Liverpool Telescope / Liverpool Telescope 2

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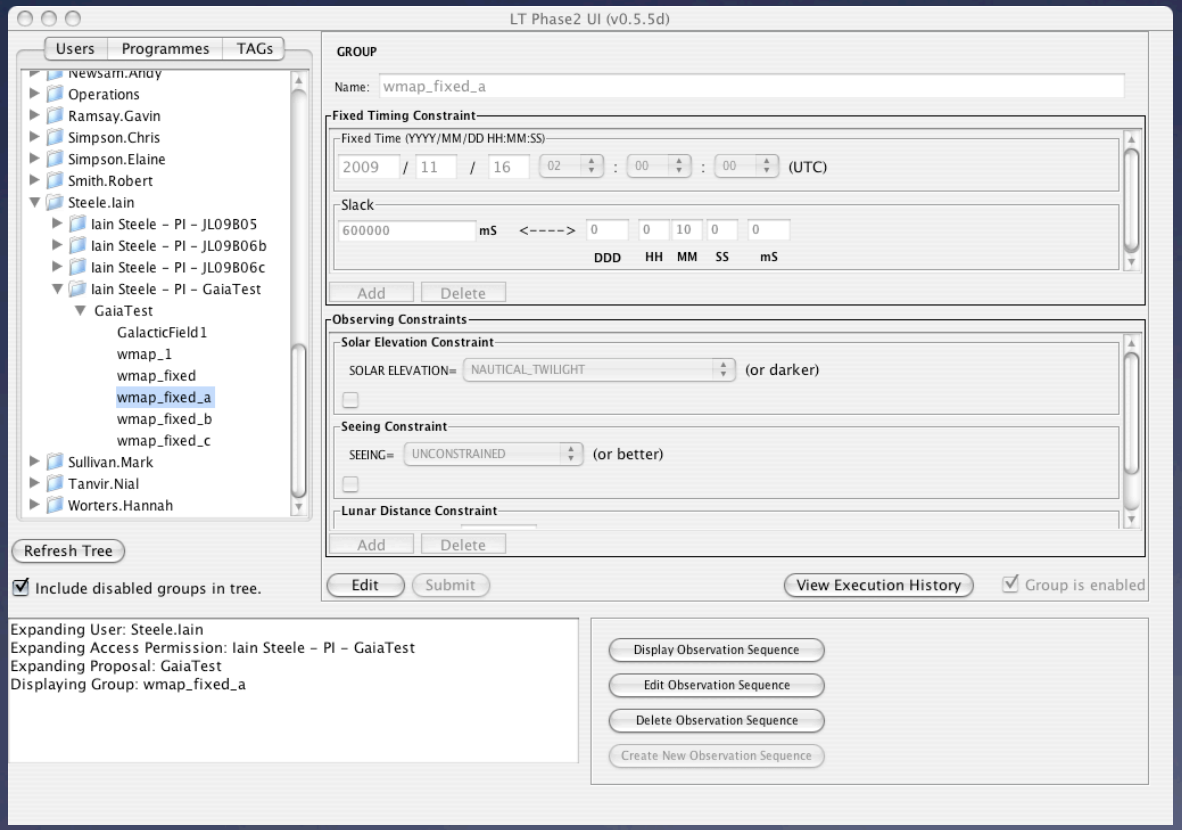
http://telescope.livjm.ac.uk/

LT - “A 2.0m Robotic Telescope”

- Common User Facility
- One that can operate without nighttime supervision.
- Not “remote controlled”.
- Software decides what and how to observe and is responsible for the safety of the telescope and observatory.
- Owned by LJMU. Operations funding from STFC (~50%), LJMU and other smaller partners (Oxford, Slovenia, ESA, HEFCE, OPTICON etc.).

Observing Requests entered at any time for immediate "queue" execution



* Phase 2 GUI (manual)
* RTML document (automated)

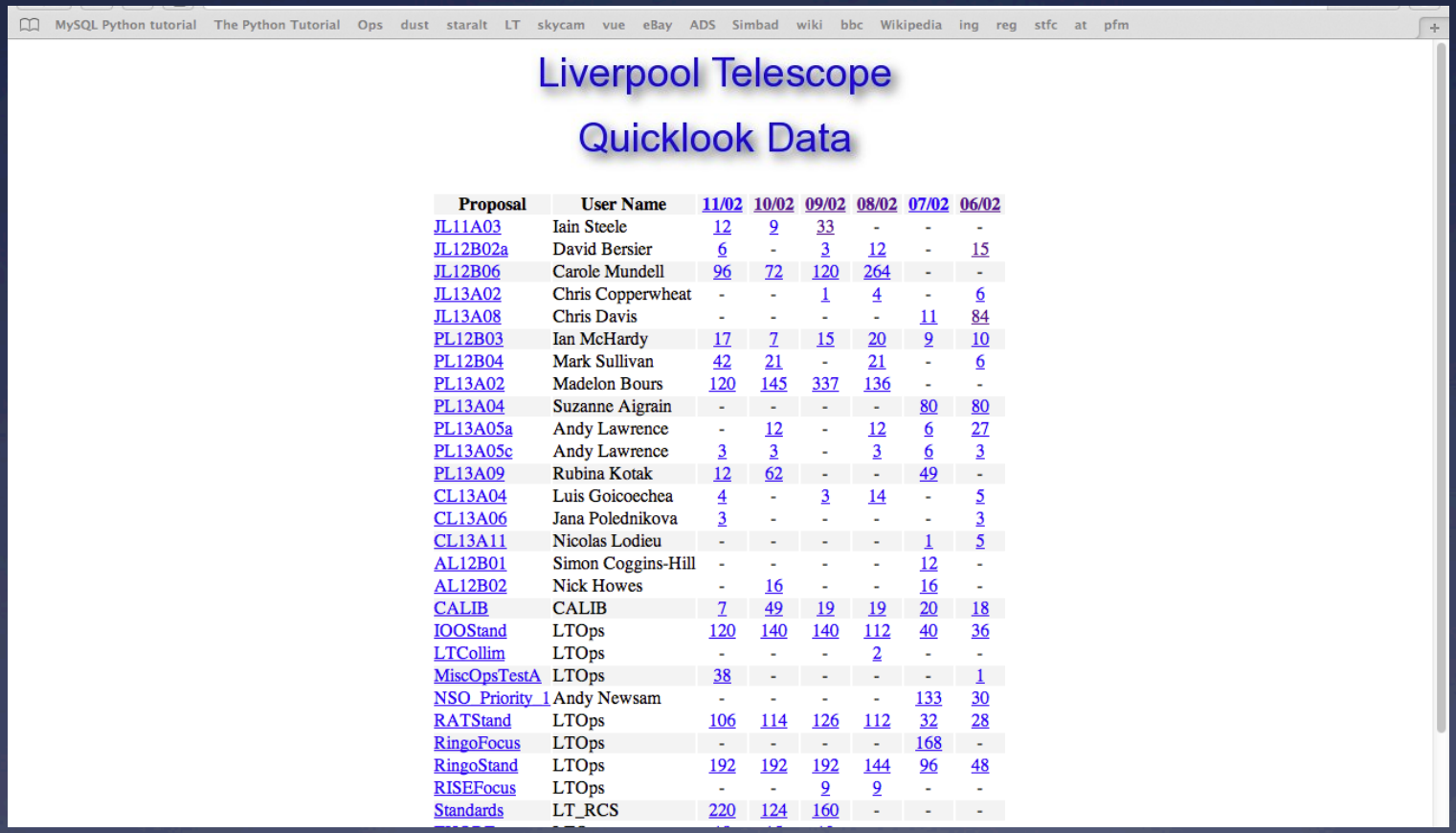
Also have “Overrides“

Overrides can take over the telescope now and abort the current exposure.

Either triggered by “special” systems designed for a science task (e.g. GRB response to GCN notices) or can be entered using RTML.

