RUNDOWN INTERNATIONAL GUEST LECTURE

KABINET ADARMA SAHITYA

HMDM ITS 2022

NO.	HARI, TANGGAL	WAKTU	DURASI	KEGIATAN
1	Kamis, 21 April 2022	13.15-13.30 WIB	15”	Pengkondisian
		13.30-13.40 WIB	10”	Pembukaan
		13.40-13.50 WIB	10”	Indonesia Raya dan Hymne ITS
		13.50-13.55 WIB	5”	Sambutan Kepala Departemen Teknik Mesin Industri
		13.55-14.00 WIB	5”	Sambutan Kepala Departemen Teknik Instrumentasi
		14.00-14.05 WIB	5”	Penyerahan Forum kepada Moderator
		14.05-15.05 WIB	10”	Penyampaian Materi
		15.05-15.35 WIB	30”	Sesi Tanya Jawab
		15.35-15.45 WIB	10”	Presensi, Dokumentasi, dan Penutup

INTERNATIONAL GUEST LECTURE

"Role of instrumentation and machinery or equipment in astronomical observations"

Thursday, April.21.2022

DAY 13.30 WIB

Link Zoom:

intip.in/ZoomKuliahTamu

Speaker:

Dr. Hanindyo Kuncarayakti, ST, MSc.

Academy of Finland Research Fellow

Department of Physics and Astronomy at University of Turku, Finland

Rizaldy Hakim
Ash Shiddieqy, S.T., M.T.

Moderator

Siti Ana
DTMI Students Batch 2020

Master of Ceremony

PERAN INSTRUMENTASI DAN MESIN/ PERALATAN DALAM PENGAMATAN ASTRONOMI

HANINDYO KUNCARAYAKTI
UNIVERSITY OF TURKU, FINLAND

Kuliah Tamu ITS, 21.4.2022

Turku

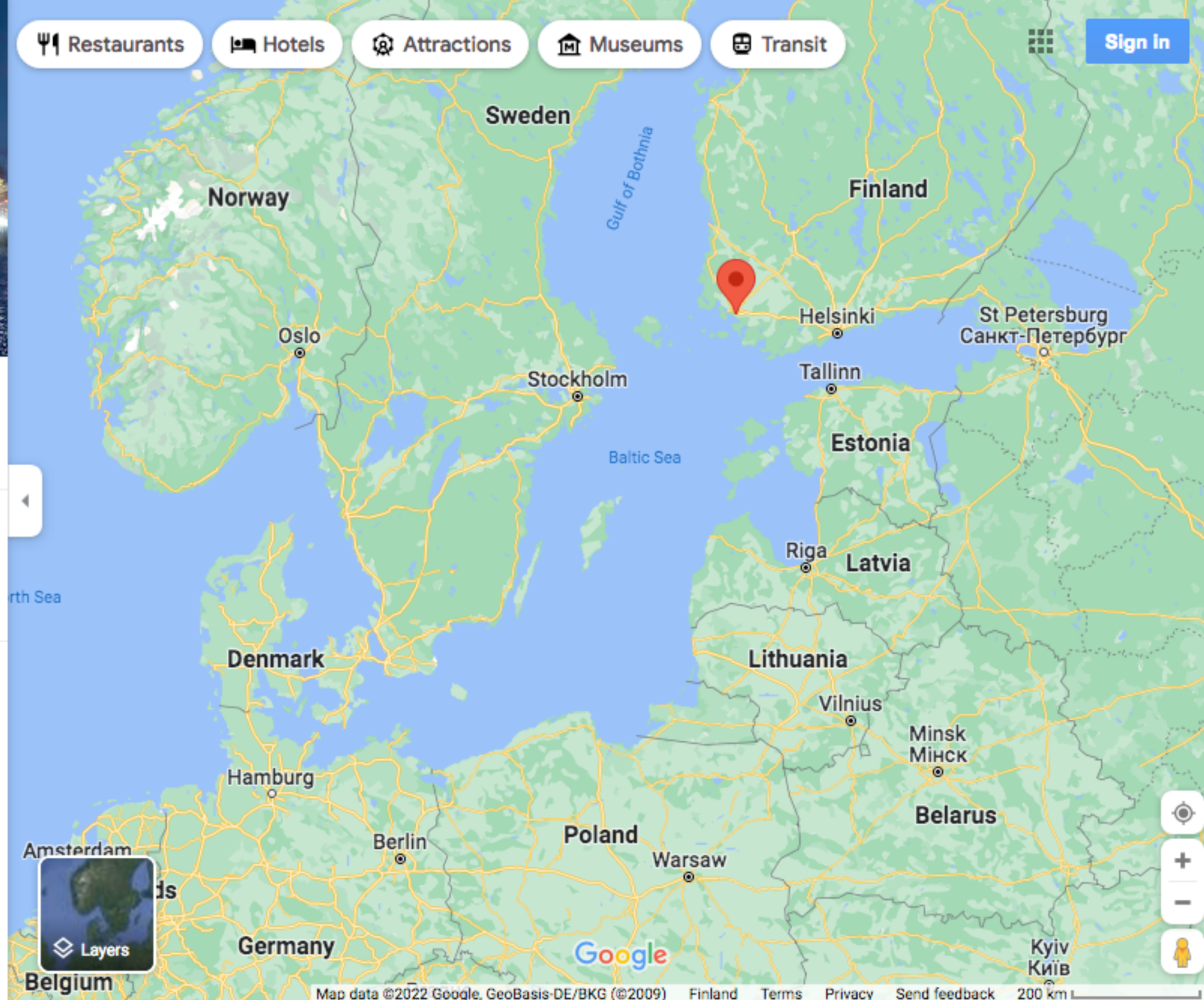
Turku

Sunny · 8°C
8:48 AM

Directions | Save | Nearby | Send to your phone | Share

Quick facts

Turku, a city on the southwest coast of Finland, straddles the Aura River. Dating from the 13th century, it's known for Turku Castle, a medieval fortress with a history museum, perched at the river mouth. Restaurants line the cobbled riverside streets. On the eastern bank lies the Old Great Square, a former trade hub, surrounded by grand buildings. The nearby Turku Cathedral houses a royal tomb and a museum.

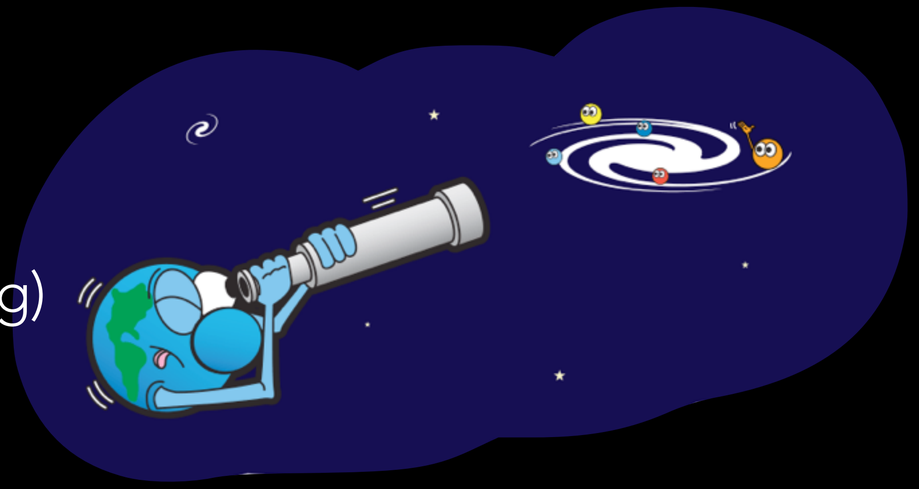


Turun yliopisto
University of Turku

- Academy of Finland Research Fellow, Dept. Physics & Astronomy
  - Tugas riset dan mengajar
- Supervisi: 1 postdoc, 1 PhD, 1 MSc (+ 2 PhD co-spv)
- Bagian dari Stellar Explosions research group (https://sites.utu.fi/sne/)
- Topik riset utama: supernova

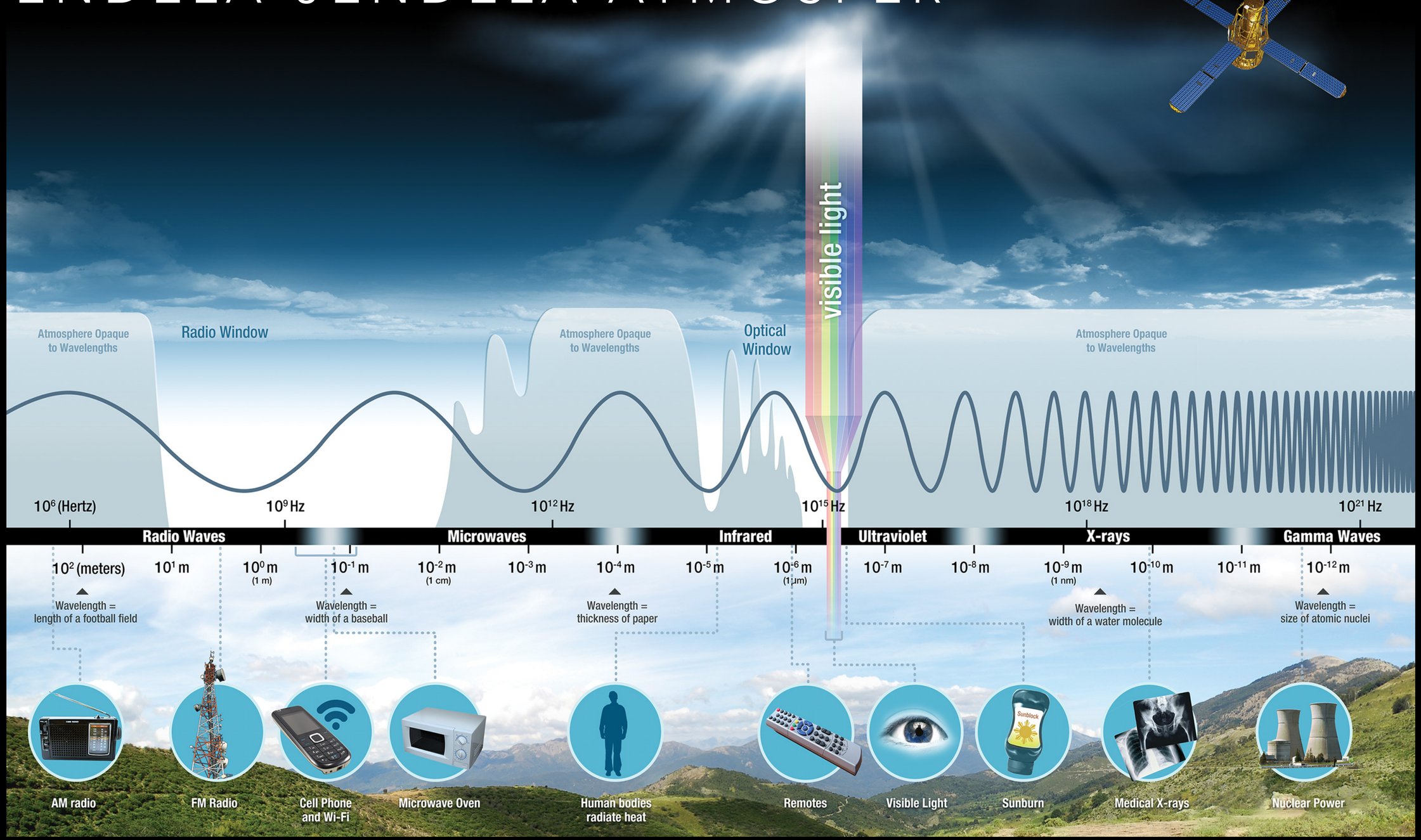
PRINSIP PENGAMATAN ASTRONOMI

- Pengamatan pasif: hanya menerima cahaya
- Pengukuran: intensitas cahaya, warna (panjang gelombang)



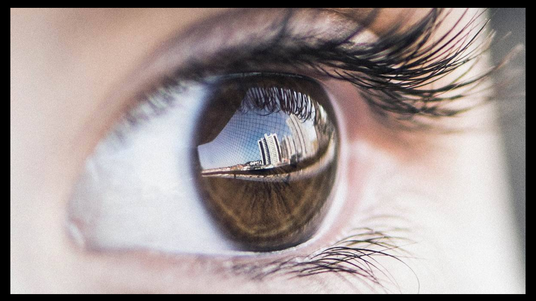
- Daya keluaran matahari: 3.8×10^{26} Watt
  - Kecerlangan tampak matahari: 1370 W/m^2
  - Bintang paling redup yang kasat mata: 10^{-10} W/m^2
  - Ambang batas teleskop ruang angkasa Hubble: 10^{-22} W/m^2

