

CHEOPS

An exoplanet follow-up mission

Willy Benz, University of Bern, Switzerland
on behalf of the CHEOPS Team

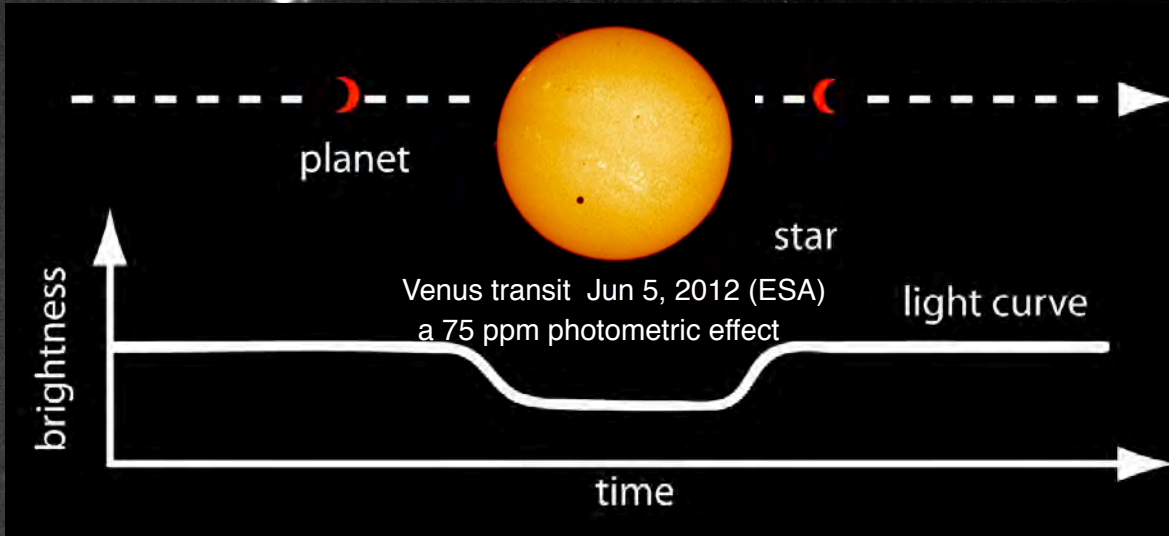


| CHEOPS ESA's first S-mission | |
|---------------------------------|---|
| goal | measurement of the size of planets orbiting bright stars |
| targets | $V < 12$ stars already known to host planets |
| wavelength | optical: 400 to 1100 nm |
| telescope | Ritchey-Chretien telescope, effective aperture 30cm, F/5 optics, FoV 17'x17' arc min. |
| spacecraft | Airbus D&S design, 3-axis stabilised, nadir locked. 1.5x1.5x1.5 m, 290 kg |
| orbit | LEO sun-synchronous, LTAN 6am, 700km altitude |
| timeline | selected: November 2012 adopted: February 2014 launched: December 2019 operations: 3.5 years nominal |

Kourou: 18.12.2019 (credit: Arianespace)



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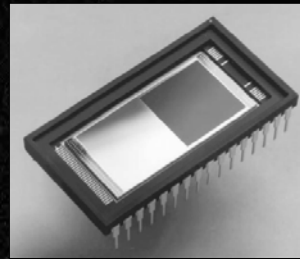
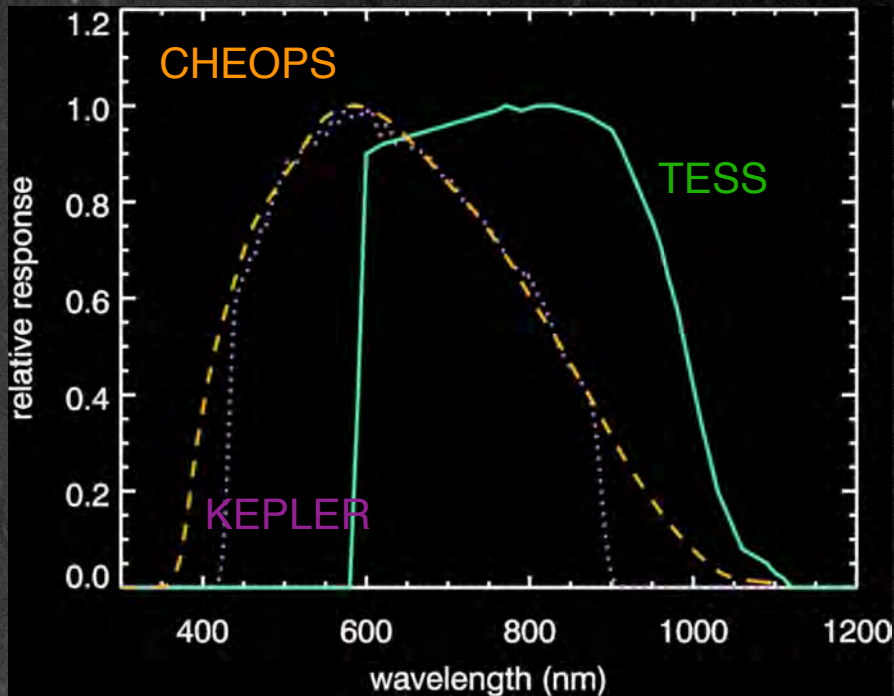
1) Transits of super Earth-size planets around G5 dwarfs of $V < 9$ and radius to 10% accuracy: $\rightarrow 20 \text{ ppm in 6h of integration}$