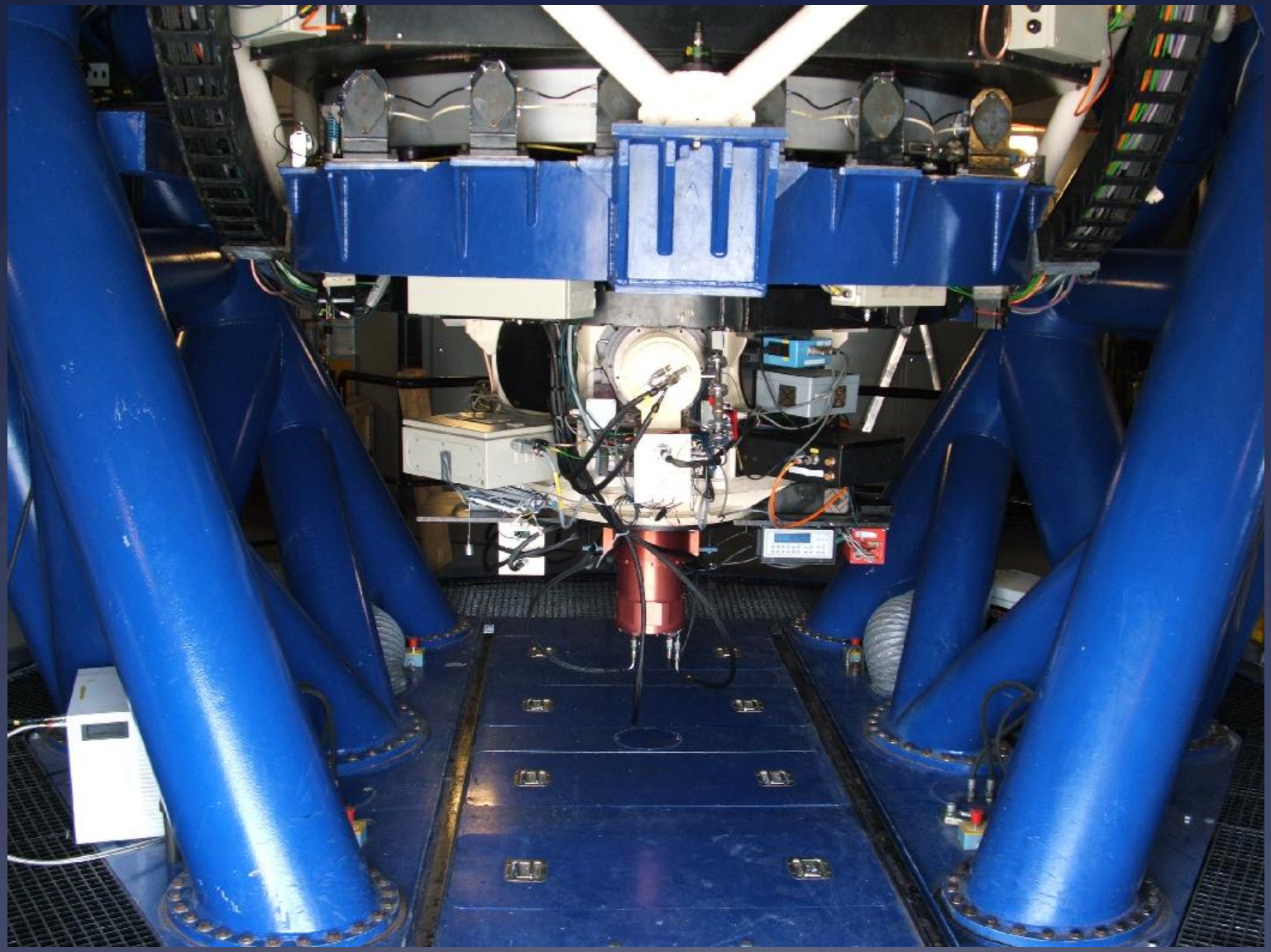
Typical on source time < 3 minutes.

Data available within 10 minutes...



Proposal	User Name	11/02	10/02	09/02	08/02	07/02	06/02
JL11A03	Iain Steele	12	9	33	-	-	-
JL12B02a	David Bersier	6	-	3	12	-	15
JL12B06	Carole Mundell	96	72	120	264	-	-
JL13A02	Chris Copperwheat	-	-	1	4	-	6
JL13A08	Chris Davis	-	-	-	-	11	84
PL12B03	Ian McHardy	17	7	15	20	9	10
PL12B04	Mark Sullivan	42	21	-	21	-	6
PL13A02	Madelon Bours	120	145	337	136	-	-
PL13A04	Suzanne Aigrain	-	-	-	-	80	80
PL13A05a	Andy Lawrence	-	12	-	12	6	27
PL13A05c	Andy Lawrence	3	3	-	3	6	3
PL13A09	Rubina Kotak	12	62	-	-	49	-
CL13A04	Luis Goicoechea	4	-	3	14	-	5
CL13A06	Jana Polednikova	3	-	-	-	-	3
CL13A11	Nicolas Lodieu	-	-	-	-	1	5
AL12B01	Simon Coggins-Hill	-	-	-	-	12	-
AL12B02	Nick Howes	-	16	-	-	16	-
CALIB	CALIB	7	49	19	19	20	18
IOOStand	LTOps	120	140	140	112	40	36
LTCollim	LTOps	-	-	-	2	-	-
MiscOpsTestA	LTOps	38	-	-	-	-	1
NSO_Priority_1	Andy Newsam	-	-	-	-	133	30
RATStand	LTOps	106	114	126	112	32	28
RingoFocus	LTOps	-	-	-	-	168	-
RingoStand	LTOps	192	192	192	144	96	48
RISEFocus	LTOps	-	-	9	9	-	-
Standards	LT_RCS	220	124	160	-	-	-

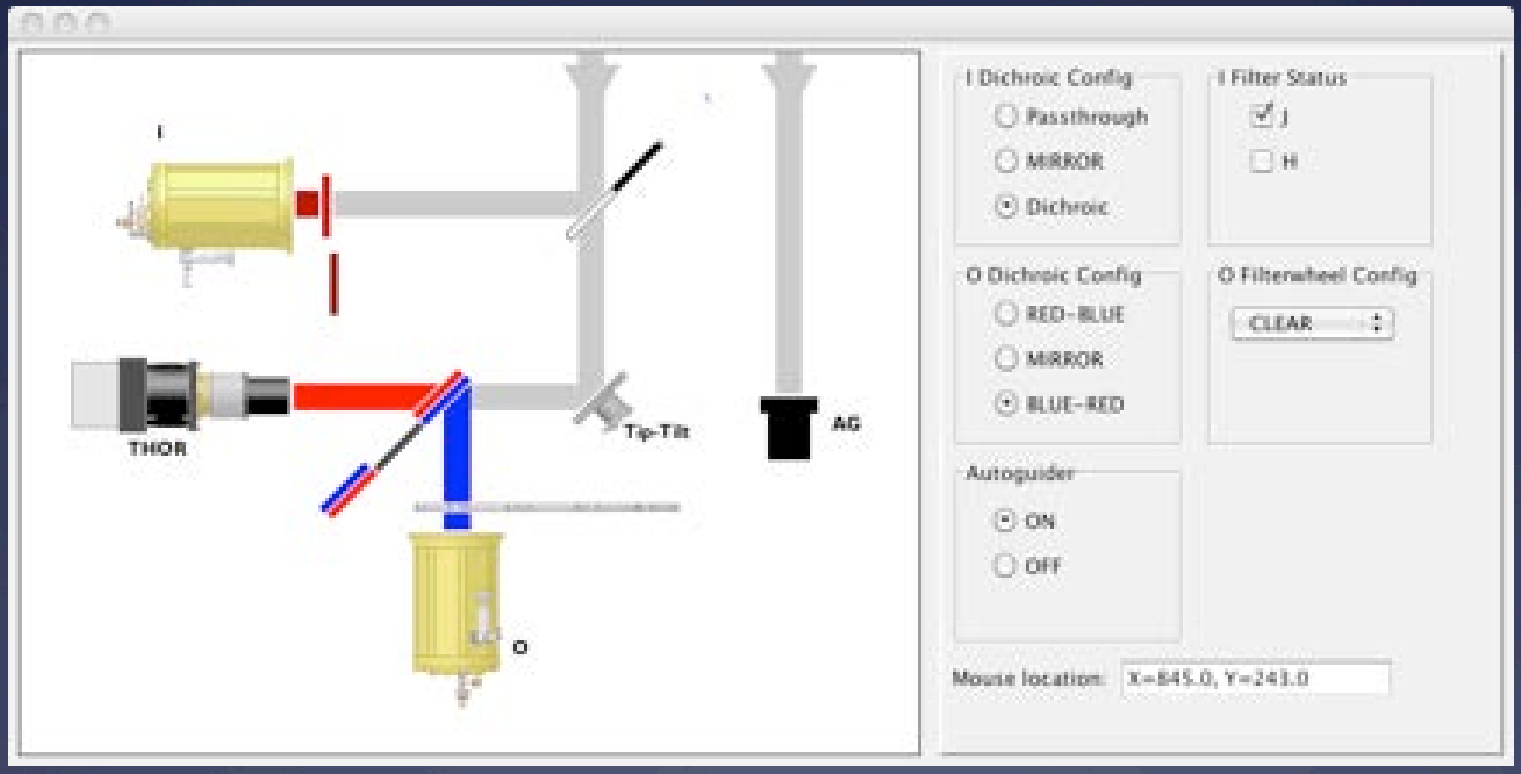
7 instruments hosted simultaneously, change ~ 20 sec



