CHEOPS Mission Overview

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ESA science programme

CHEOPS
CHARACTERISING EXOPLANET SATELLITE

- L-missions

  Cost to ESA: 1 b€

  Examples: XMM-Newton, Rosetta, Herschel, Juice

- M-missions

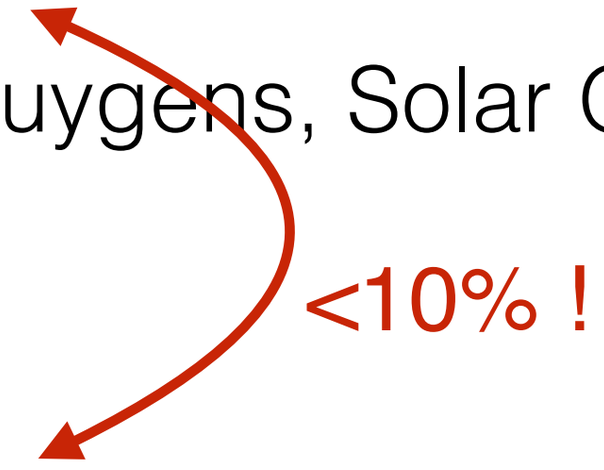
  Cost to ESA: 0.5 b€

  Examples: Integral, Huygens, Solar Orbiter, Euclid, Plato

- S-mission(s)

  Cost to ESA: 0.05 b€

  Example: CHEOPS



S-mission requirements

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- S-missions must be science-driven and selected through an open call for missions (bottom-up process)

- The mission implementation cycle, from the call for proposals to launch, must be drastically shorter than for medium (M) and large (L) class missions

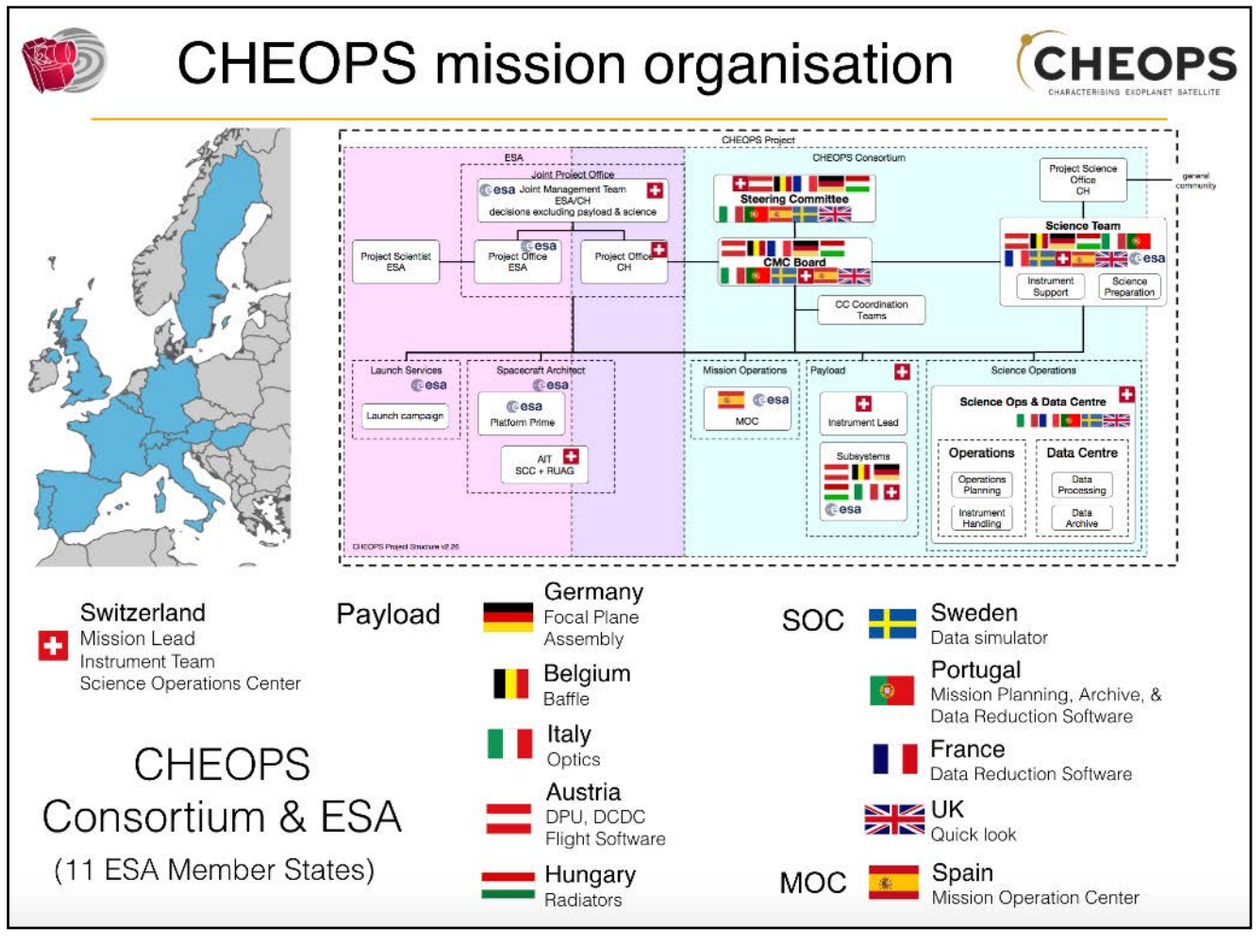
  ≤ 4 years

- Missions must be cost-capped, possibly with a proportionally larger Member State involvement than for M or L missions

  cap: 50 M€ ESA cost (including launch)

Important remarks

- ESA is procuring the platform, the launch and the CCD. It is the mission architect
- The Consortium is responsible for the payload and for setting-up and running the ground segment
- In terms of overall mission cost, ESA and the Consortium share the burden at a level of ~50% each



- The ground segment is nationally funded and therefore operating on a very restricted budget
- The consortium will have virtually have no resources to provide help for the community for which the point of contact will be ESA

