



# Fiber Dual Echelle Optical Spectrograph (FIDEOS): a stable high-resolution spectrograph.



Matias Jones F.  
FONDECYT postdoctoral fellow

FIDEOS TEAM: Leonardo Vanzi ; Matias Jones ; Marcelo Tala ; Samuel Ropert;  
Mauricio Flores; Amokrane Berdja; Carlos Viscasillas; Holger Drass

# OUTLINE

- Scientific case
- Instrument specifications
- Optical elements
- Calibration unit and telescope interface
- The spectrograph
- Temperature control
- Summary

# SCIENCE CASE

## MAIN GOAL:

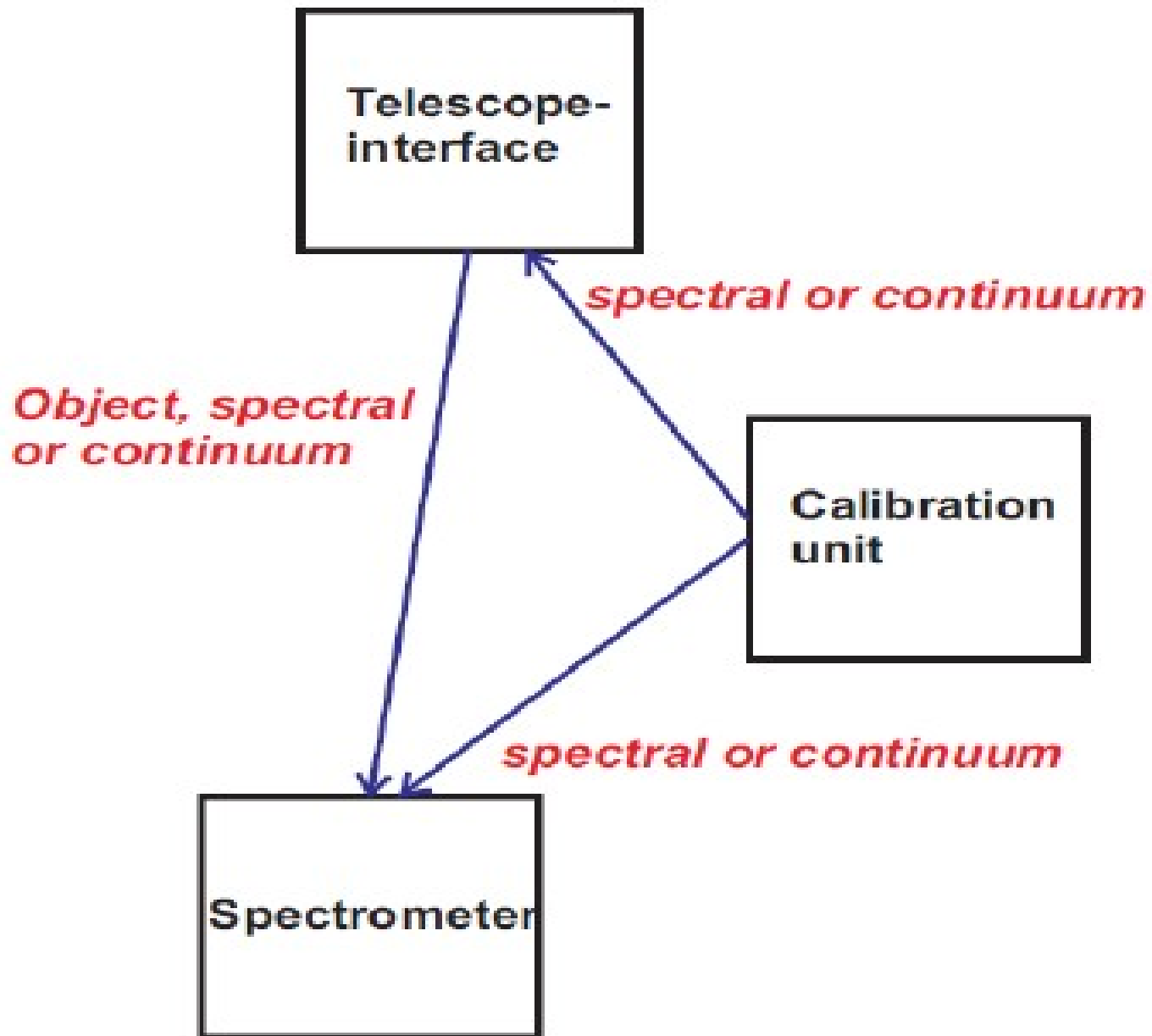
Precision RVs aimed at detecting exoplanets/BDs and follow-up of transiting planets (RV precision  $\sim 5$  m/s)

## SECONDARY GOALS:

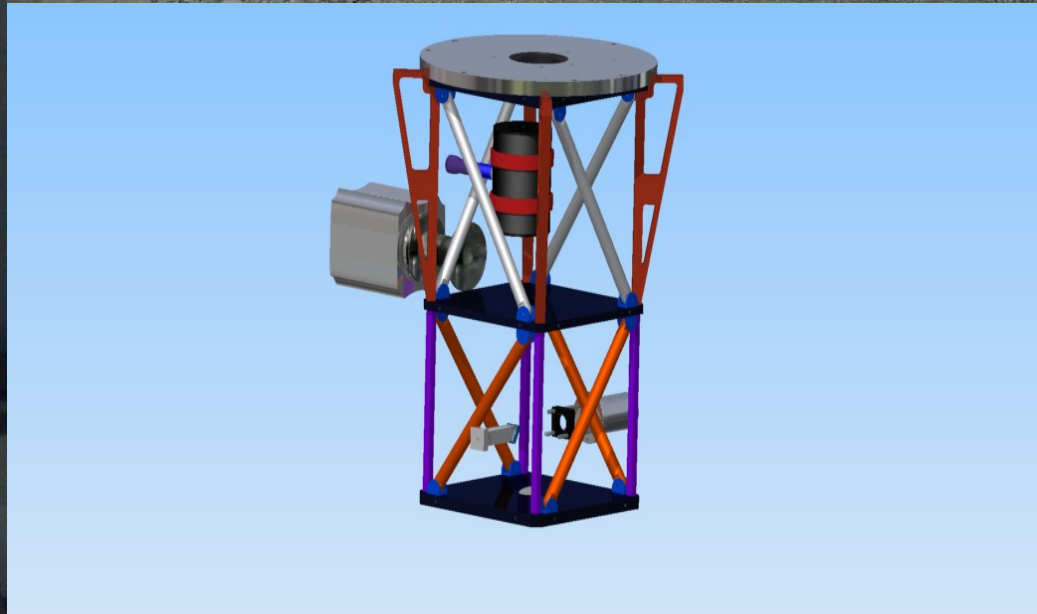
- Age determination for field stars in the Galaxy
- RV of eclipsing stars (binary systems)
- Circumstellar environments
- Monitoring of massive stars erupting phenomena
- Chemical abundances and stellar parameters