IO Imager Suite

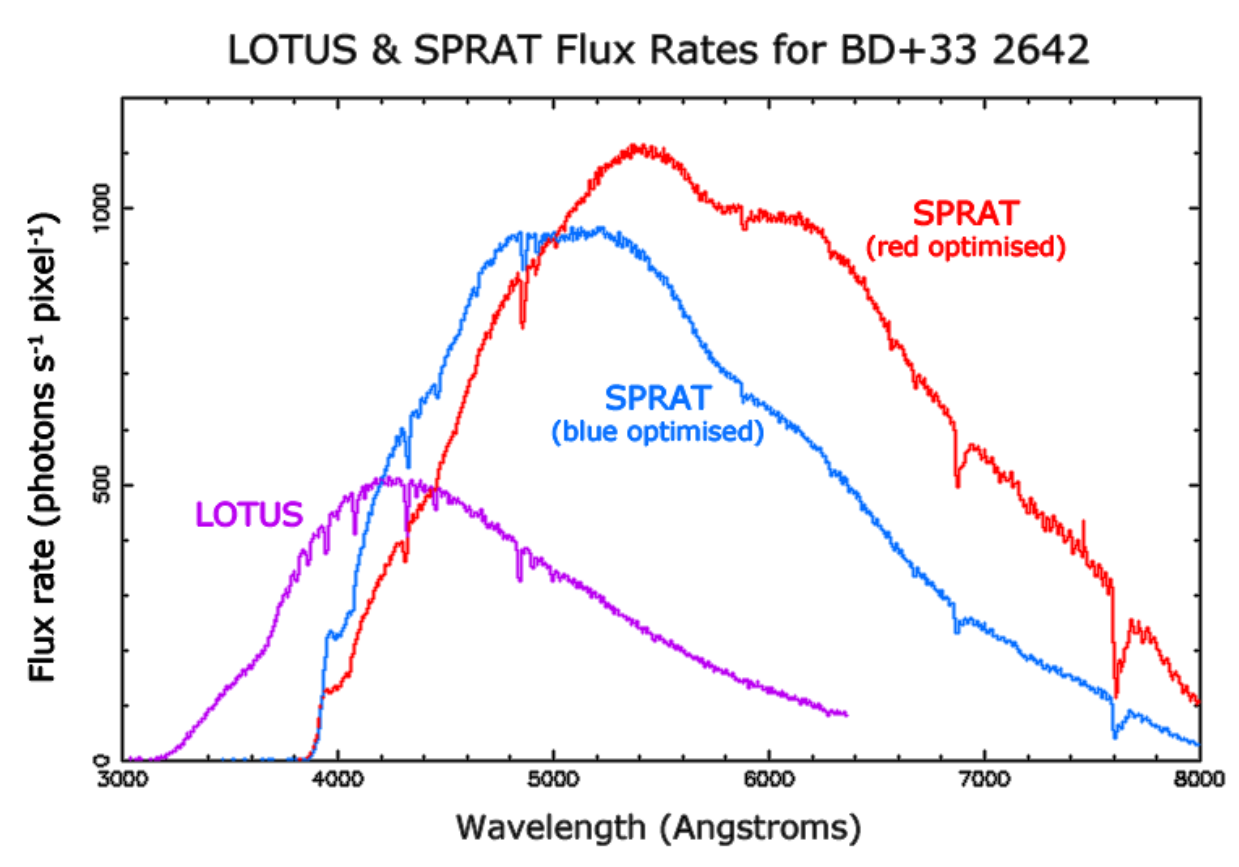
- IO:Optical 10x10 arcmin uBVgriz + Halpha
- IO:Infrared 6x6 arcmin H (J option)
- IO:THOR 2x2 arcmin optical red/blue fast readout (*not currently on telescope*)
- IO:Beam tip-tilt and dichroic optics (*development suspended*)

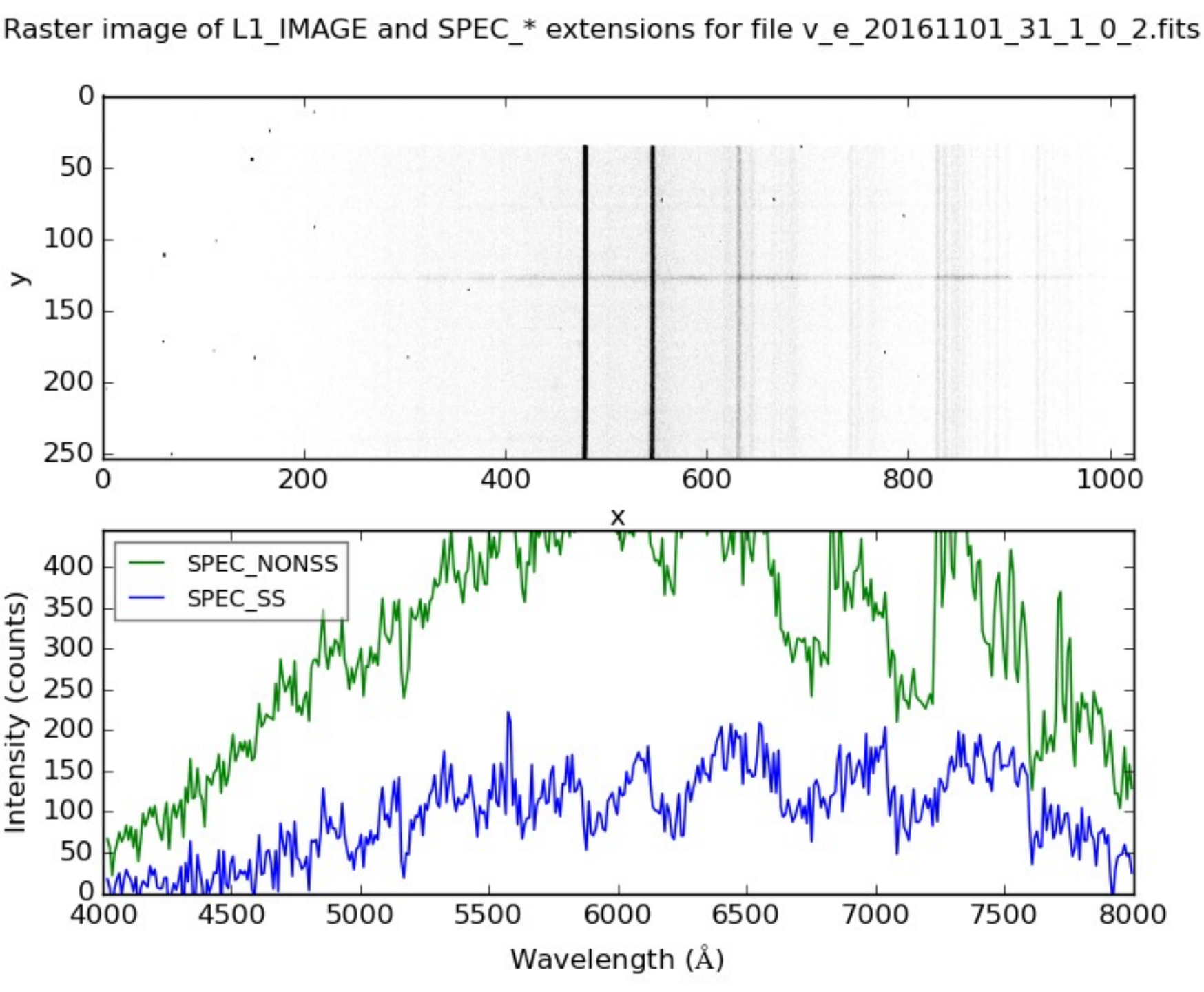
IO “Plan”