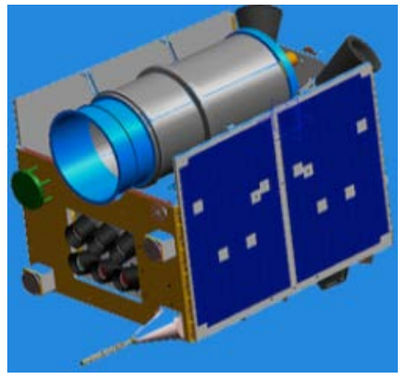
History of CHEOPS (1/2)

CHEOPS
CHARACTERISING EXOPLANET SATELLITE

- 2008: Feasibility study proposed to SNSF

  As part as a call for establishing national centres of excellence in research in Switzerland

  CHEOPS is a mini-satellite (< 100 kg) carrying a 40cm telescope with a small field of view designed to conduct ultra-precise optical photometric observations. The CHEOPS science programme is to complement the ongoing space transit measurements mid-term programme from both Europe (CoRoT, Plato) and the US (Kepler). In contrast to these missions that "search for" transits in wide fields, CHEOPS is a follow-up mission built to obtain precise photometry of selected targets.



The name: CH EOPS

→ not funded!

(follow-up proposal funded in 2014: PlanetS National Centre of Competence in Research)

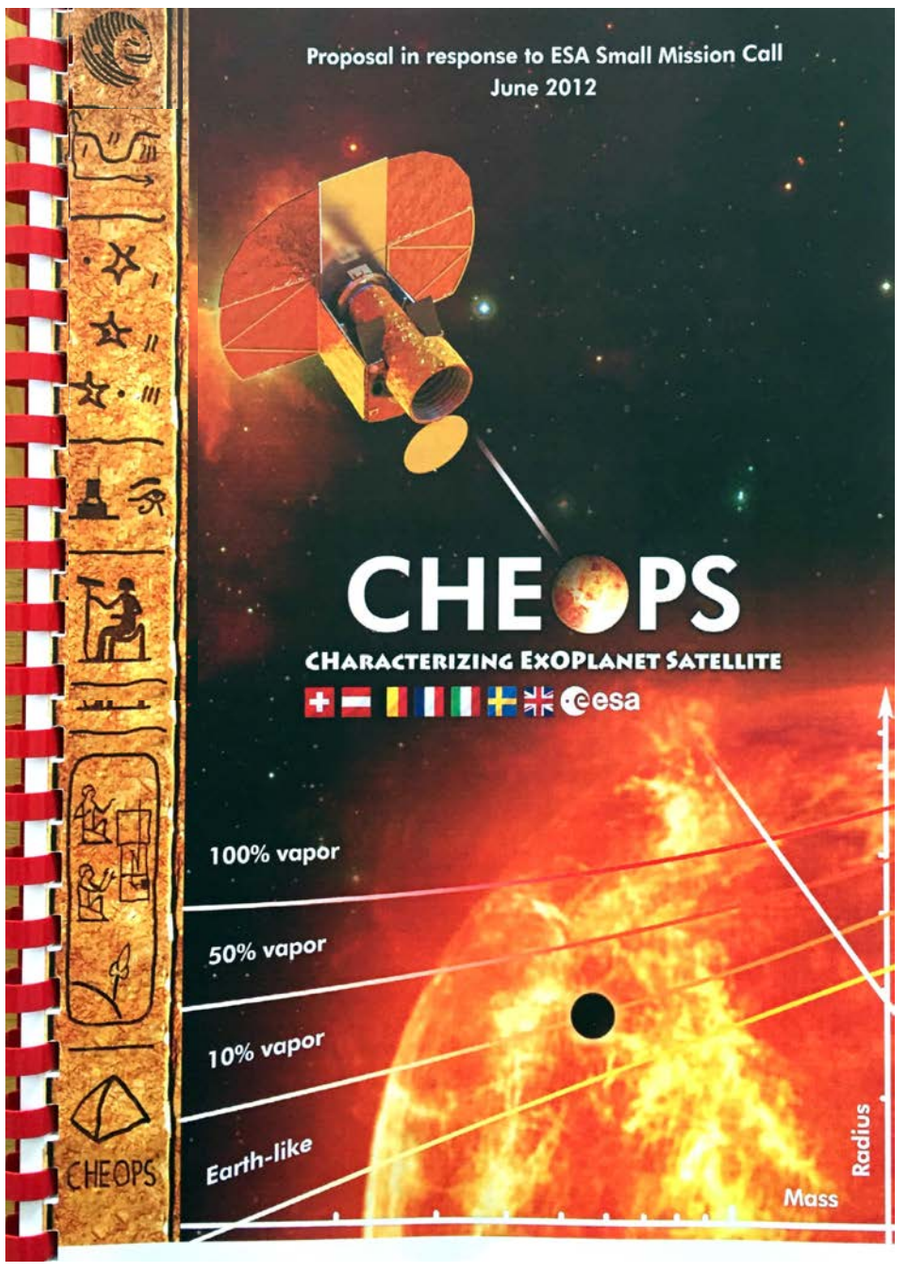
- 2010: Feasibility study (1.5 years) funded by Swiss State Secretary and Swiss industry (RUAG)

History of CHEOPS (2/2)

CHEOPS
CHARACTERISING EXOPLANET SATELLITE

- March 2012: ESA call for small missions (deadline June)