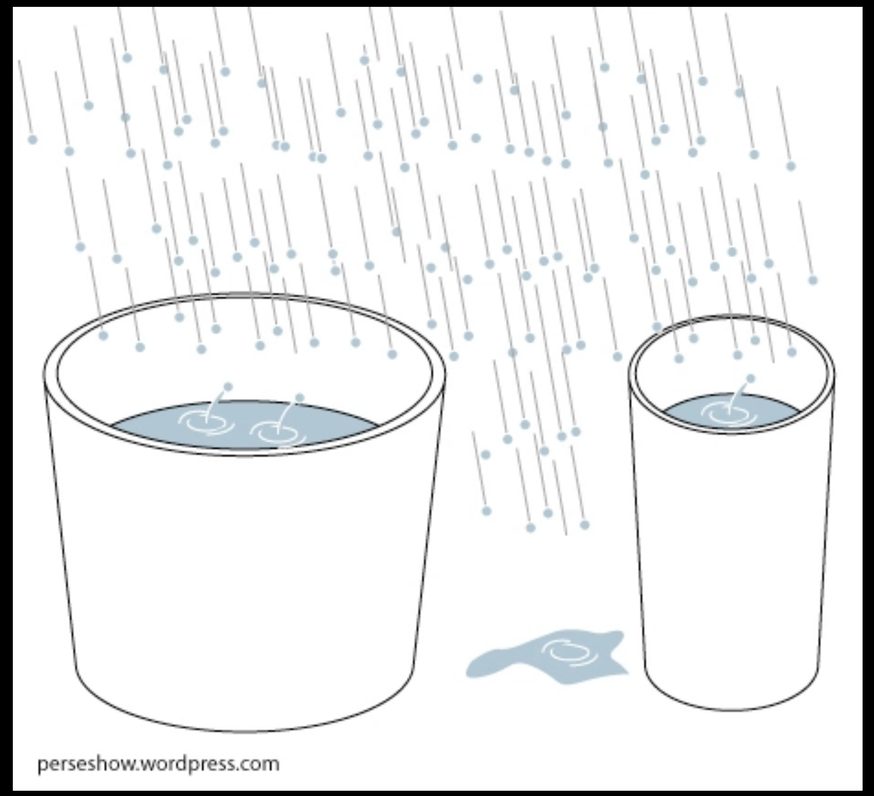
JENDELA-JENDELA ATMOSFER



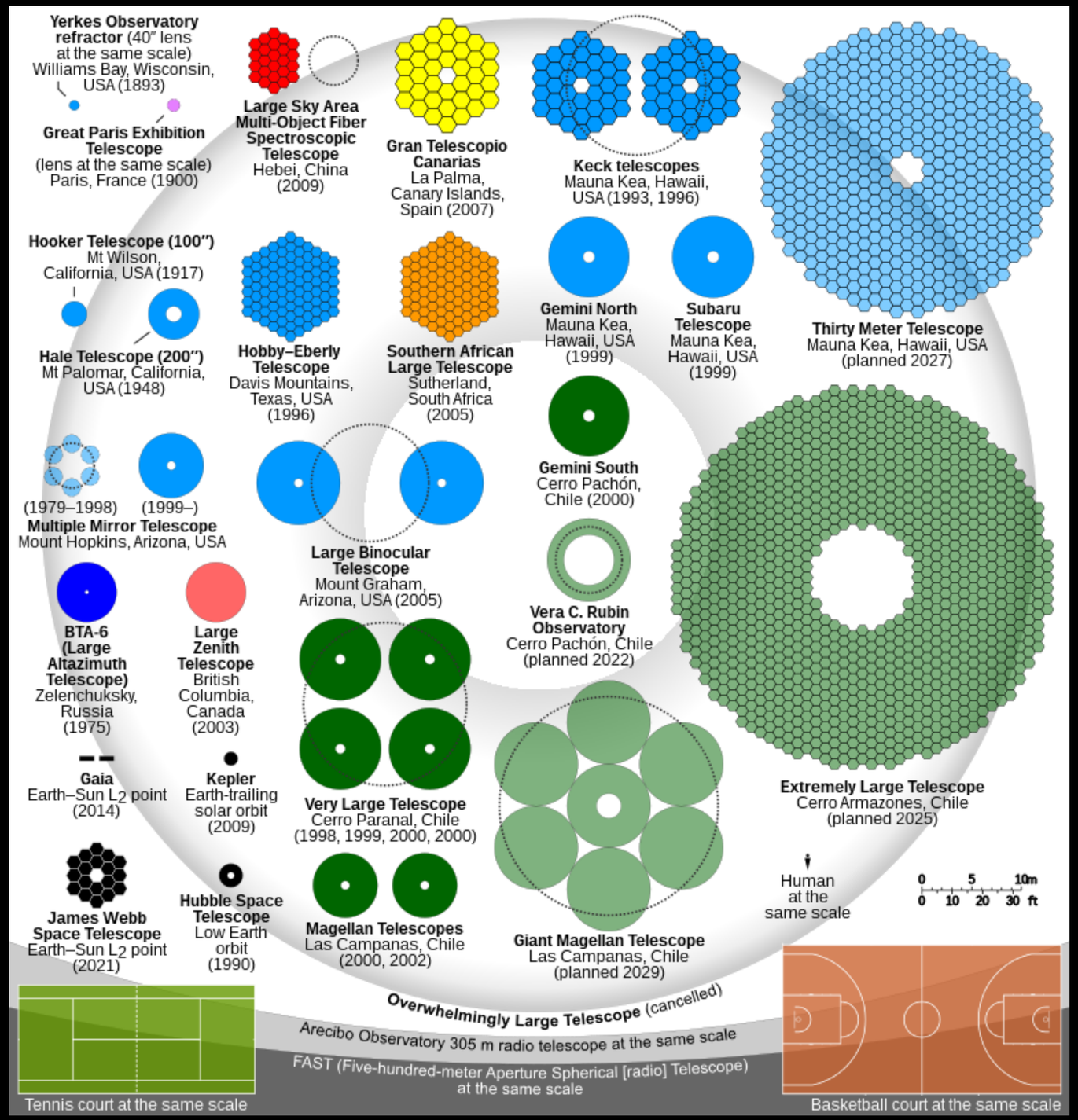
FUNGSI TELESKOP

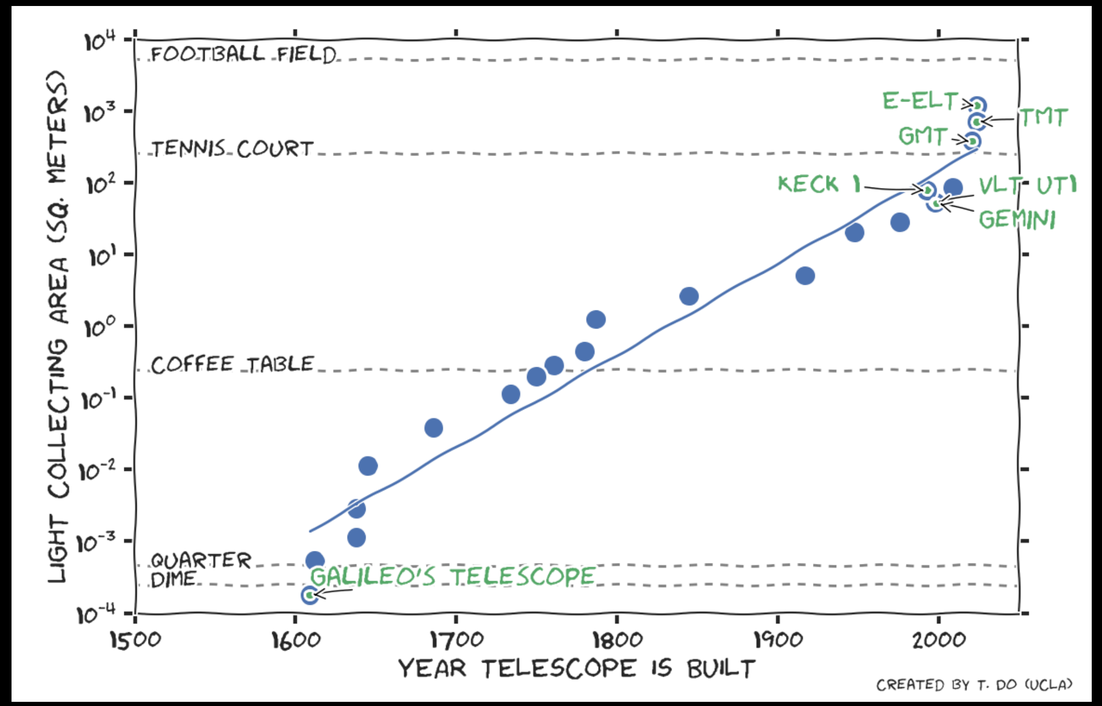
- Fungsi perbesaran
- Fungsi pengumpulan cahaya
  - Diameter pupil mata: ~5 mm; teleskop terbesar: 39 m (luas area 60 juta kali lebih besar)





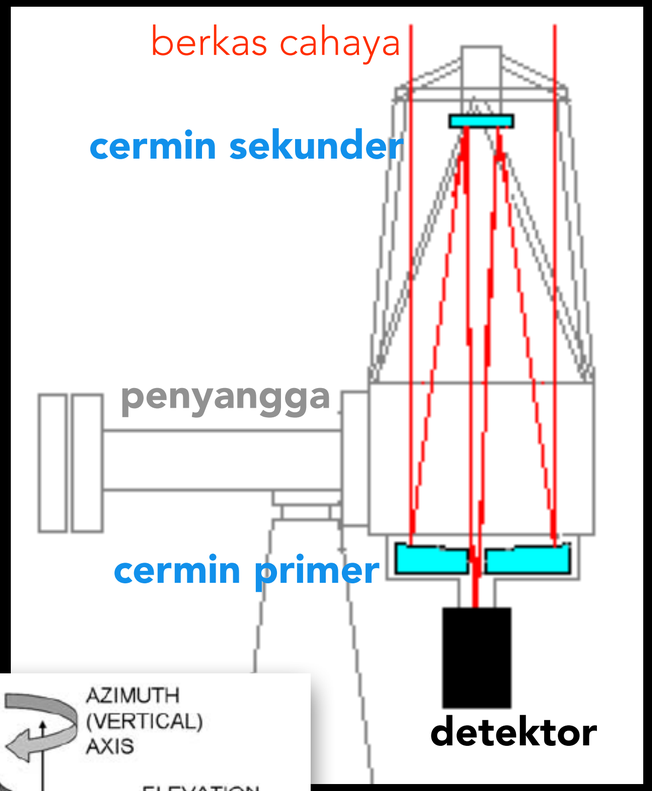
PERTUMBUHAN UKURAN TELESKOP

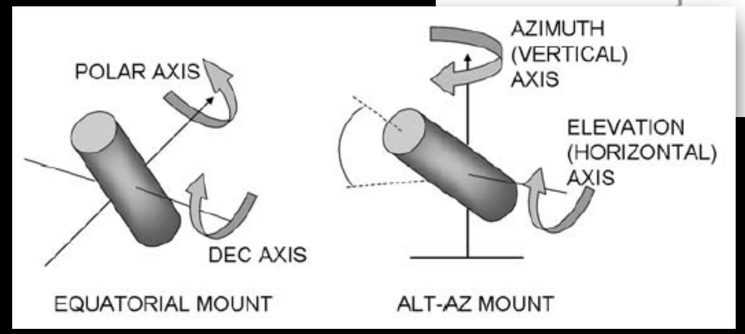




KONSTRUKSI DASAR TELESKOP

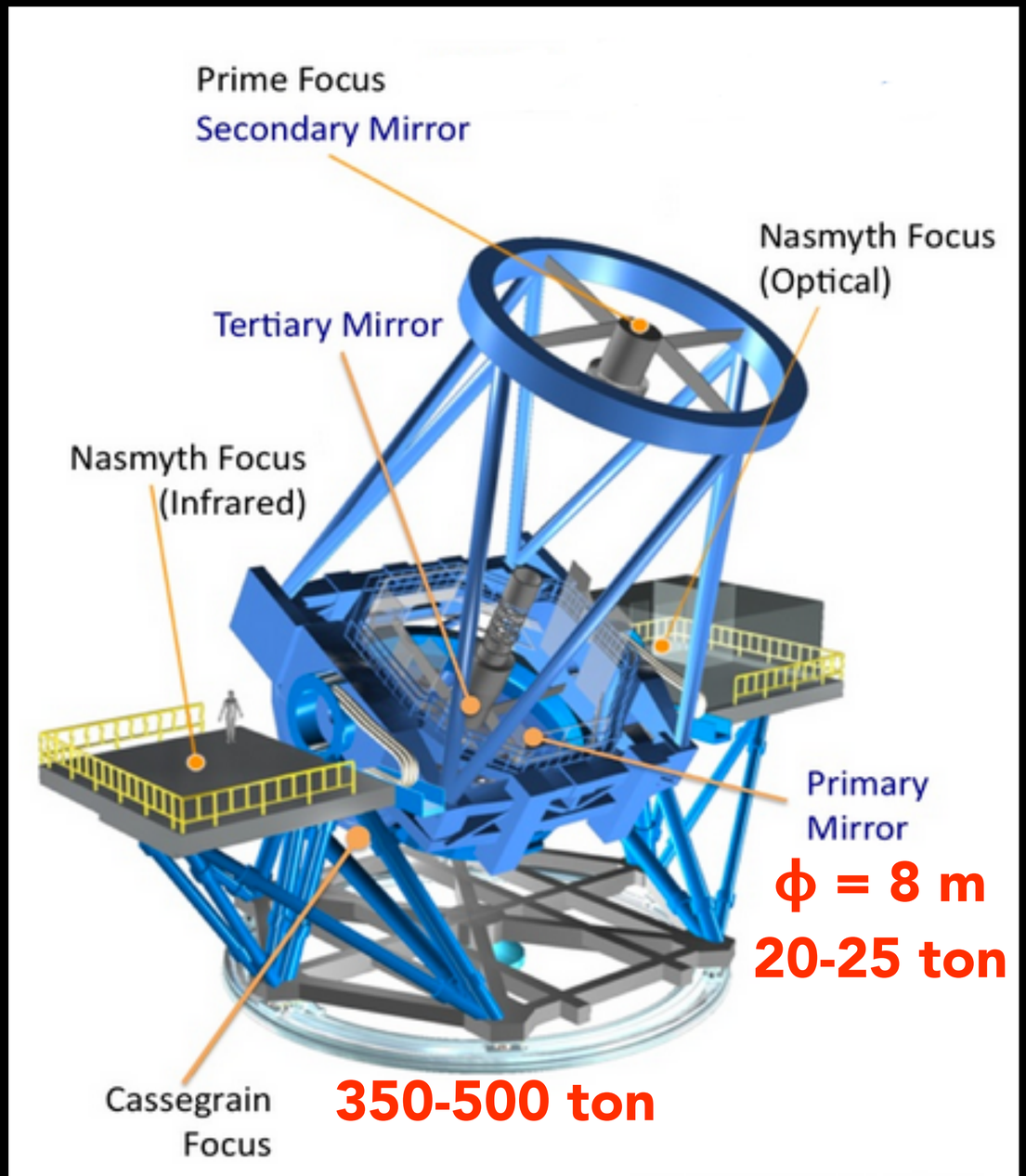
- Umumnya cermin sebagai pengumpul cahaya
- Penyangga/mounting dengan 2 sumbu gerakan
  - ekuatorial (U-S, B-T)
  - alt-azimuth (ketinggian, arah azimut)
- Instrumen/kamera





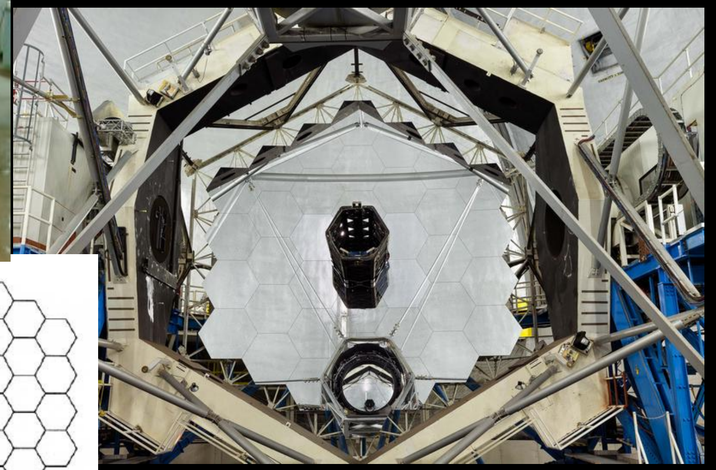
STRUKTUR TELESKOP BESAR

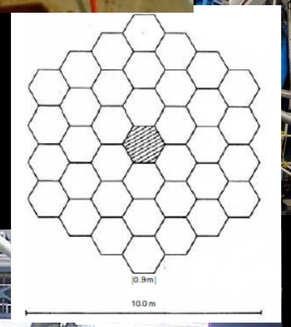
- Beberapa titik fokus
  - Untuk menampung berbagai macam instrumen dengan kegunaan masing-masing
  - Cermin ketiga untuk mengarahkan cahaya
- Konstruksi alt-azimuth
  - Lebih stabil untuk beban berat

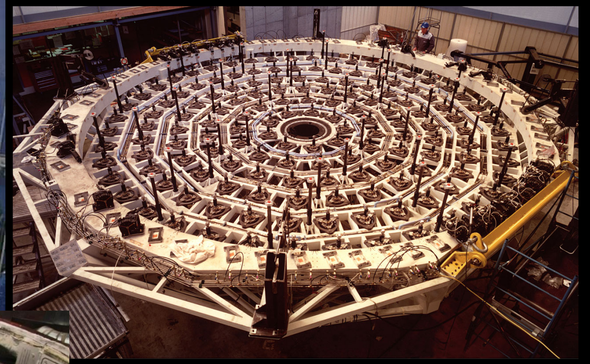


KONSTRUKSI CERMIN

- Cermin solid
- Cermin bersegmen
- Cermin meniskus tipis
- Cermin sarang lebah (honeycomb)