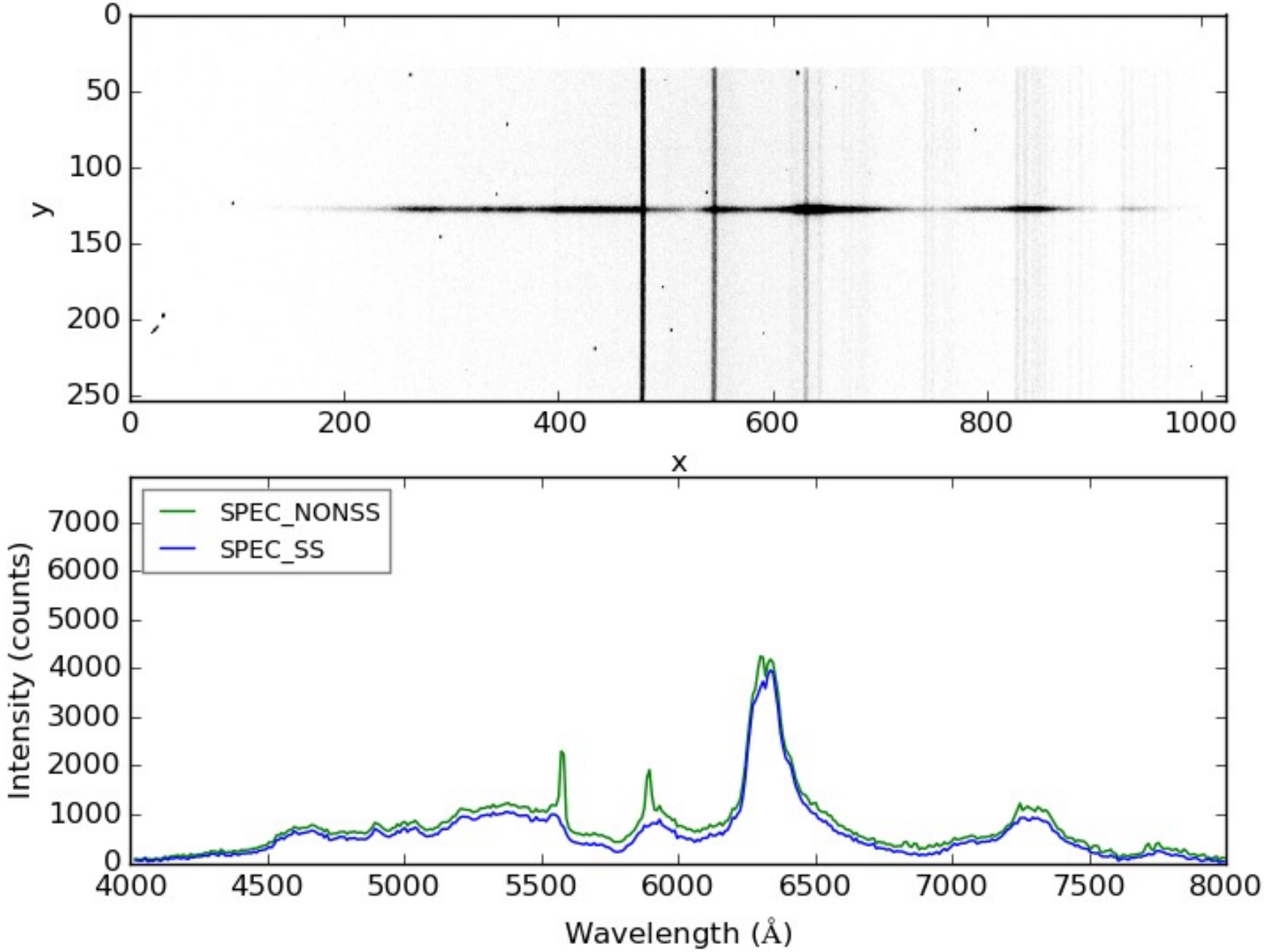

I
THOR
Tip-Tilt
AG
O
I Dichroic Config
Passthrough
MIRROR
Dichroic
I Filter Status
J
H
O Dichroic Config
RED-BLUE
MIRROR
BLUE-RED
O Filterwheel Config
CLEAR
Autoguider
ON
OFF
Mouse location:
X=845.0, Y=243.0

SPRAT and LOTUS

* Low resolution (R=350), low cost spectrographs




Raster image of L1_IMAGE and SPEC_* extensions for file v_e_20161101_31_1_0_2.fits
y
x
0
50
100
150
200
250
0
200
400
600
800
1000
SPEC_NONSS
SPEC_SS
Intensity (counts)
0
50
100
150
200
250
300
350
400
4000
4500
5000
5500
6000
6500
7000
7500
8000
Wavelength (Å)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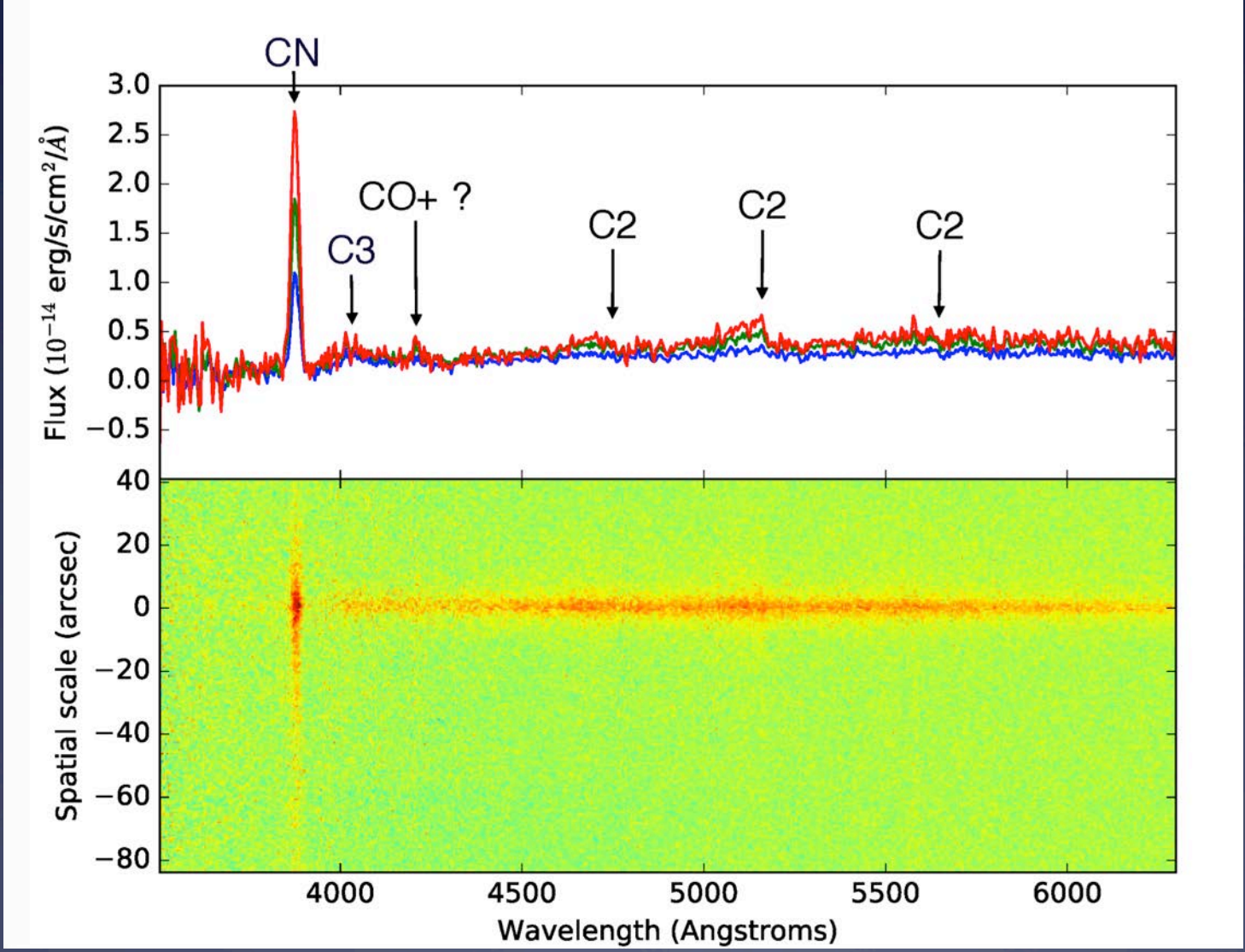
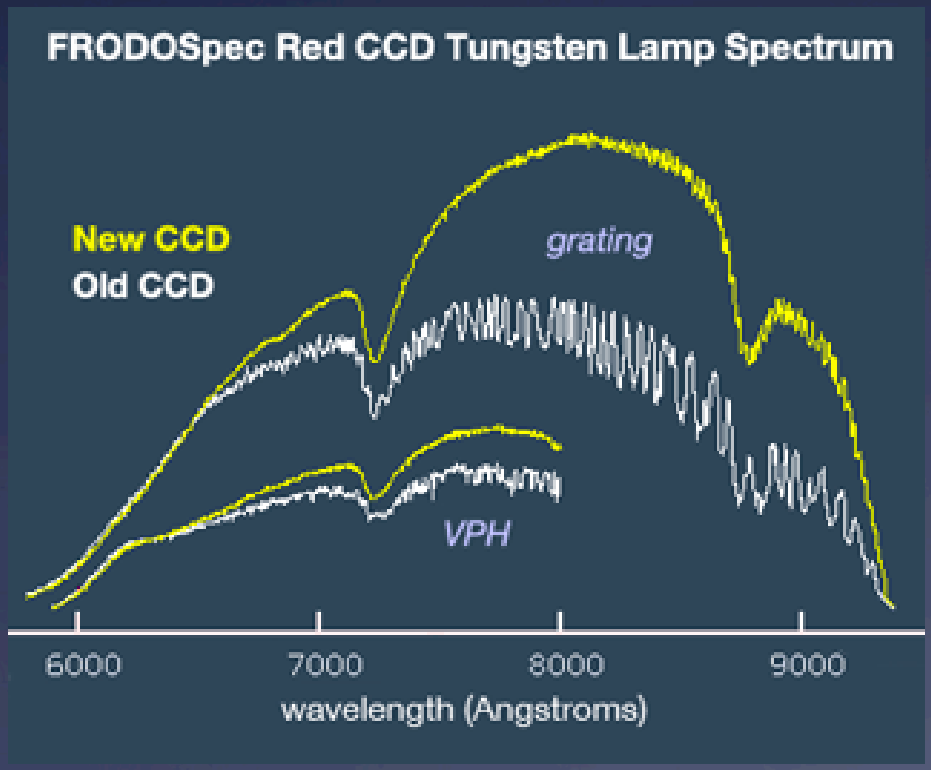
y
x
0
50
100
150
200
250
0
200
400
600
800
1000
SPEC_NONSS
SPEC_SS
Intensity (counts)
7000
6000
5000
4000
3000
2000
1000
0
4000
4500
5000
5500
6000
6500
7000
7500
8000
Wavelength (Å)