2) Transits of Neptune-size planets around K dwarfs of $V < 12$ and radius to $< 2\%$ accuracy: $\rightarrow 85 \text{ ppm in 3h of integration}$

January 12, CHEOPS as seen from the SAINT-EX robotic 1m telescope located at the National Astronomical Observatory of Mexico at San Pedro Martir estimated visual magnitude: ~ 8.4



CHEOPS

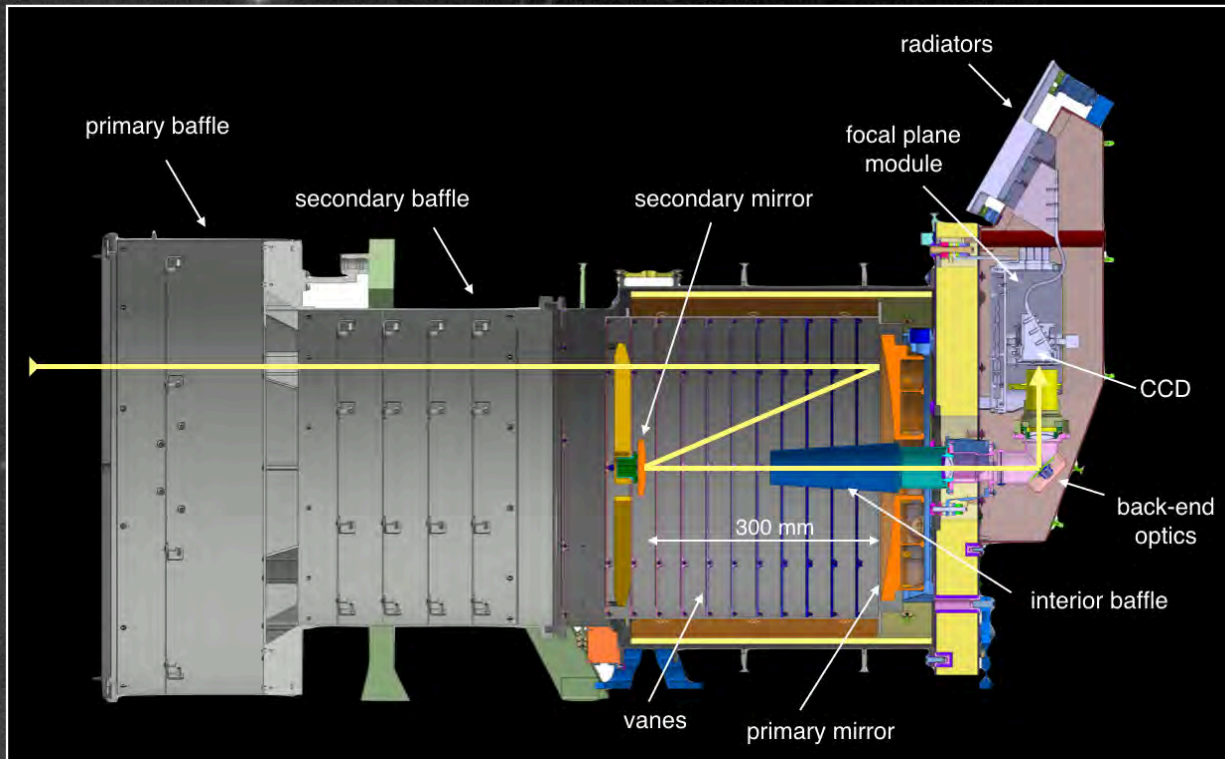


1k x 1k
Frame-transfer CCD,
e2v CCD47-20, AIMO

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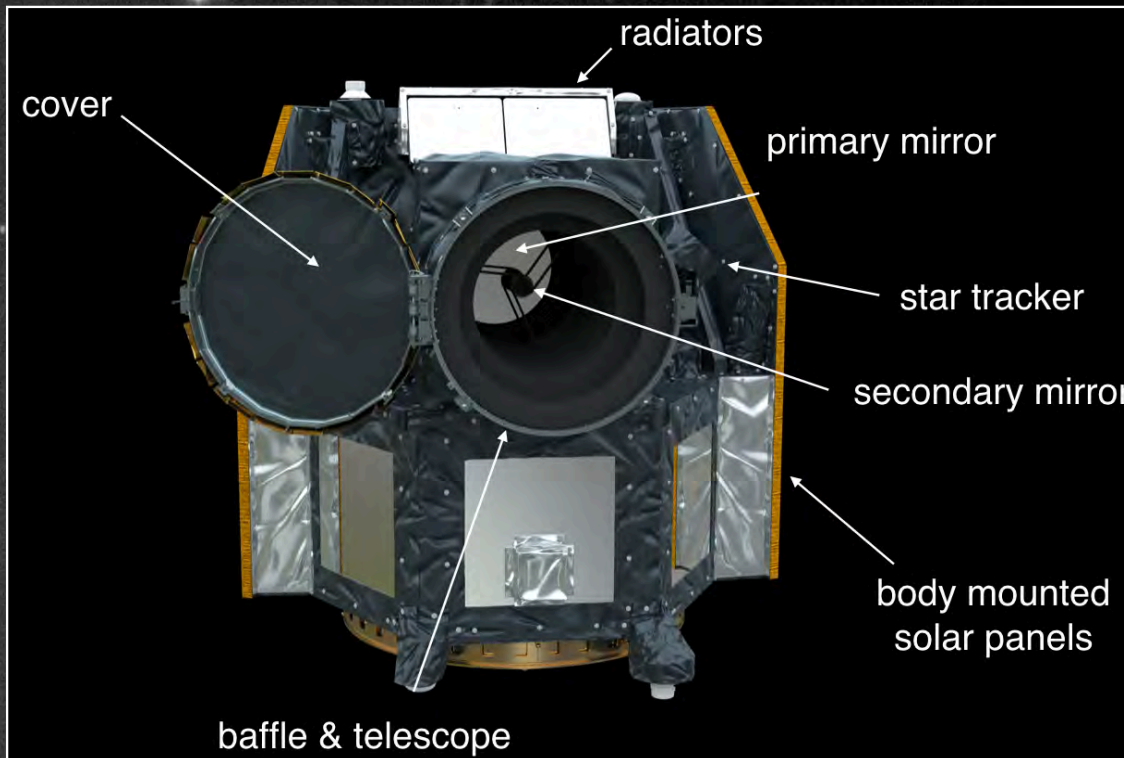
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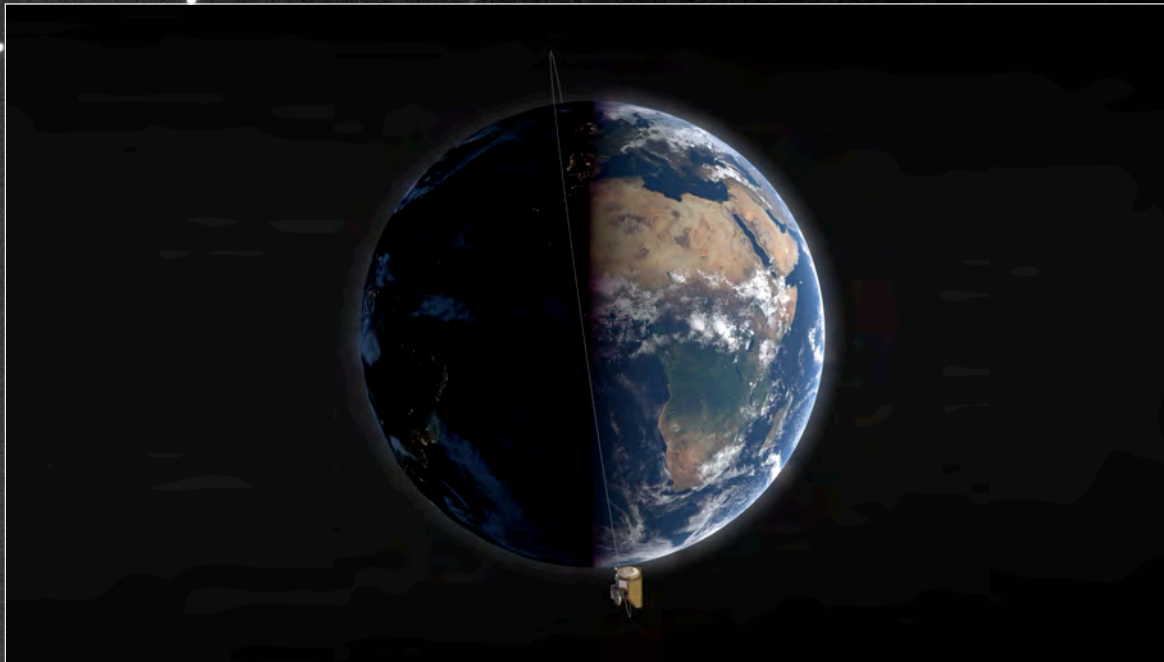
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CHEOPS: an ESA small mission