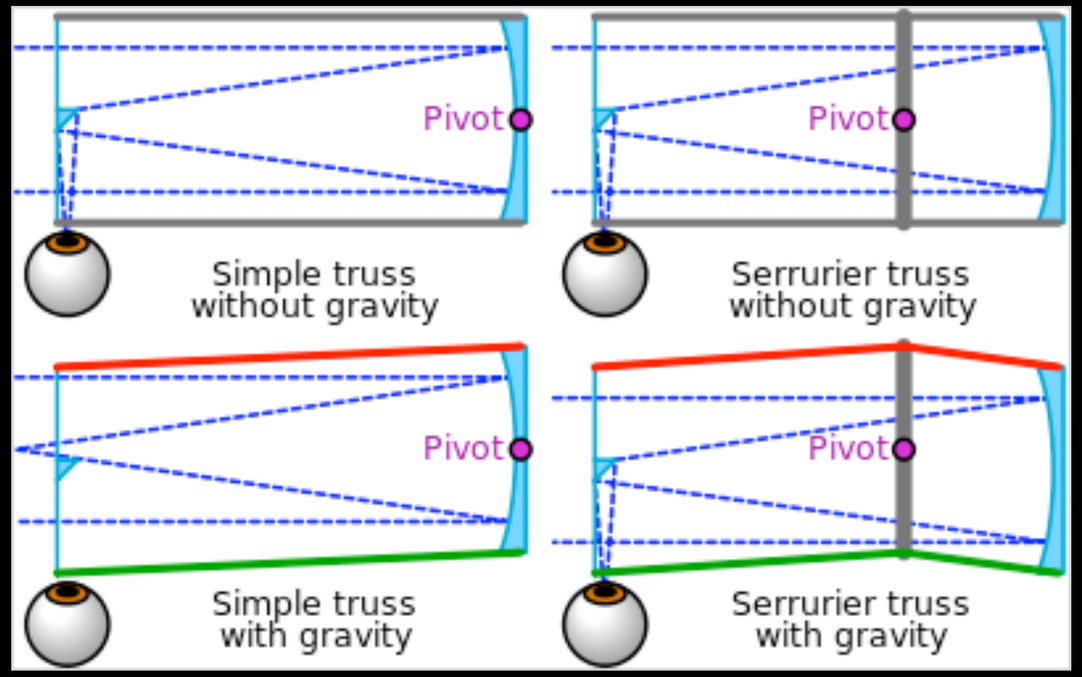


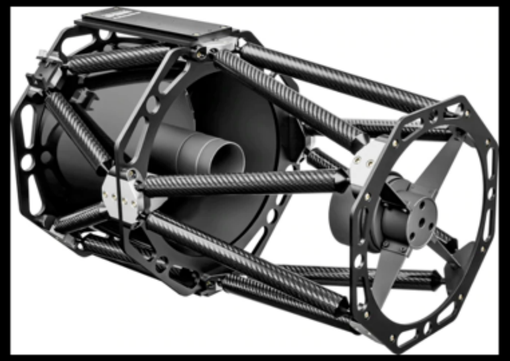


Aktuator untuk mengatur bentuk kelengkungan

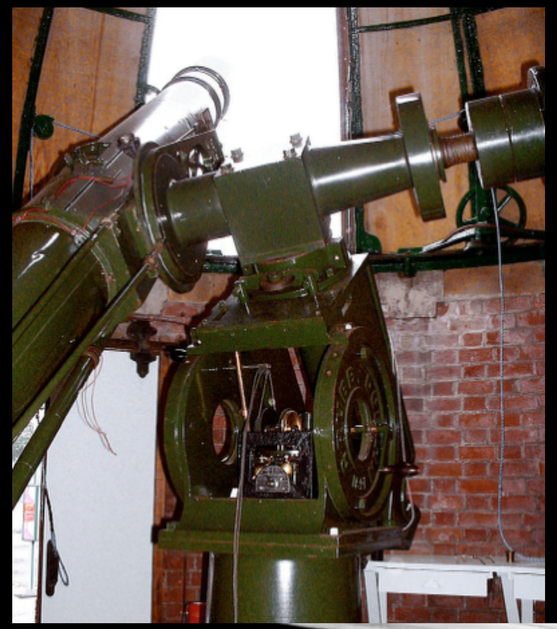
SERURRIER TRUSS

- Tabung teleskop menopang beban cermin: pada posisi-posisi tertentu terjadi pembengkokan (*flexure*) karena gaya gravitasi
  - Sumbu optik tidak lurus/selaras (*aligned*)
- **Serrurier truss**: 2 set tiang berlawanan dengan pembengkokan yang sama ➔ *alignment* sumbu optik terjaga

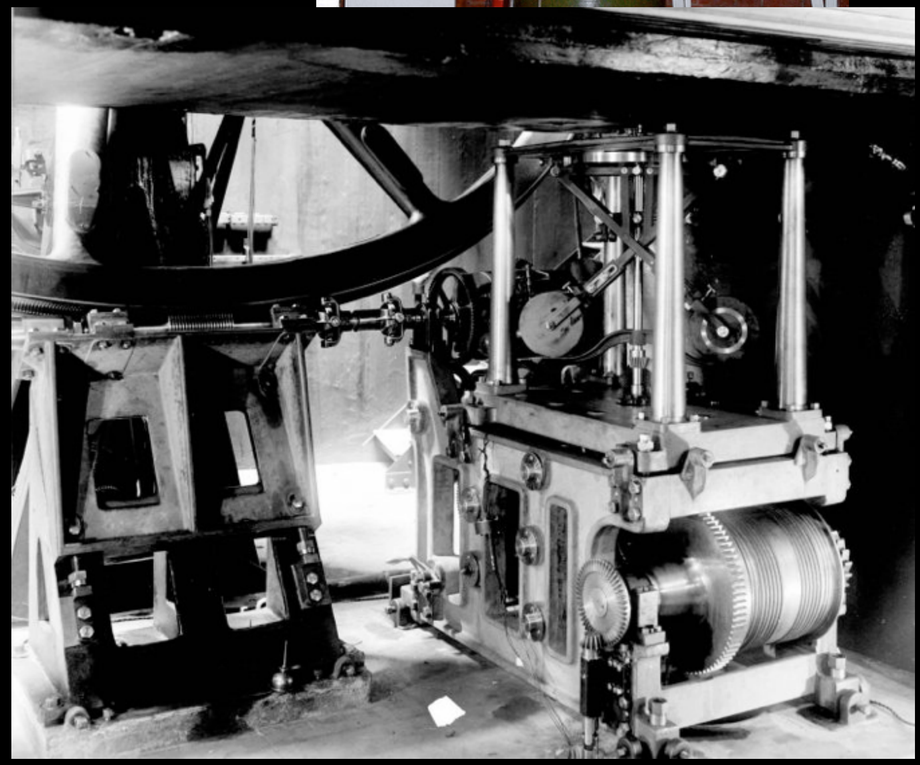




CLOCKDRIVE/PENGGERAK JAM

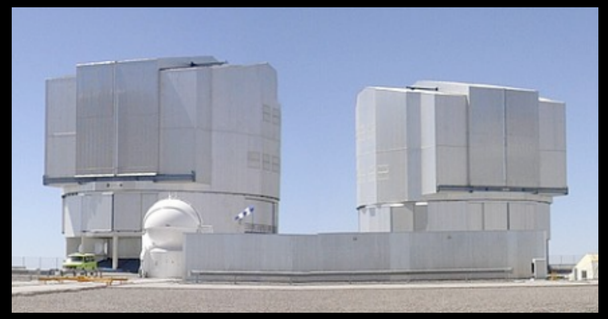


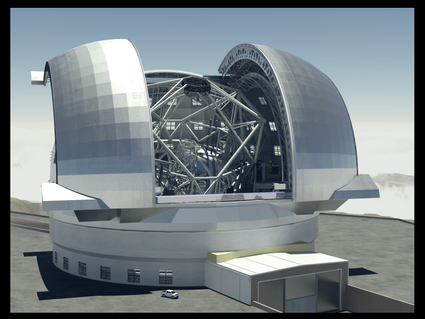
- Rotasi bumi ➔ bola langit berputar (360° dalam 24 jam = 15°/jam), gerak semu benda langit
- Teleskop dirancang untuk bergerak mengikuti arah objek
  - ekuatorial: 1 sumbu gerak (arah timur ke barat)
  - alt-azimuth: 2 sumbu gerak (+ rotasi bidang fokus)
- Historik: beban pendulum; sekarang motor listrik

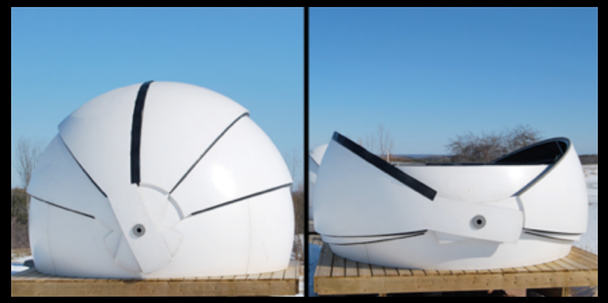


BANGUNAN TELESKOP

- "Rumah" teleskop, untuk melindungi dari cuaca
  - Fasilitas lain seperti ruang kontrol, bengkel, derek, penyimpanan dll.
- Umumnya konstruksi **kubah**, dengan berbagai variasi
  - Celah/jendela untuk pengamatan
  - Dapat berputar 360°, menyesuaikan arah objek
- 2000-3000 ton untuk teleskop 8 m

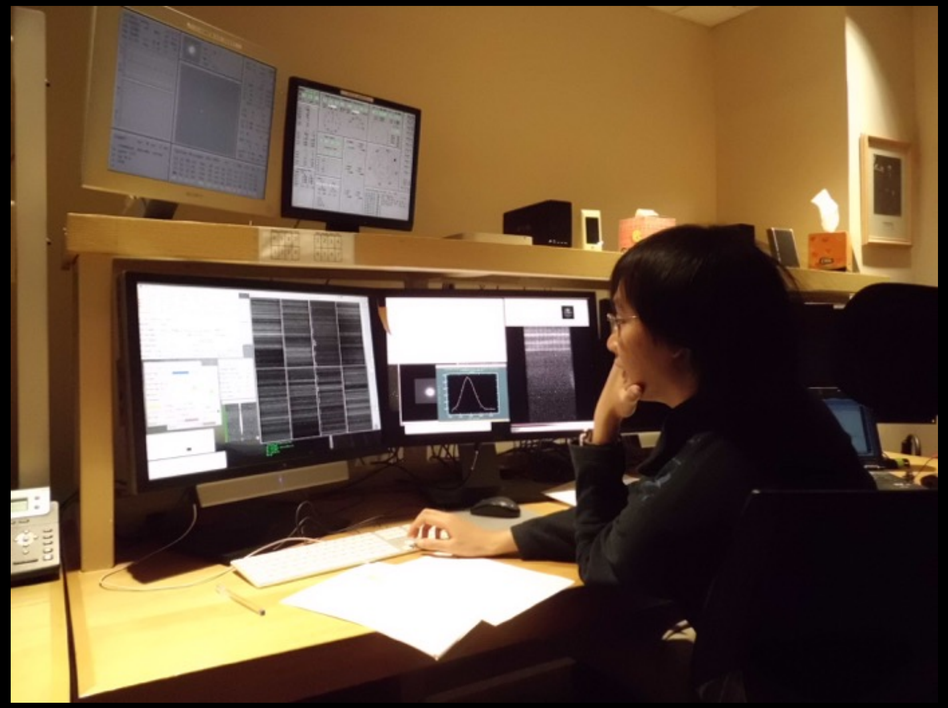






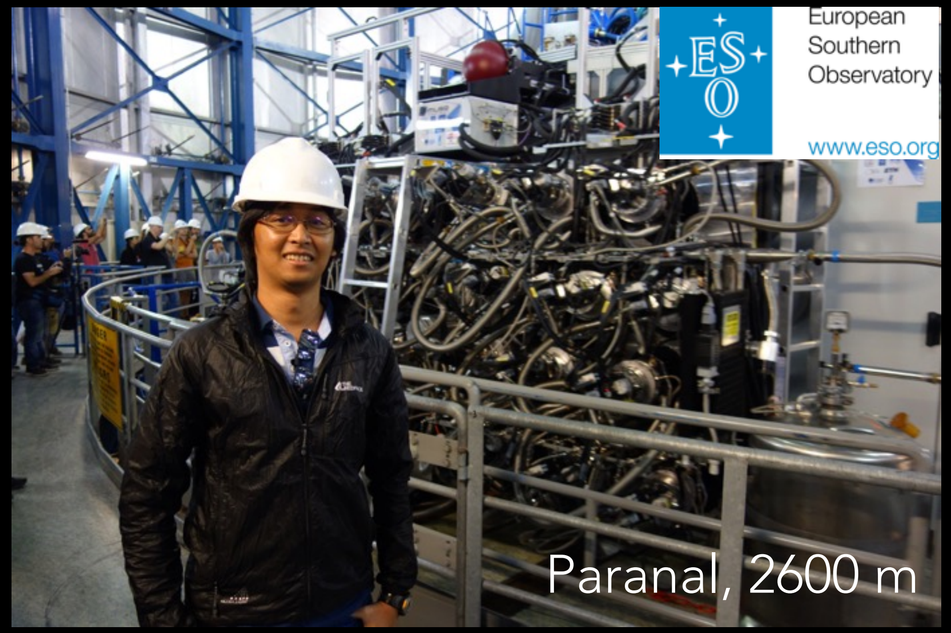
CONTOH-CONTOH

Mauna Kea, Hawaii, 4200 m



Chile

Lima
Chile
Santiago
Buenos Air
Argentina


European
Southern
Observatory
www.eso.org
Paranal, 2600 m

Cerro Tololo, 2200 m

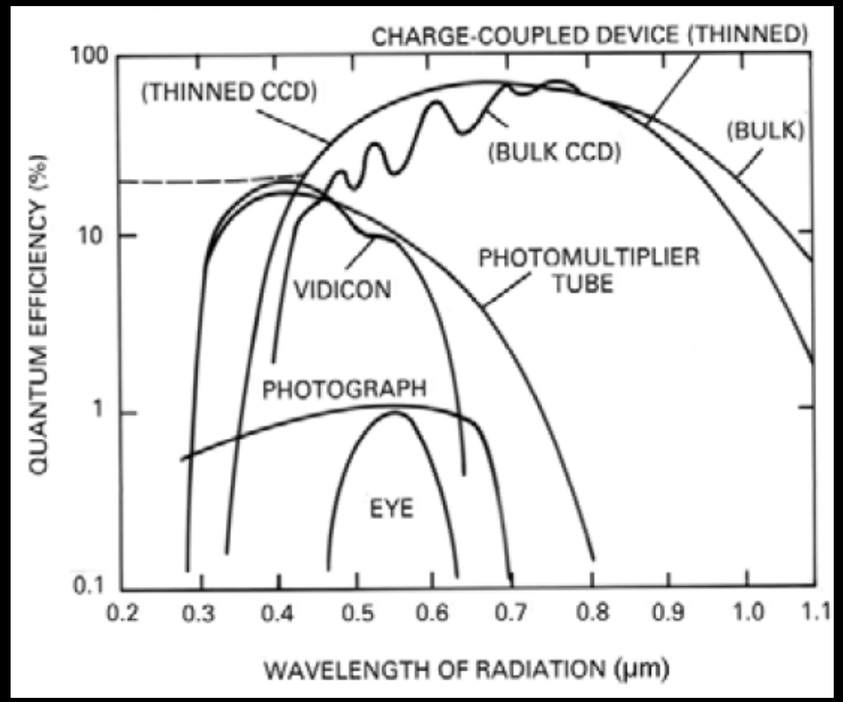
Chajnantor, 5640 m
Observatorium tertinggi di dunia
TAO
THE UNIVERSITY OF TOKYO

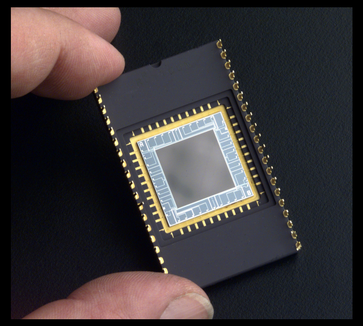
Las Campanas, 2400 m

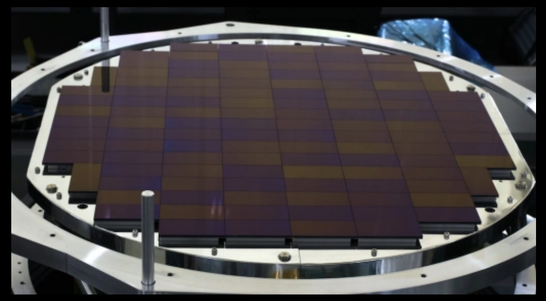
GUINNESS WORLD RECORDS
CERTIFICATE
The highest astronomical observatory is the University of Tokyo Atacama Observatory, located at an altitude of 5,640 m (18,503 ft) on the summit of Cerro Chajnantor in a scientific reserve called Atacama Astronomical Park, Chile. The observatory houses a 1 m (3 ft 3.37 in) infrared telescope called miniTAO, which saw first light on 23 March 2009.
GUINNESS WORLD RECORDS