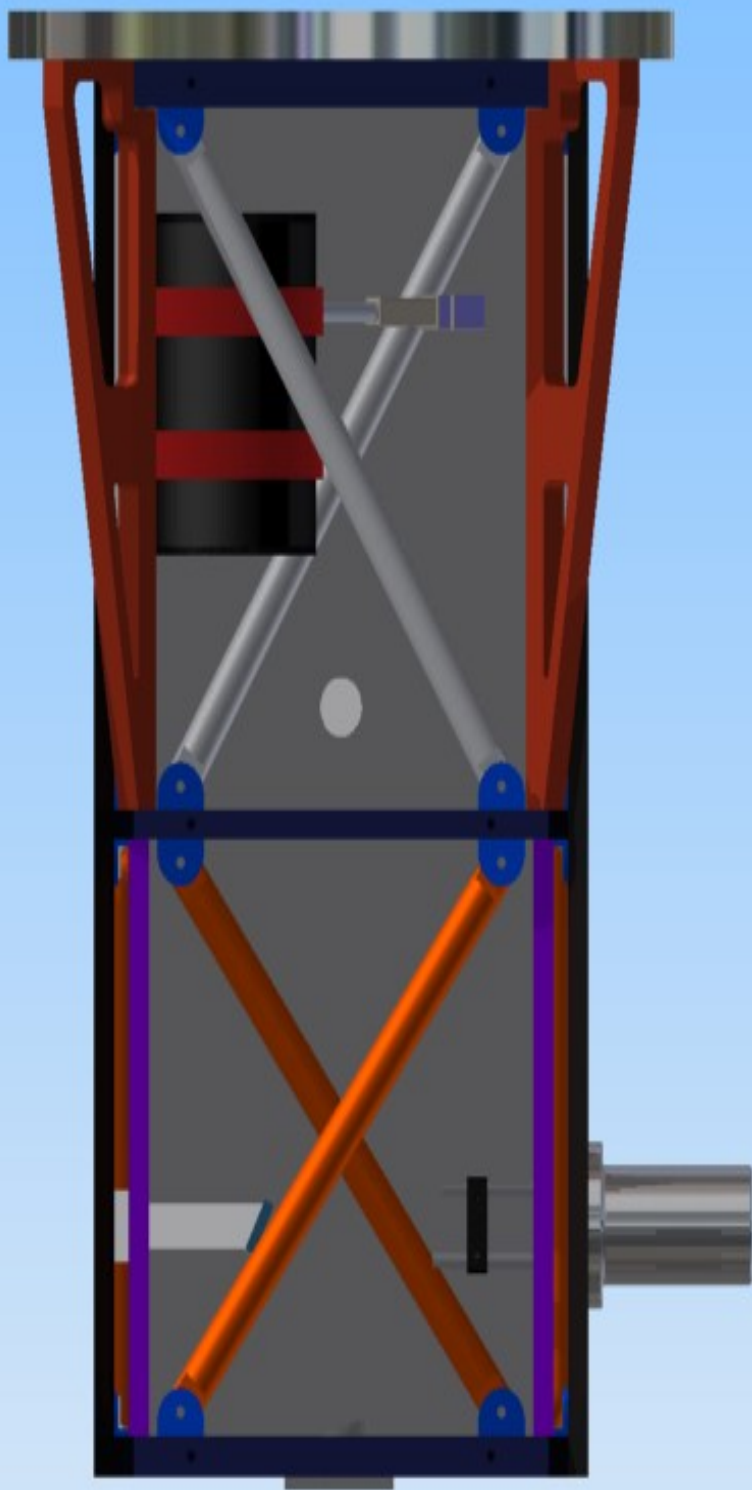
# INSTRUMENT SPECIFICATIONS

- Resolution  $R \sim 42'000$
- Wavelength coverage  $\sim 4000-7000 \text{ \AA}$
- Two fibres (simultaneous calibration fibre)
- Fibre scrambler (Constant illumination fibre output)
- Image slicer + telecentric system
- Mechanical stability (no moving parts)
- Thermal stability ( $\Delta T < 0.1 \text{ }^\circ\text{C}$ )
- Iodine Cell (precise wavelength calibration)