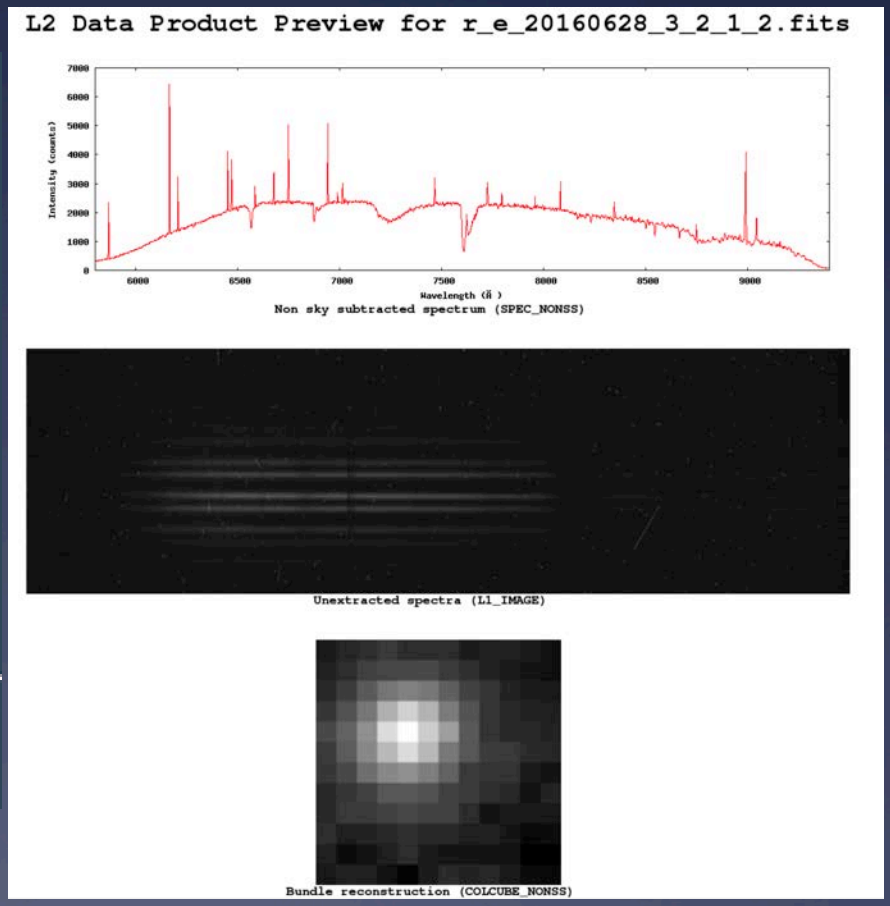
LOTUS Spectra of C67/P



FRODOSpec

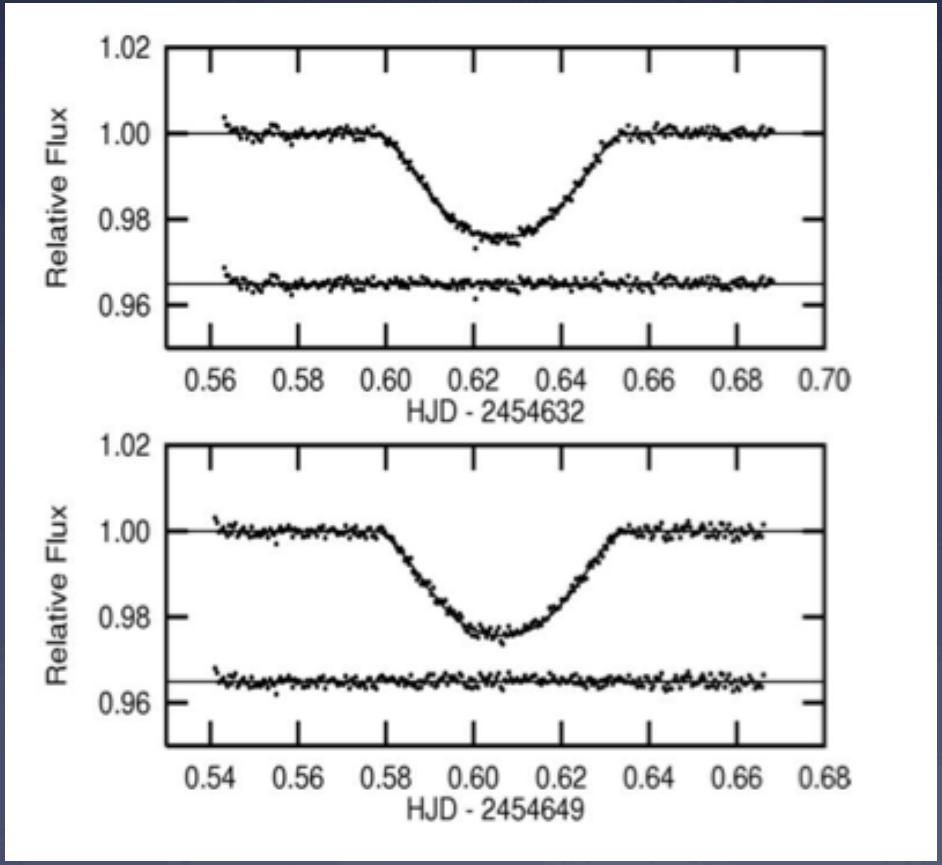
* R=2500, 5000 IFU (10x10 arcsec) spectrograph