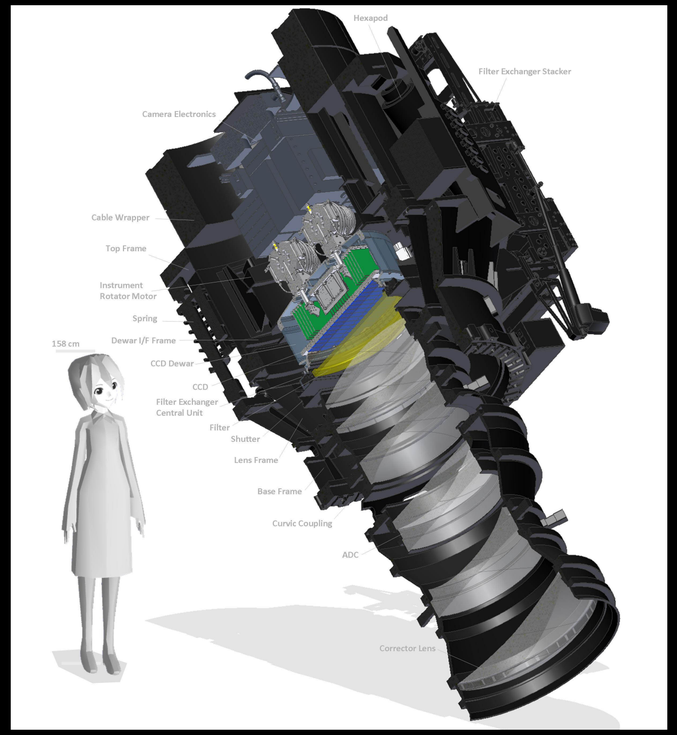
DETEKTOR DAN INSTRUMEN

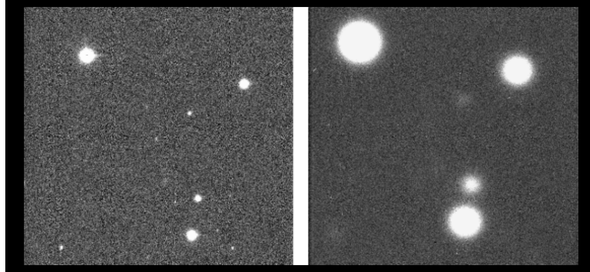
- Detektor chip semikonduktor (CCD, CMOS)
- Instrumen: merekam gambar, spektrum (uraian cahaya), polarisasi cahaya
- Cahaya redup: sensitivitas tinggi

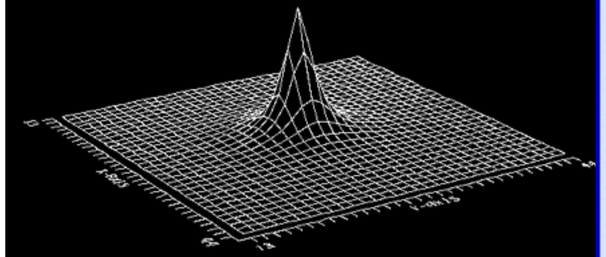


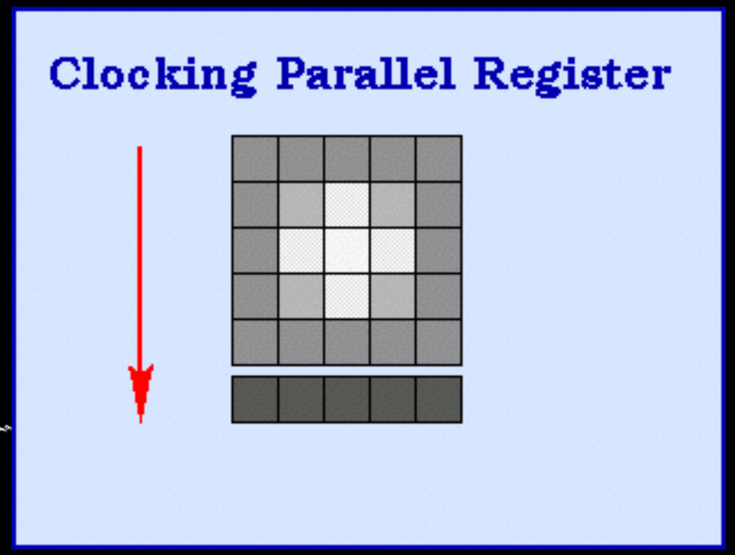




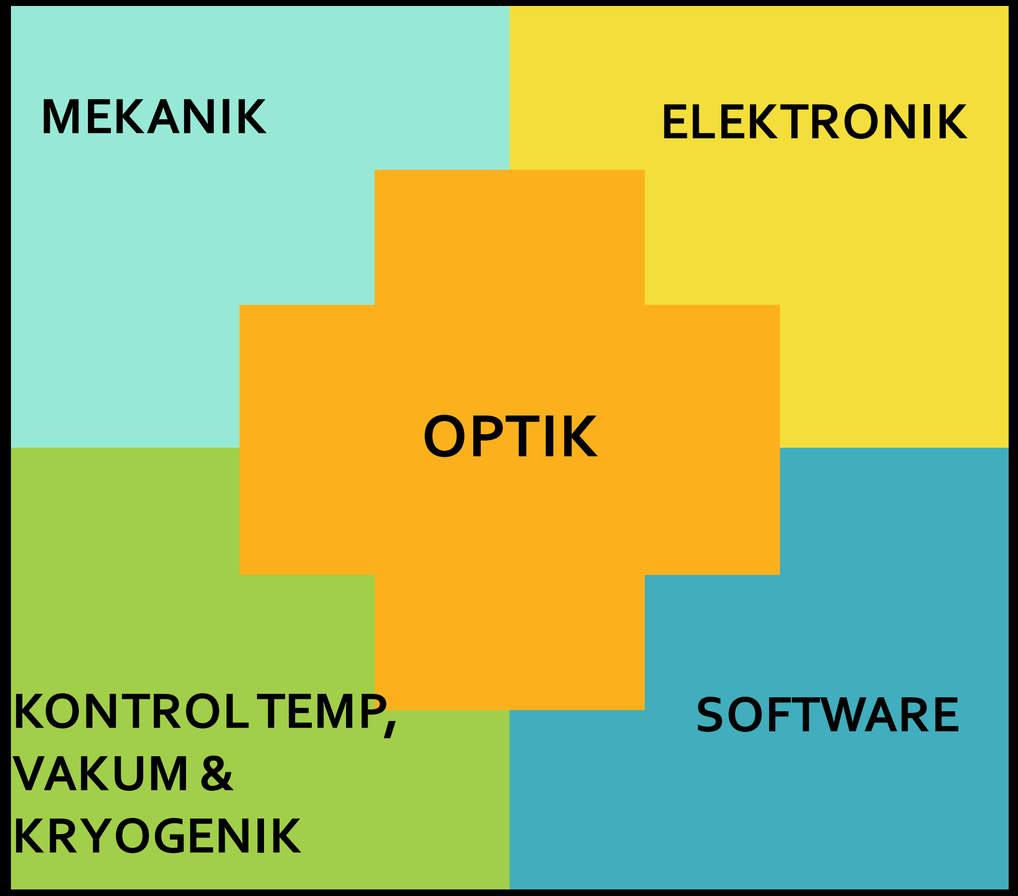








PEMBANGUNAN INSTRUMEN ASTRONOMI



Umumnya, instrumen dibangun dari gabungan komponen-komponen COTS dan custom (buatan sendiri)

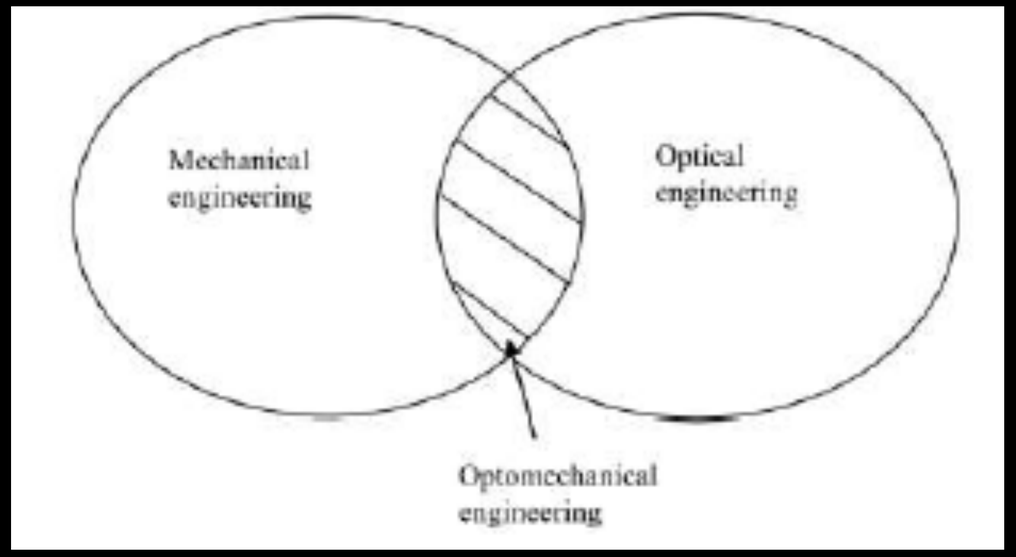
"COTS":
Commercial Off-The-Shelf components

PROSES DESAIN

- Kenali keperluan instrumen
- Mulai dengan konsep sederhana, iterasi hingga makin kompleks
  - Optik sebagai tulang punggung, tambahkan struktur mekanik dll.
- Evaluasi awal manufaktur dan assembly, sebelum alokasi sumber daya ke model yang lebih detail
- Kenali batas dan juga potensi kemampuan teknologi yang tersedia

DESAIN (OPTO)MEKANIK

- Dari desain optik ke layout mekanik:
  - Pilihan komponen optik dan penyangga
  - Stress termal dan mekanika pada optik
  - Komponen bergerak
  - Kemudahan handling dan perawatan, assembly-disassembly
  - Tata kabel dan komponen elektrik
  - Sistem pendingin
  - Struktur penutup



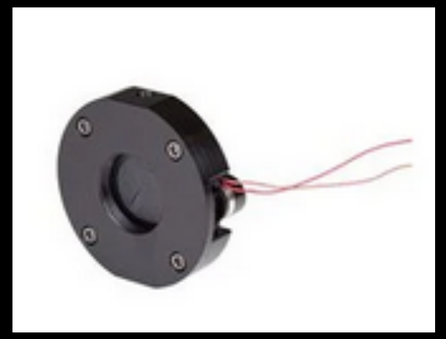
CAD/CAM

- Dua strategi desain umumnya:
  - Optimisasi untuk performa
  - Optimisasi untuk biaya

KOMPONEN PENDUKUNG OPTIK

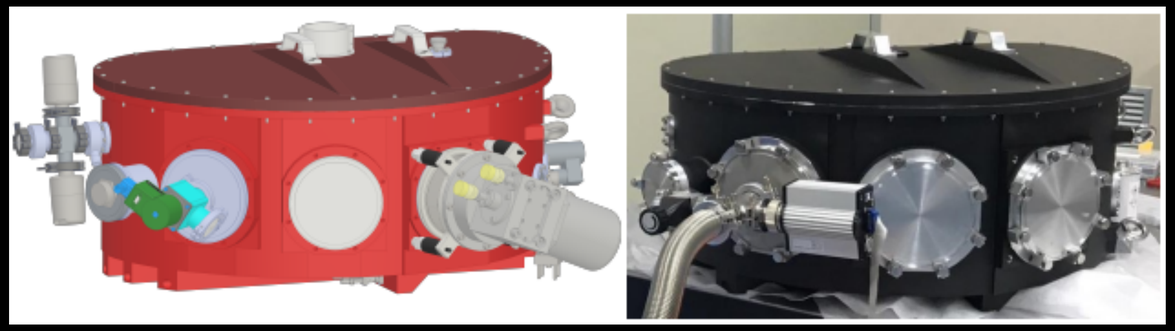
- Penyokong/holder

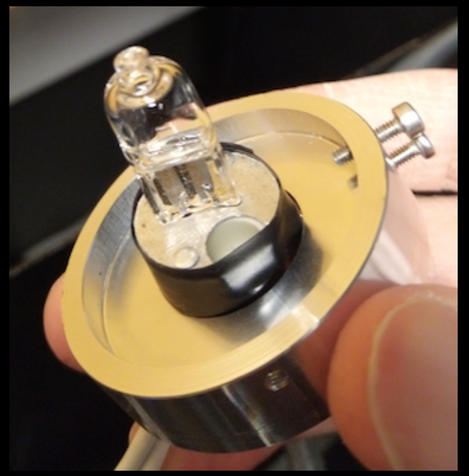
- Pergerakan presisi

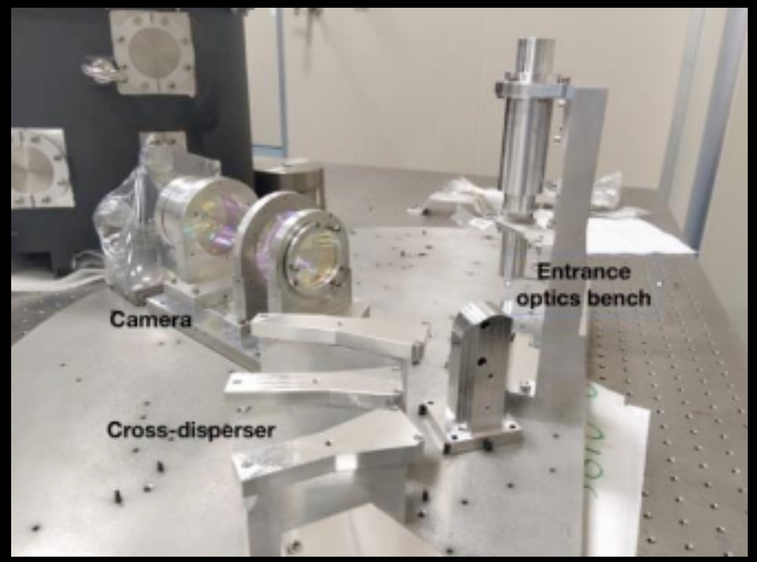


KOMPONEN CUSTOM

- Dibuat dengan mesin bubut / bor / CNC
- 3D printer

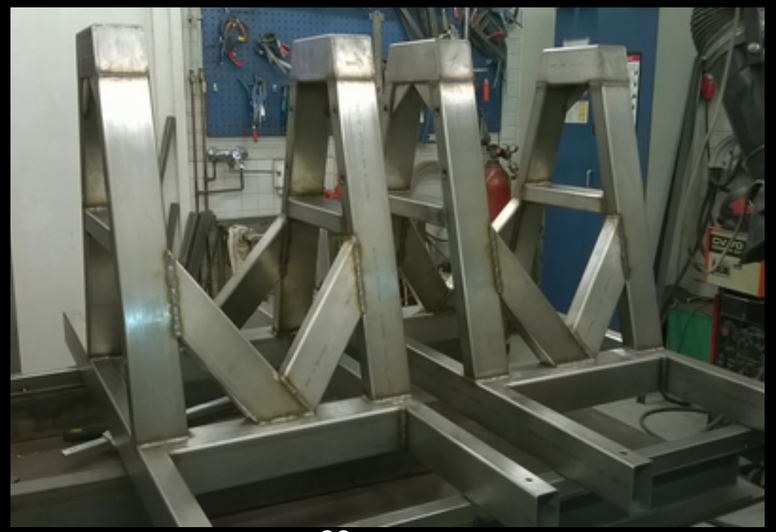


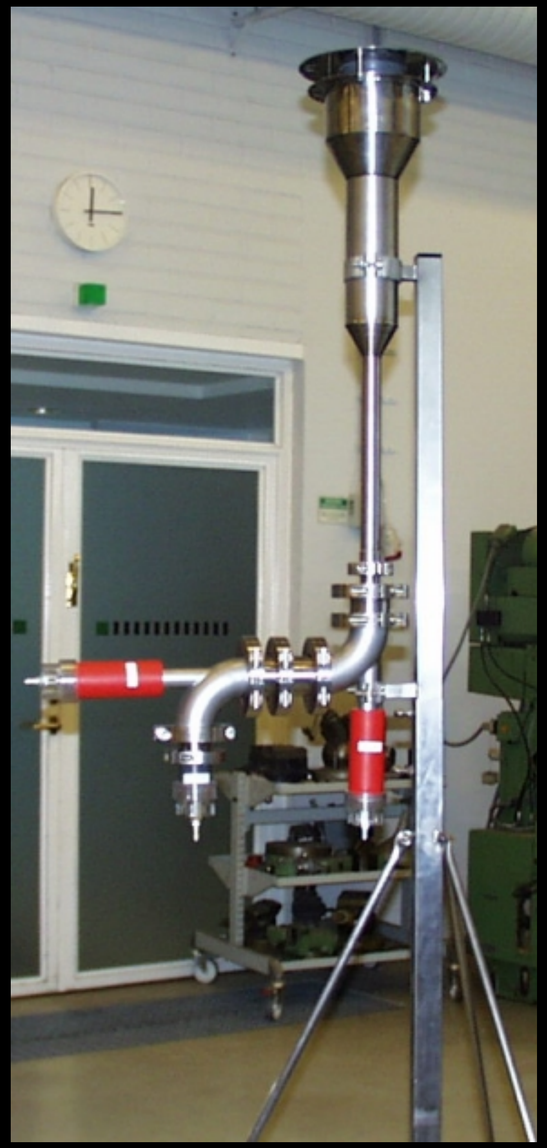


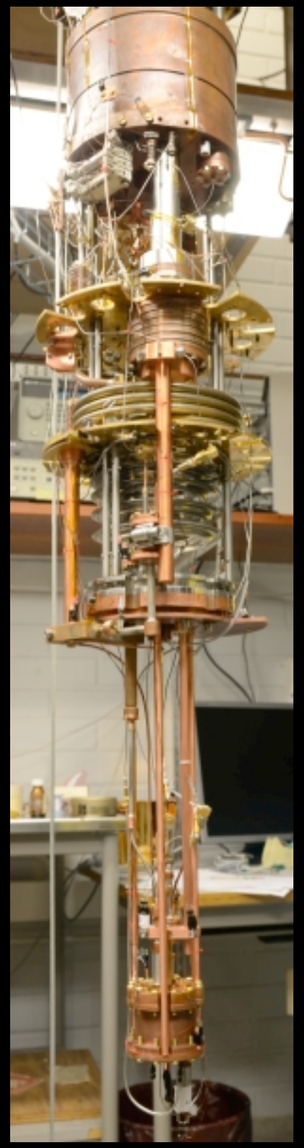


BENGKEL PROTOPAJA UNIV. TURKU

- Pekerjaan mekanik dengan logam, plastik
- Elektronik
- Perawatan
- Cairan & kryogenik
- Bantuan teknis

