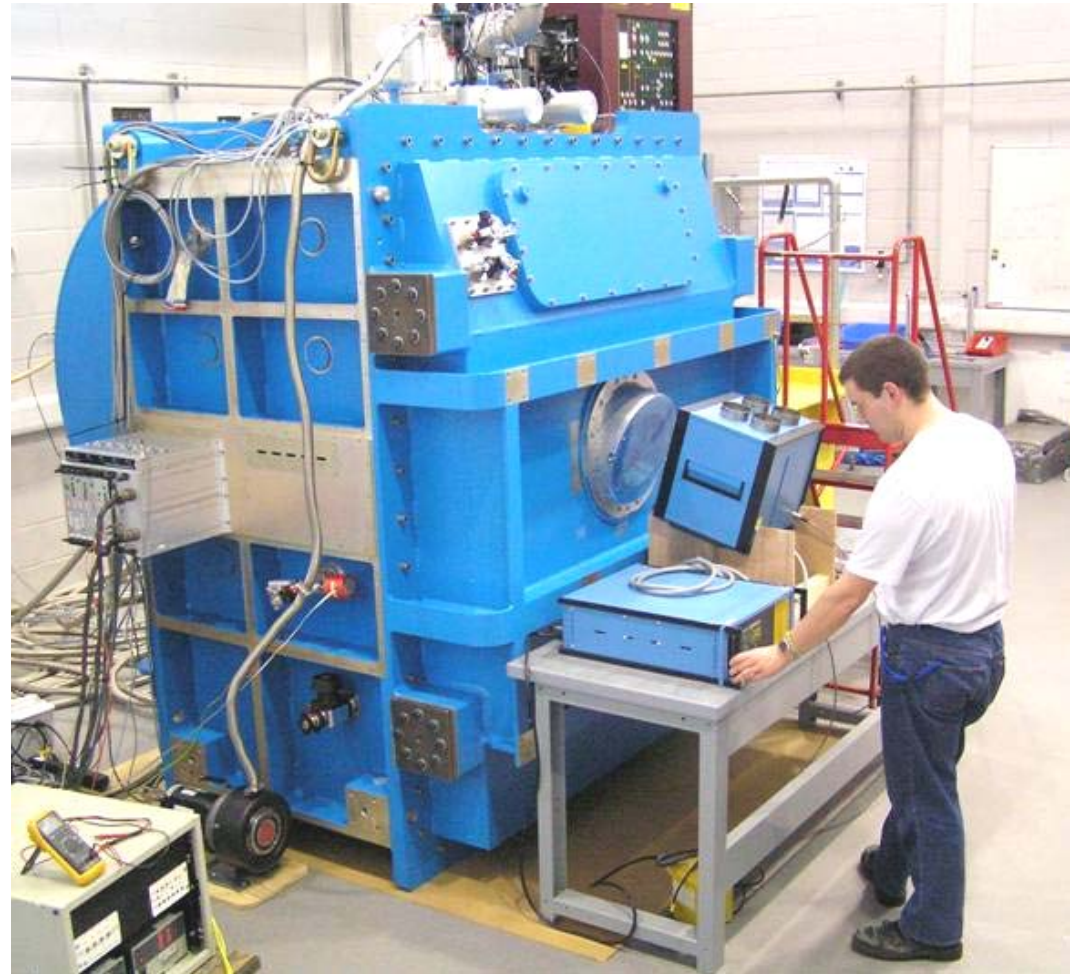
SCUBA-2 450µm  
prototype array  
mounted in focal  
plane unit



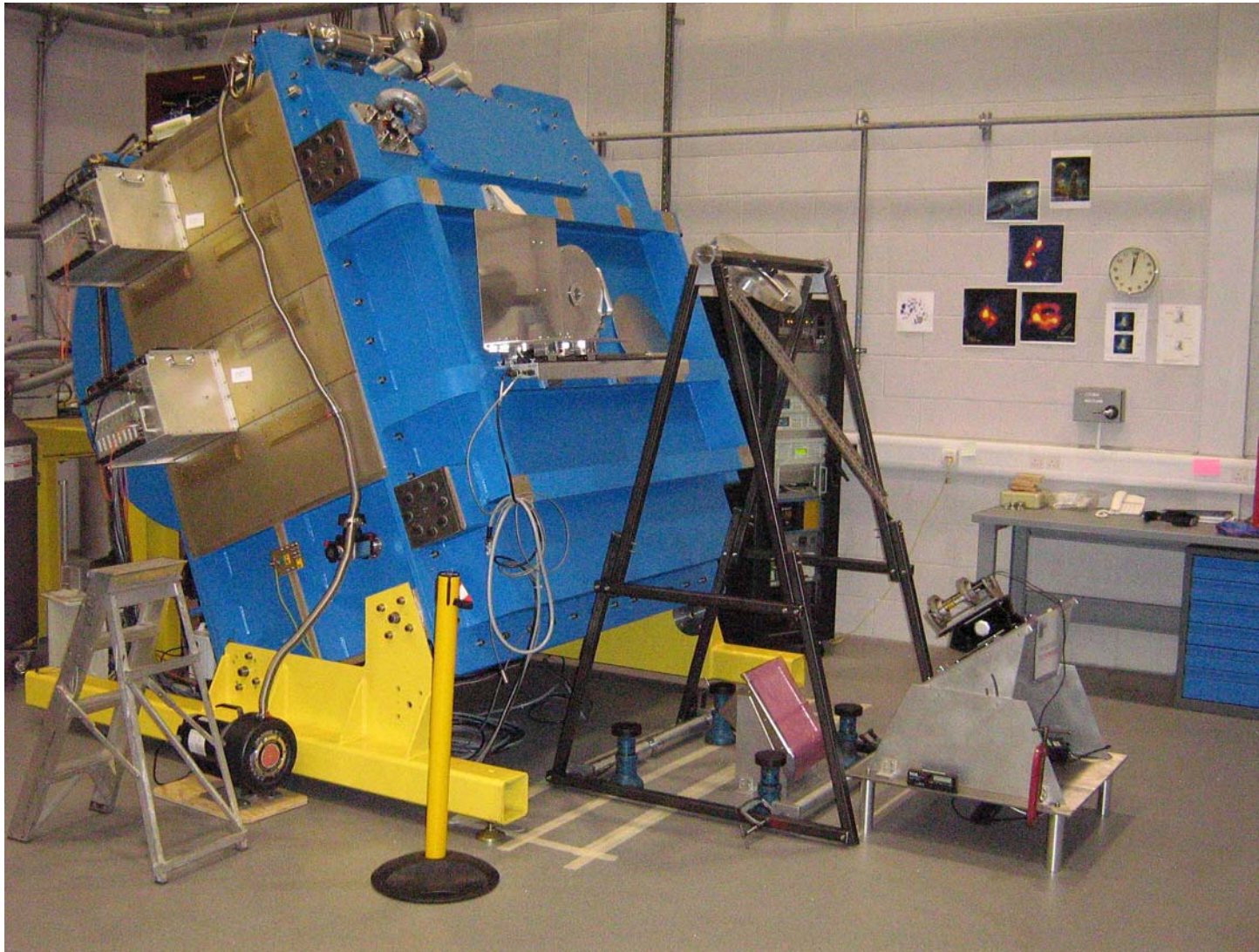


# Status

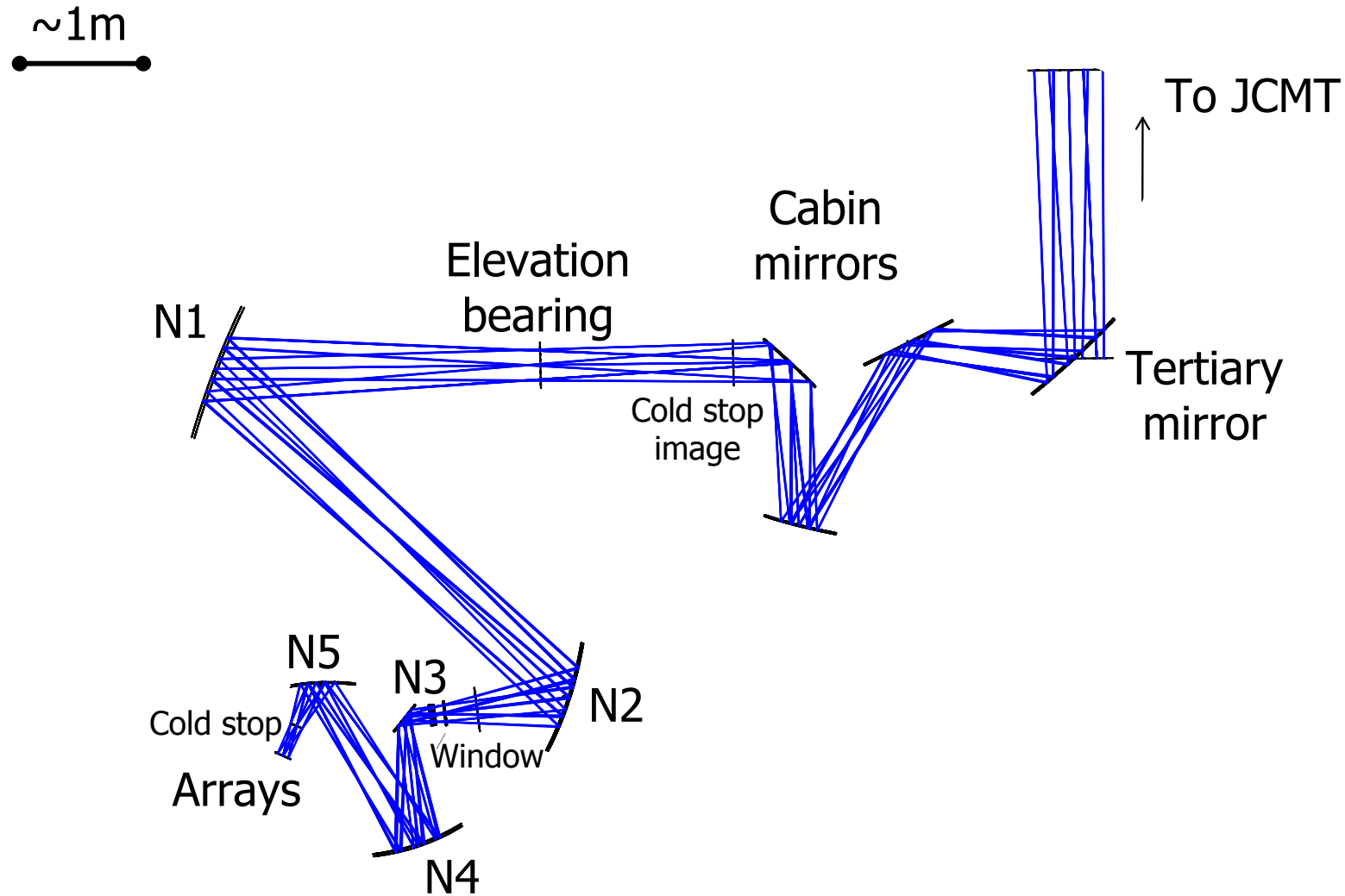
- Instrument is now essentially complete – at delivery standard
- Testing is underway of science-grade sub-arrays – one for each wavelength
- Delivery expected to JCMT in April 2007
- Survey programme approved and due to start in summer 2007