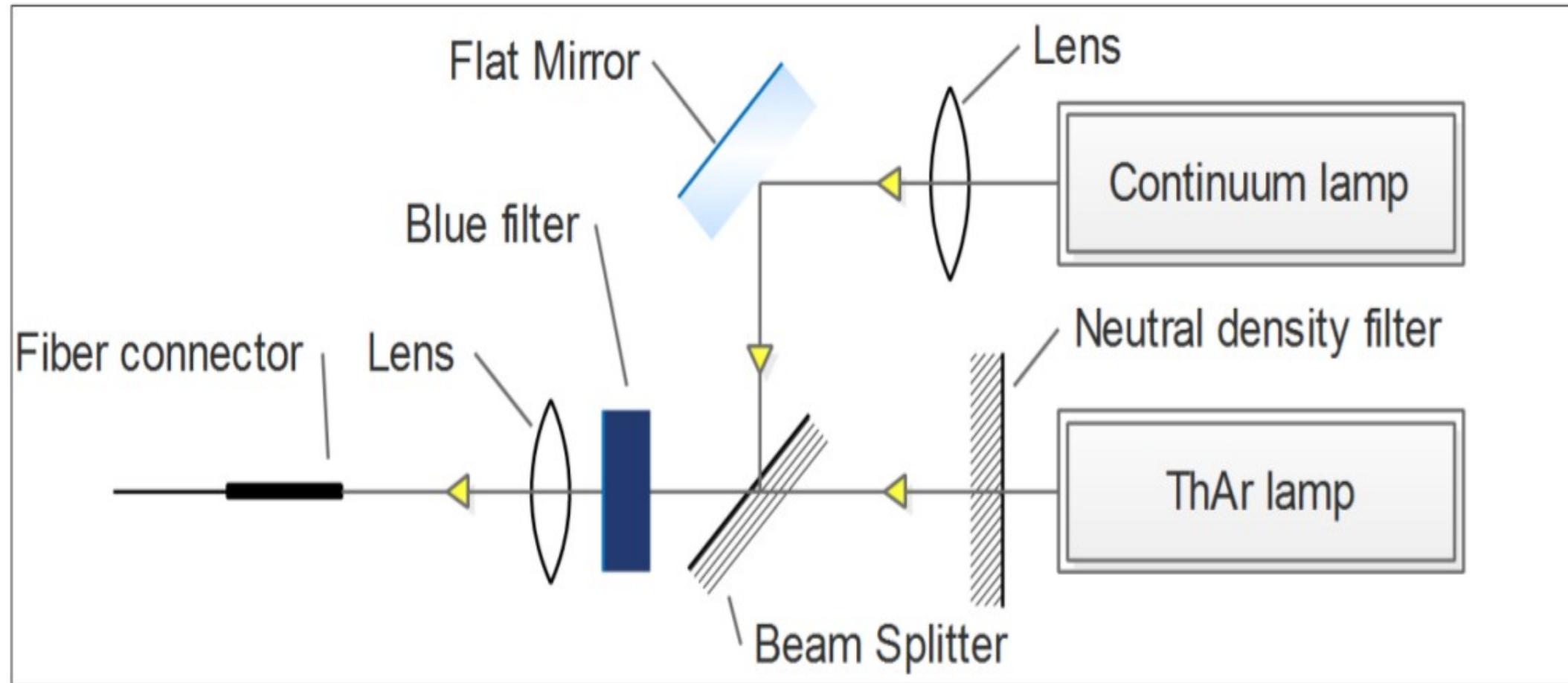


# TELESCOPE INTERFACE @ UCN 1m telescope (La Silla)



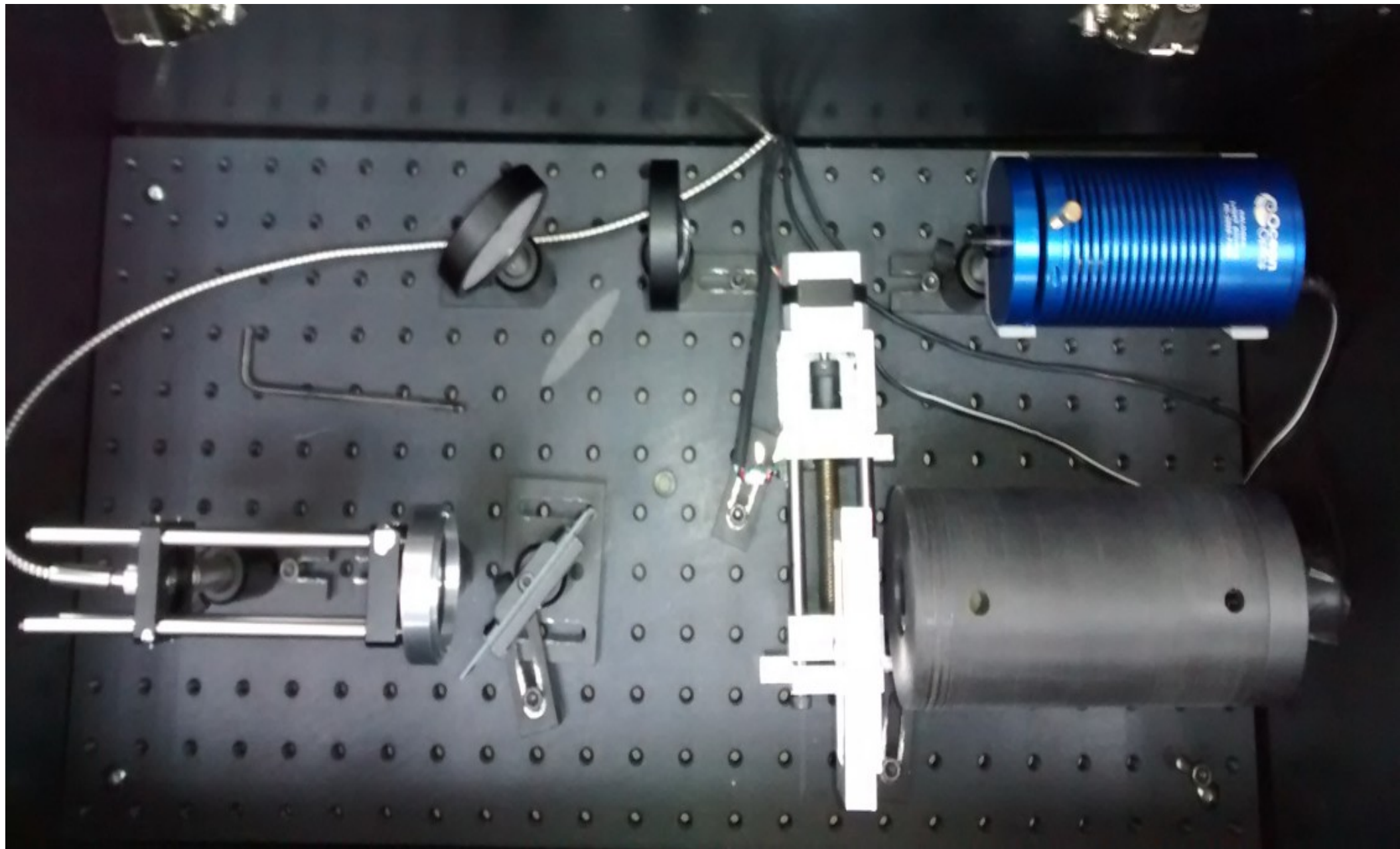


# CALIBRATION UNIT

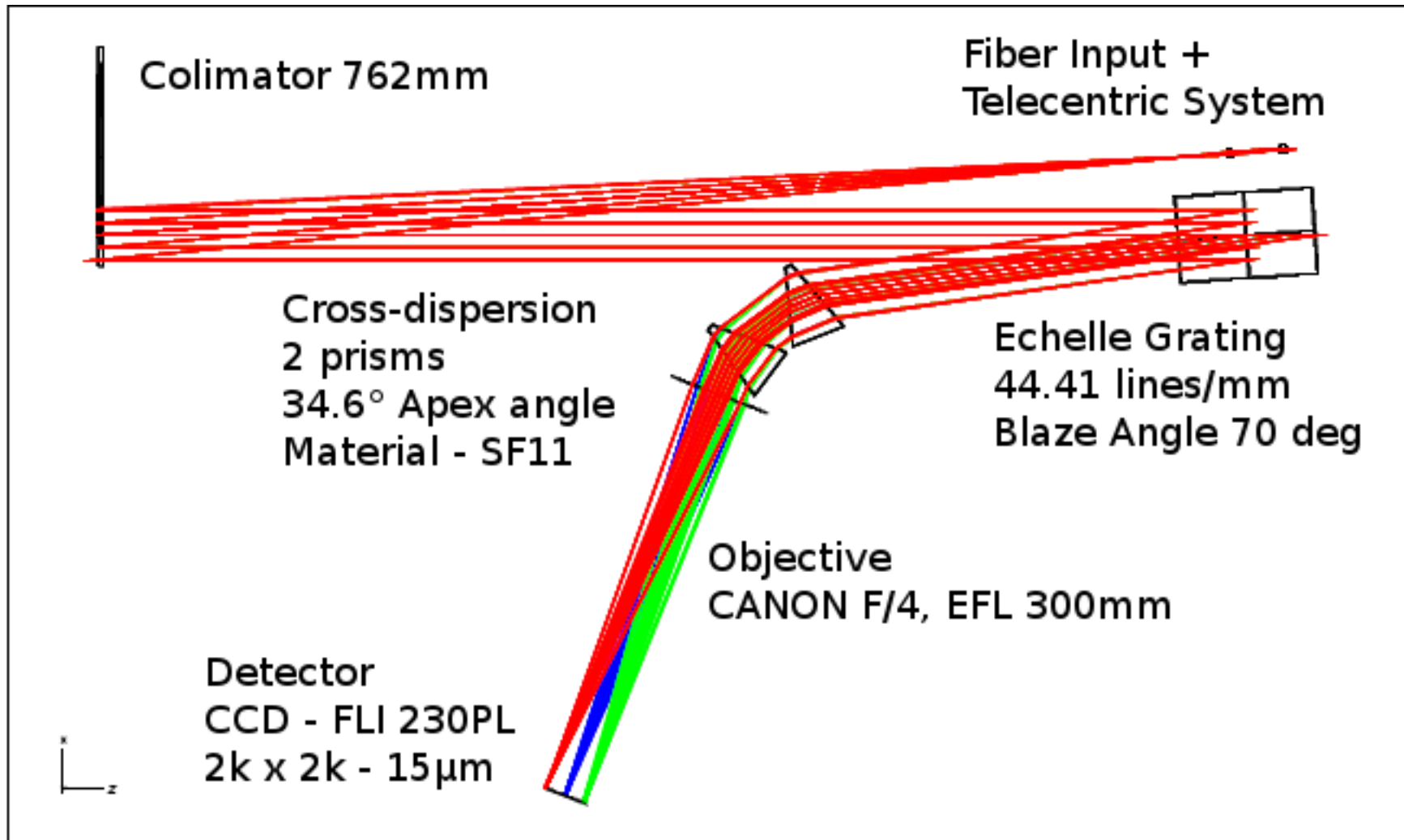




# CALIBRATION UNIT



# THE SPECTROGRAPH



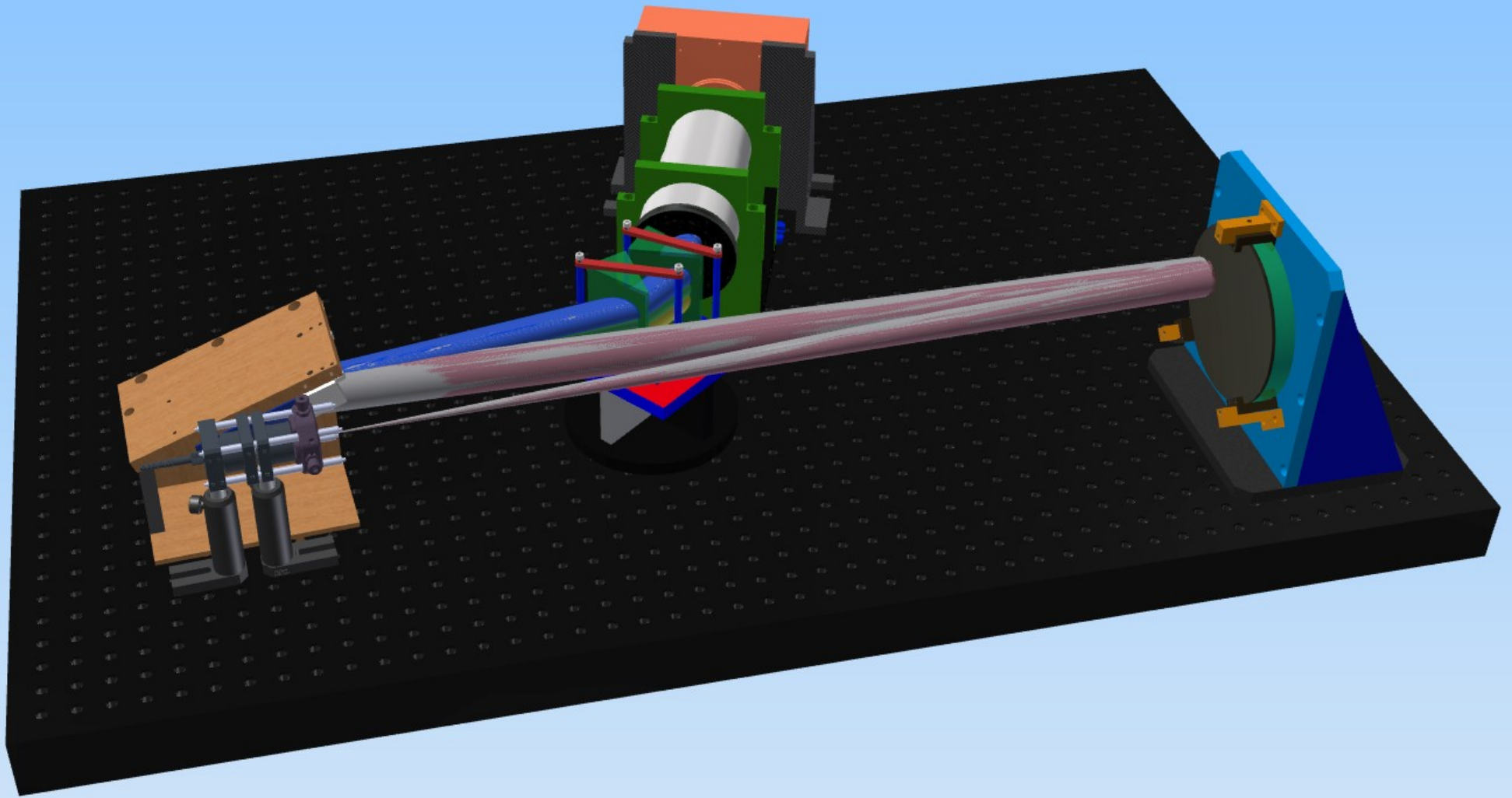
3D LAYOUT

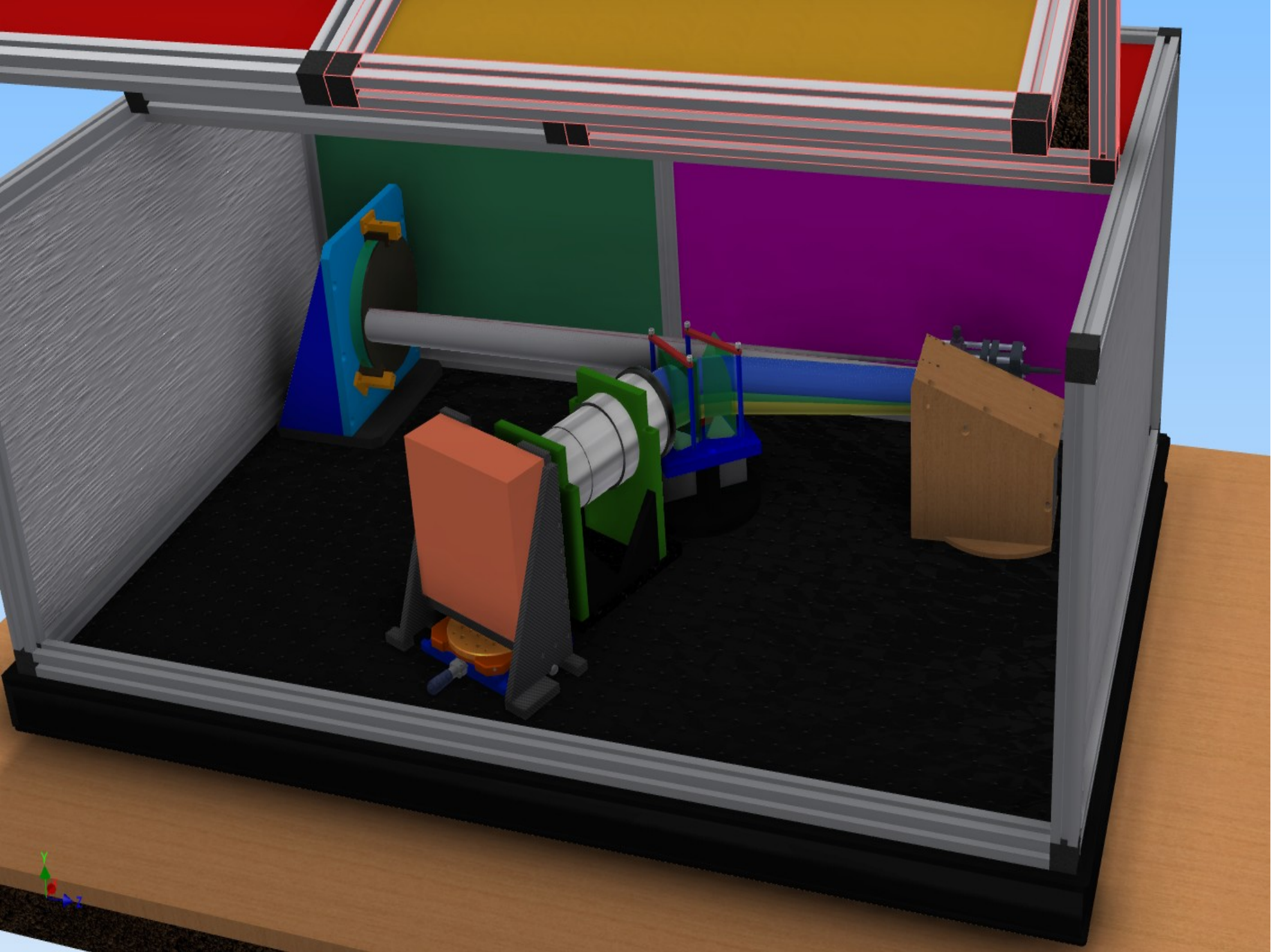
FIDEOS  
MON JUN 24 2013

FIDEOS2\_TELECENTRIC3.ZMX  
CONFIGURATION: ALL 3

# OPTICAL ELEMENTS

Component	Characteristics
2 Optical fibres	$\phi=50\mu m$ , 10m length
1 Optical fibre	$\phi=100\mu m$ , 10m length
Image slicer	home-made
Parabolic mirror	$f_{col}=762mm$ , $D=152.4mm$
Echelle Grating	$G=44.41mm^{-1}$ , $\theta=70^\circ$
2 prisms	Apex= $33^\circ$
Objective	$f_{cam}=300mm$ , $f/4$
CCD Detector	pixels: $2048 \times 2048$ , pixel size = $15\mu m$