→ feasibility study used to write CHEOPS proposal



The name:
Characterising ExOPlanet Satellite

→ CHEOPS ranked top by SSAC out of 26 proposals in September 2012

→ CHEOPS selected by SPC in November 2012

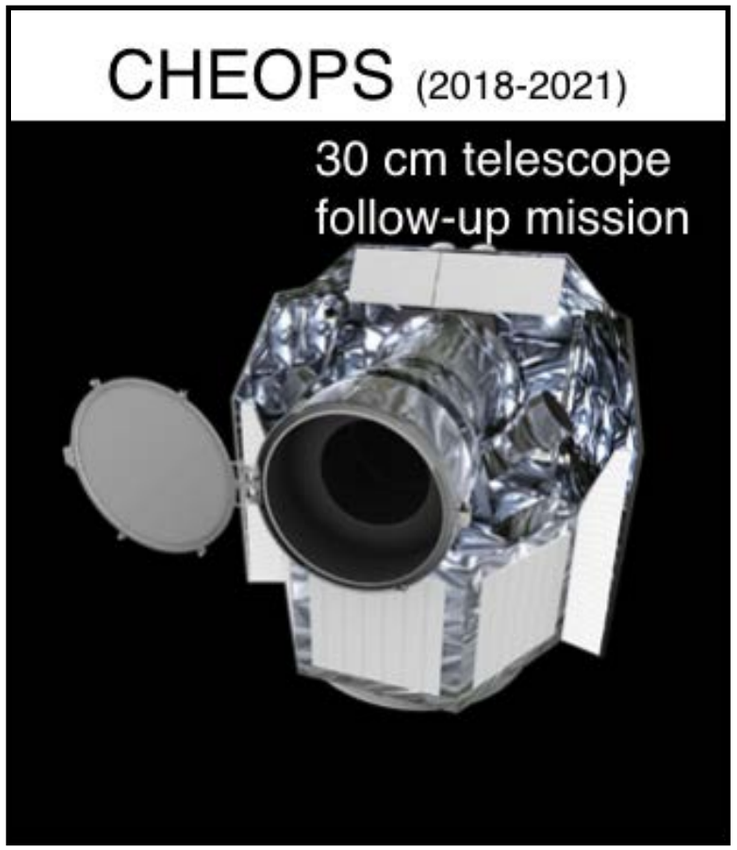
→ CHEOPS adopted by SPC in February 2014

CHEOPS in a nutshell

CHEOPS
CHARACTERISING EXOPLANET SATELLITE

Mission summary	
Name	CHEOPS (CHaracterizing ExOPlanet Satellite)
Primary science goal	Measure of the radius of planets transiting bright stars to 10% accuracy
Targets	Known exoplanet host stars with a V-magnitude < 12 anywhere on the sky
Wavelength	Visible range : 400 to 1100 nm
Telescope	30 cm effective aperture reflective on-axis telescope
Orbit	LEO sun-synchronous, LTAN 6am, 700 km
Lifetime	3.5 years nominal, 5 years extended
launch readiness	end 2018 (first launch opportunity as passenger)

The CHEOPS mission



- single target pointing
- large fraction of sky available
- large aperture single telescope
- flexibility
- reasonably rapid response time

Precision measurements on selected targets

Comments

- Quality not quantity!
  - → science case is based on what precision photometry of a relatively small sample of well selected targets (“Rosetta stones”) can tell us

- Time of observation
  - → efficient single target observing mode requires the best possible knowledge of the ephemeris

- Mission planing
  - → most targets will require time-critical observations, optimal scheduling is essential

CHEOPS flight instrument (1/2)

CHEOPS
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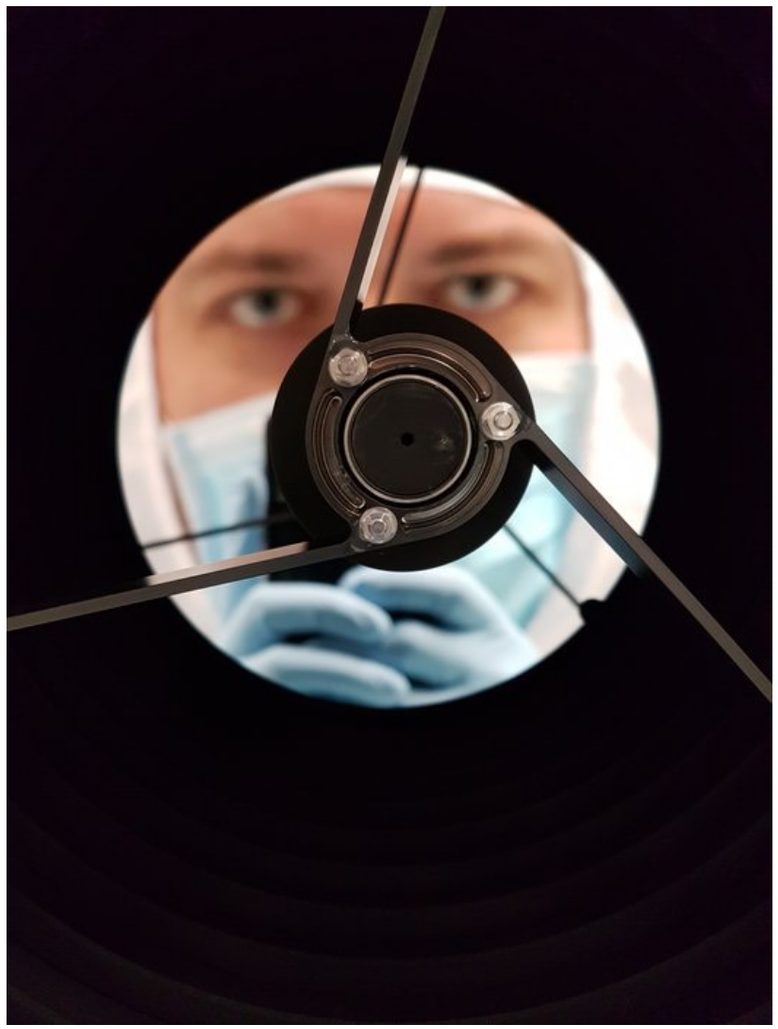
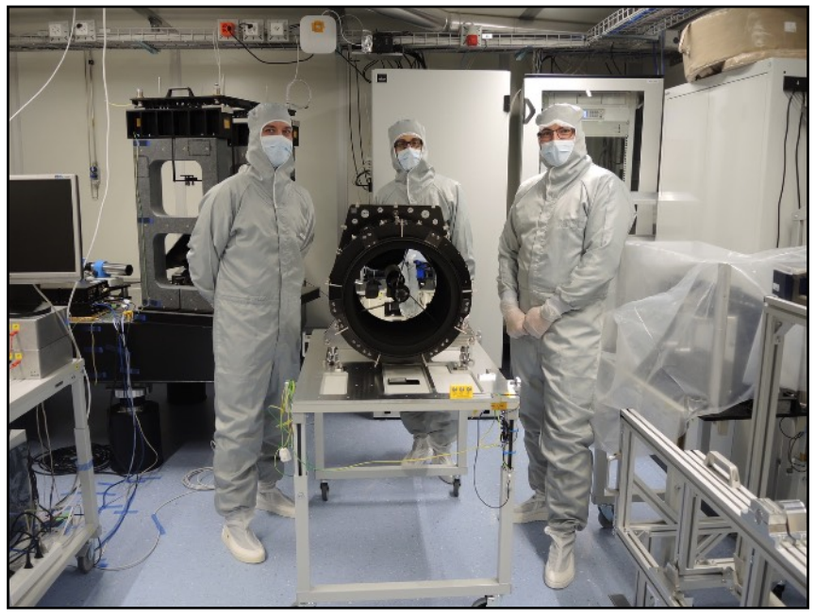
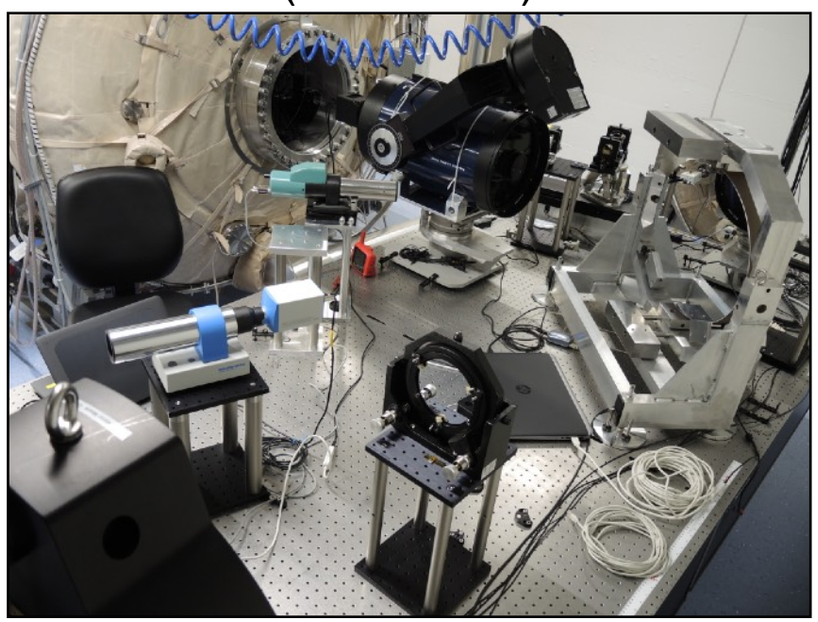
CHEOPS flight instrument system AIV activities at UBE