# SCUBA-2 under test (today...)

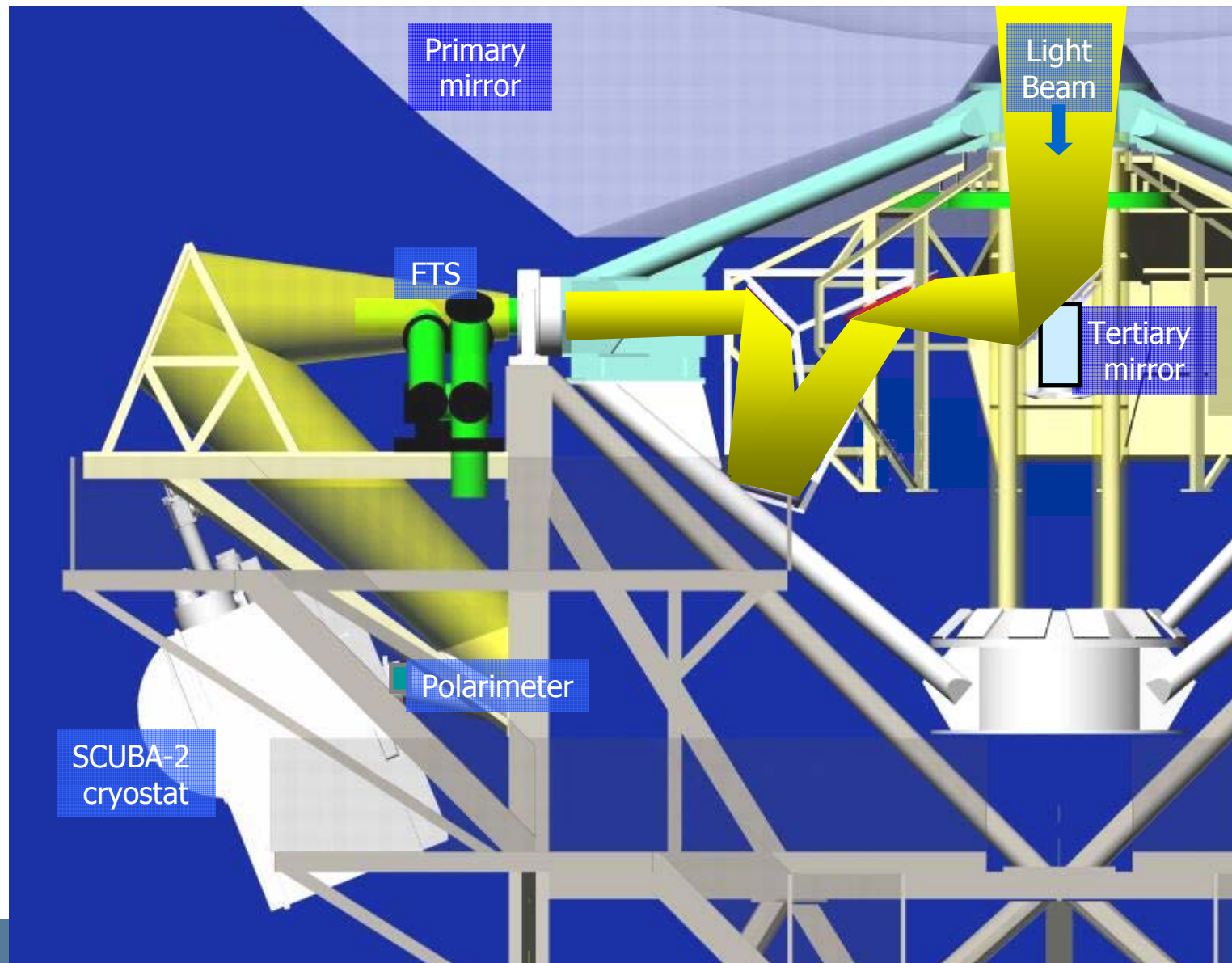


# Optical layout of SCUBA-2 on JCMT





# SCUBA-2 on JCMT



# Left Nasymth - Before





# Left Nasymth - After





# Cryostat Frame



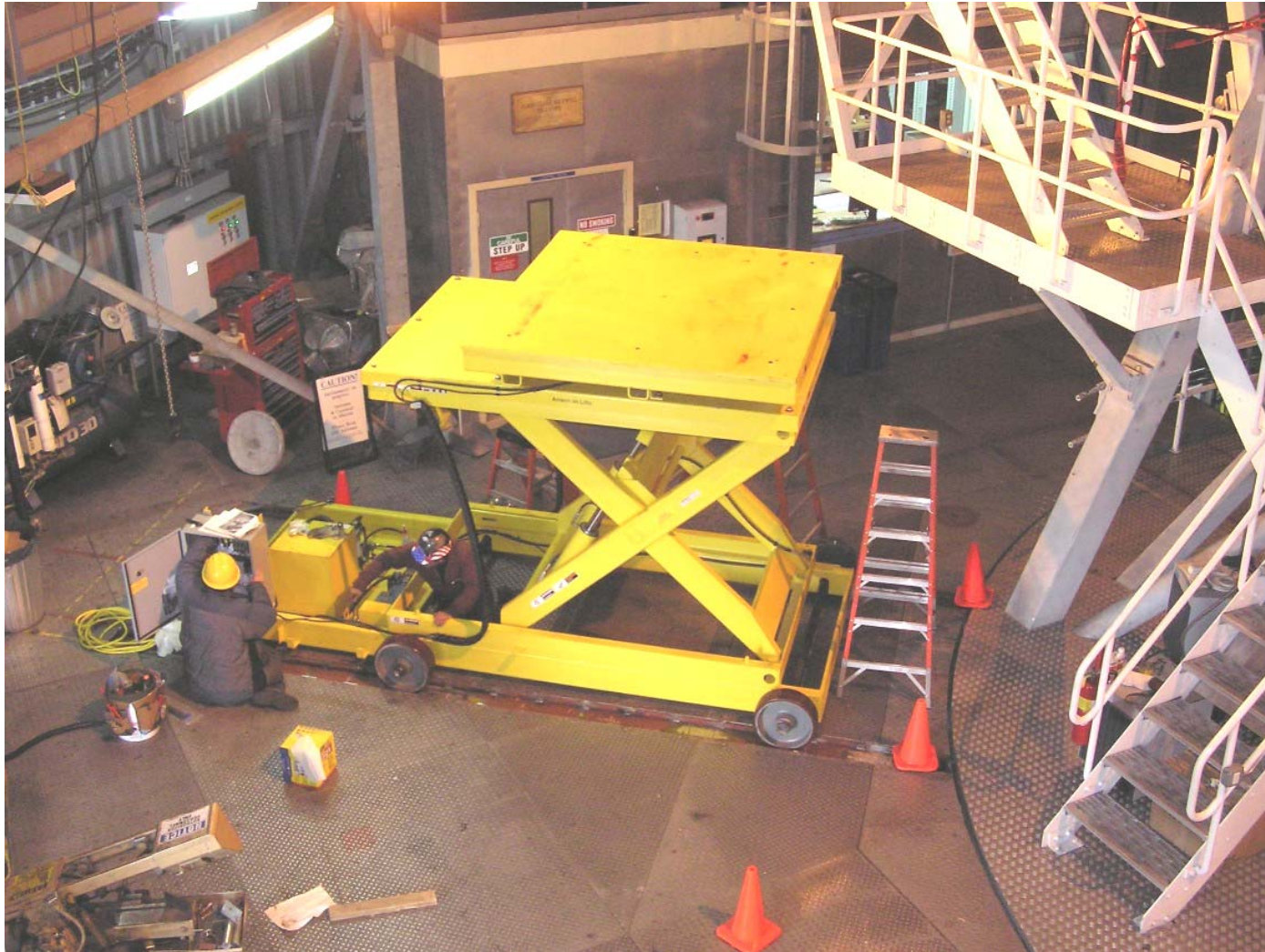


# Cryostat Frame Mounted





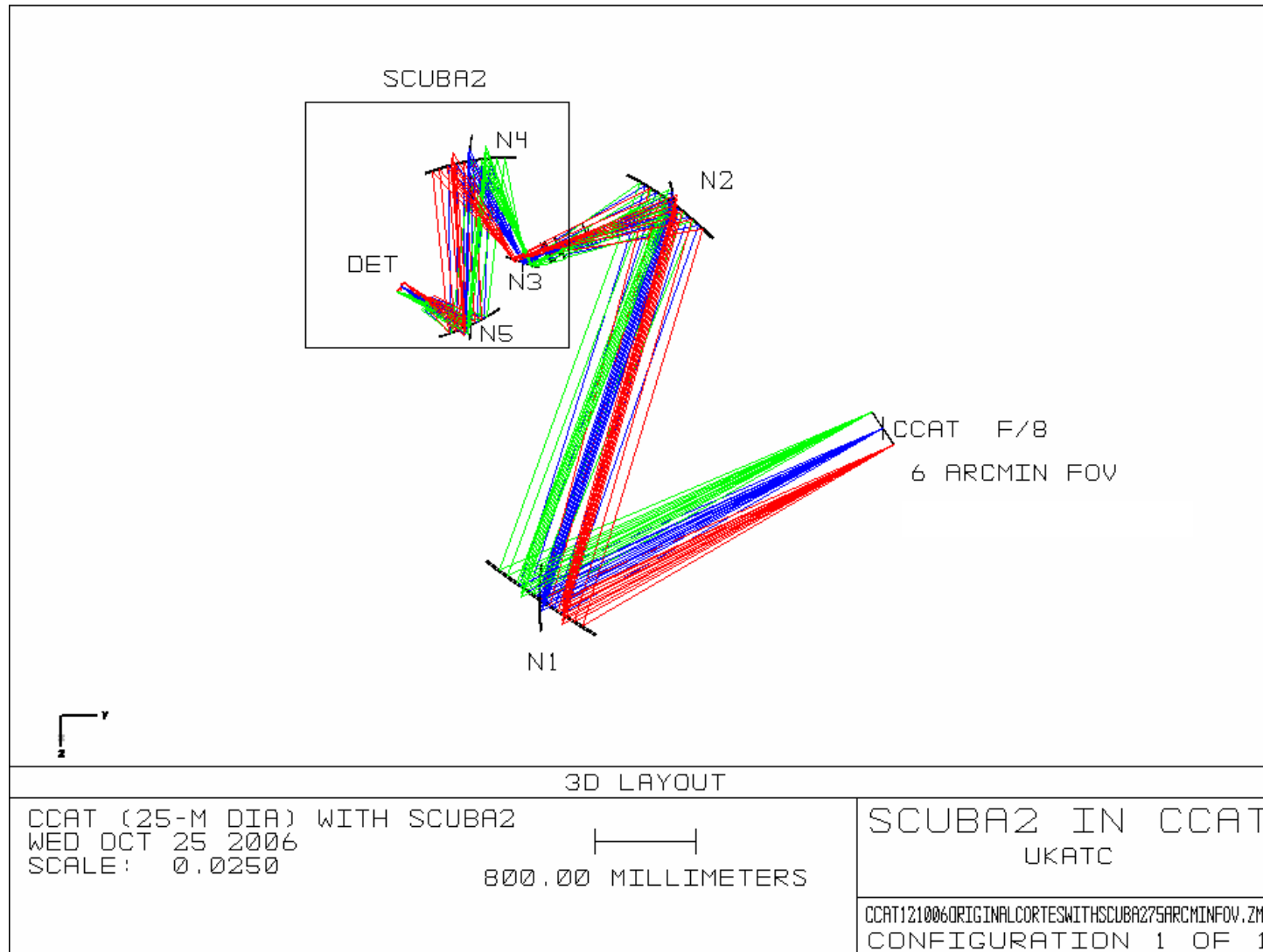
# Getting SCUBA-2 into position...



# SCUBA-2 on CCAT: Design criteria

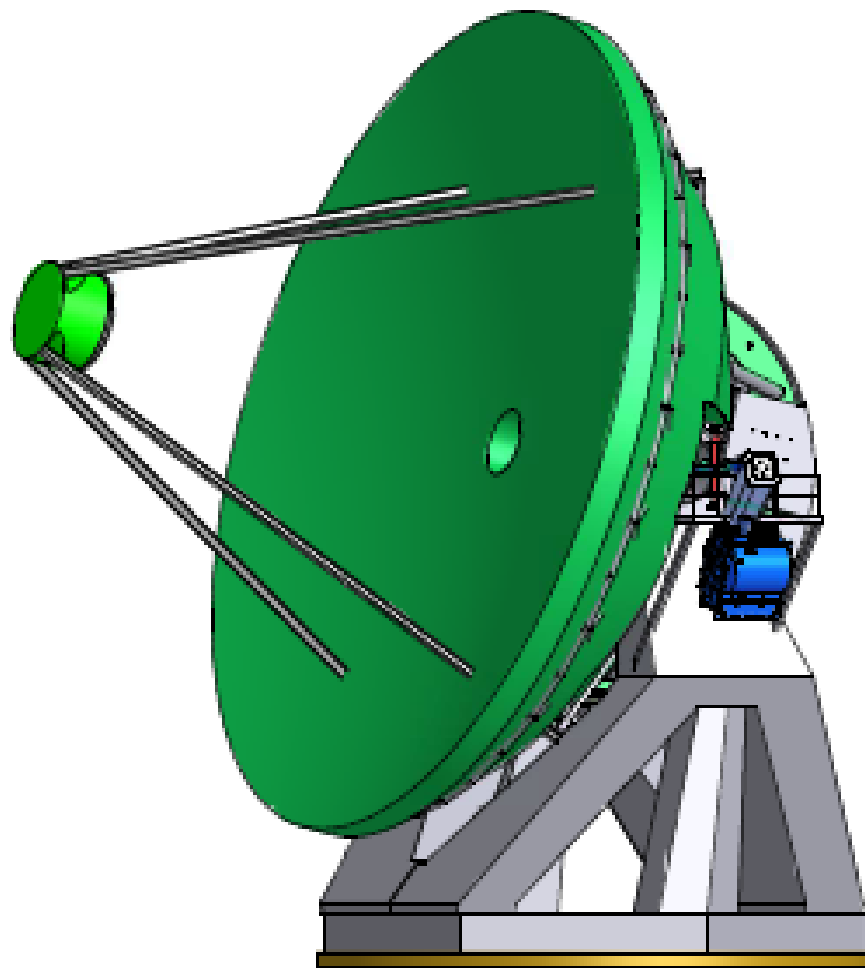
- Has to match to CCAT optics, specifically to the f/8 Nasmyth focus
- Assume no changes to the SCUBA-2 cryostat: window and filters are same, cold mirrors and cold stop not altered
- Can change (warm) re-imaging optics but keep mirrors of order 1m class or smaller
- What field-of-view is possible?