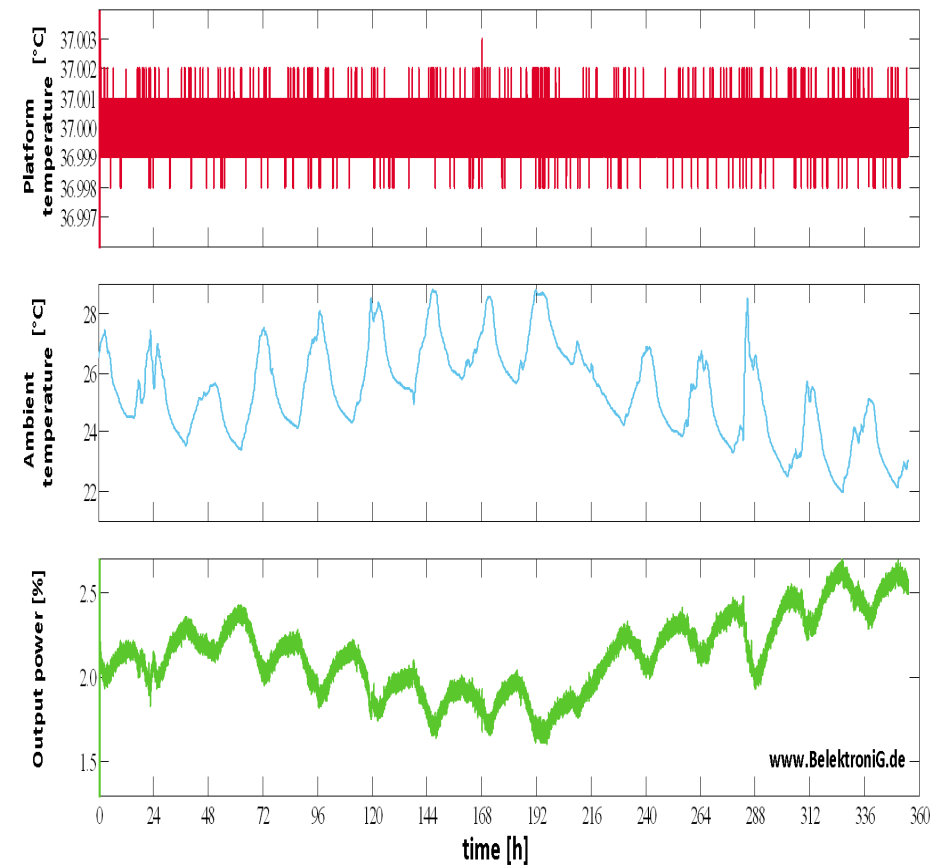




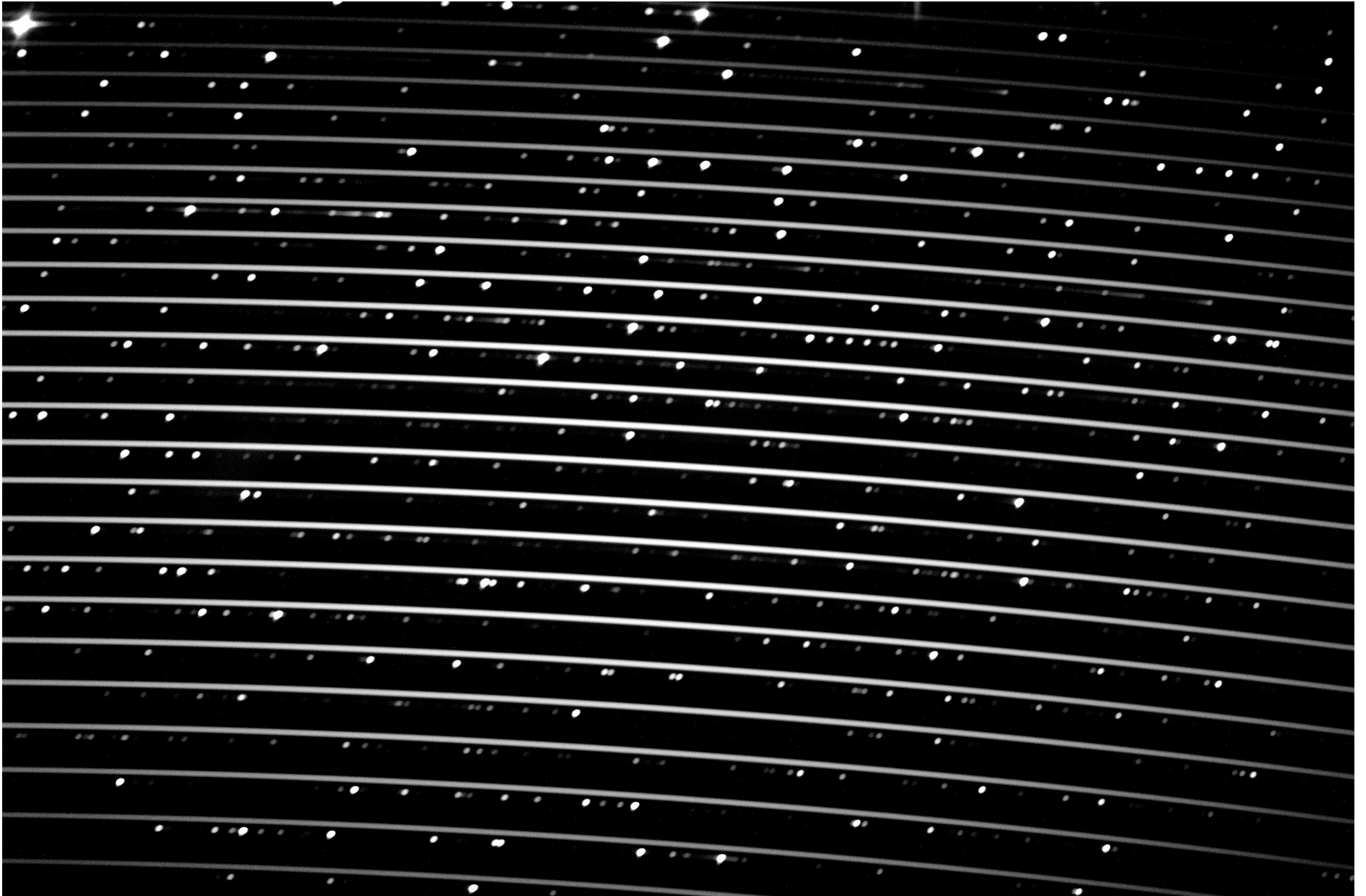
# TEMPERATURE CONTROL



HAT Control – B20 (15V / 150W) – long-term temperature stabilisation of sensor platform – 18.08.-02.09.2011