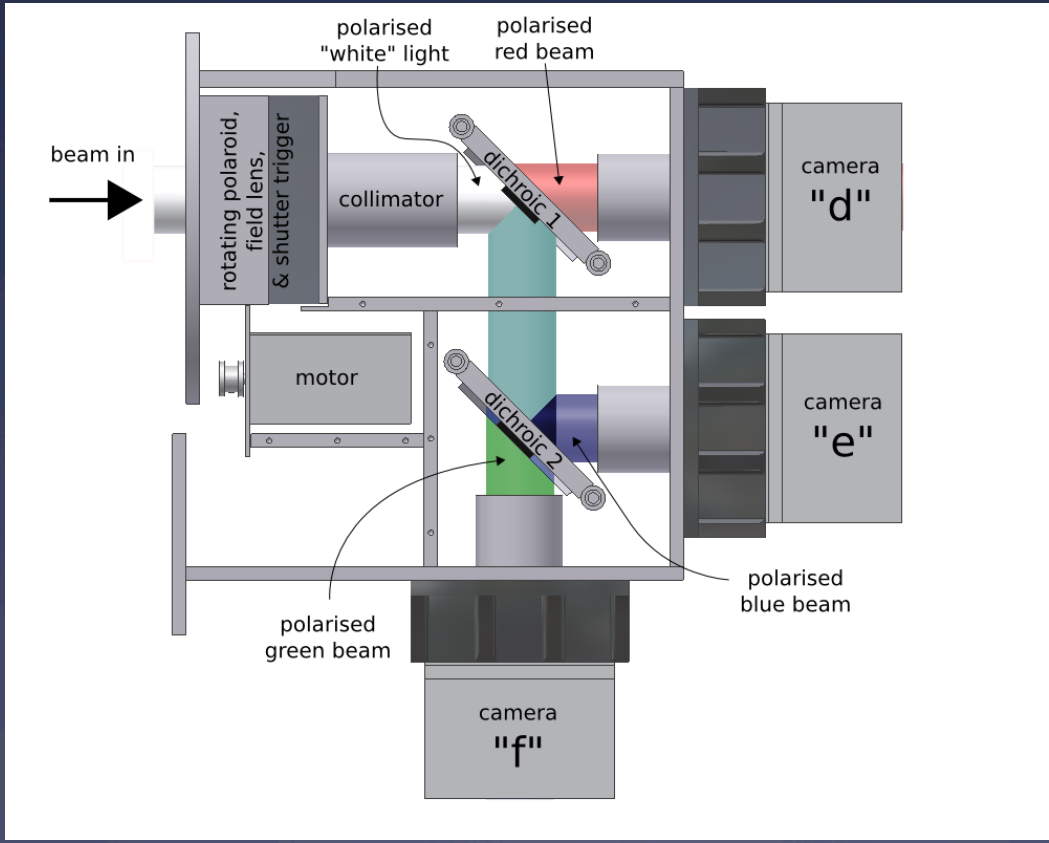
RISE: Fast Photometry

* 10x10 arcmin, No dead time (0.6s min exp)

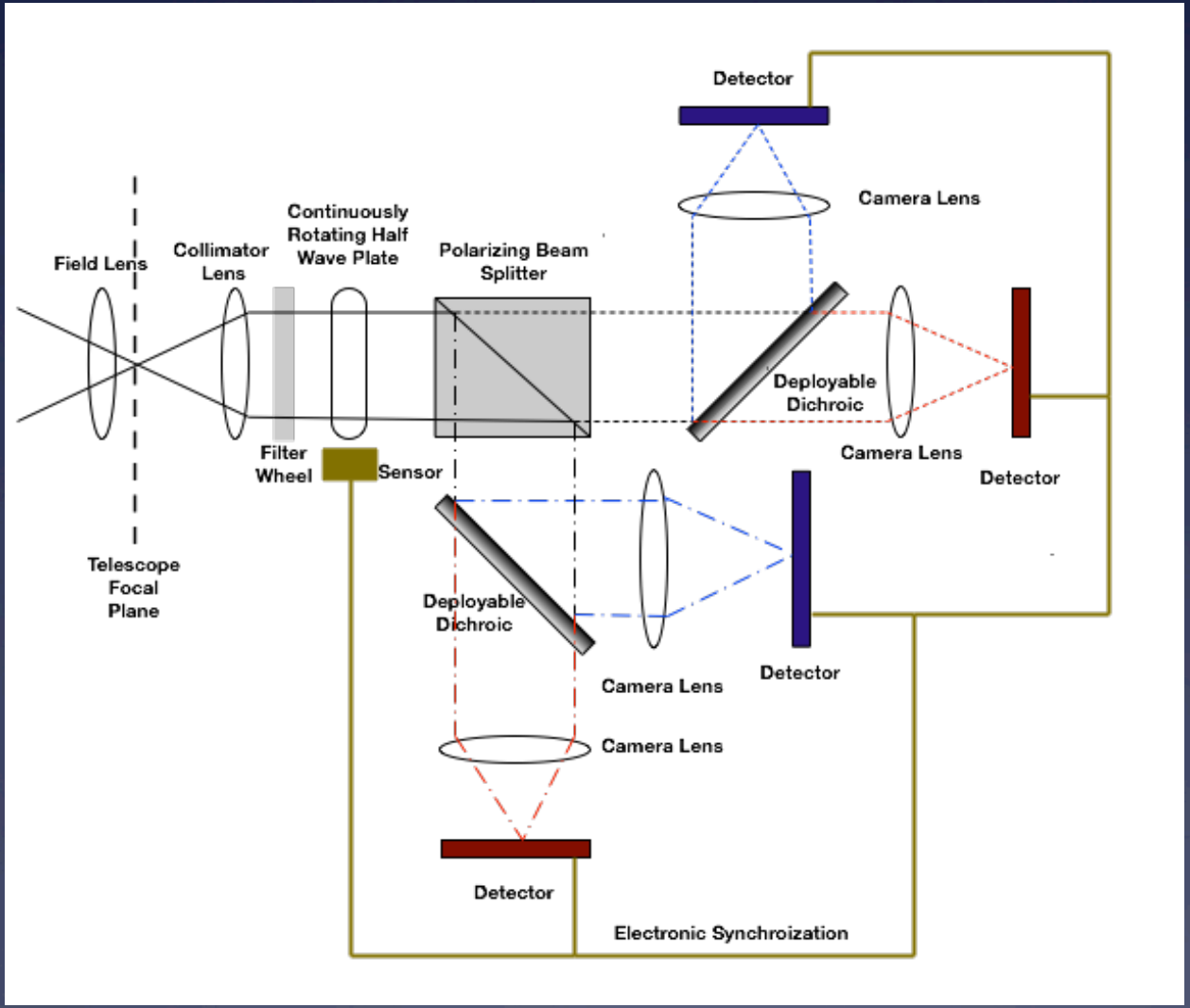


RINGO3 Polarimeter

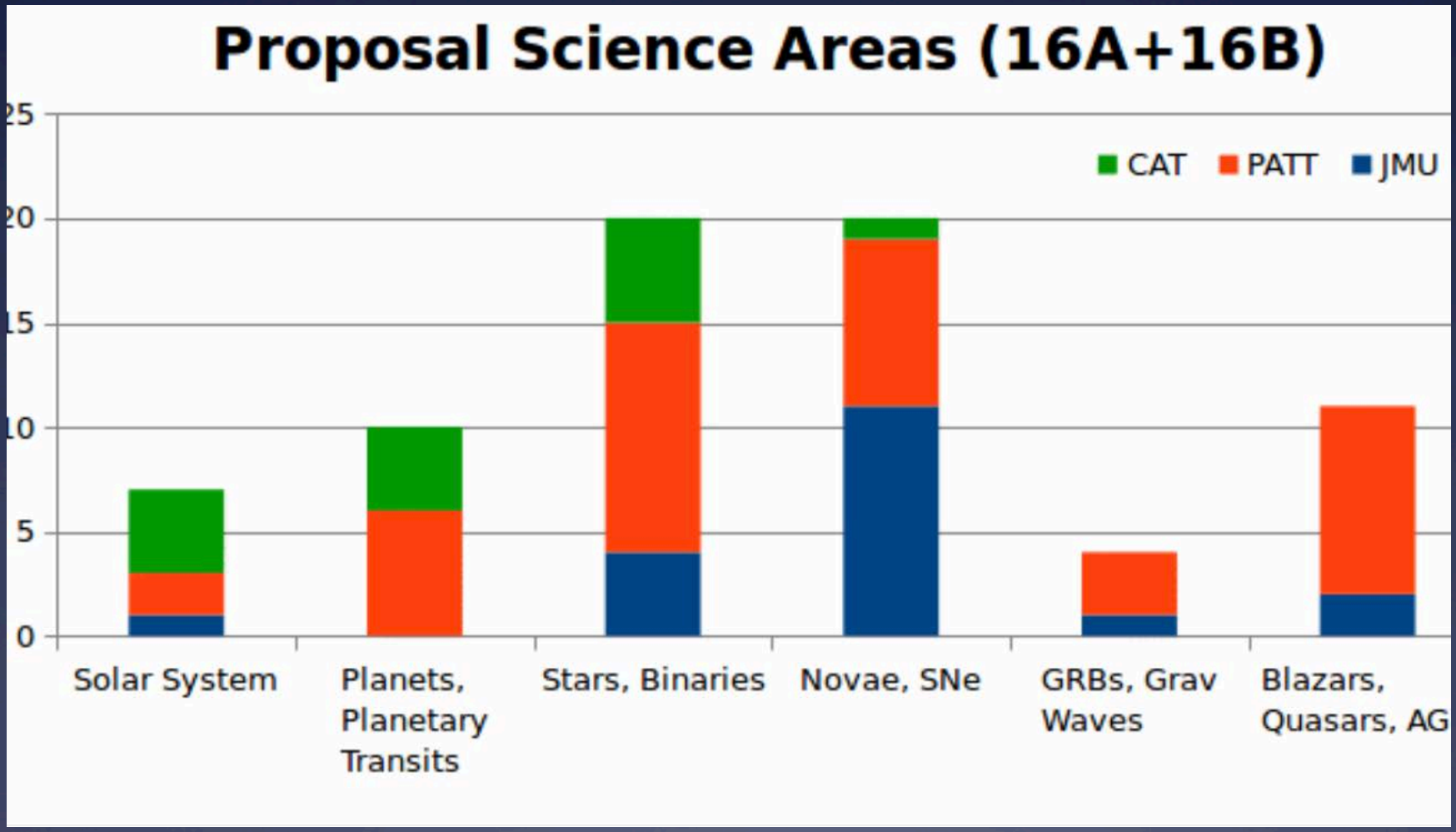
4 x 4 arcmin, 3 band, 2.5 sec time resolution