# SCUBA-2 on CCAT

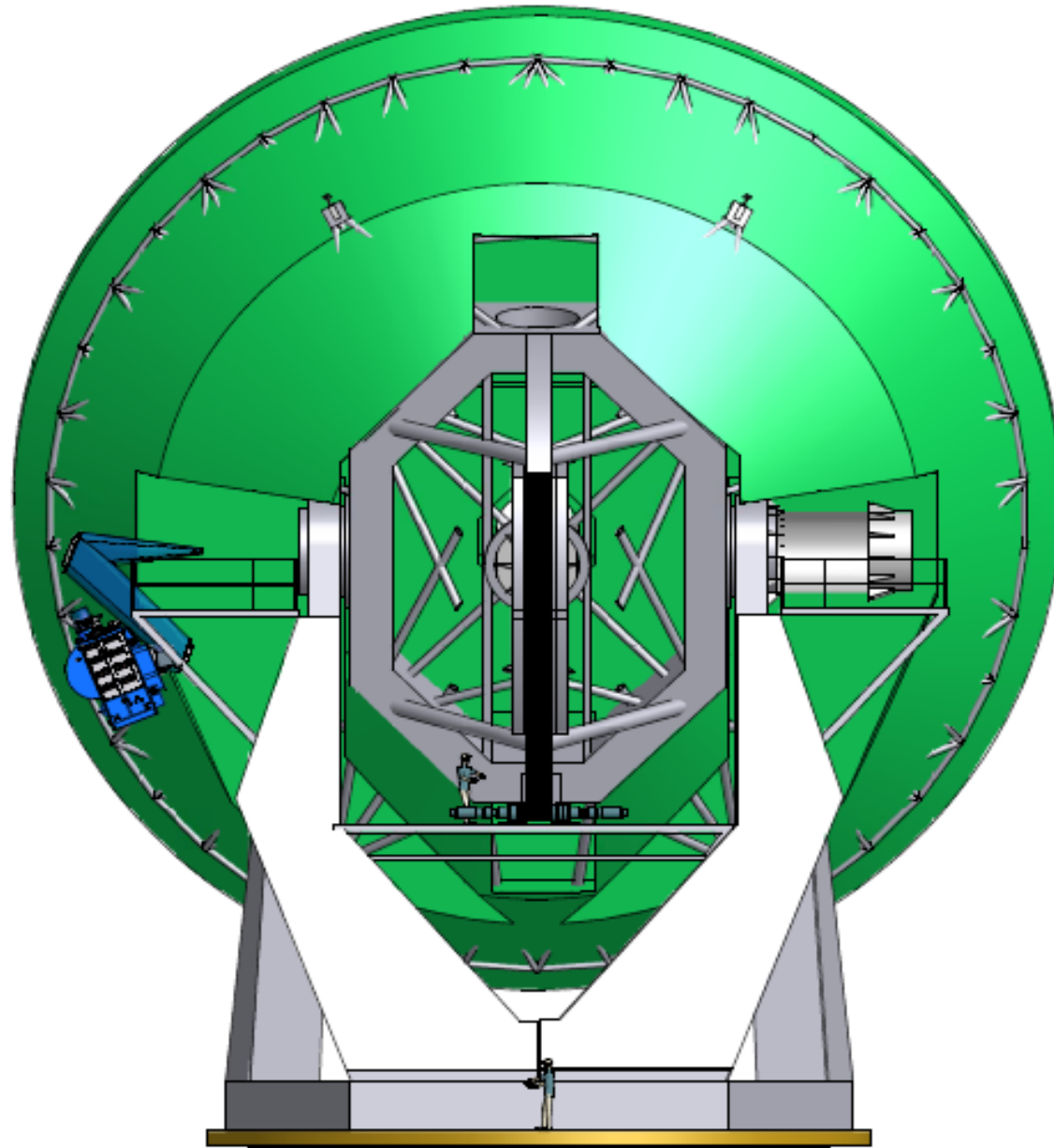




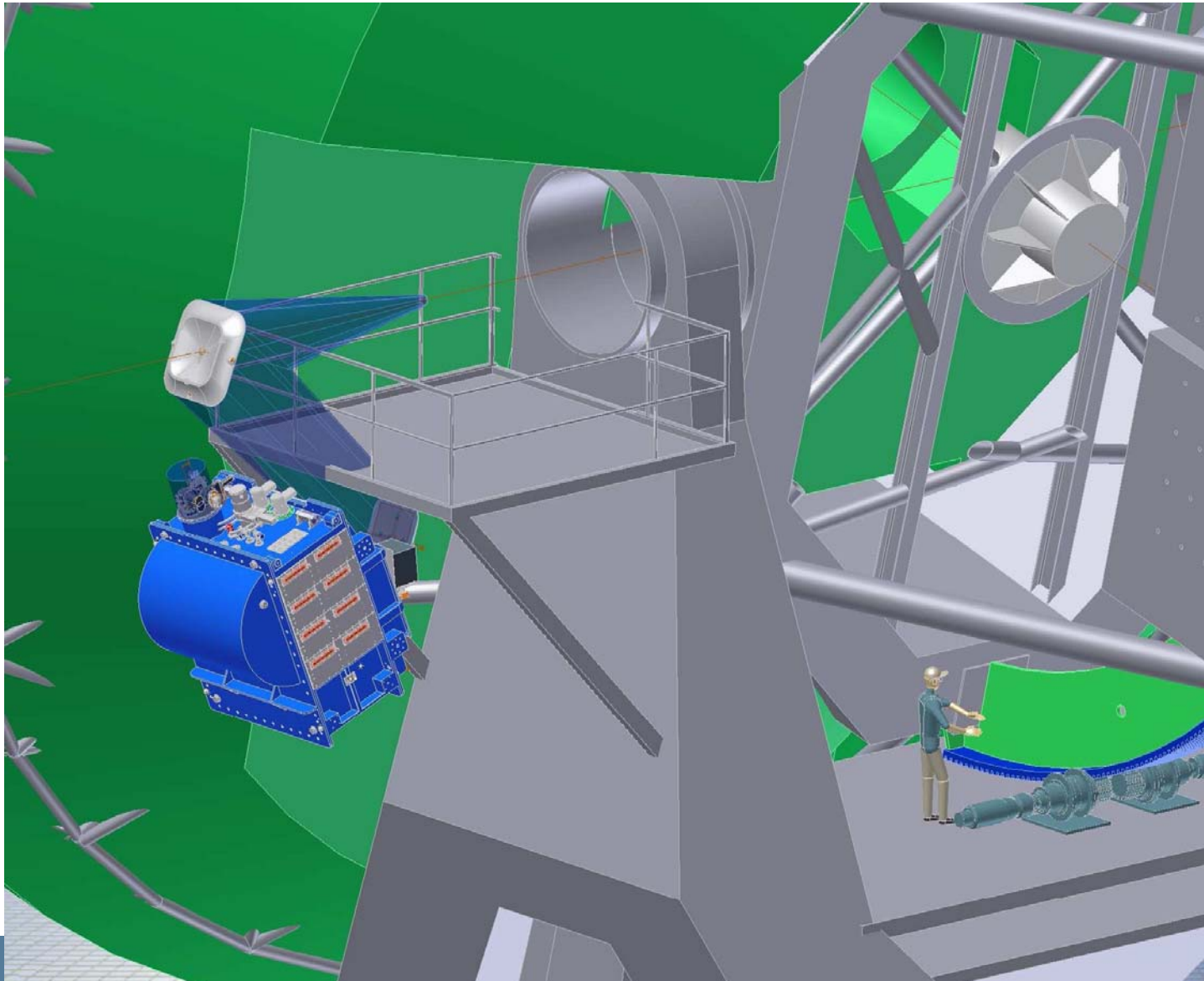
# SCUBA-2 on CCAT



# SCUBA-2 on CCAT

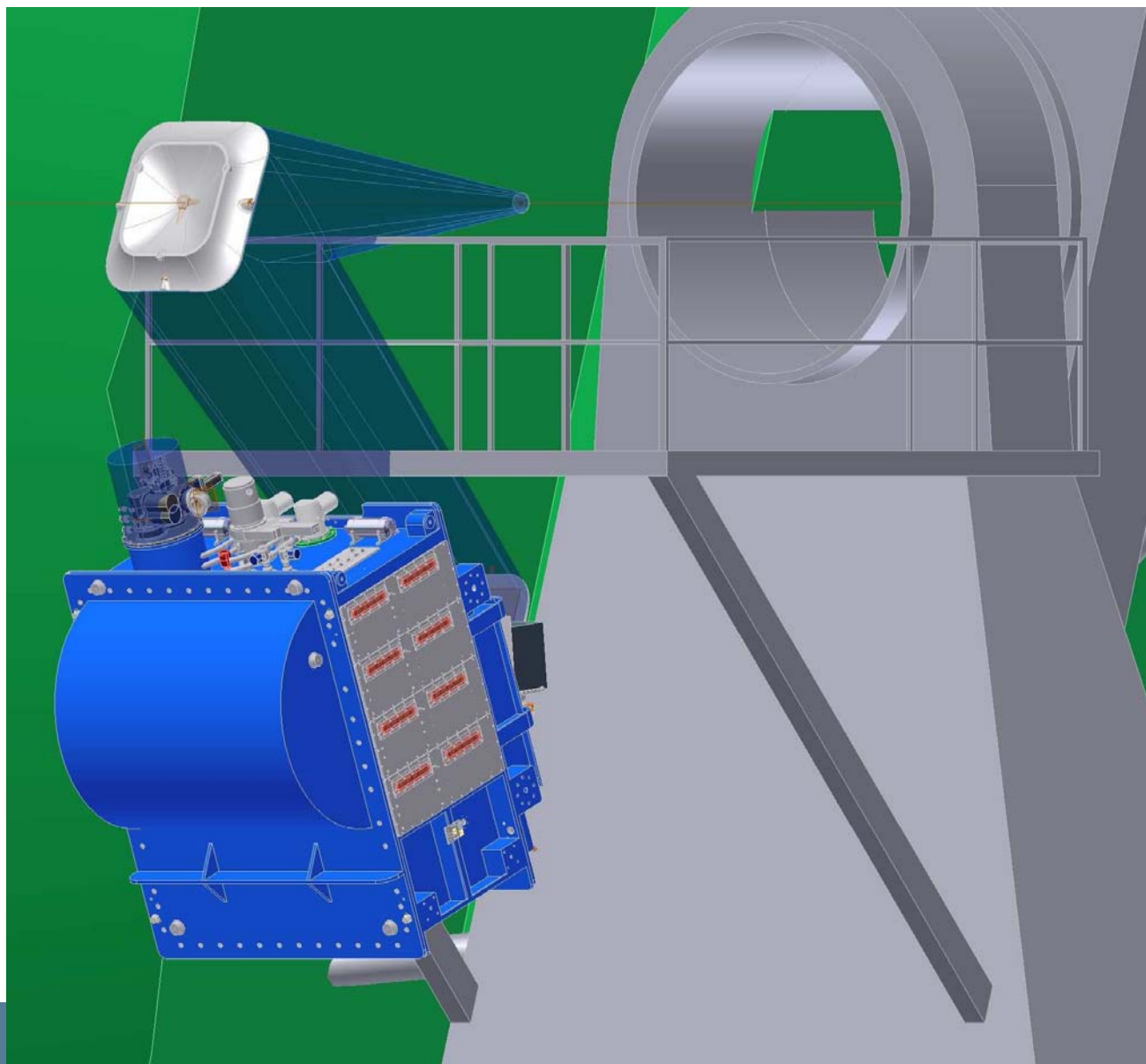


# SCUBA-2 on CCAT

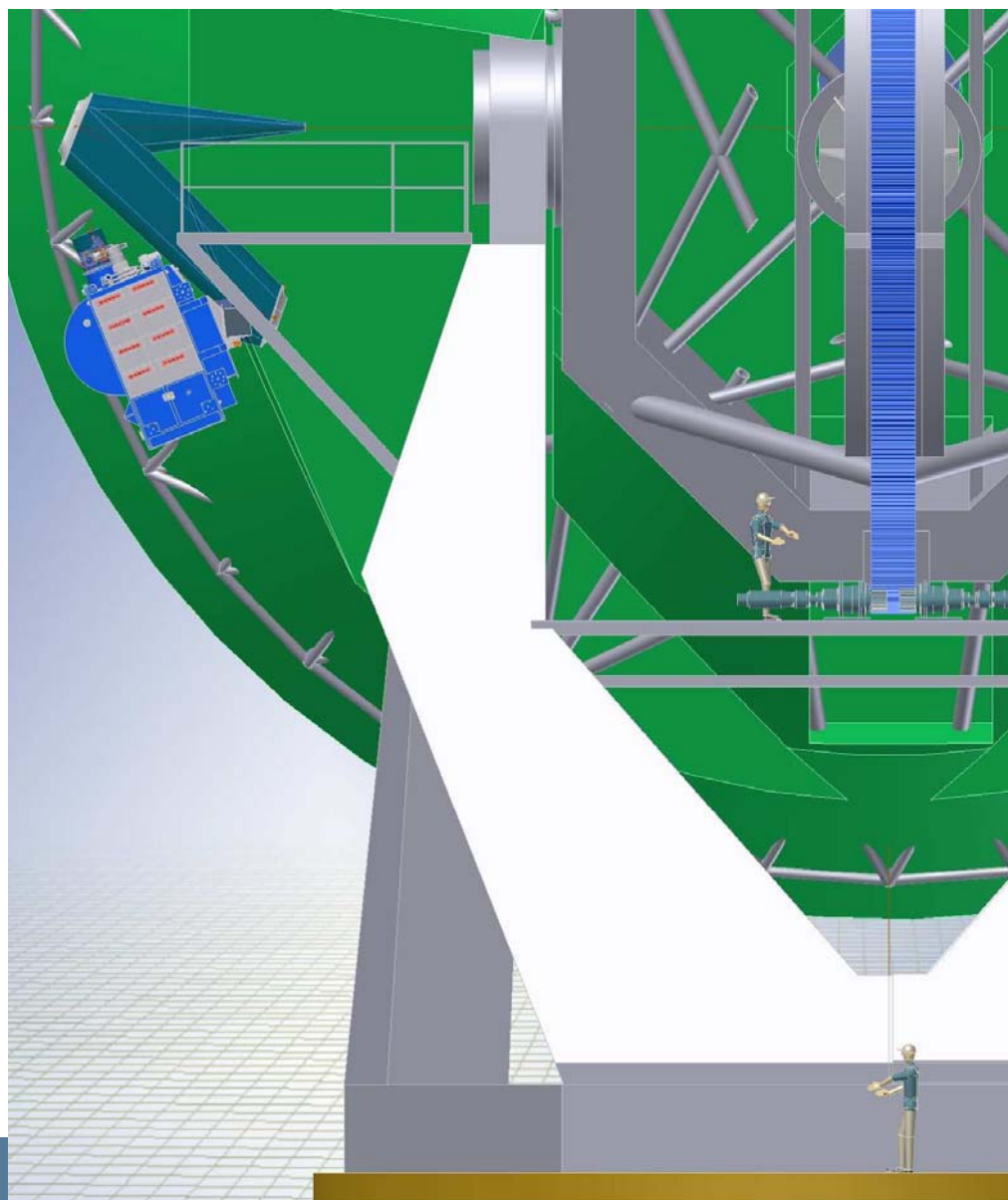