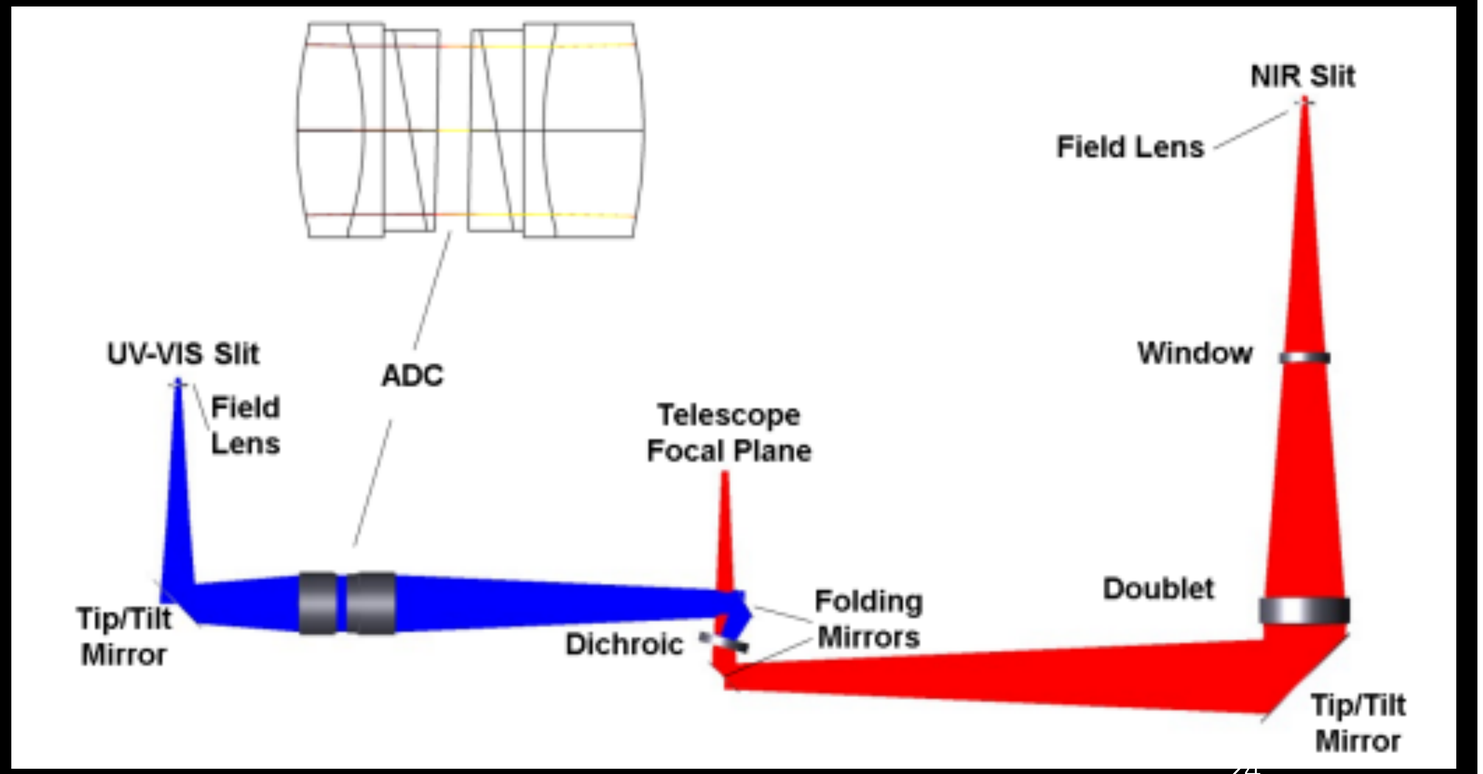


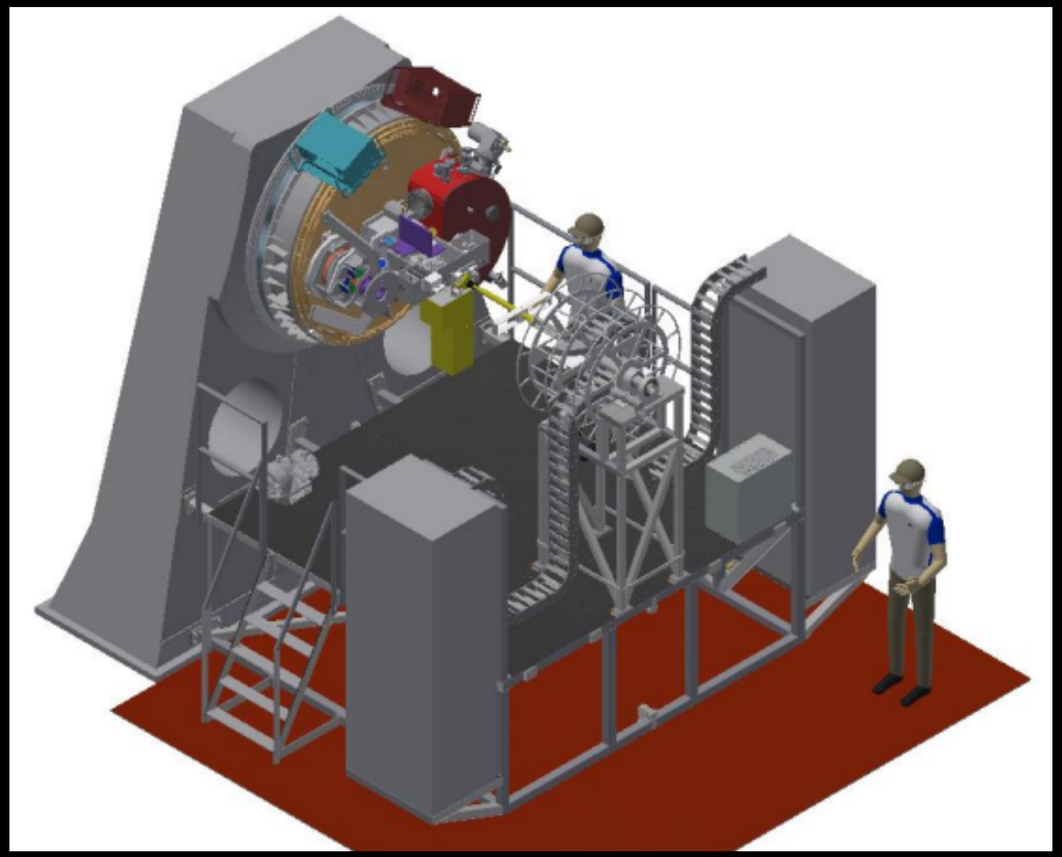


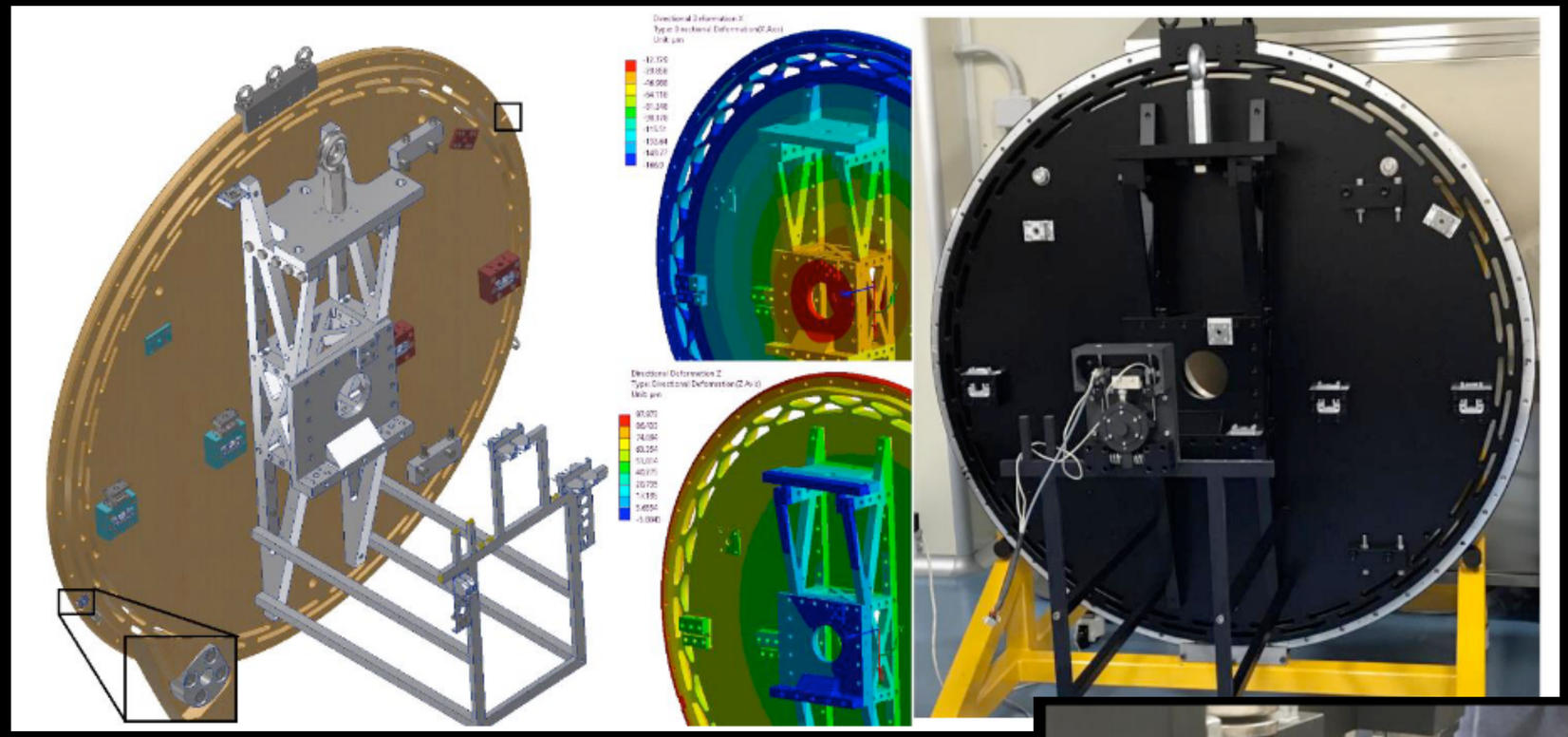


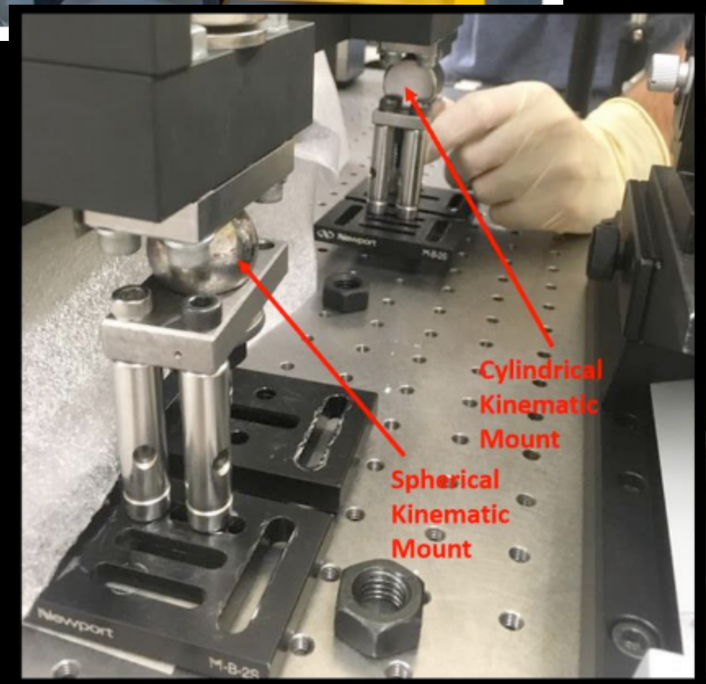
CONTOH KASUS: INSTRUMEN SOXS

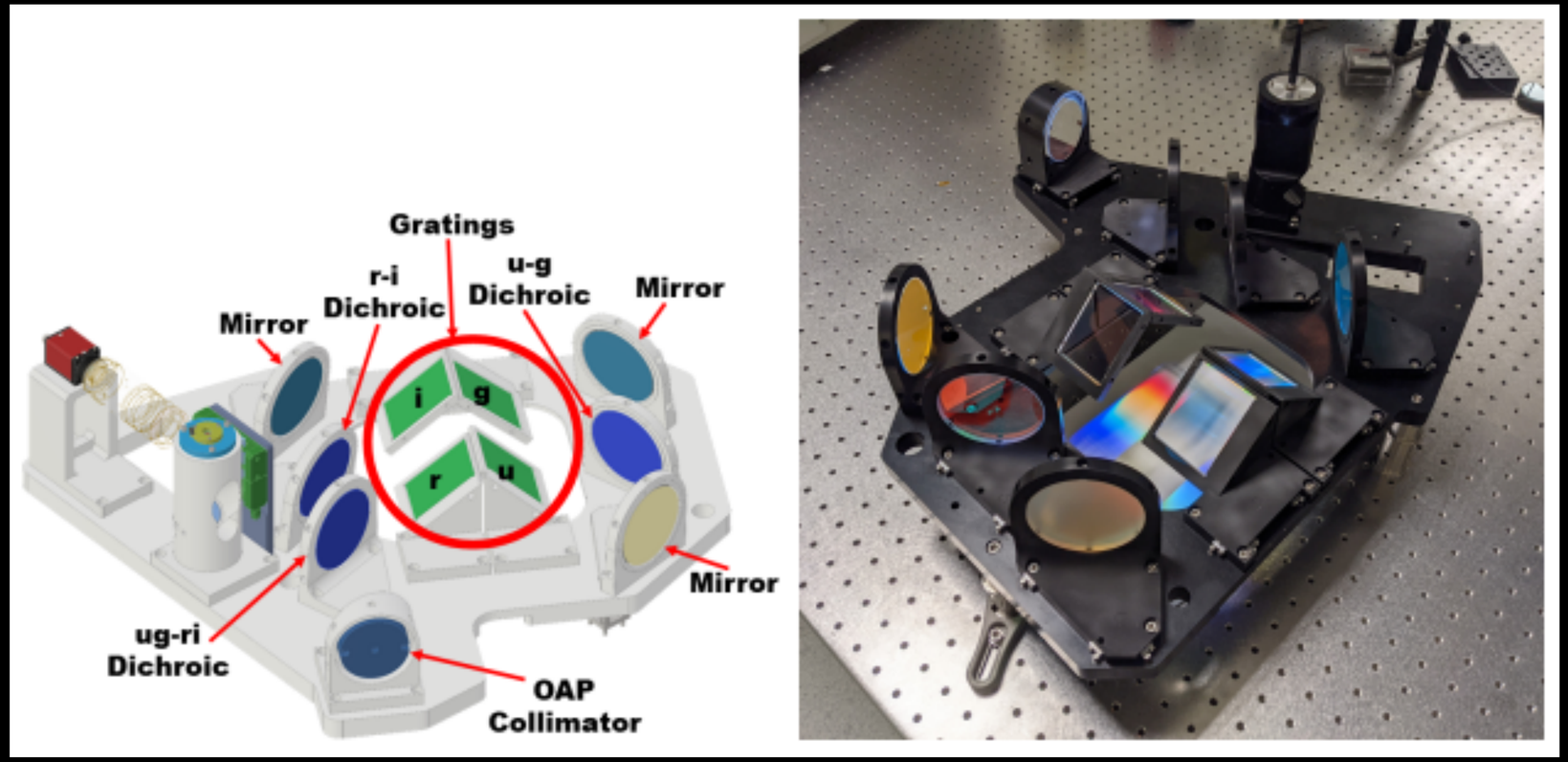
- https://www.eso.org/sci/facilities/develop/instruments/SoXS.html
- Instrumen cahaya tampak dan inframerah: pendinginan detektor hingga 40 K
- Konsorsium 6 negara, 10+ institusi dan universitas

