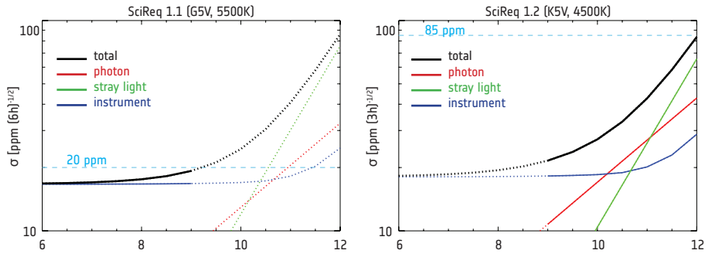
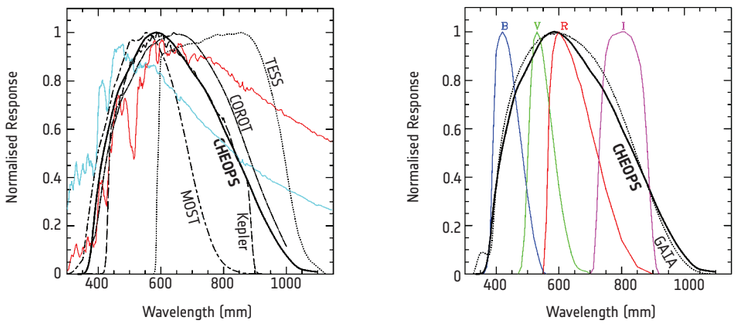
CHEOPS IN A NUTSHELL
→ KEY PERFORMANCE METRICS

Photometric Performance



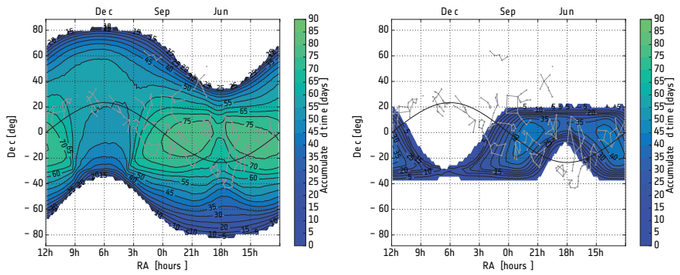
1-sigma photometric precision (in parts per million) for two sizing cases. ***Left:*** *precision foreseen after a total on-source integration time of 6 hours (duration of transit of planet with orbital period of 50 days).* ***Right:*** *precision foreseen after a total on-source integration time of 3 hours (duration of transit of planet with orbital period of 13 days). The dashed horizontal lines denote requirements.*

Bandpass



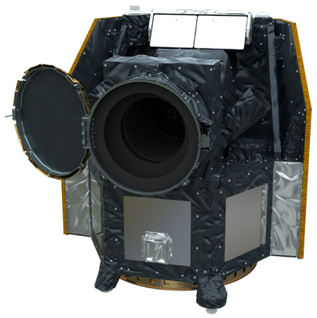
Left: *Normalised spectral response of CHEOPS and selected exoplanet space missions. Cyan = spectral energy distribution (SED) of a T_{eff}~5500K dwarf; pink = SED of T_{eff}~4500K dwarf.* ***Right:*** *Normalised spectral response of CHEOPS and GAIA, compared with the bandpasses of the BVRI filter set (Bessell, 1990, PASP, 102, 118 with data taken from http://spiff.rit.edu/classes/phys440/lectures/filters/filters.html). See https://www.cosmos.esa.int/web/cheops/cheops-performances for further details.*

Sky coverage



Accessible sky (in days per year) for which the contribution to the noise budget from Earth stray light is ≤ 5 ppm /70 ppm for a V=9 G-type (T_{eff}=5500K)/ V=12 K-type (T_{eff}=4500K) dwarf, and for which the maximum % of each spacecraft orbit that is free from interruptions due to Earth Occultation or passage through the South Atlantic Anomaly is 50% ***(left)*** *or 80%* ***(right)****. Solid black line: locus of the Sun.*

CHEOPS IN A NUTSHELL
→ MORE INFORMATION ...



CHEOPS is an ESA mission implemented in partnership with Switzerland through the Swiss Space Office. The University of Bern leads a Consortium of 11 ESA member states contributing to the mission and represented in the CHEOPS Science Team.

Austria
Belgium
France
Germany
Hungary
Italy
Portugal
Spain
Sweden
Switzerland
United Kingdom

For further details, see the following websites:

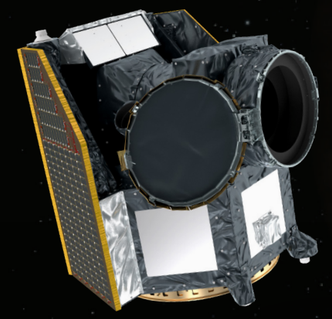
https://sci.esa.int/cheops

https://cosmos.esa.int/cheops

http://cheops.unibe.ch/

CHEOPS

→ CHARACTERISING EXOPLANET SATELLITE
ESA'S FIRST SMALL SCIENCE MISSION



CHEOPS is the next European Space Community contribution to the long-term international effort of finding life beyond our Solar System. The mission will use the technique of ultra-high precision transit photometry to measure accurate sizes of large samples of Earth to Neptune-sized planets, targeting individual bright stars already known to host exoplanets.