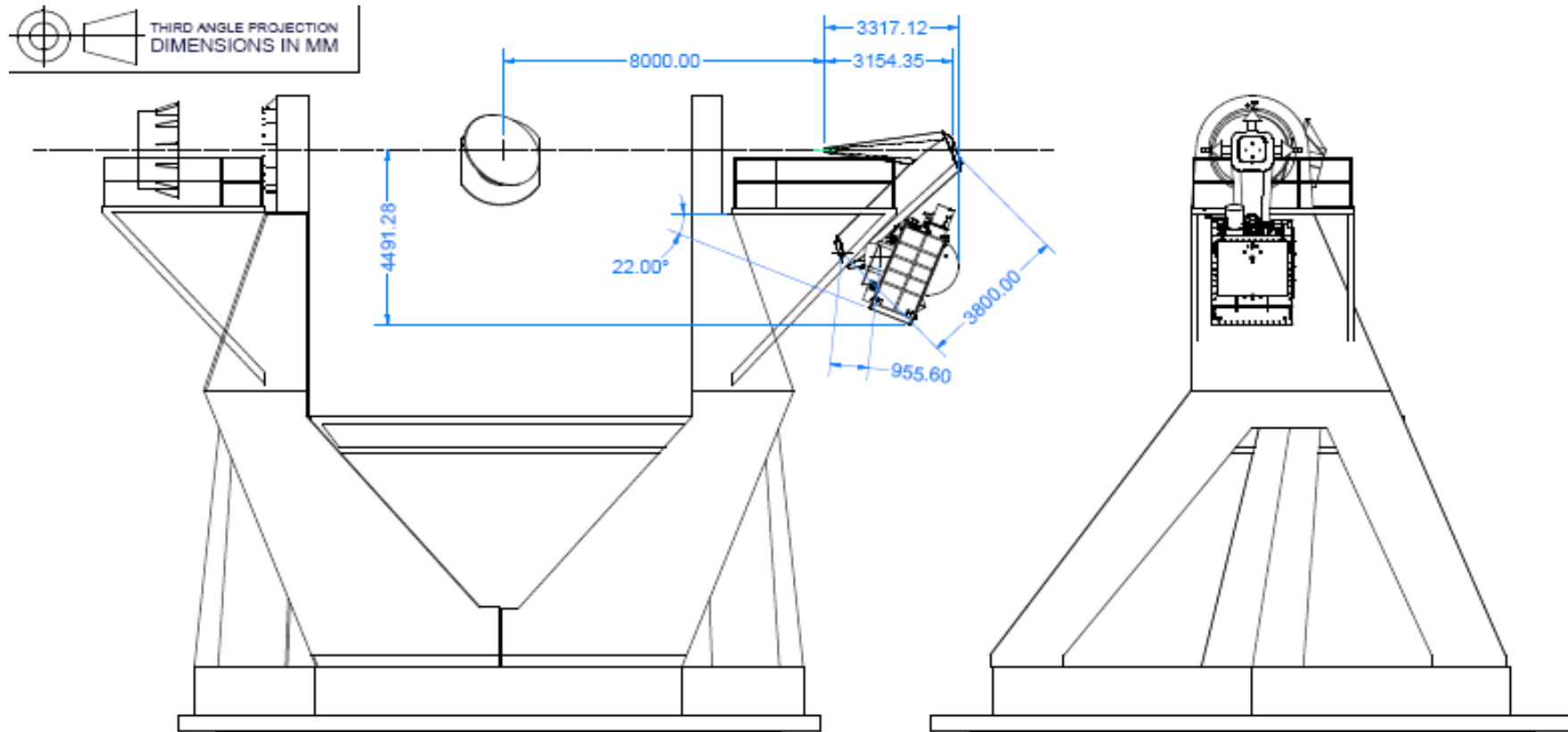
# SCUBA-2 on CCAT



# SCUBA-2 on CCAT

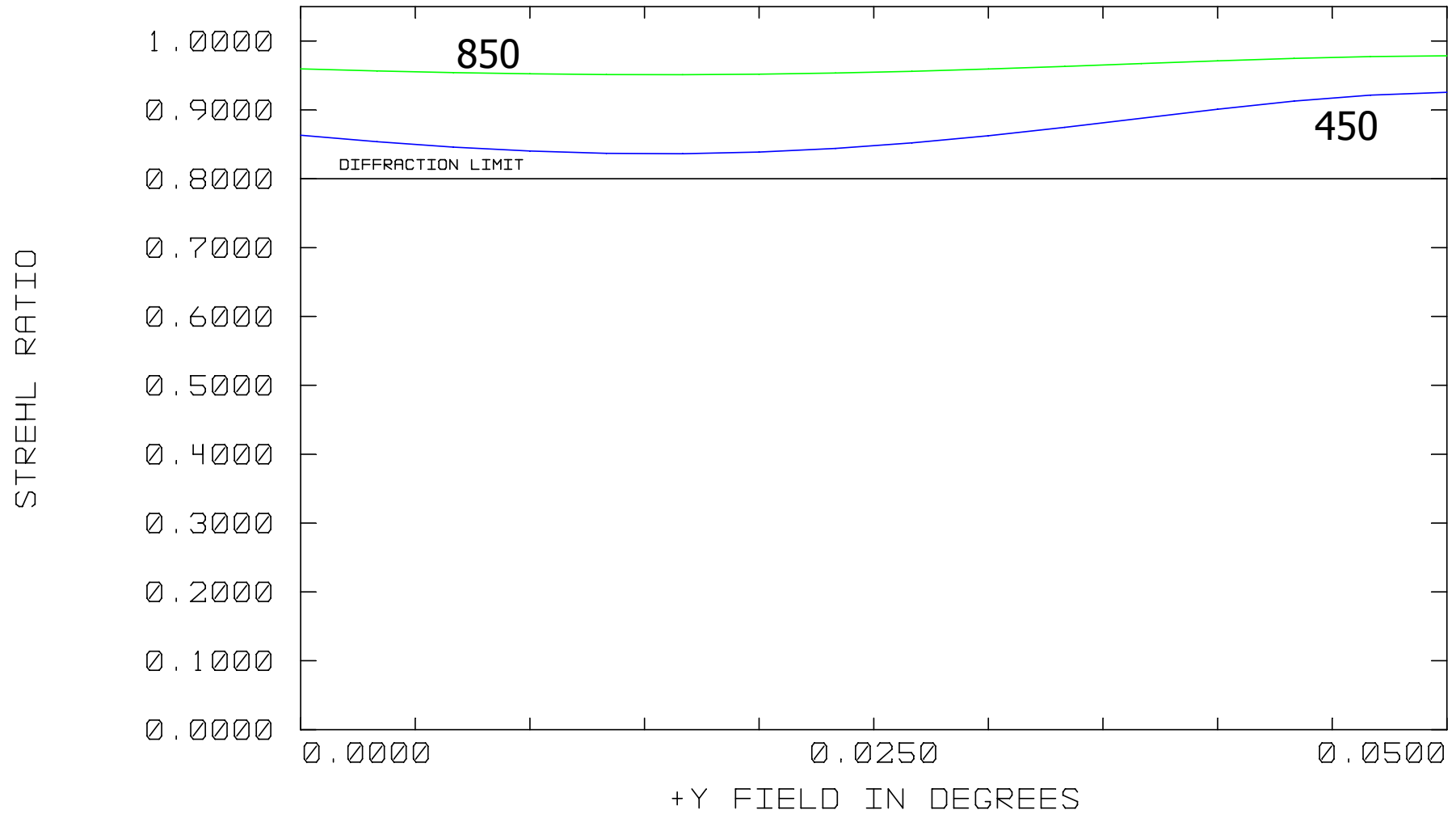


# SCUBA-2 on CCAT





# Strehl ratios



# SCUBA-2 properties/services

**Dimensions:** Cryostat  $2.3 \times 1.7 \times 2.1\text{m}$  (pumped volume of  $5\text{m}^3$ )

**Weight:** Cryostat (including electronics) 3400kg

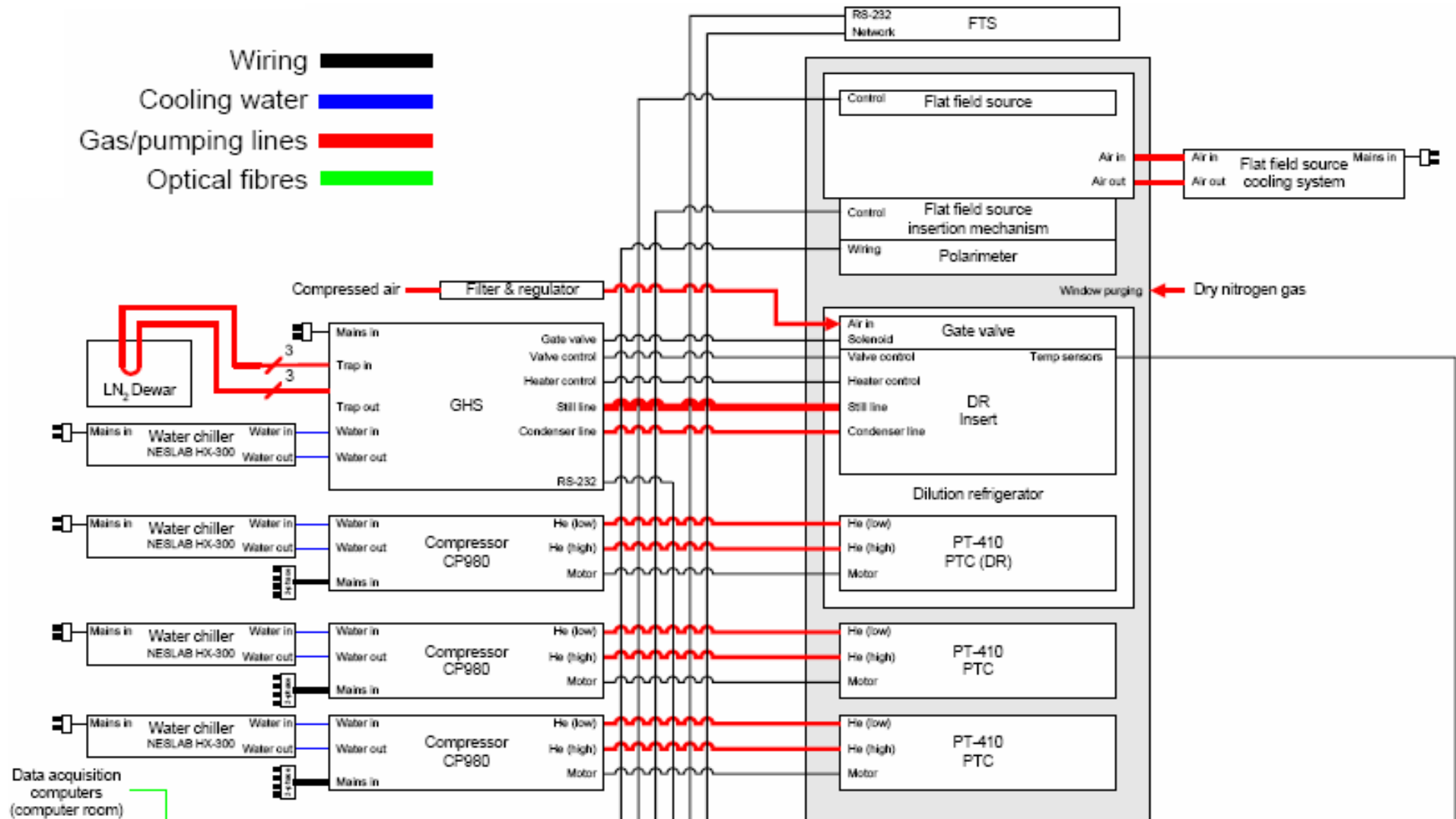
**Power consumption:**  $\sim 45\text{kW}$  in total