MOPTOP “Plan”


Detector
Camera Lens
Continuously
Rotating Half
Wave Plate
Collimator
Lens
Field Lens
Polarizing Beam
Splitter
Deployable
Dichroic
Camera Lens
Detector
Filter
Wheel
Sensor
Telescope
Focal
Plane
Deployable
Dichroic
Camera Lens
Detector
Camera Lens
Detector
Electronic Synchroization

All of which adds up to a telescope designed for time domain and transient astronomy…

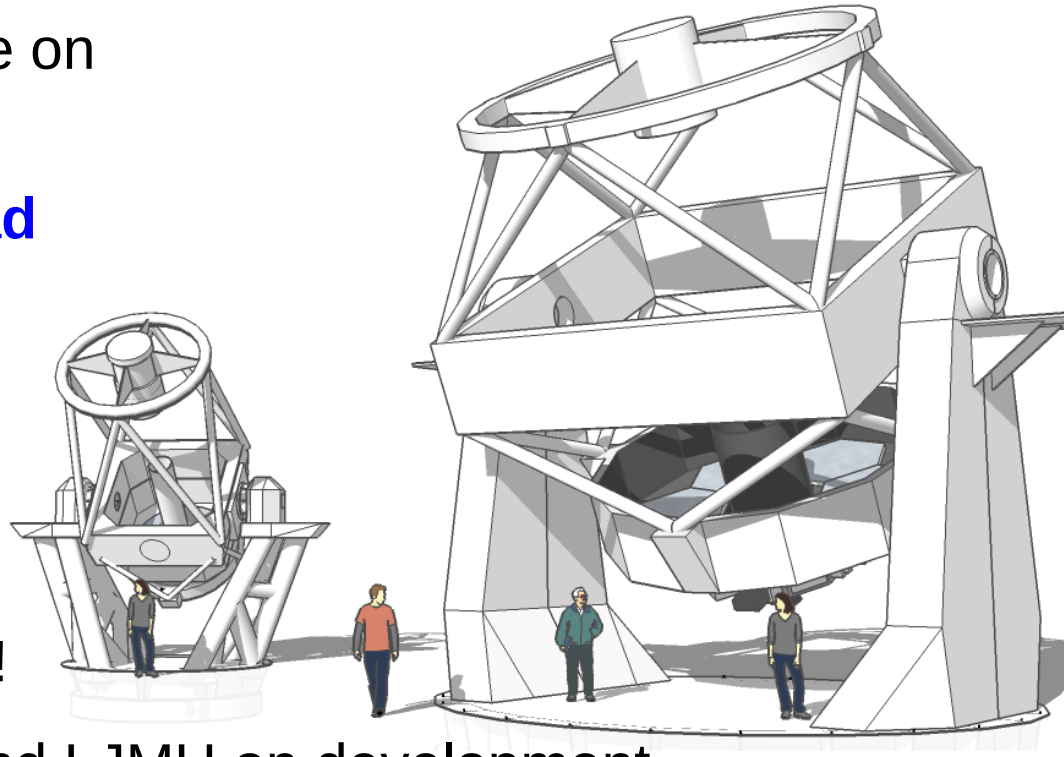


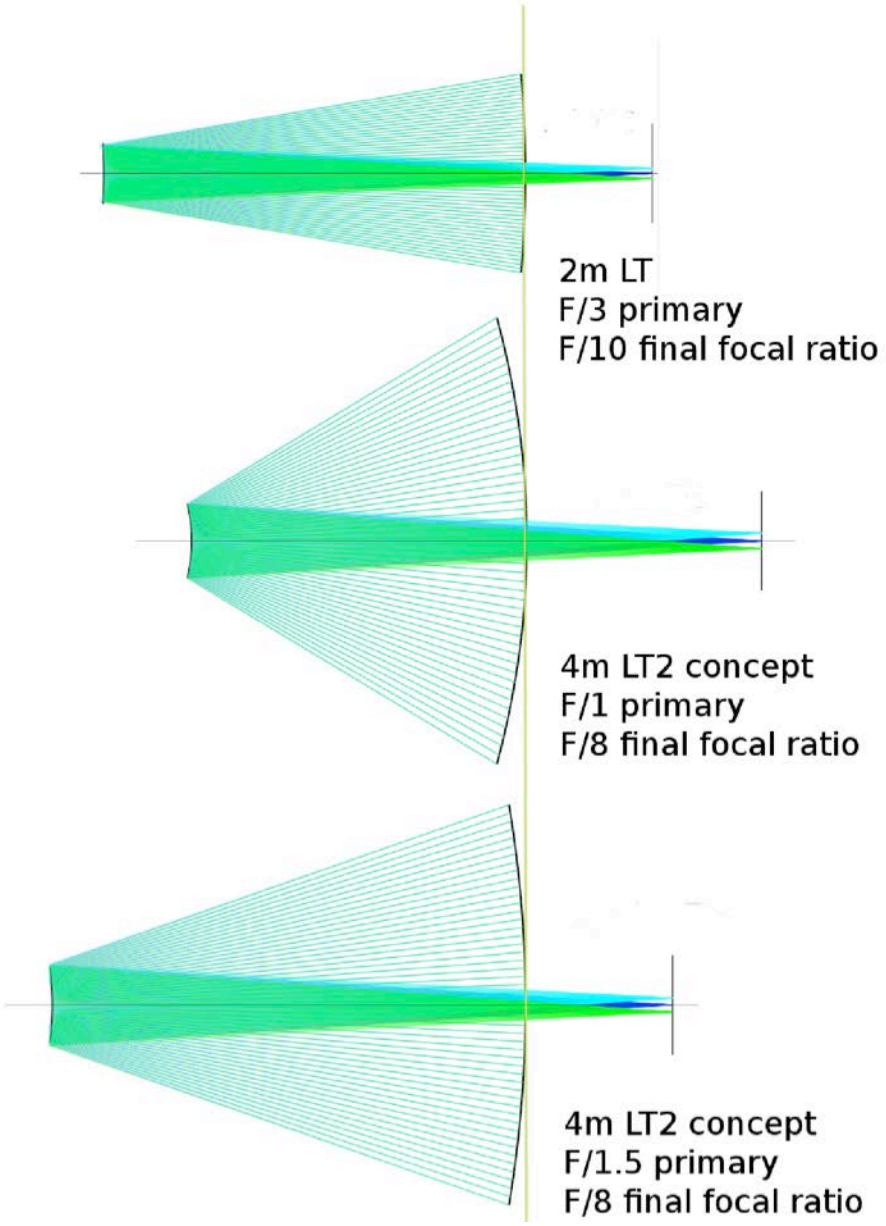
Time Allocations

- PATT (UK) 30%
- Liverpool JMU 30%
- CAT (Spain) 20%
- CCI (International) 5%
- Schools/Education 10%
- ESA 1%
- Oxford 4%
- OPTICON up to 5%