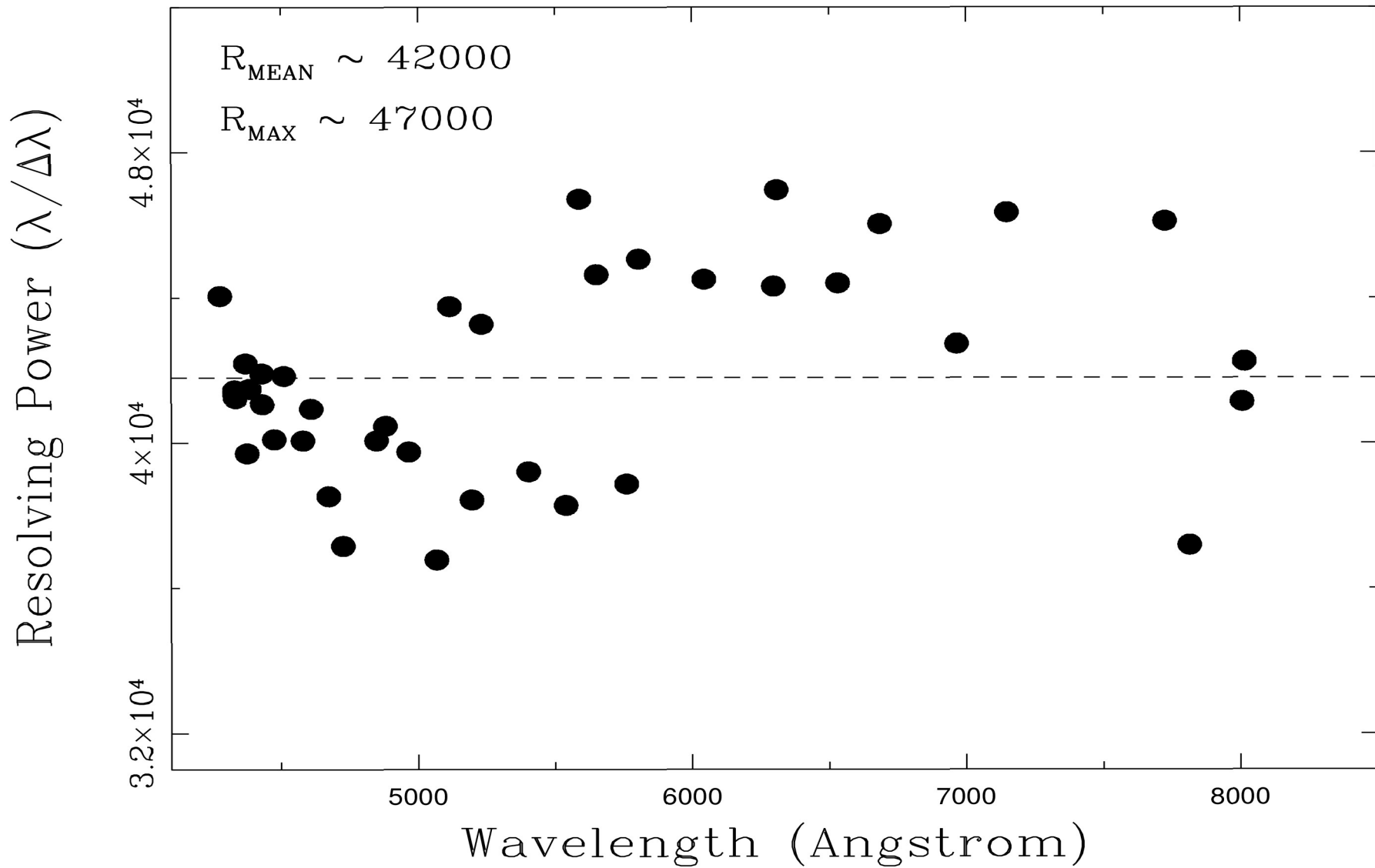


# PRELIMINARY RESULTS





# PRELIMINARY RESULTS



# PRELIMINARY RESULTS

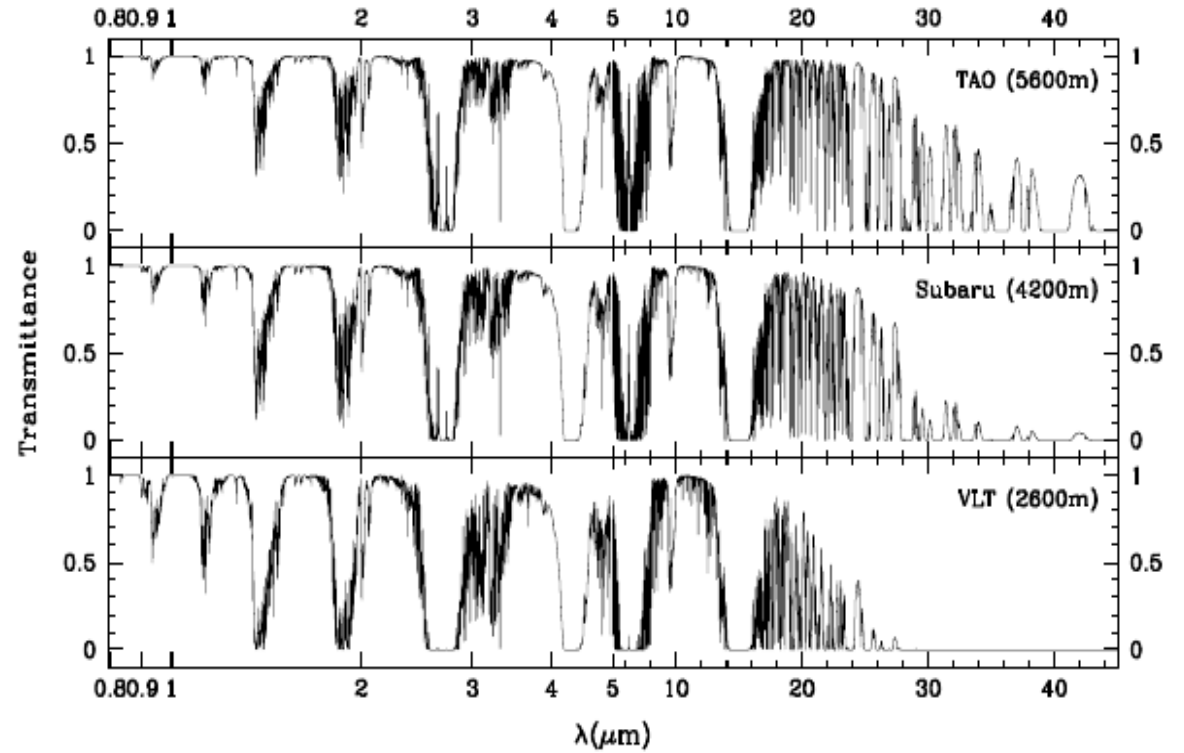
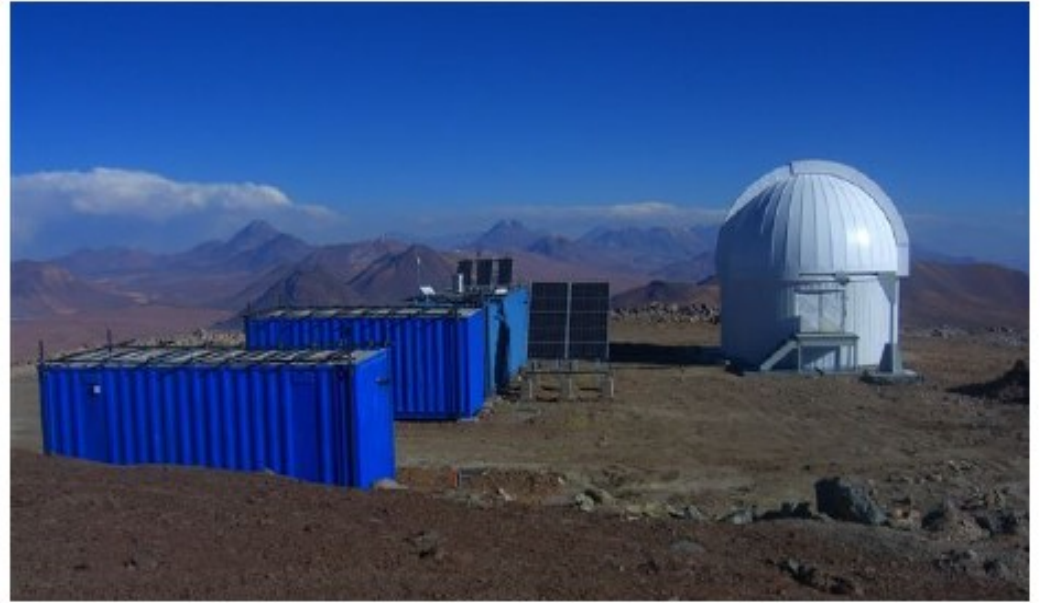
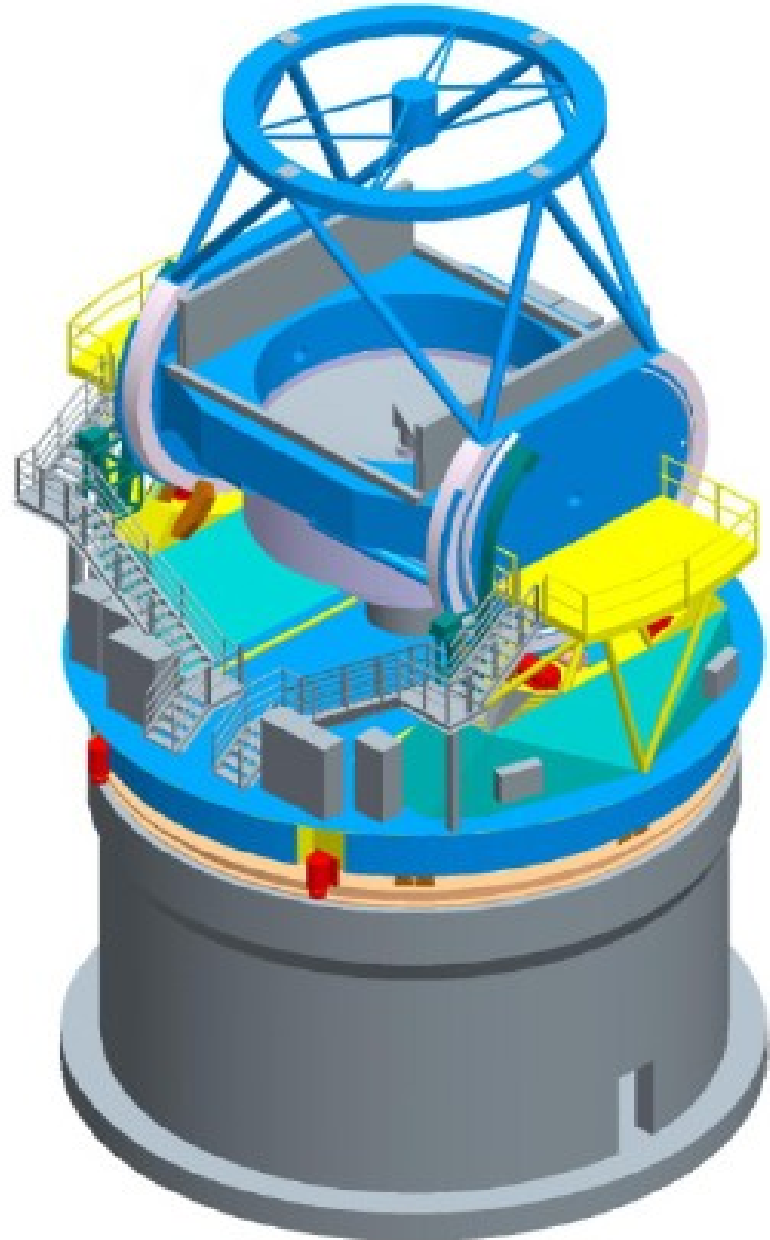
Wavelength Coverage	$\sim 4200\text{-}8200 \text{ (\AA)}$
Mean Resolution (w/fibre slicer)	42'000
Order number	$m = 50 - 101$
Separation between orders (red)	20 (pixels)