**Communications:** Fibre optics from electronics to RT Linux PCs;  
RS232 control of mechanisms

**Cryogenics:** 600 litres of LN for pre-cool;  $\sim 5$  litres of LN per day during operation

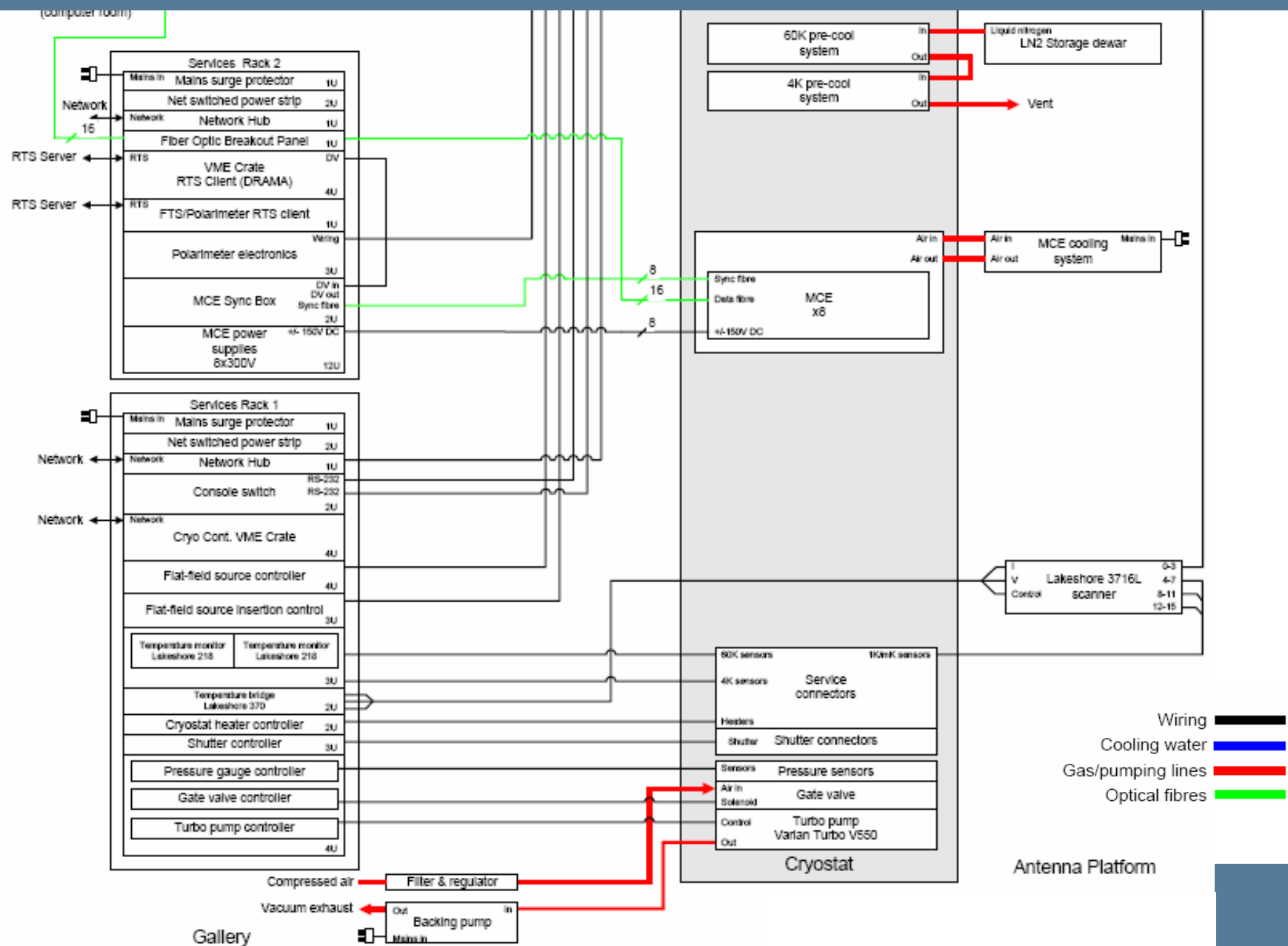
**Services:** Two electronics service racks; DR control unit; 3 (water cooled) compressors for PTCs; backing pump for turbo; compressed air for gate-valves

# Services





# Services



# Dilution fridge control

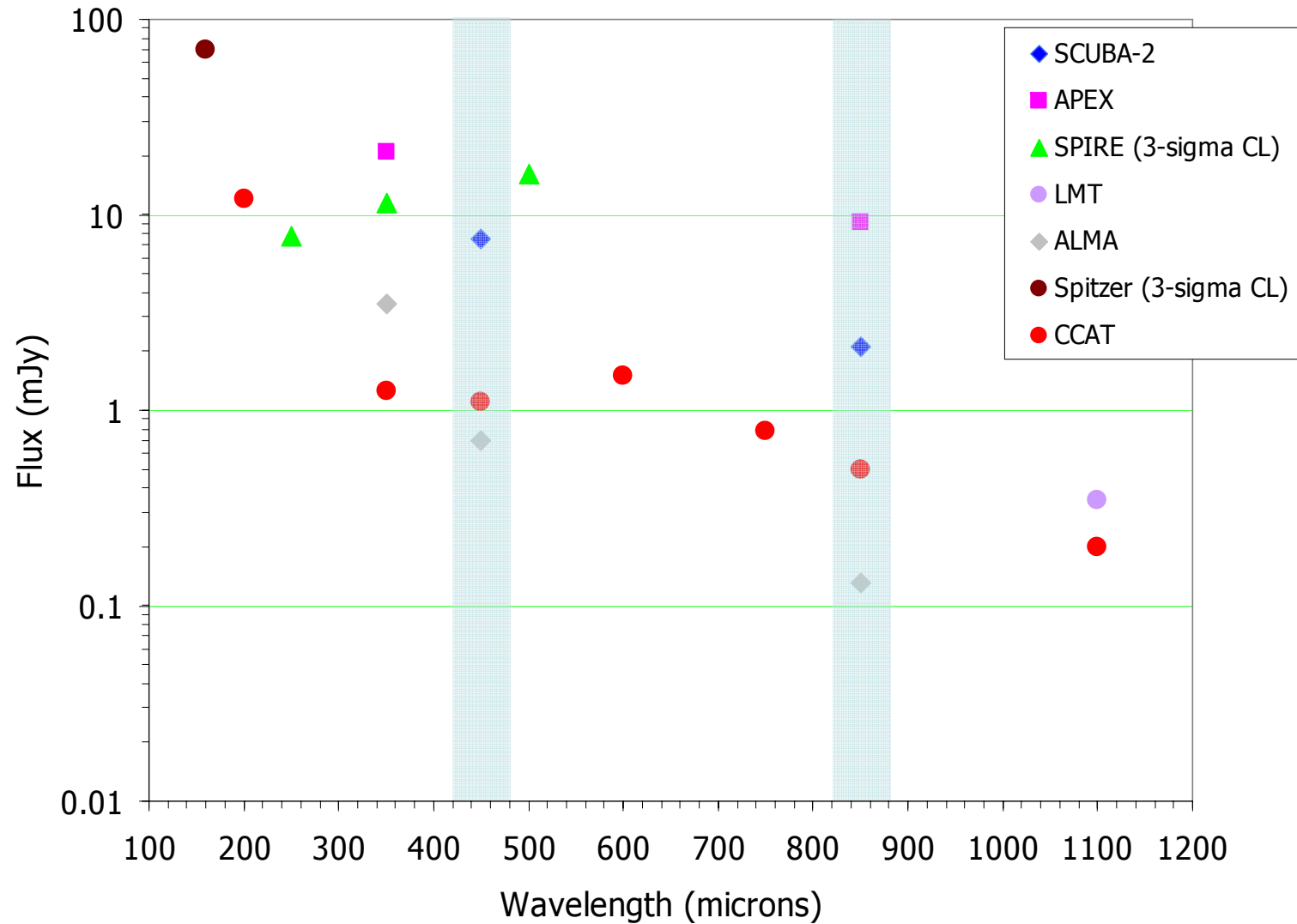


# SCUBA-2 pixel scales on CCAT

	Number of pixels	Arcsecs/ pixel	Pixel size (F $\lambda$ )	Field-of-view (sq-arcmin)
450 $\mu$ m (JCMT)	5120	6.0	0.9	51.3
850 $\mu$ m (JCMT)	5120	6.0	0.5	51.3
450 $\mu$ m	5120	4.5	1.2	30
850 $\mu$ m	5120	4.5	0.6	30