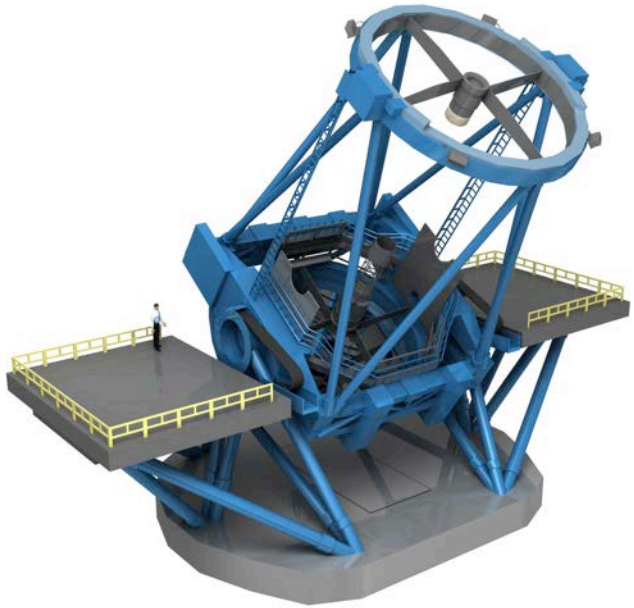
The new telescope…

- A new, **4-metre class robotic telescope** for rapid follow-up of astrophysical transients. Largest robotic telescope in the world
- To be co-located with the LT on **La Palma**
- **First light ~2022** to capitalise on new discovery facilities
- **Versatile instrument payload** spectroscopy a core focus (X-shooter like)
- Fast slewing
- (<30 seconds on target)
- Ownership Structure Unclear!
- MoU in place between IAC and LJMU on development.

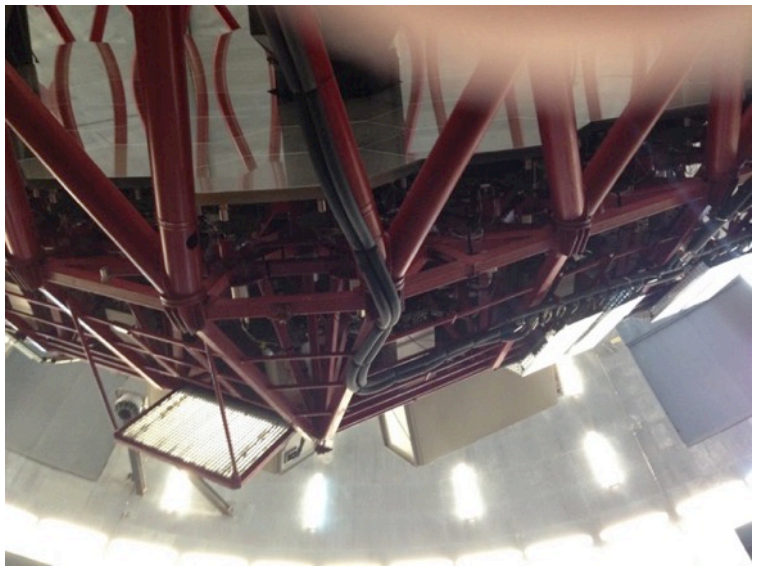


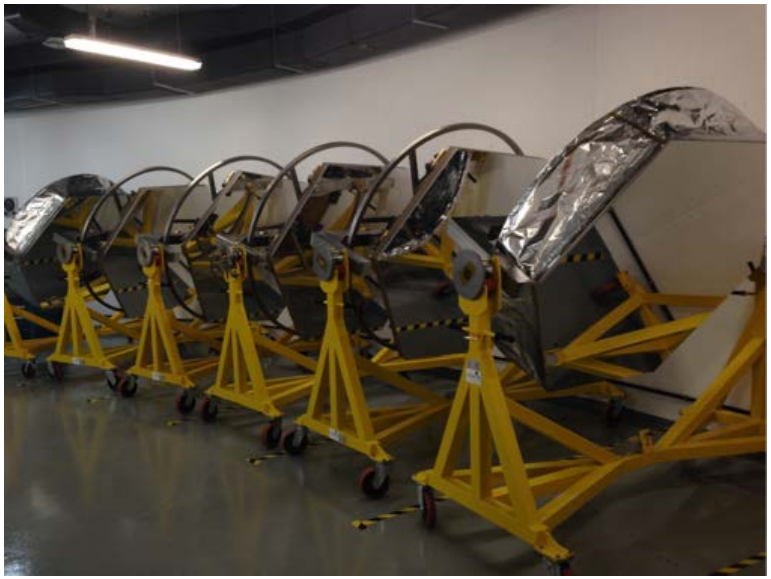


- Ritchey–Chrétien design
- Minimisation of the moment of inertia for fast slewing
- Fast primary mirror: f/1 to f/1.5
- Cassegrain or Nasmyth?

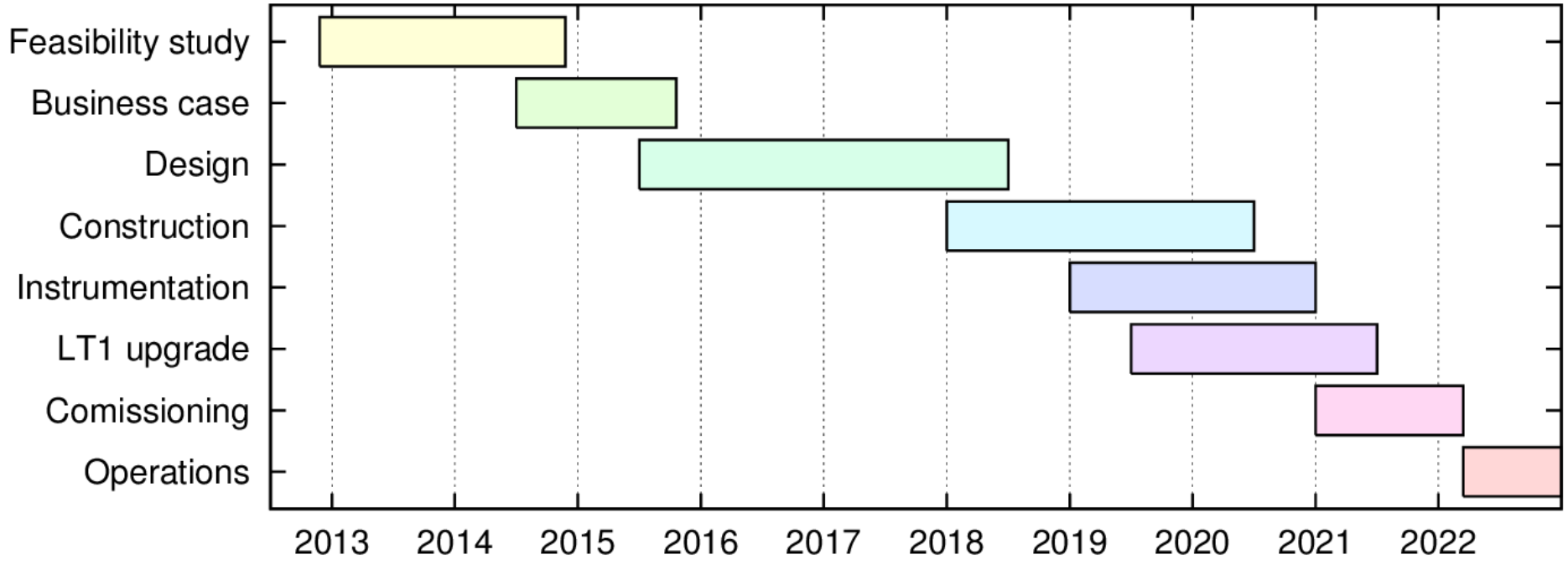


- On balance, we currently favour 6 segmented primary configuration
- Overall mirror mass ~2700kg. Each segment 1.8 metres corner-to-corner
- This is the same segment size as used in the 10.4 metre G*ran Telescopio Canarias,* operated on La Palma by IAC
- Mirror support structure for segments of this size already designed. A recoating tank for segments of this size already exists at the observatory...





Beginning the design phase



- We are beginning the process of appointing the staff which will form the core of the project office
- Engineering positions at both LJMU and IAC being recruited
- We anticipate 2x scientist positions at LJMU shortly after

Summary: LT and LT2

- Current Operations Grant until April 2017
- New Operations Grant April 2017 – April 2019 under STFC review (meeting went well, no problems anticipated!)
- Possible new instrument plans (sCMOS):
  - Tip Tilt
  - MOPTOP
  - MultiBand RISE
- Planning for LSST
  - Transient Identification & Classification
  - Interoperability (VO) Standards
- New 4.0m Robotic Telescope – first light 2022 – if this happens, LT would be changed to prime focus (2x2 degree imager)