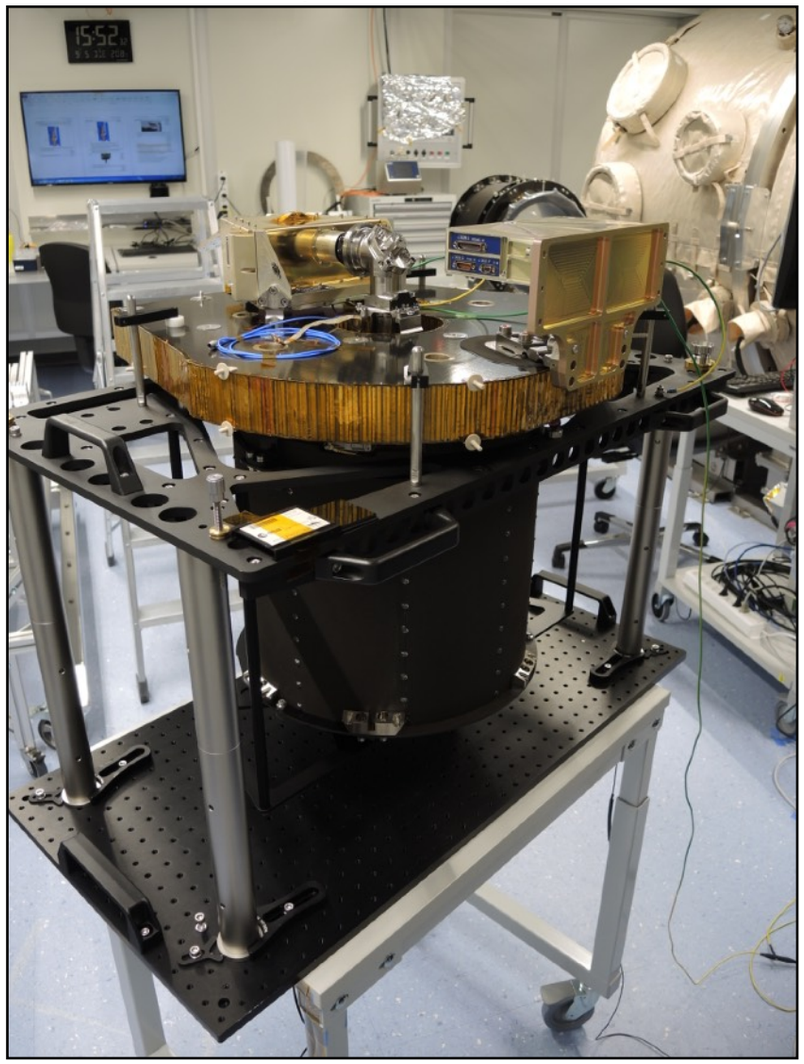
CHEOPS flight telescope incoming inspection (31.4.2017)



CHEOPS calibration facility (14.2.2017)



Alignment of the FPM EM (9.5.2017)



CHEOPS flight instrument (2/2)