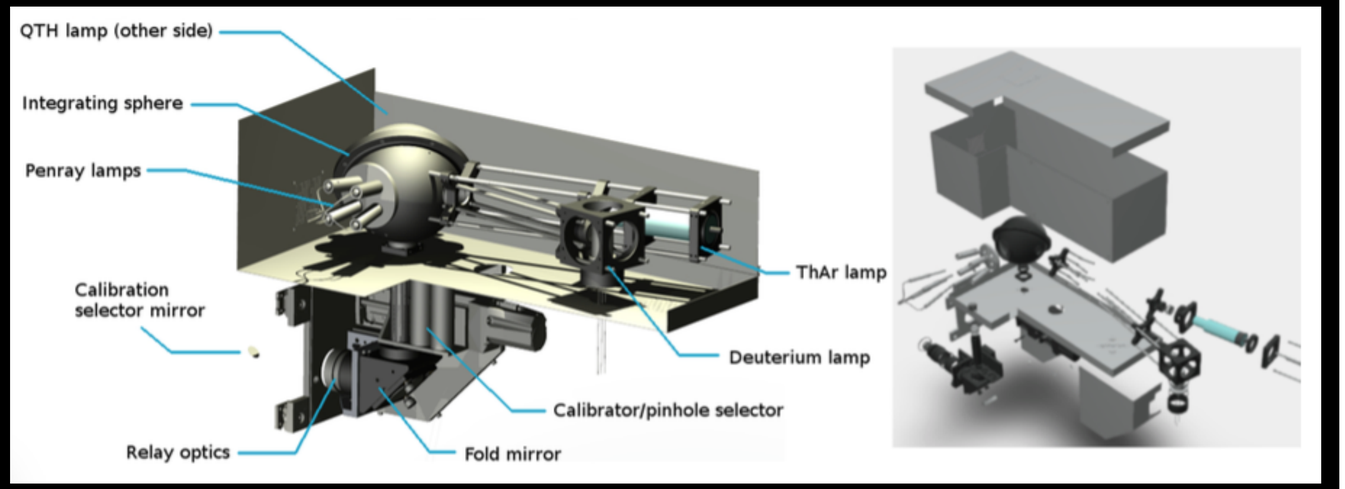


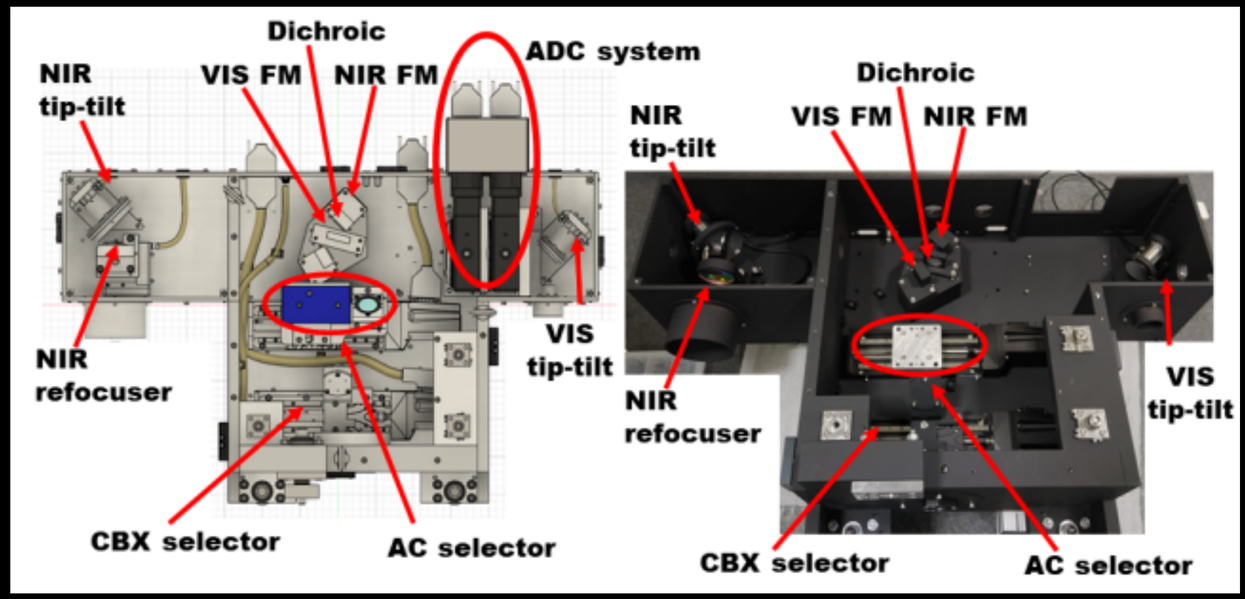


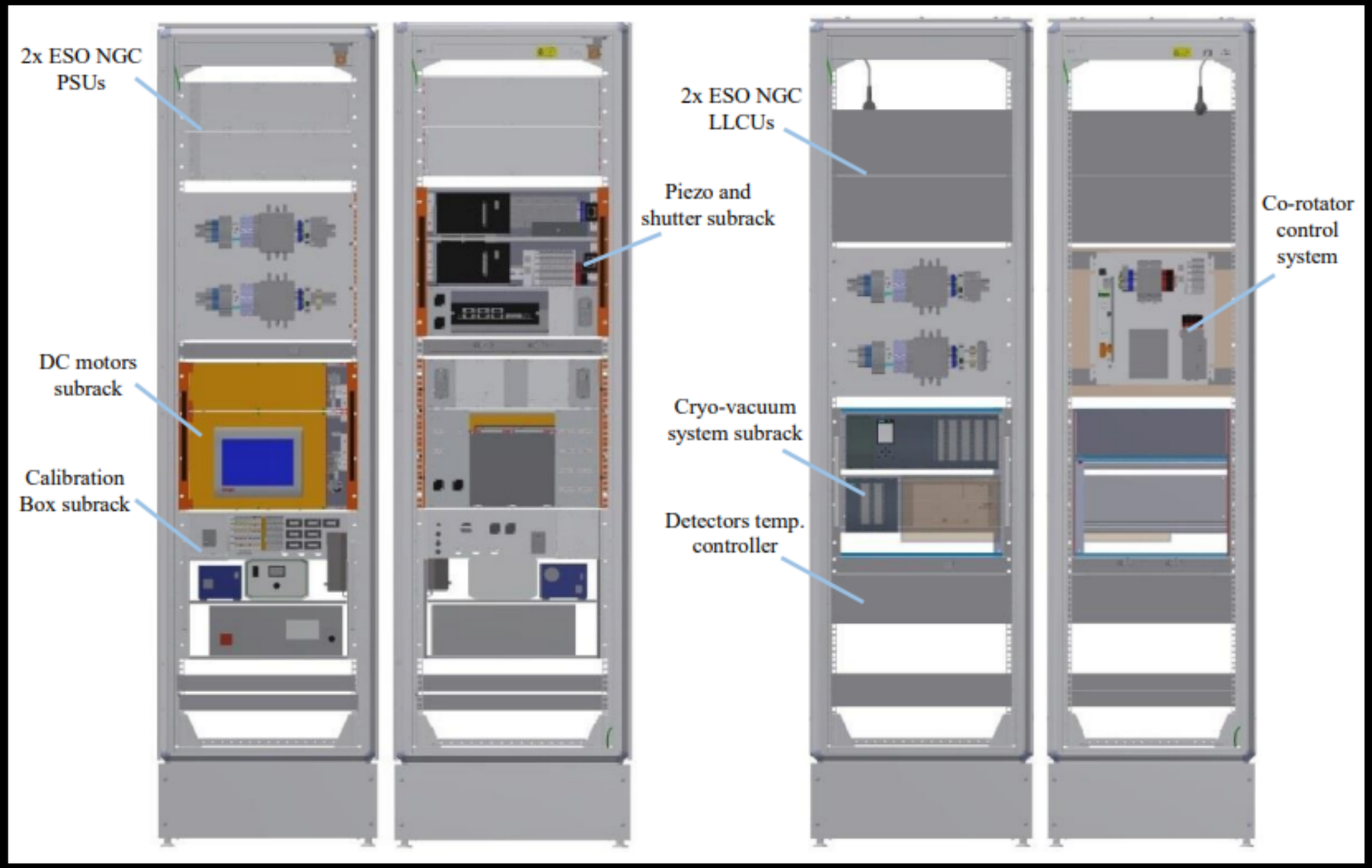



Cylindrical
Kinematic
Mount
Spherical
Kinematic
Mount

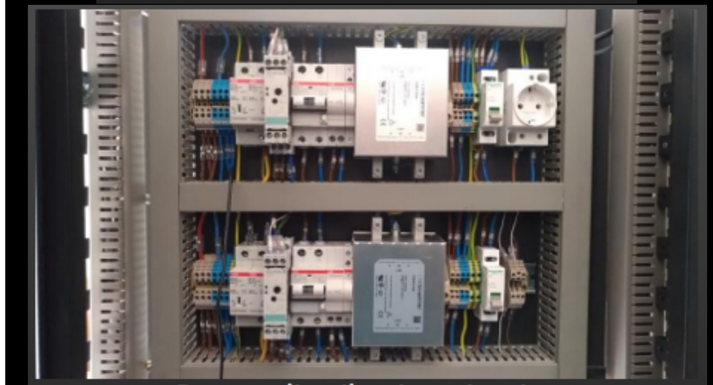

Gratings
r-i
Dichroic
u-g
Dichroic
Mirror
Mirror
i
g
r
u
Mirror
ug-ri
Dichroic
OAP
Collimator


QTH lamp (other side)
Integrating sphere
Penray lamps
Calibration
selector mirror
ThAr lamp
Deuterium lamp
Calibrator/pinhole selector
Relay optics
Fold mirror


Dichroic
NIR
tip-tilt
VIS FM
NIR FM
ADC system
NIR
refocuser
VIS
tip-tilt
CBX selector
AC selector
Dichroic
NIR
tip-tilt
VIS FM
NIR FM
NIR
refocuser
VIS
tip-tilt
CBX selector
AC selector