By combining measurements of radius made with CHEOPS with existing mass determinations, it will be possible to determine the mean density of the planets and thus to start to constrain their internal structure and composition. These constraints will be combined with key parameters of the host stars and the planetary orbits to provide vital clues to how small planets form, migrate and evolve.

CHEOPS will identify prime targets for searches for the fingerprints of key molecules in the planets' atmospheres using facilities such as Webb Telescope and future ground-based facilities such as the European Extremely Large Telescope. It will also be used to study the physical mechanisms driving energy transport in the atmospheres of hot Jupiters, through measurements of their phase curves.

To achieve these science objectives, the design and implementation of CHEOPS has been optimised to achieve:

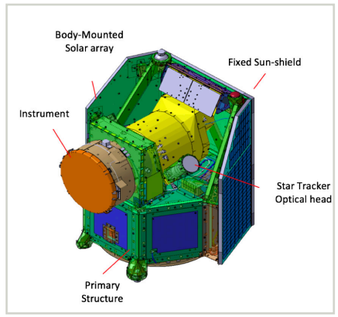
- Ultra-high precision photometry in the visible-NIR, over periods of up to 48 hours.
- High sampling cadence (up to 1 sample per minute).
- Large instantaneous and annual sky coverage.

CHEOPS IN A NUTSHELL → MISSION OVERVIEW

Overview:

- First ESA small (S-) class science mission.
- Partnership with Switzerland with contributions from 10 other member states.
- Short development time (5 yrs), ESA cost of 50M€ .
- Responsibilities:

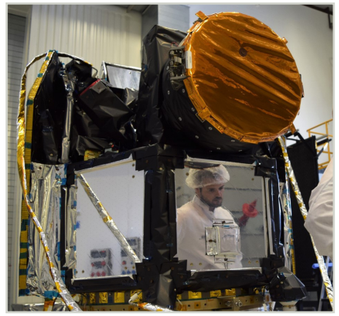
ESA: mission architect + launch, spacecraft procurement (delegated to ADS Spain), instrument CCD, mission operation tools, Guest Observers Programme.
Consortium: instrument, mission/science operations, science team, monitoring + evaluation of science performance.



CAD of the CHEOPS spacecraft. Credit: Airbus Defence and Space Spain.

Spacecraft:

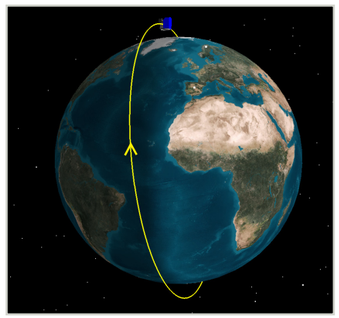
- Based on flight proven Airbus D&S platform, with small modifications.
- ~ (1.5 m)^3, 290 kg mass (wet).
- Rolls around Line of Sight to ensure radiators point to free-space (nadir locked).
- 3-axis stabilised, "payload in the loop" to provide < 4 arcsec (rms) pointing stability.
- Design compatible with wide range of launcher environments.



The Intgrated CHEOPS flight hardware. Credit: Airbus Defence and Space Spain.

Mission Profile:

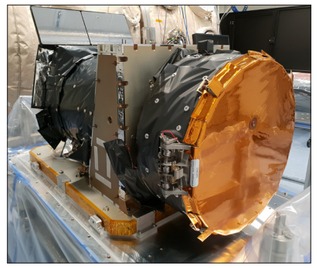
- Sun-synchronous orbit (~100 mins): dawn-dusk (6 am), 700 km altitude.
- Shared launch on Soyuz from Kourou; completion of satellite-level tests end 2018, launch in 2019.
- Mission Operations Centre (MOC) - INTA (Torrejòn, ES).
- Science Operations Centre (SOC) - Geneva Observatory (CH).
- 2-month commissioning period, 3.5 years nominal science operations (goal: 5 years).

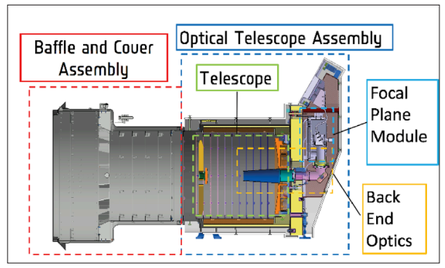


Operational orbit of CHEOPS, on the day-night terminator. Credit: ESA.