# Sensitivities



5 $\sigma$ , 1-hour sensitivities for various instruments

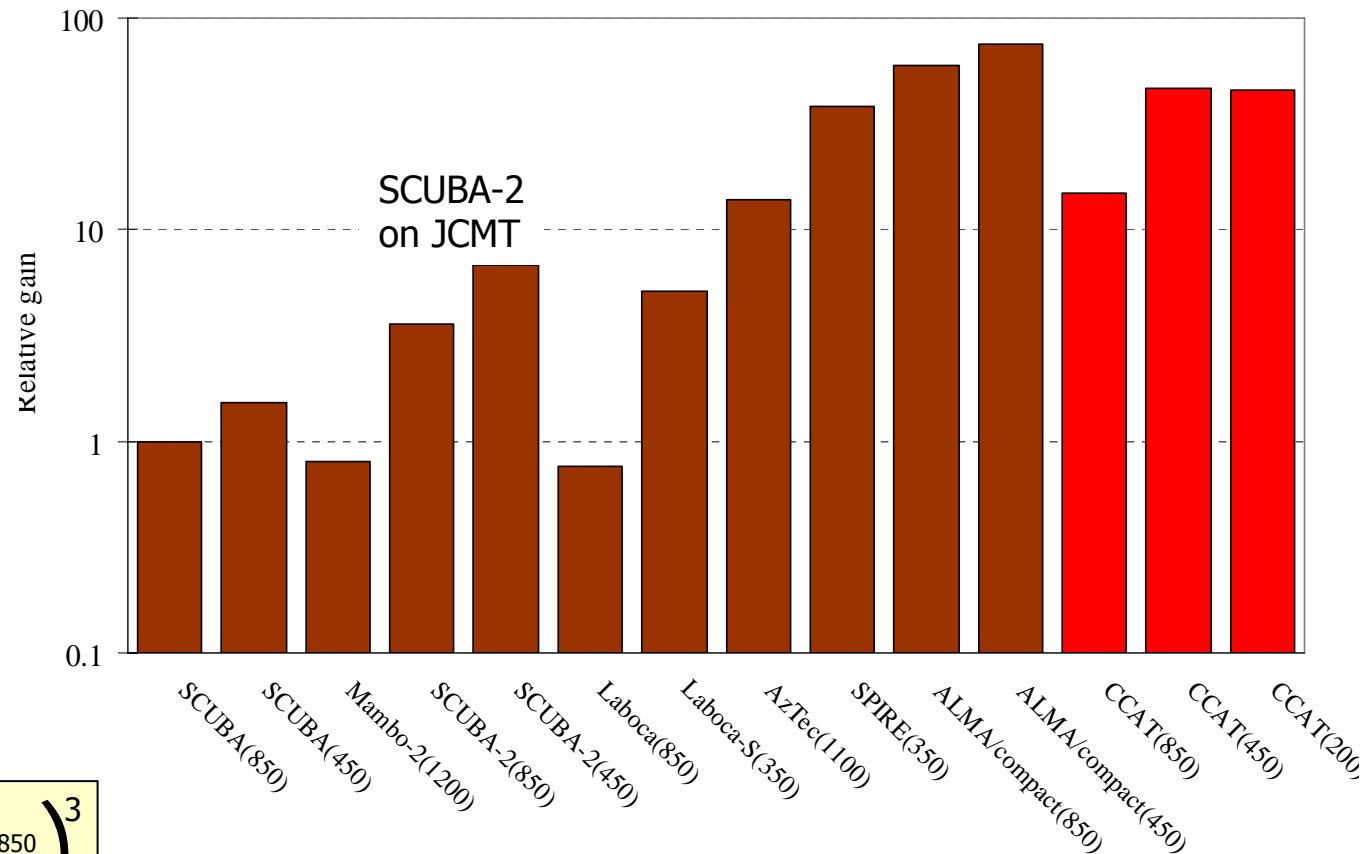
# Dust Mass Sensitivity (per pixel)

For dust at  $>30K$  and objects  $z < 2$  emission has a spectral index slope of  $\sim 2 + \beta$

$\beta = 0$  for a pure black-body, whilst  $\beta = 2$  for small ISM grains

Taking  $\beta = 1$  compute the relative gain of CCAT for a given mass of dust compared with other instruments

$$\text{Relative Gain} = \frac{\text{NEFD}_{S/850}}{\text{NEFD}} \left( \frac{\lambda_{S/850}}{\lambda} \right)^3$$



Relative to SCUBA at 850 $\mu$ m

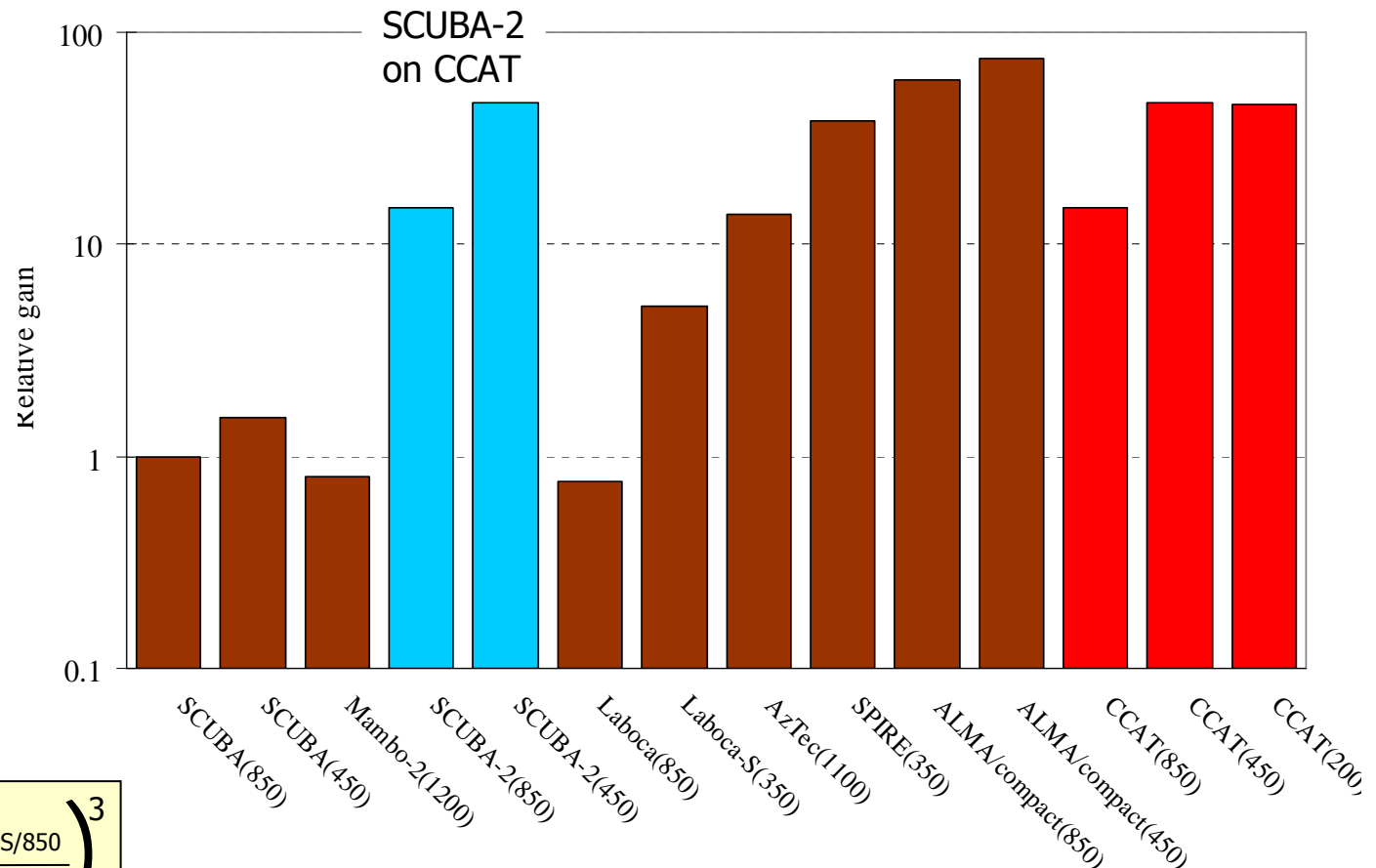
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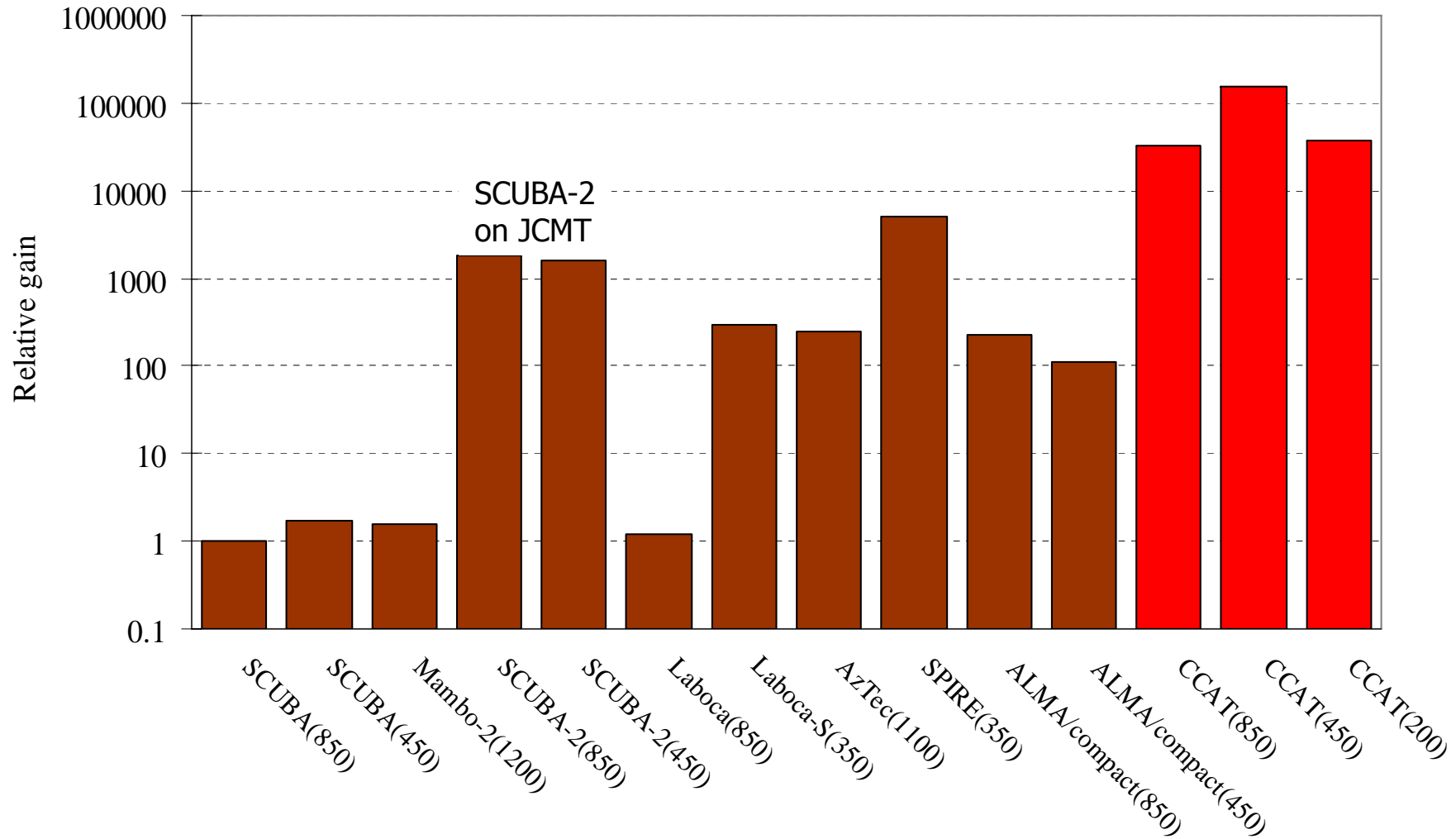
$$\text{Relative Gain} = \frac{\text{NEFD}_{S/850}}{\text{NEFD}} \left( \frac{\lambda_{S/850}}{\lambda} \right)^3$$