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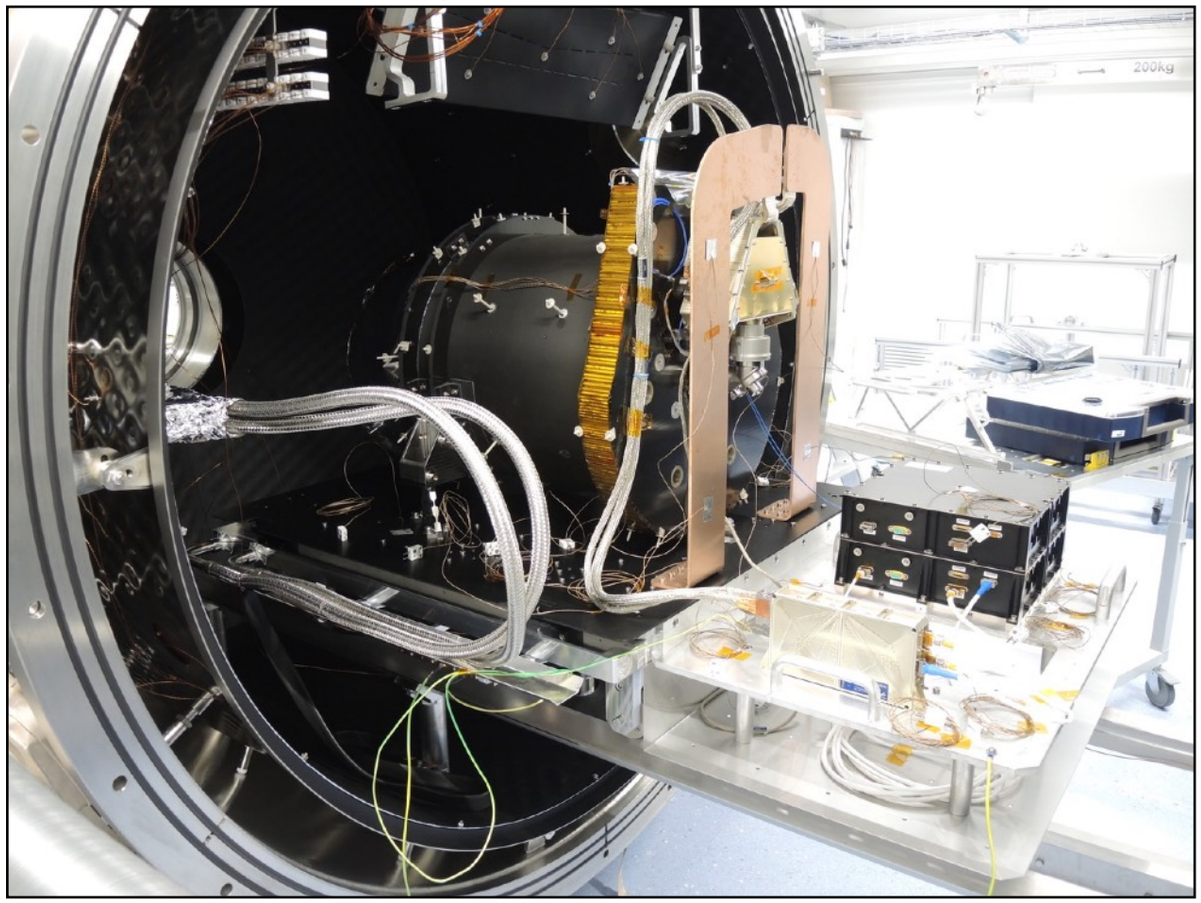
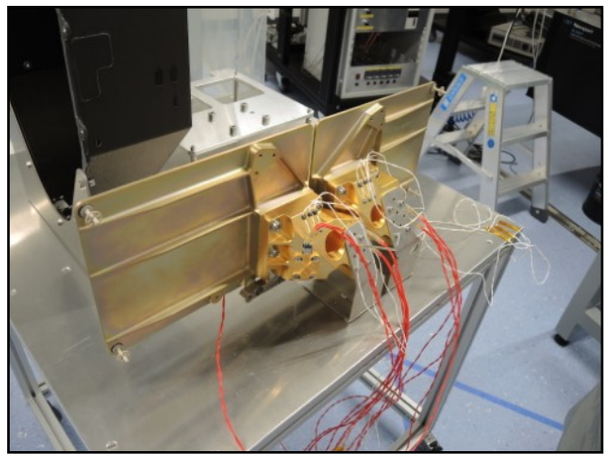
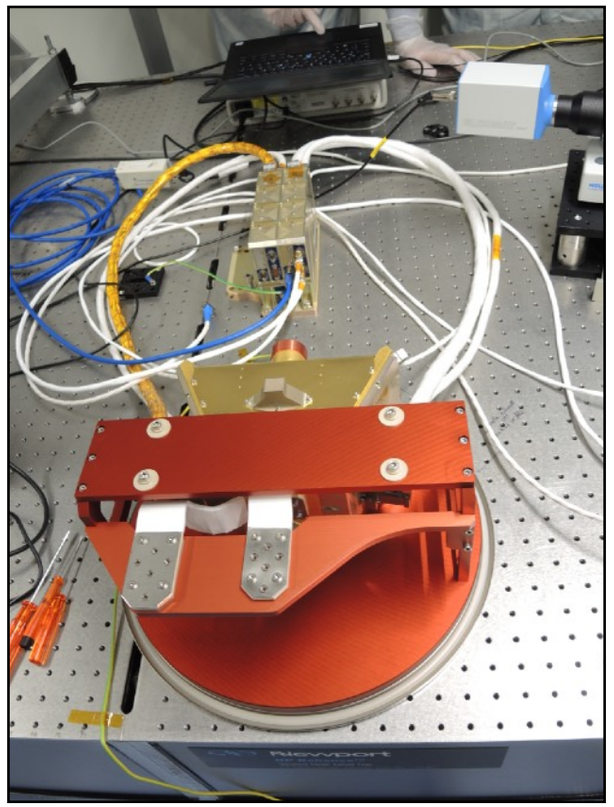
Preparation of the CHEOPS flight telescope TV tests (27.6.2017)



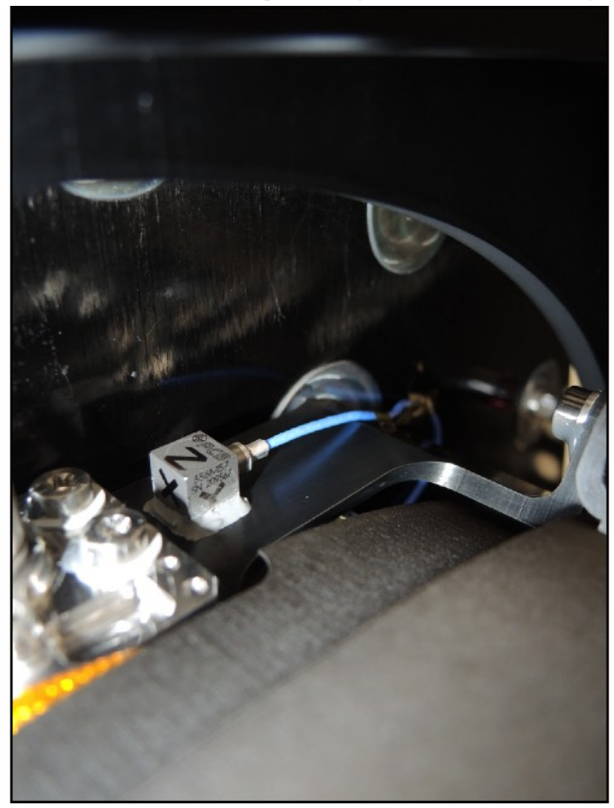
Assembly of the CHEOPS flight radiators (10.7.2017)