CHEOPS IN A NUTSHELL → PAYLOAD

Single ultra-high precision photometer covering 0.33 – 1.1 microns

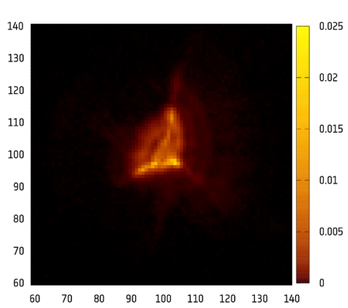


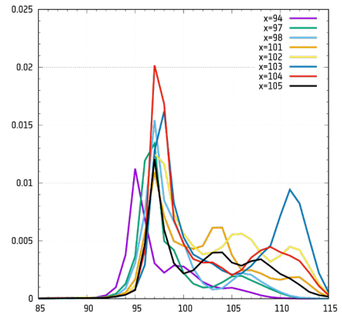


Left: *Fully-assembled flight model of the CHEOPS payload;* ***Right:*** *Cross-section through the payload. Credit: University of Bern.*

Telescope Optics:

- Ritchey Chrétien Telescope, primary mirror effective diameter 30cm, F/5 optics, effective focal length 1600 mm.
- De-focussed point spread function (PSF), radius (90% encircled energy) ~12 pixels.
- Plate scale of ~ 1 arcsec/pixel, 17' x 17' field of view (0.32 deg^2).
- Multiple baffles to minimise straylight.





Left: *White light PSF measured over 500 - 800 nm waveband during the on-ground calibration campaign (x- and y-axes in pixels relative to bottom lower left pixel in a 200x200 pixel image frame, colour scale indicates fraction of total power in an individual pixel);* ***Right:*** *Cuts through the PSF at the specified value of x. Credit: University of Bern.*

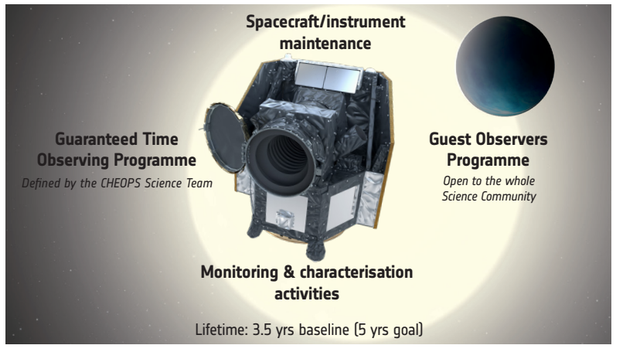
Detector:

- Single CCD 4720 (Teledyne e2v): back-illuminated, thinned, operating in advanced inverted mode to minimise dark current.
- 13 micron square pixels, 1024 x 1024 pixel full-frame array, frame transfer.
- Cooled to -40 deg C, thermally stabilised to 10 mK.

Operations:

- Pointed observations of single targets, with the field of view rotating around the pointing centre.
- 1 minute sampling cadence (eg. 200 x 200-pixel sub-frame rate), cadence of additional imagettes (eg. 15-pixel radius) can be up to one every few seconds.
- Maximum exposure time of 60 s.
- Standard ultrabright, bright and faint modes to cover wide target magnitude range.

CHEOPS IN A NUTSHELL → OBSERVING WITH CHEOPS



- 10% of time per year top-sliced for spacecraft-/instrument-related activities, together with programme to monitor and characterise CHEOPS performance.
- 80% of remaining observing time allocated to the Guaranteed Time Observing Programme (GTO), defined by the CHEOPS Science Team.
- 20% of remaining observing time - 1578 hours/946 orbits per year - available to Community through the ESA-run CHEOPS Guest Observers (GO) Programme.
- Target list for the GTO Programme defined for full 3.5 year mission from outset:
  - List frozen shortly before annual calls, updated over the course of the mission according to agreed procedures.
- ESA Guest Observers' Programme.
  - Annual Announcements of Opportunity (AOs) – first call ~ 6 months before launch.
  - Open to all, regardless of nationality or country of employment.
  - Any science that makes use of the capabilities of CHEOP eligible, however targets on the GTO target list are blocked.
  - Proposals evaluated by an independent ESA-appointed Time Allocation Committee (TAC), selected based on scientific merit and applicability of CHEOPS.
  - To allow newly discovered sources to be observed by Community, up to 25% of the GO time will be available via Discretionary Programme that can be applied to at any time of year. Opens shortly after launch.
- Same proprietary period applies for GTO data, and GO data from annual AOs.
  - 1 year after last visit of a given observation request has been made and declared complete; will not exceed a period of 1.5 years that starts from time of successful completion of first visit of observation request.
  - Proprietary time for Discretionary Programme component of GO up to that of standard, annual call.
- All CHEOPS data reduced using pipeline running at Science Operations Centre (SOC) in Geneva. Data accessed via CHEOPS archive at SOC.
- Observations scheduled according to priorities set by the TAC (GO) and the Science Team (GTO), respecting the 20%:80% split between GO and GTO.
  - Award of observing time does not guarantee that observations will be executed due to complexities of scheduling large numbers of time-critical observations.
- Tools and documentation to support Guest Observers in proposal preparation/submission and use of CHEOPS provided by the CHEOPS Mission Consortium and ESA.
- Community support provided by ESA Project Scientist.