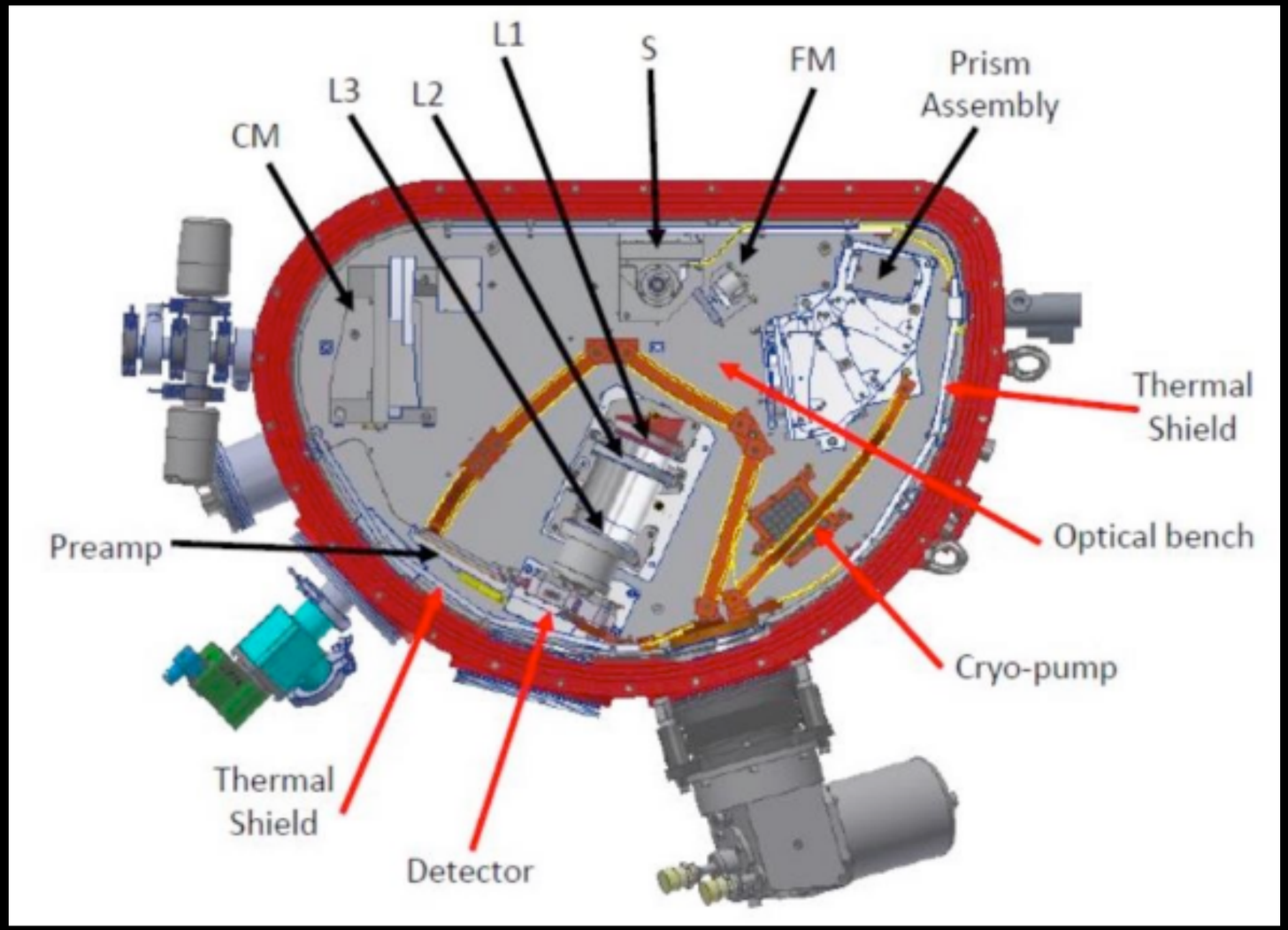


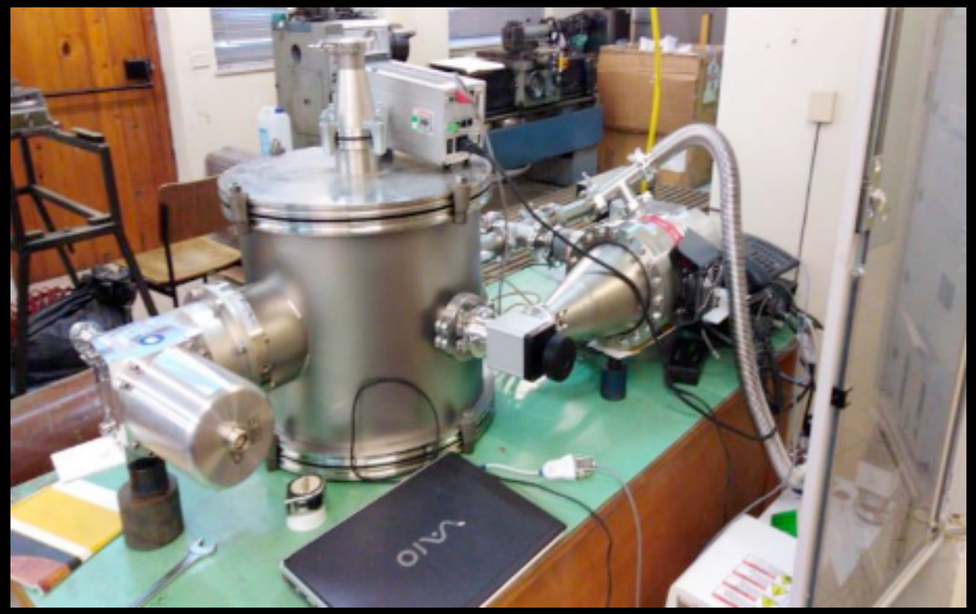
DC motors subrack

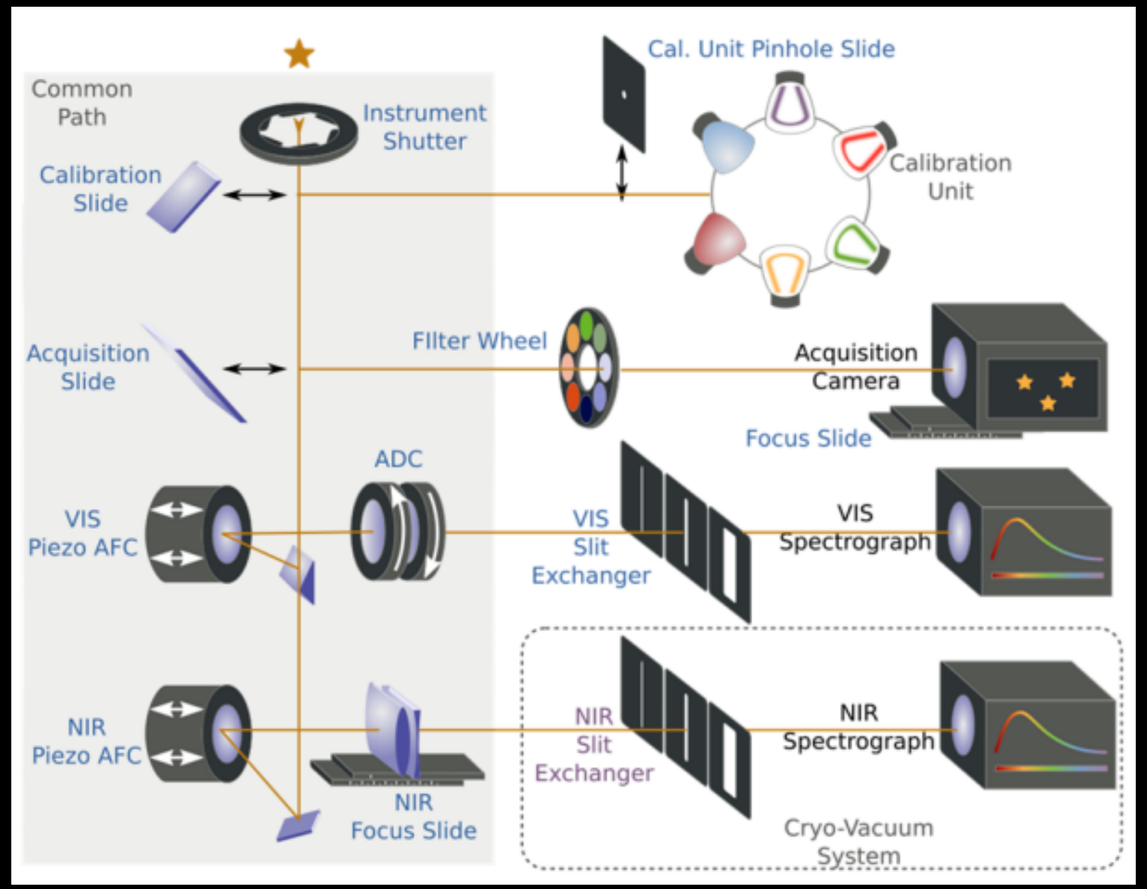


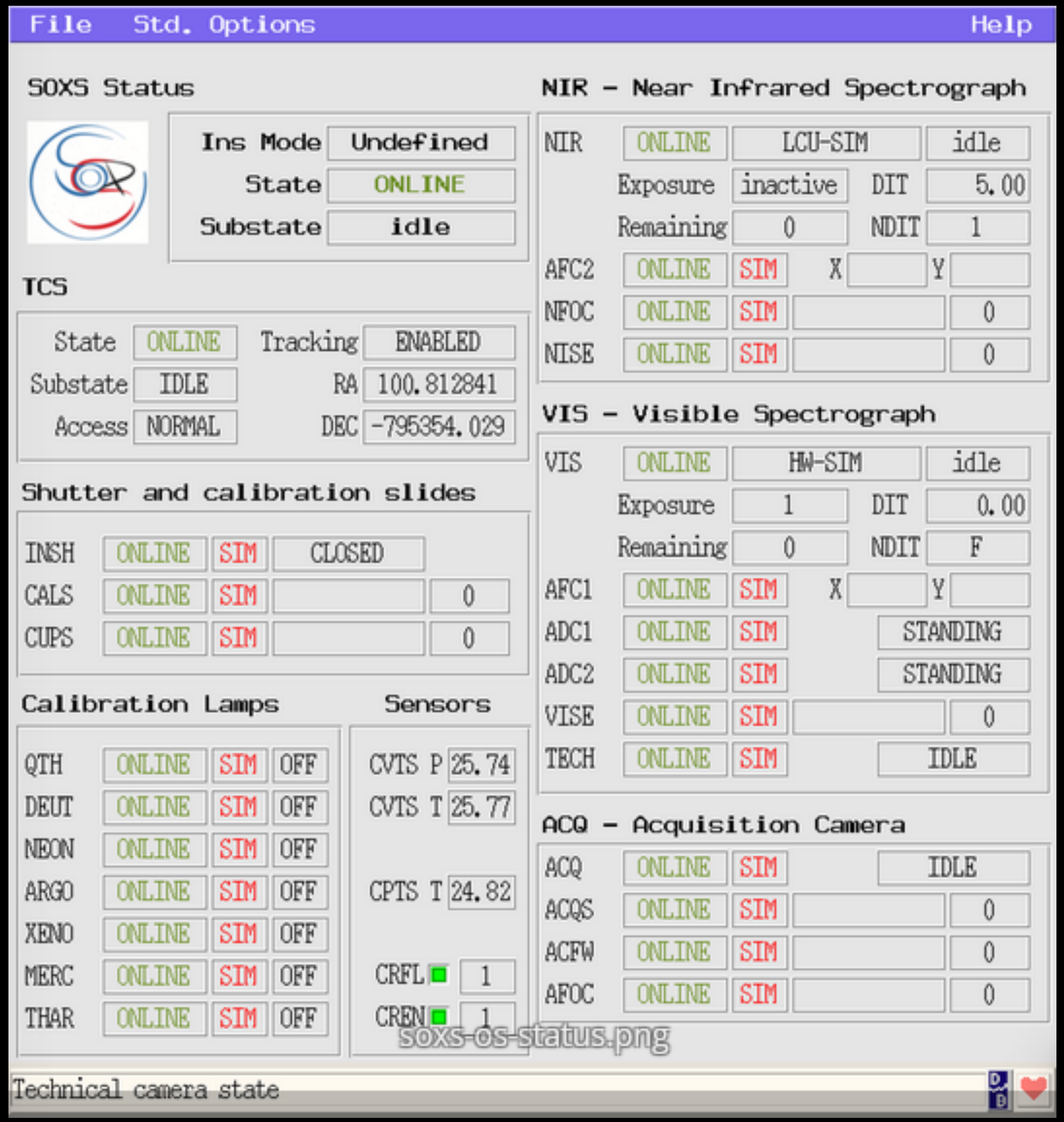
Power distribution circuits

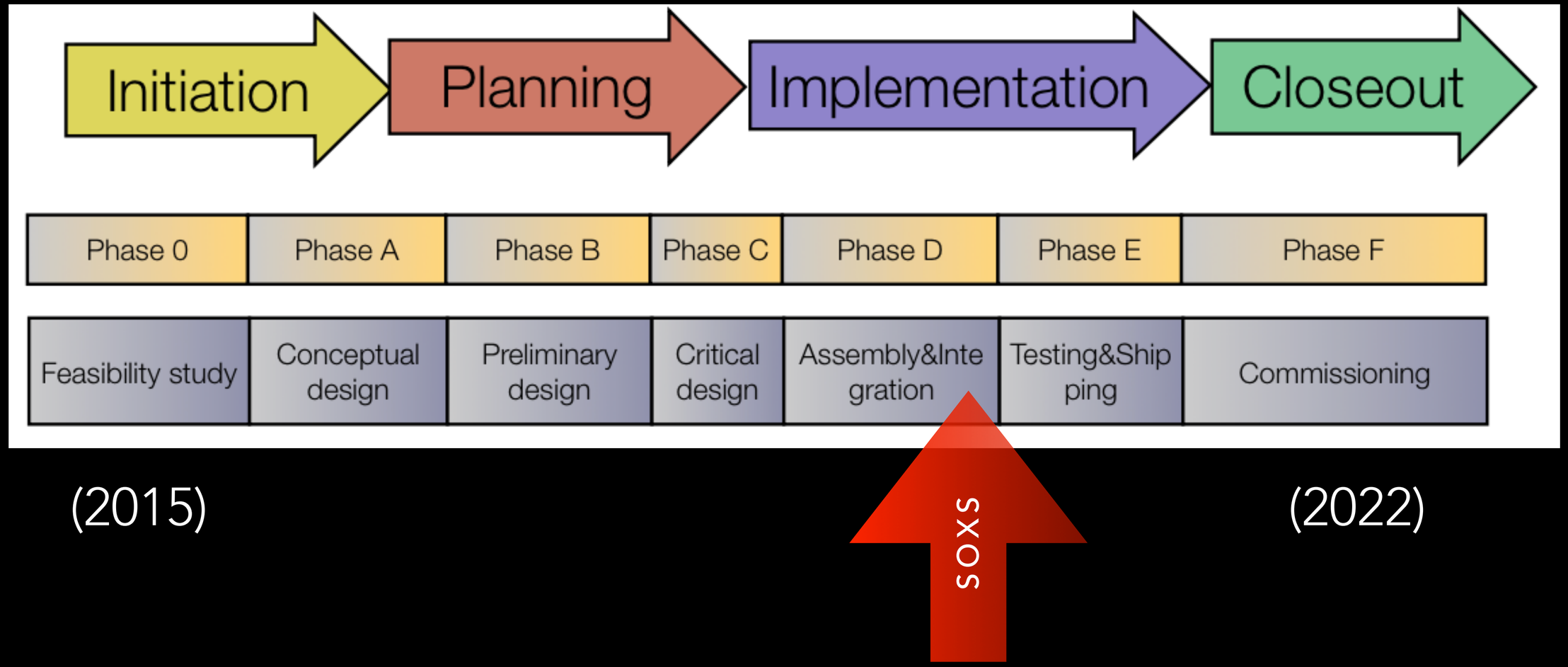
Cabinet cooling control system


L1
S
FM
Prism
Assembly
L3
L2
CM
Thermal
Shield
Optical bench
Preamp
Cryo-pump
Thermal
Shield
Detector




Common Path
Instrument Shutter
Calibration Slide
Cal. Unit Pinhole Slide
Calibration Unit
Acquisition Slide
Filter Wheel
Acquisition Camera
Focus Slide
ADC
VIS Piezo AFC
VIS Slit Exchanger
VIS Spectrograph
NIR Piezo AFC
NIR Slit Exchanger
NIR Spectrograph
NIR Focus Slide
Cryo-Vacuum System


File Std. Options Help
SOXS Status
Ins Mode Undefined
State ONLINE
Substate idle
TCS
State ONLINE Tracking ENABLED
Substate IDLE RA 100.812841
Access NORMAL DEC -795354.029
Shutter and calibration slides
INSH ONLINE SIM CLOSED
CALS ONLINE SIM 0
CUPS ONLINE SIM 0
Calibration Lamps
QTH ONLINE SIM OFF
DEUT ONLINE SIM OFF
NEON ONLINE SIM OFF
ARGO ONLINE SIM OFF
XENO ONLINE SIM OFF
MERC ONLINE SIM OFF
THAR ONLINE SIM OFF
Sensors
CVTS P 25.74
CVTS T 25.77
CPTS T 24.82
CRFL 1
CREN 1
NIR - Near Infrared Spectrograph
NIR ONLINE LCU-SIM idle
Exposure inactive DIT 5.00
Remaining 0 NDIT 1
AFC2 ONLINE SIM X Y
NFOC ONLINE SIM 0
NISE ONLINE SIM 0
VIS - Visible Spectrograph
VIS ONLINE HW-SIM idle
Exposure 1 DIT 0.00
Remaining 0 NDIT F
AFC1 ONLINE SIM X Y
ADC1 ONLINE SIM STANDING
ADC2 ONLINE SIM STANDING
VISE ONLINE SIM 0
TECH ONLINE SIM IDLE
ACQ - Acquisition Camera
ACQ ONLINE SIM IDLE
ACQS ONLINE SIM 0
ACFW ONLINE SIM 0
AFOC ONLINE SIM 0
soxs-os-status.png
Technical camera state


Initiation
Planning
Implementation
Closeout
Phase 0
Phase A
Phase B
Phase C
Phase D
Phase E
Phase F
Feasibility study
Conceptual design
Preliminary design
Critical design
Assembly&Integration
Testing&Shipping
Commissioning
SOXS

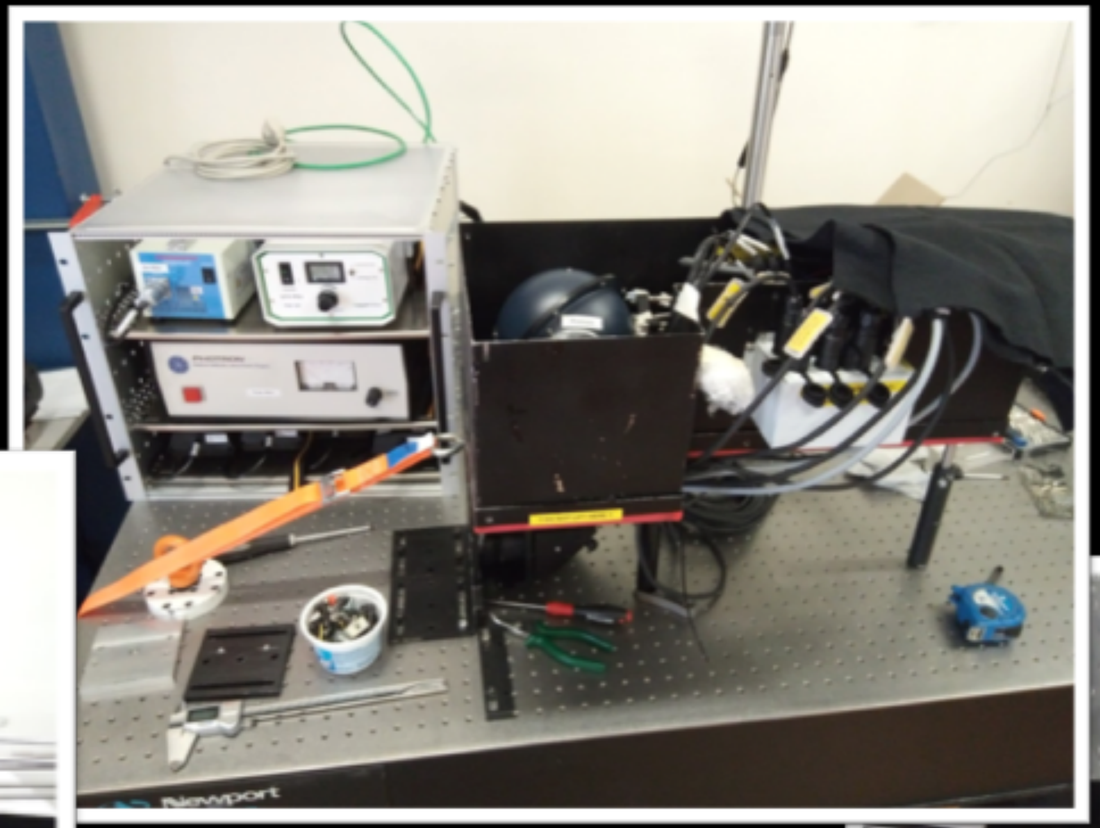
(2015)

(2022)