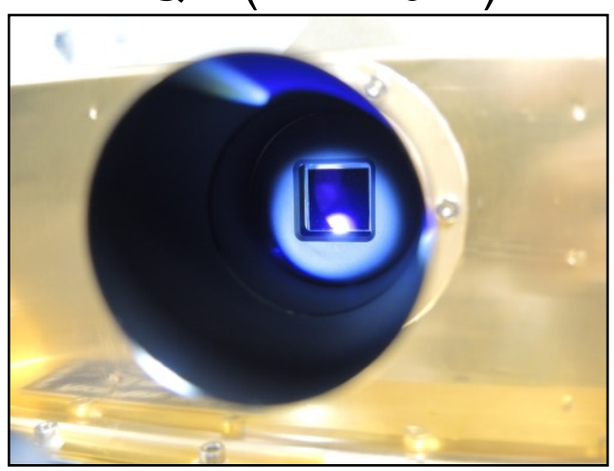
Incoming inspection of SES EQM (18.7.2017)



Placing accelerometers on the telescope (13.7.2017)



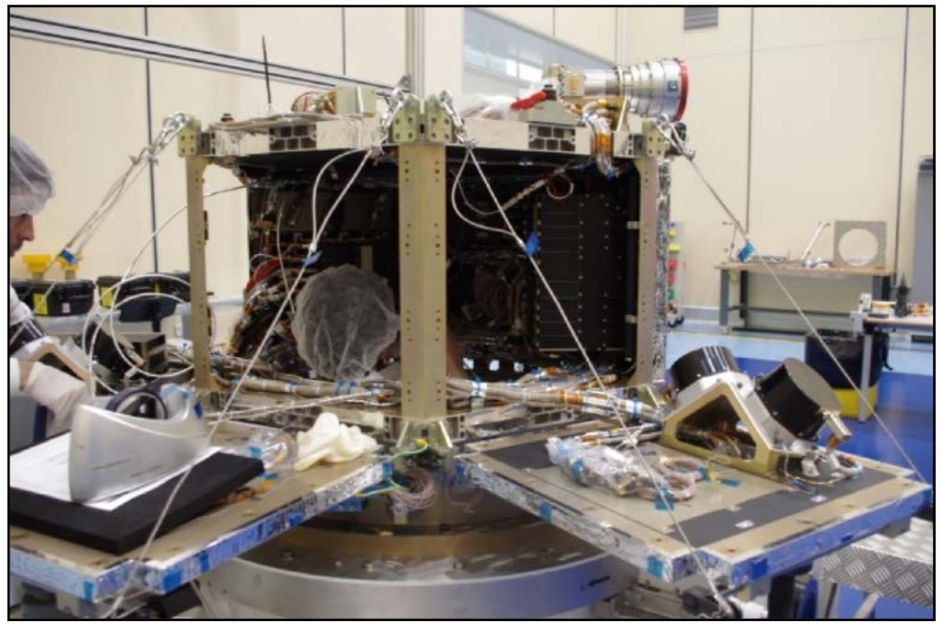
Cleanliness check SES EQM (21.7.2017)