# SUMMARY

- FIDEOS is a high-resolution stable spectrograph that is optimized for precision radial velocities
- The spectrograph is nearly ready, but we are still working on the details
- The telescope interface and thermal stabilization system are currently under development
- By the end of the year FIDEOS will be fully operational

# Tao Aiuc high Resolution (D) Y band Spectrograph - TARdYS





## Scientific motivations

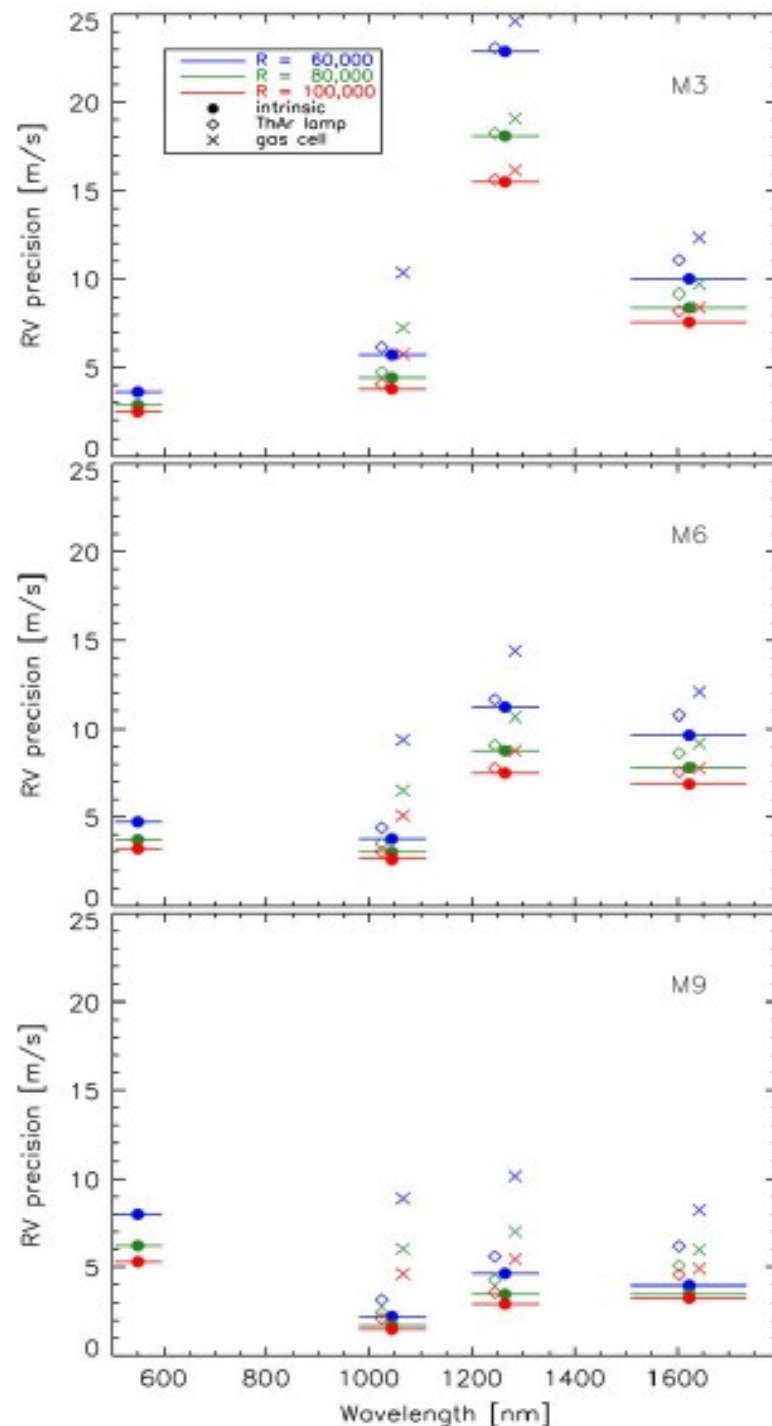
Studying low mass stars with:

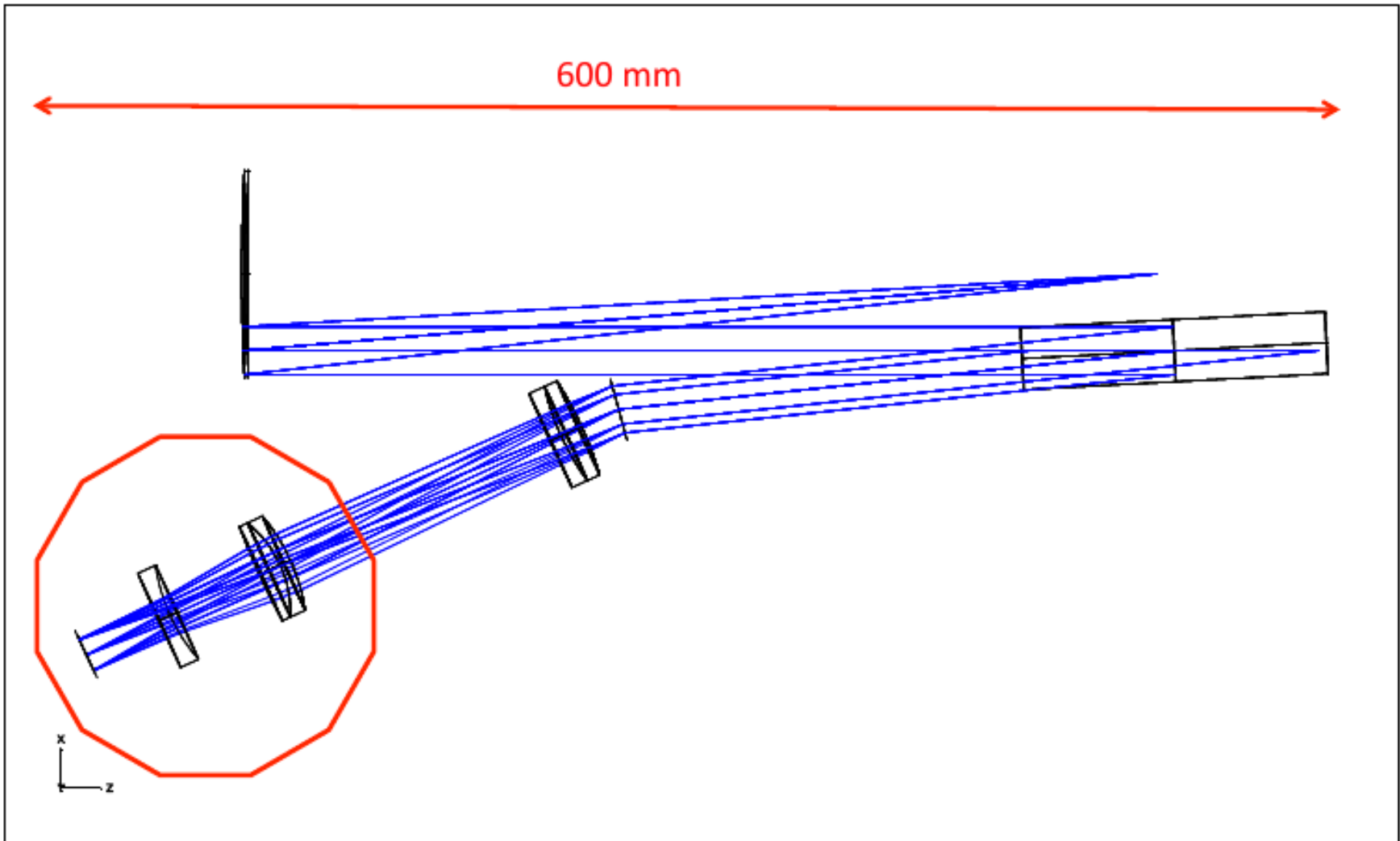
- high spectral resolution
- high RV precision