TELWATCH PLUS
TELWATCH PLUS

SHOCKWATCH 2
INSPECT IF RED
SHOCKWATCH 2
INSPECT IF RED
SHOCKWATCH 2
INSPECT IF RED

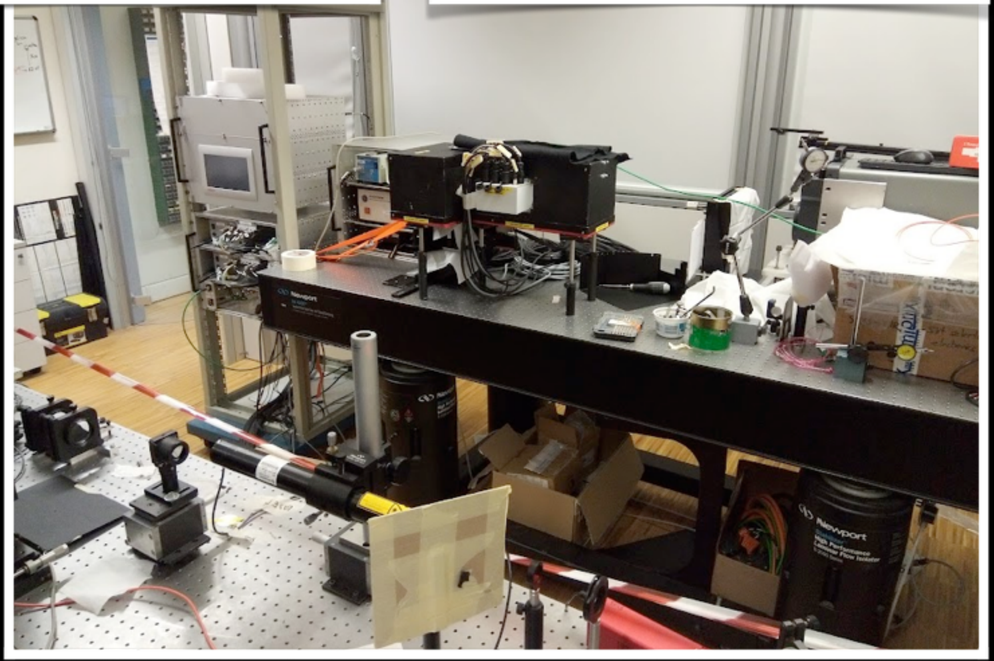
SOXS


Newport

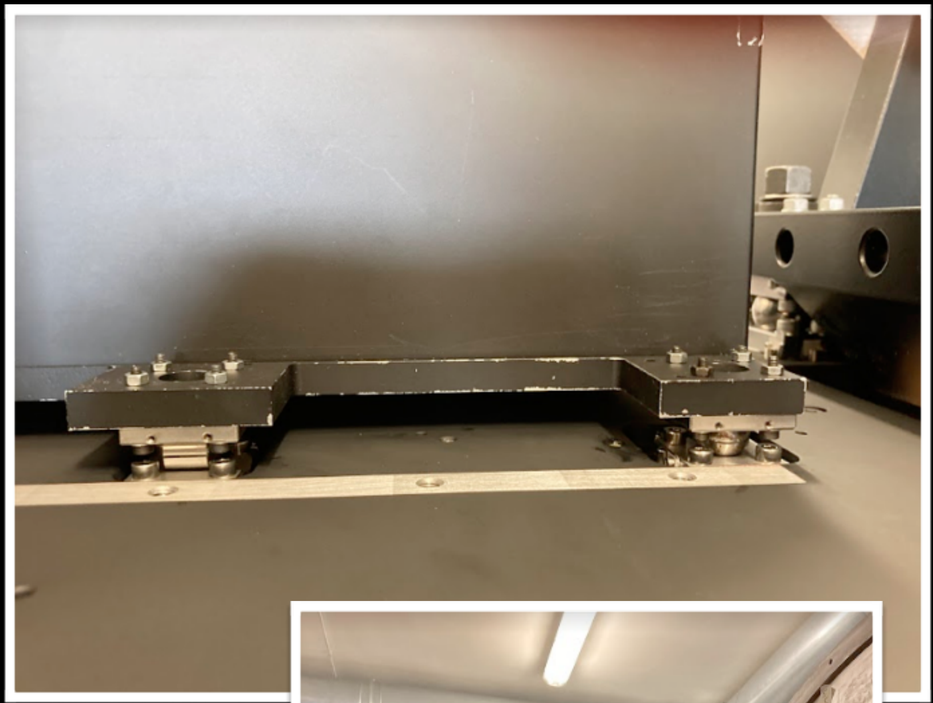
PHOTRON

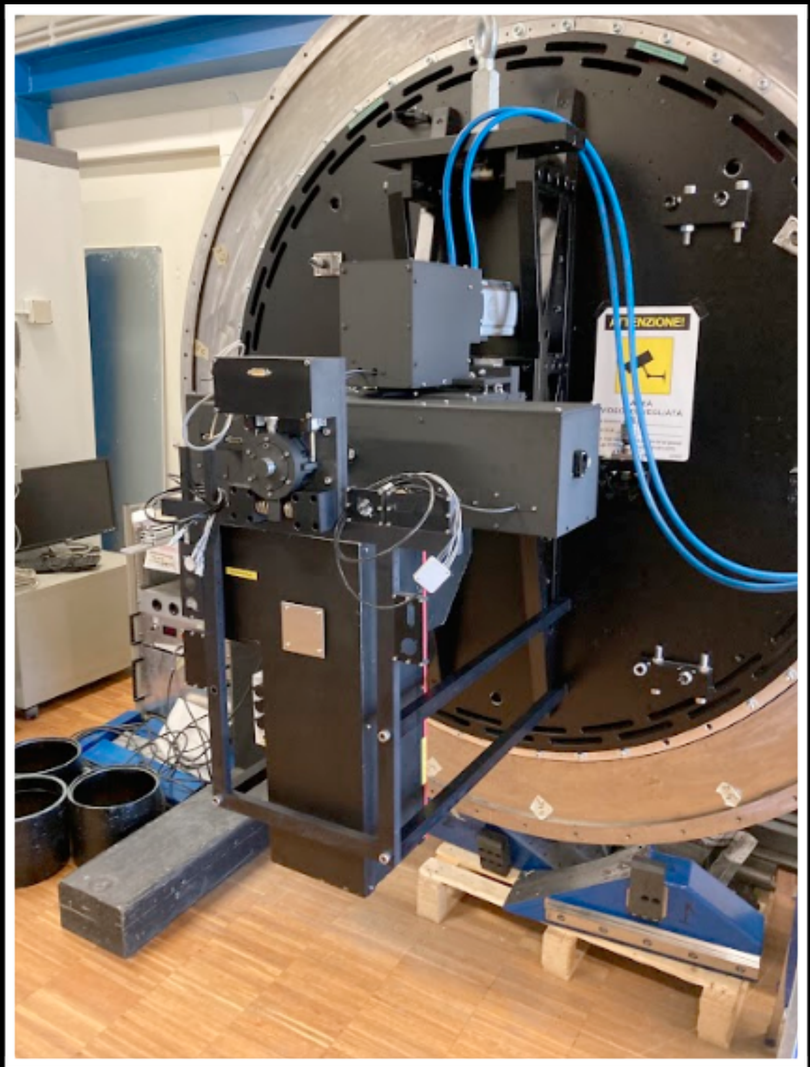
FRAGILE

DEMAG

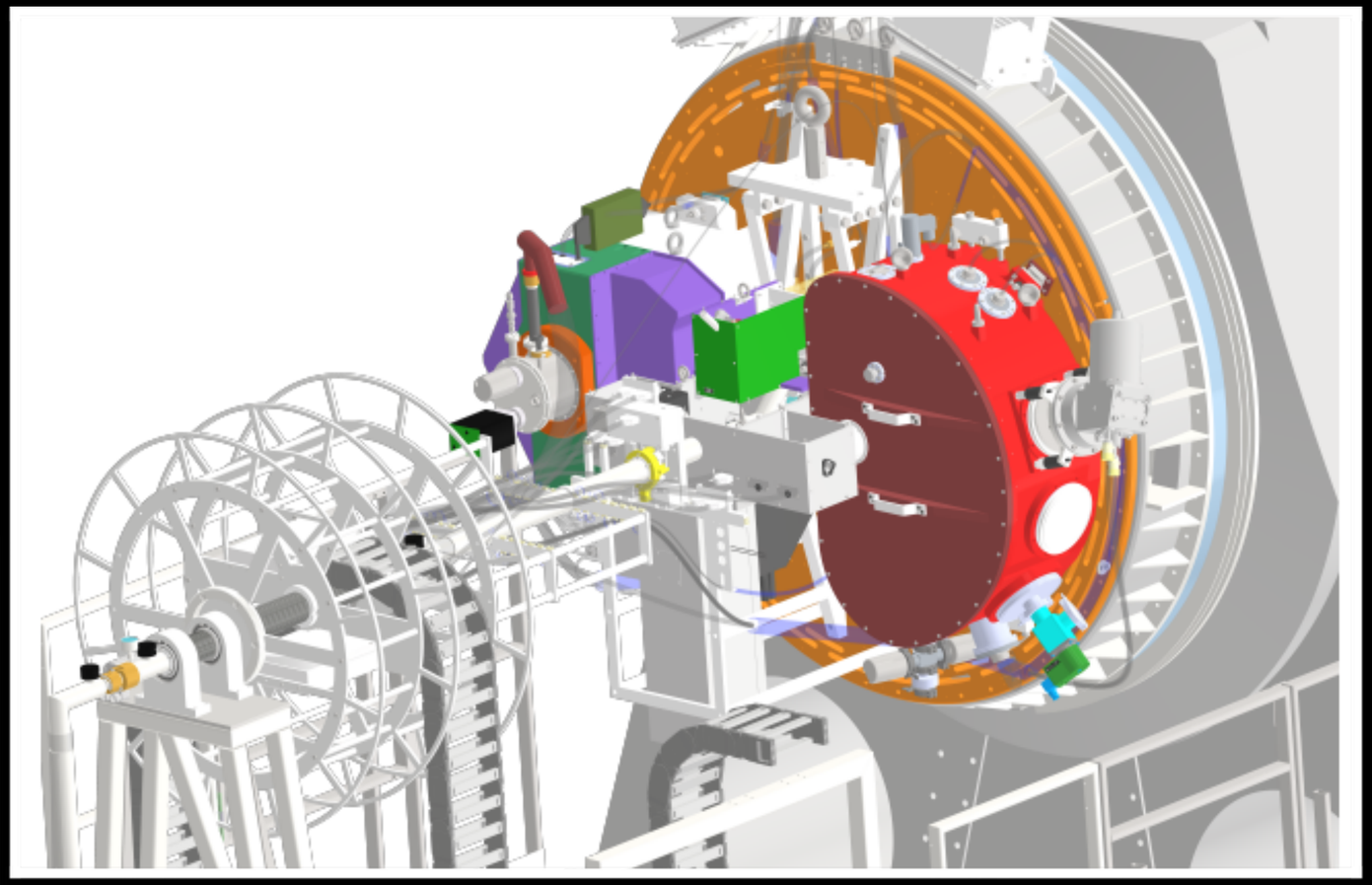

Newport

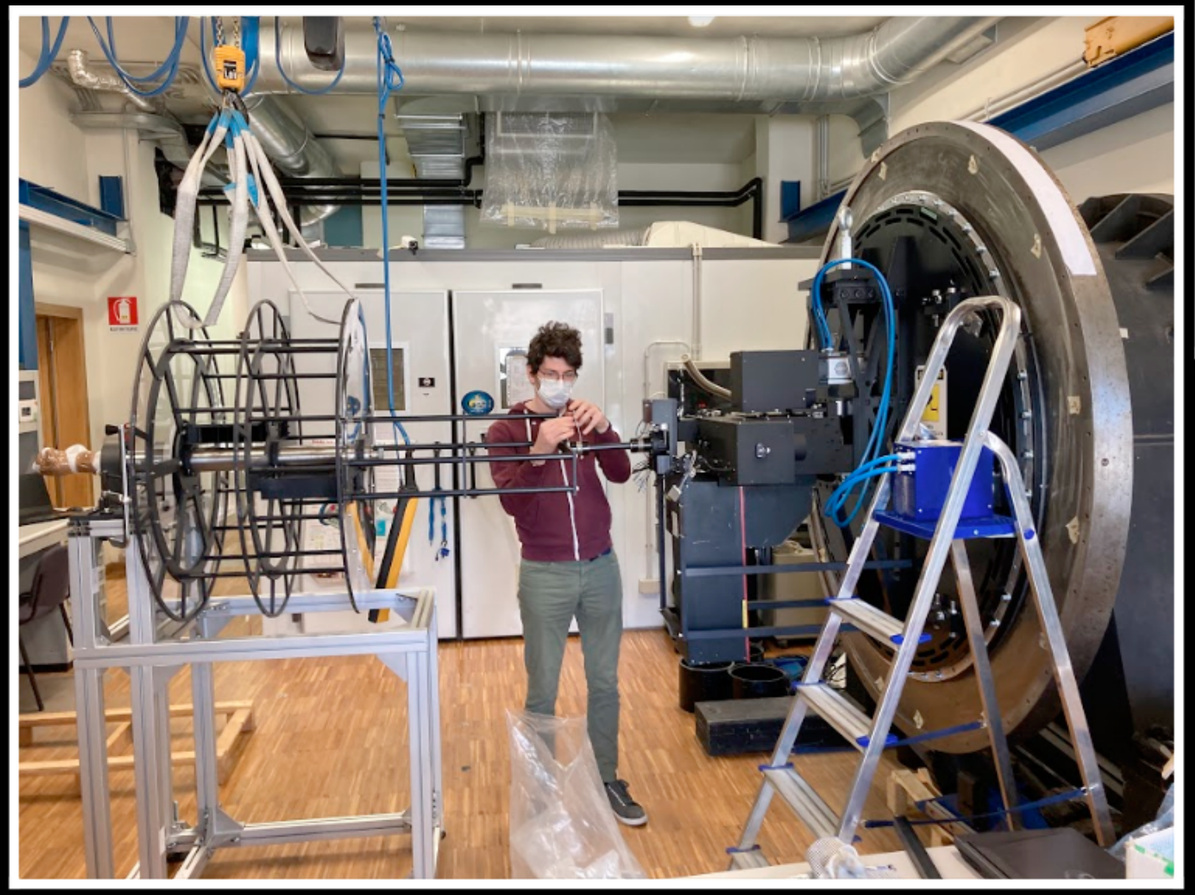
455




ATTENZIONE!

Dari desain…





… hingga realisasi

(sebagian)

PENUTUP

- Peran instrumen dan mesin sangat penting dalam astronomi pengamatan
- Aspek-aspek yang diperhitungkan dalam pembangunan instrumen:
  - optik
  - mekanik
  - elektronik
  - kontrol temperatur & vakum
  - software
- Masing-masing adalah bidang keahlian yang sangat spesifik — butuh kolaborasi jangka panjang dengan berbagai ahli

TERIMA KASIH

Zoom Meeting

Recording...

3 people entered the waiting room View

PERAN INSTRUMENTASI DAN MESIN/ PERALATAN DALAM PENGAMATAN ASTRONOMI

HANINDYO KUNCARAYAKTI
UNIVERSITY OF TURKU, FINLAND

Type here to search

31°C 13:59 21/04/2022

Zoom Meeting

AudioSmart

Recording...

2 people entered the waiting room View

MC_Siti A. Muawanah

DTMI_Heru Mirmanto

DTINS_Mochamad Royan ...

Moderator_ITS_Rizaldy H...

ITS_ Suhariyanto

Arino

Vks_349_Totok Soehartan...

DTINS_Muham...

DTINS_Muhammad Fadhil

DTINS_2B_062_Zhafran K...

DTMI_Dhewana Alnafis

DTINS_2B_074_Riski Muly...

DTINS_Syahrul Akmal

Winarto DTMI

DTINS_Fawwaz

DTMI_Adinda Putri

DTINS_Restu Sanjaya Putra

DTINS_Albert

DTins_2A_Althea Xaviera

DTINS_Fariz

DTINS_Fariz

DTINS_Yusvita

DTINS_Yusvita

DTINS_Dion PD

DTINS_Dion PD

Amanda Evin Muzzaki

DTINS_Ervin Da...

DTINS_Ervin Darmawan

DTINS_Miftach...

DTINS_Miftachul Falach

DTINS_2A_Nauf...

DTINS_2A_Naufan Nurdia...

Type here to search

31°C

13:46

21/04/2022