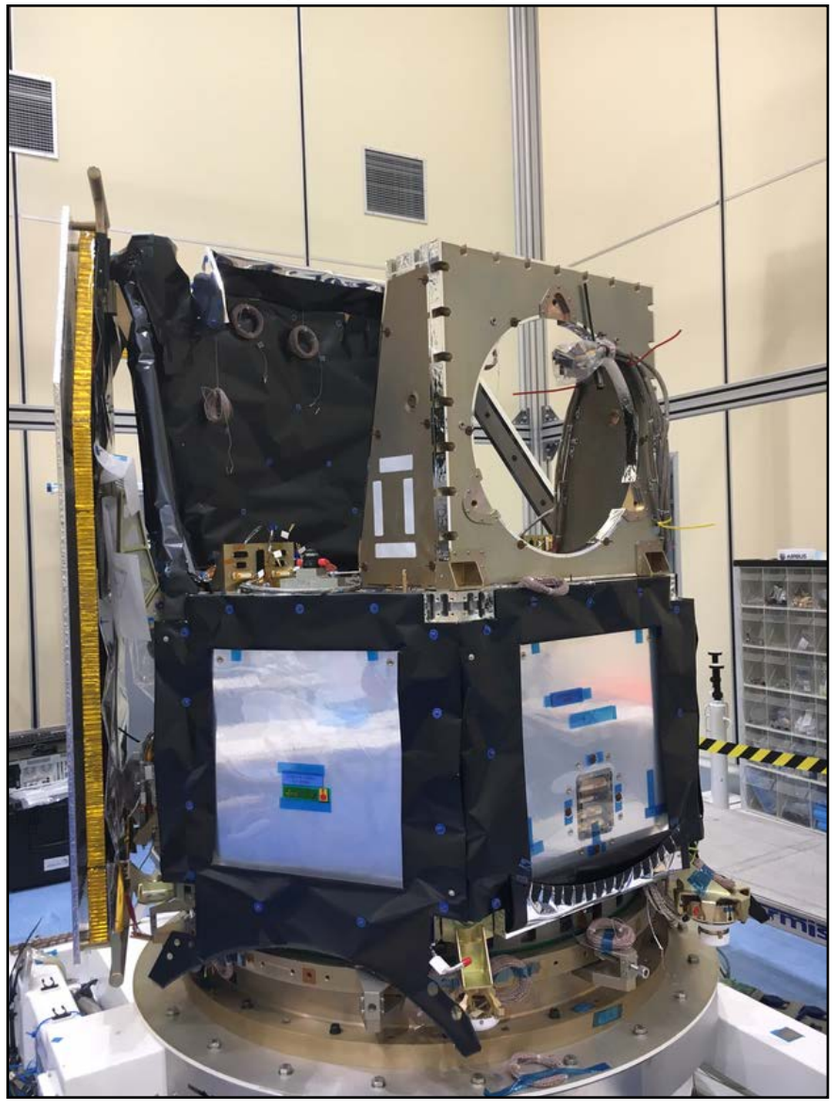
CHEOPS flight platform

Preparation of the CHEOPS flight platform at ADS Spain

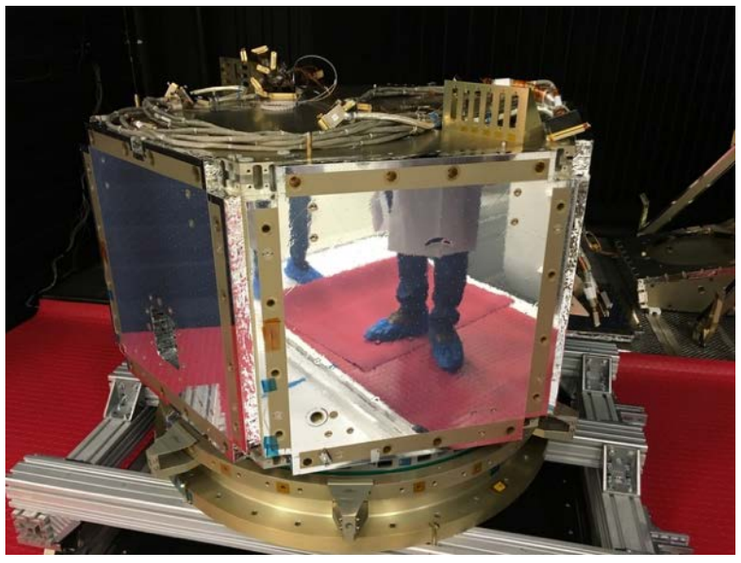
Integration of equipment on CHEOPS flight platform (1.2.2017)



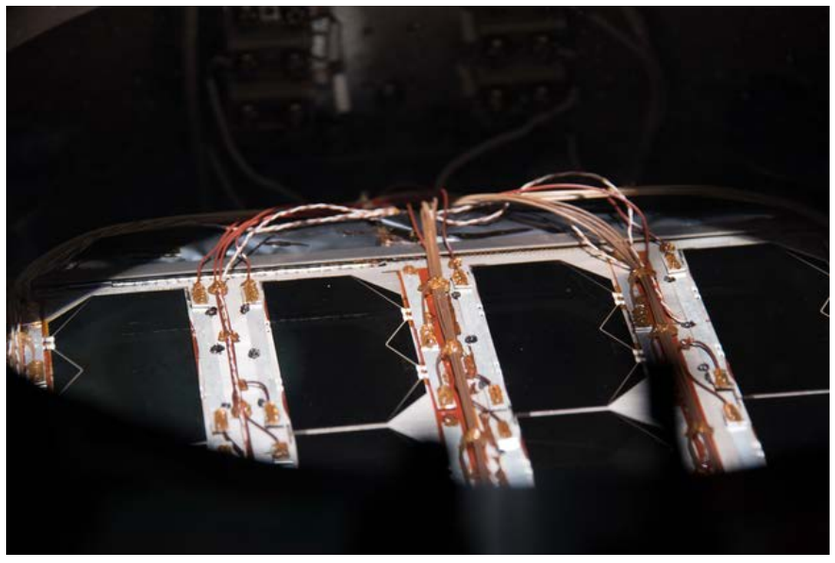
1.5m x 1.4m x 1.5 m CHEOPS flight platform (3.4.2017)



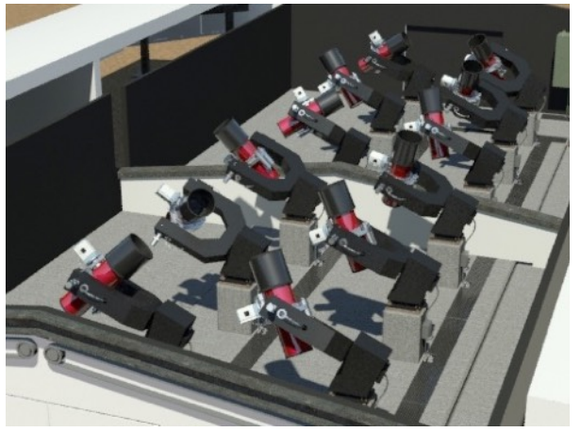
CHEOPS flight structure in TV chamber (3.5.2016)



Qualification tests at ESTEC of CHEOPS solar cell flight platform (15.12.2016)



Target providers



Ground-based transit surveys
NGTS

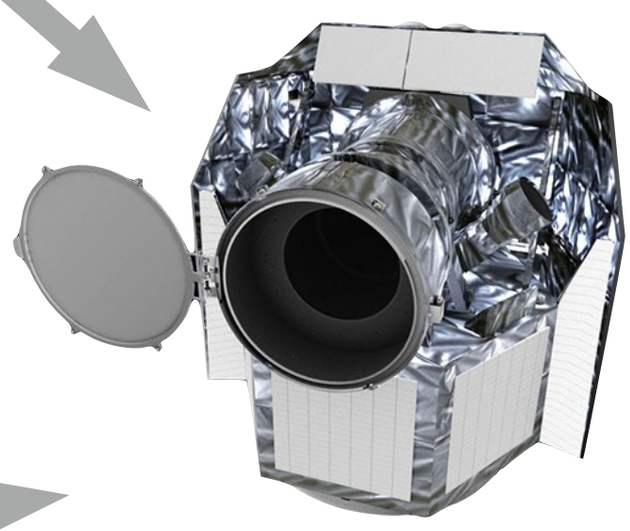
Ground-based RV surveys
HARPS, HARPS-N, HIRES, SOPHIE,
CARMENES, SPIRou, ESPRESSO

K2

TESS

Measure accurate light curves for (sub-)Neptunes

Detect the transit of known super-Earths



CHEOPS

20% open time
(25% of which DDT)

The core science team

D. Queloz
Science Team Chair

22 members from Consortium member states
5 members appointed by ESA
3 ex officio members