- ESA S-class missions approved by SPC in 2011 and first call issued in February 2012

- Requirements

- Scientific excellence in any area
- Cost
 - Total cost < 150 M€
 - Cost to ESA: not to exceed 50 M€
- Schedule
 - Developed and launched within 4-5 years

- CHEOPS selected in 2012 as a Partnership with Switzerland with important contributions from 10 other members states

The mission has been launched within schedule and allocated budget

CHEOPS Consortium



11 countries + ESA



The CHEOPS organisation

Joint overall lead: ESA - Switzerland



Consortium: institutes from 11 countries



Payload



Switzerland
Payload system
engineering & AIT
telescope structure



Austria
DPU, PSDU
flight software



Belgium
baffle



Germany
Focal Plane
Assembly



Hungary
radiators



Italy
optical system

- launching state
- platform procurement
- launch services
- CCD
- space debris service

SOC



Switzerland
Operations
Data products



France
Data Reduction
Software



Portugal
Mission Planning,
Archive, & Data
Reduction Software



Sweden
data simulator



UK
Quick look

MOC



Spain
Mission Operations
Center

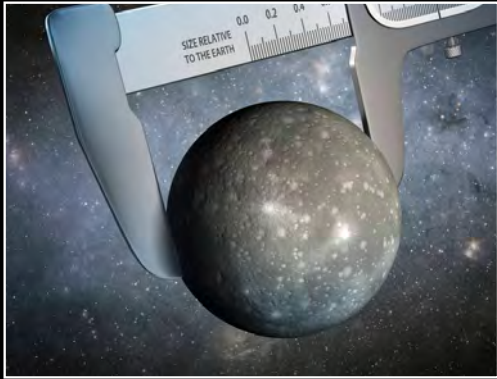
*New approach to mission development
had to be implemented to allow
meeting schedule and budget
requirements*



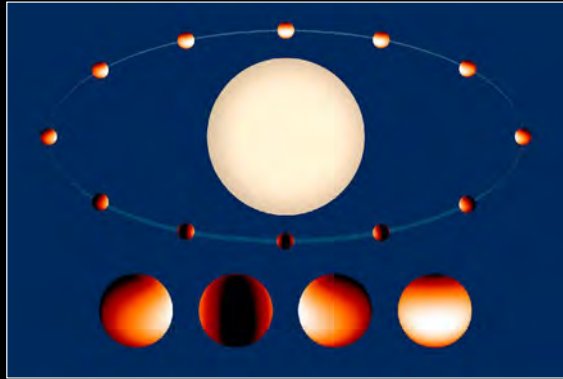
CHEOPS Science

defined by the CHEOPS science team

accurate sizing: M/R relation



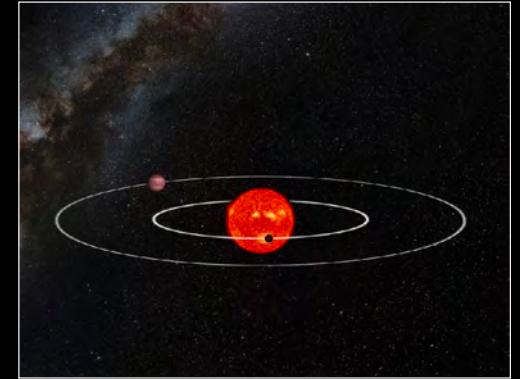
Atmospheres: phase curves



Exomoons, rings, etc.