Relative to SCUBA at 850 $\mu$ m

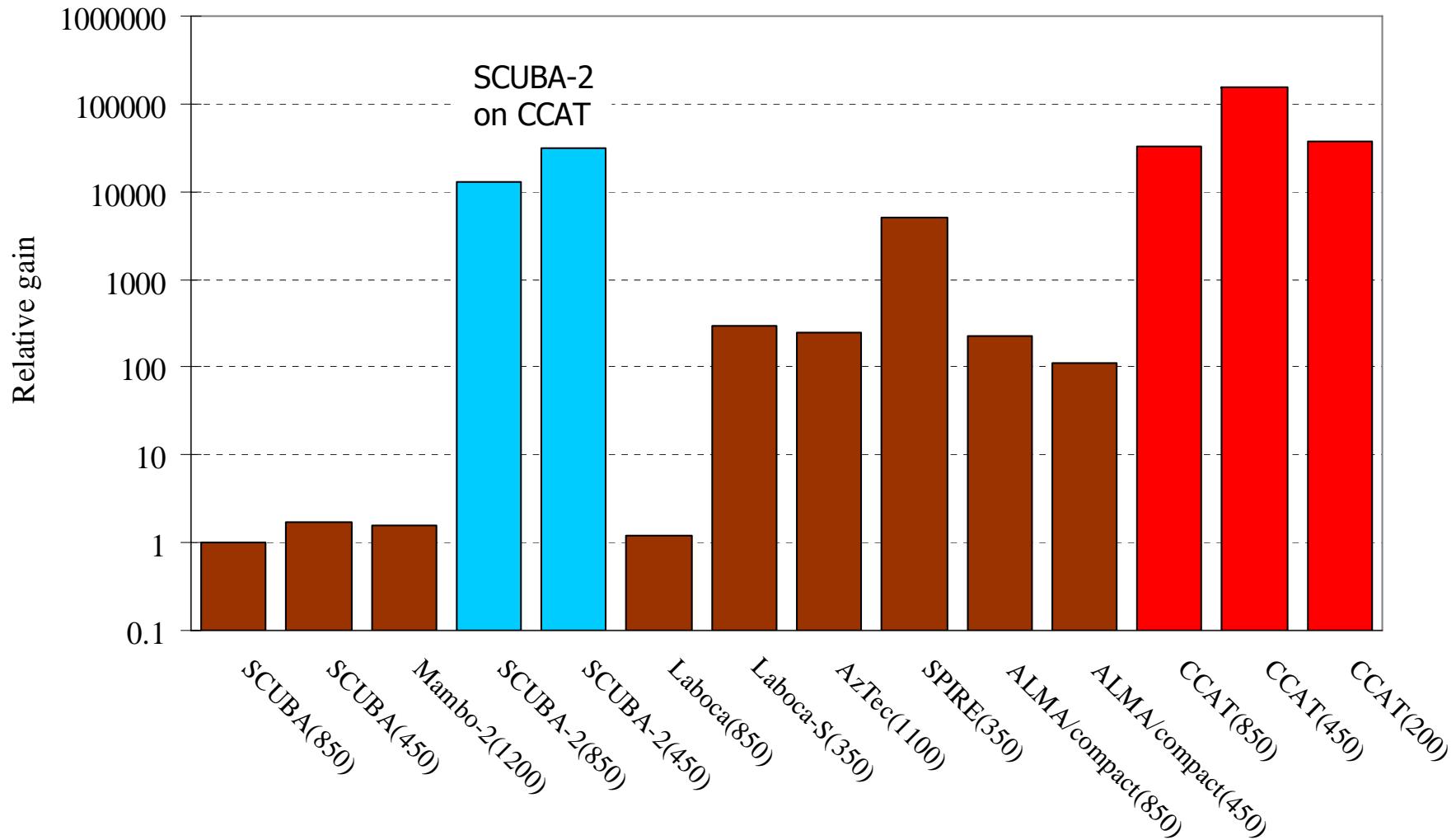


# Mapping Speed



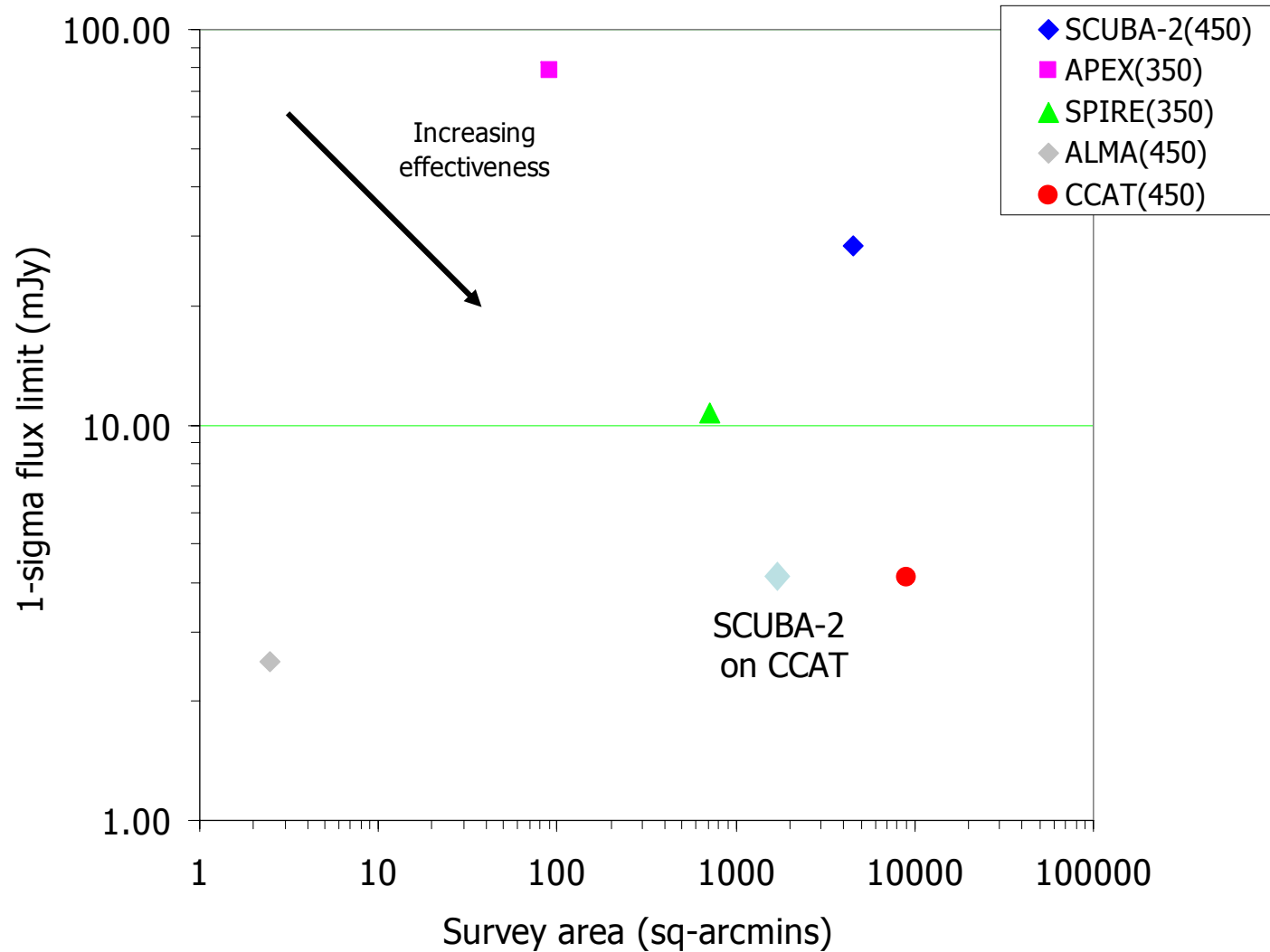
Large area mapping speeds assuming the same dust mass sensitivity (relative to SCUBA 850)

# Mapping Speed



Large area mapping speeds assuming the same dust mass sensitivity (relative to SCUBA 850)

# Field Mapping



Flux limit versus area mapped assuming 10sec/pointing (no overheads)



# Summary

- It is possible to interface SCUBA-2 to CCAT giving an  $\sim 30$  sq-arcmin field-of-view
- This is possible by just changing two of the re-imaging mirrors in the current JCMT/SCUBA-2 optical layout
- Infrastructure needs could be minimised by using the existing JCMT mounting frames, lines/compressors etc
- SCUBA-2 would provide CCAT with well-tested imaging instrument at 450 and 850 $\mu\text{m}$  from Day One