Y. Alibert

R. Alonso

D. Barrado

X. Bonfils

A. Brandeker

J. Cabrera

A. Cameron

S. Charnoz

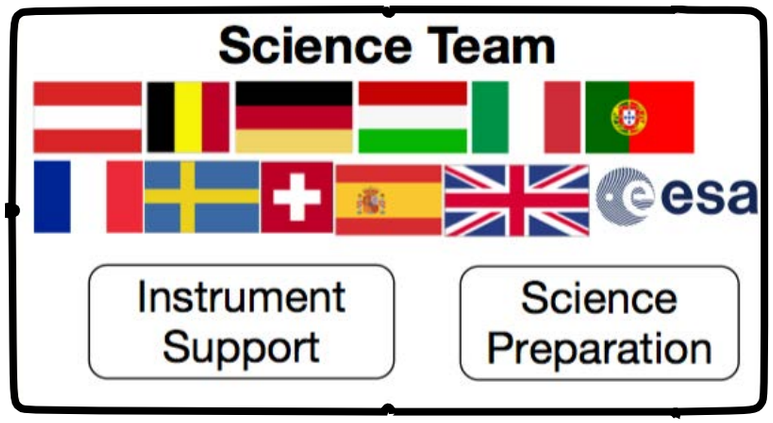
O. Demangeon

A. Erikson

D. Gandolfi

L. Fossati

M. Fridlund



M. Gillon

M. Güdel

K. Heng

J. Laskar

C. Lovis

G. Piotto

I. Ribas

G. Scandariato

D. Ségransan

S. Sousa

G. Szabó

T. Spohn

V. Van Groote

C. Broeg
Project Manager

A. Fortier
Instrument Scientist

D. Ehrenreich
Mission Scientist

Open Time Workshop menu

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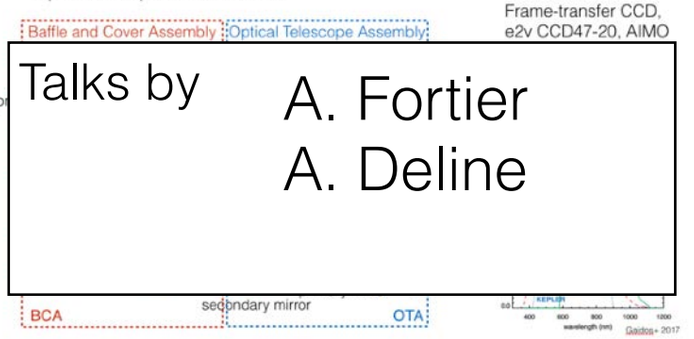
CHEOPS instrument

Ritchey-Chretien telescope of 30cm effective aperture
On-axis carbon fiber structure
Optical band-pass: 330-1100 nm

Baffle and Cover Assembly | Optical Telescope Assembly

Frame-transfer CCD, e2v CCD47-20, AIMO



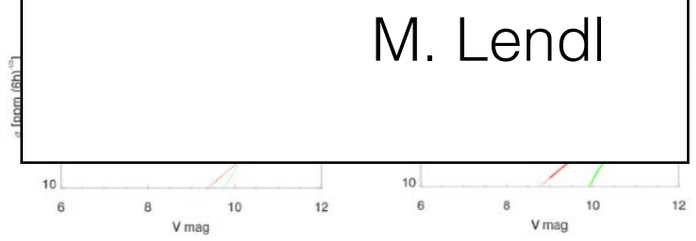
Total length: 1.3m; Total weight: < 60 kg

Talks by A. Fortier, A. Deline

Photometric performances

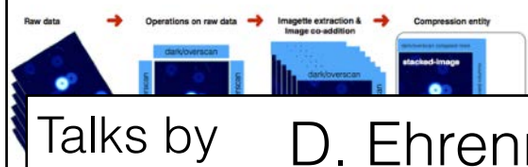
Science Req. 1.1
CHEOPS shall be able to detect Earth-size planets transiting G5 stars with magnitude 6 ≤ V ≤ 9

Science Req. 1.2
CHEOPS shall be able to detect Neptune-size planets transiting K-type stars with magnitude V ≤ 12



Talks by A. Fortier, M. Lendl

CHEOPS Science Data



Talks by D. Ehrenreich, A. Deline, R. Alonso

Ground segment

Talk by M. Beck

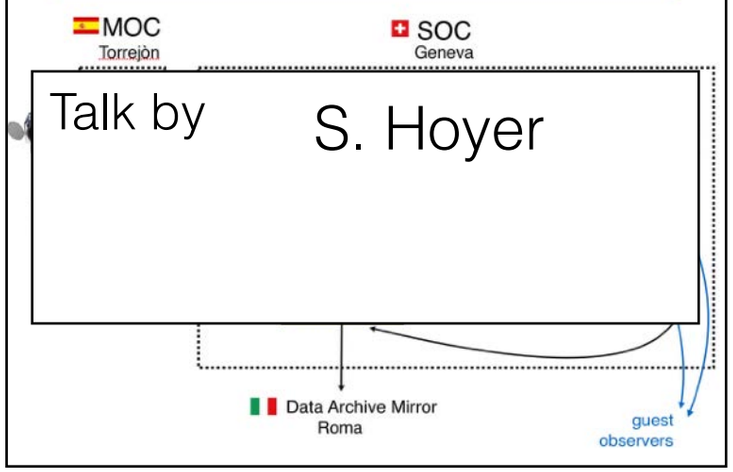
Mission planing

Fact 1: A significant fraction of all targets require time-critical observations
Fact 2: A given target will be observable for ~ 2-3 months/y

Constraints
- x+y+z ≥ 100% (possibly over-subscribed programme)
- maximum possible completion rate of requested observations
- minimum satellite idle time
- GTO = 80% and GO = 20% of actual observing time

Talk by N. Billot

Data product and data flow



Talk by S. Hoyer

GTO Programme

- TransitFind
  Search for transits for already known planets (e.g. RV)
- Other

Definition of the content of the 6 categories by the science team is ongoing

Talk by D. Queloz

Open time for guest observers

20% of CHEOPS time will be open time for guest observers

The consortium target list for the whole mission will be published prior to the call and will be protected

The consortium is not in a position to provide help with open time, ESA should be consulted

Talk by K. Isaac