Wavelength-dependent S/N and RV Precision that can be Achieved from Data of this Quality

Resolution	S/N				RV precision ( $\text{m s}^{-1}$ )			
	<i>V</i>	<i>Y</i>	<i>J</i>	<i>H</i>	<i>V</i>	<i>Y</i>	<i>J</i>	<i>H</i>
Spectral-type M3								
60000	50	100	101	95	3.6	5.7	22.9	10.0
80000	43	86	87	82	2.9	4.4	18.1	8.4
100000	39	77	78	74	2.5	3.8	15.5	7.6
Spectral-type M6								
60000	20	100	114	107	4.7	3.8	11.2	9.7
80000	18	86	99	93	3.7	3.0	8.8	7.8
100000	16	77	88	83	3.2	2.6	7.5	6.9
Spectral-type M9								
60000	12	100	134	128	8.0	2.2	4.6	4.0
80000	10	86	116	111	6.2	1.7	3.5	3.5
100000	9	77	104	99	5.3	1.5	2.9	3.3

Reiners et al. 2010





3D LAYOUT

MON NOV 10 2014

IRRESPEC\_13\_80\_444\_HOLOG\_OBJ2.ZMX  
CONFIGURATION: ALL 4

# OPTICAL ELEMENTS

			<b>COST</b>
Slicer	2 x	Home md.	< 500
COLL.	EFL=444 / $\varnothing$ 100 mm	Edmund	<500
Echelle	R6, 13.33 gr/mm, 60x150 mm	Richardson	6.500
CAM	EFL=200 / $\varnothing$ 50 mm	Custom md.	10.000
Cross	333 gr/mm, 30x50 mm	Kayser	15.000
<b>TOT Optics</b>			<b>&lt;32.500</b>
Detect	H1RG	Teledyne	175.000
Dewar	12 "	IR-Lab	30.000
Electronics	Read-out	Leach	10.000
			<b>~250.000</b>

$F_{COL}$  : 440 mm  $\rightarrow$  550 mm custom md.

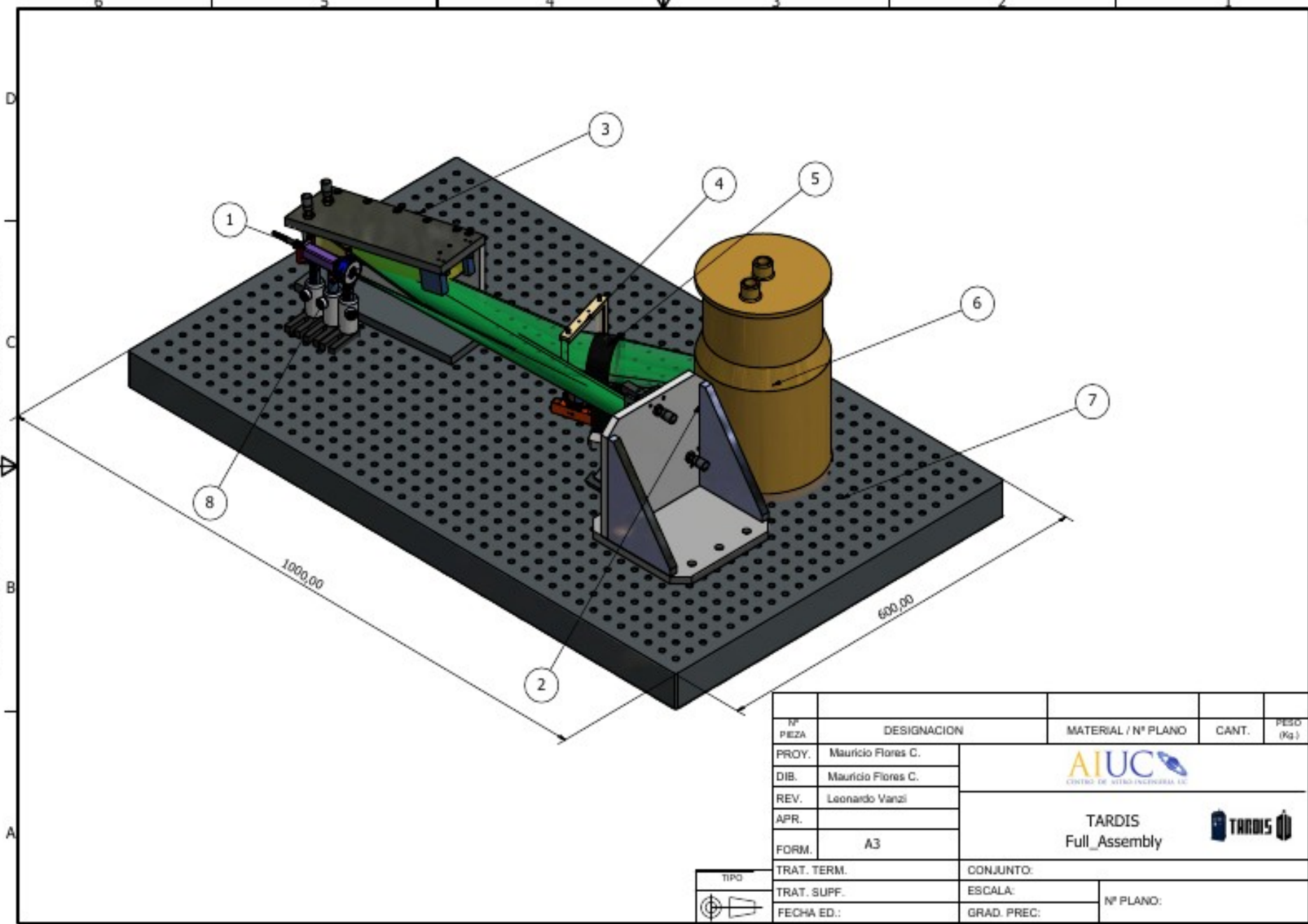
Beam:  $\varnothing$  22 mm  $\rightarrow$  28 mm

R : 54.000  $\rightarrow$  66.000

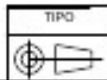
Samp: 2.5  $\rightarrow$  2 pix

Echelle 110 x 220 mm, 13.000 US\$





N° PEZA	DESIGNACION	MATERIAL / N° PLANO	CANT.	PESO (Kg.)
PROY.	Mauricio Flores C.	 CENTRO DE INGENIERIA UC  TARDIS Full_Assembly 		
DIB.	Mauricio Flores C.			
REV.	Leonardo Vanzl			
APR.				
FORM.	A3			
TRAT. TERM.	CONJUNTO:			
TRAT. SUPP.	ESCALA:		N° PLANO:	
FECHA ED.:	GRAD. PREC:			



$F_{COL} = 444 \text{ mm} \rightarrow R=54.000$ , spc sampling 2.5 pix

feam = 200mm feol = 444mm echelle 13 lines/mm 80 deg

X disp 200 lines/mm 20 deg delta 19 pix. Incident = 75

$R = 53639 \text{ m}'_{\min} = 133 \text{ m}'_{\max} = 175 \text{ lambda}'_{\min} = 840 \text{ nm}, \text{ lambda}'_{\max} = 1110 \text{ nm}$