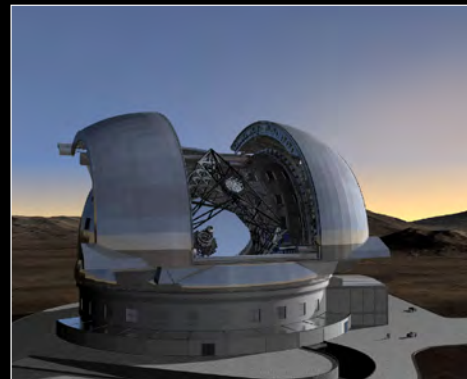
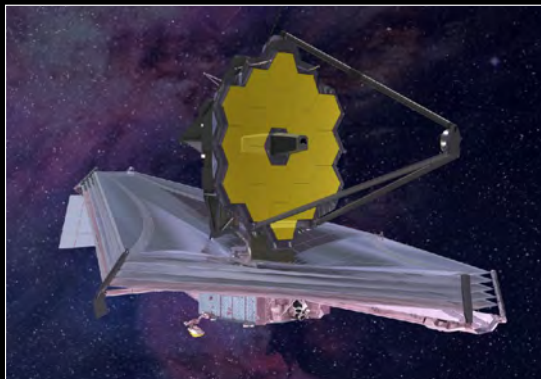
Discovery and masses



Golden targets for future facilities



CHESS
CHEOPS-TESS
collaboration



+ 20%
open
time



CHEOPS-TESS Synergy: CHESS

targets:
planets orbiting bright stars

sky coverage:
bright stars are everywhere



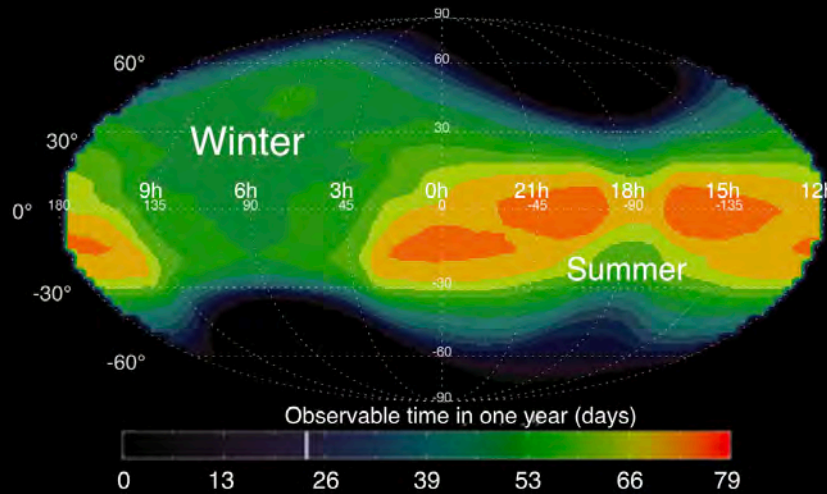
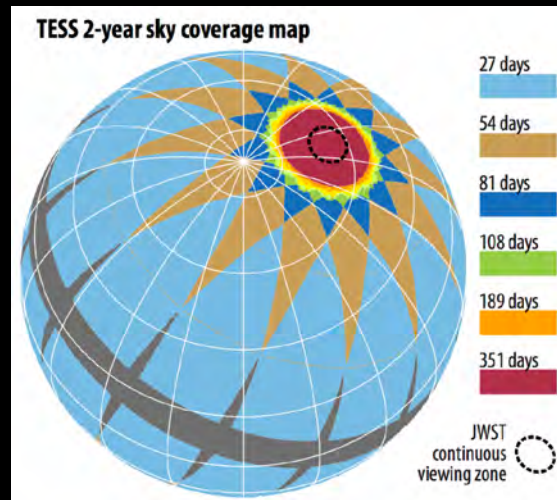
TESS: Discovery

4x10.5cm
cameras



CHEOPS: Follow-up

1x33cm
telescope

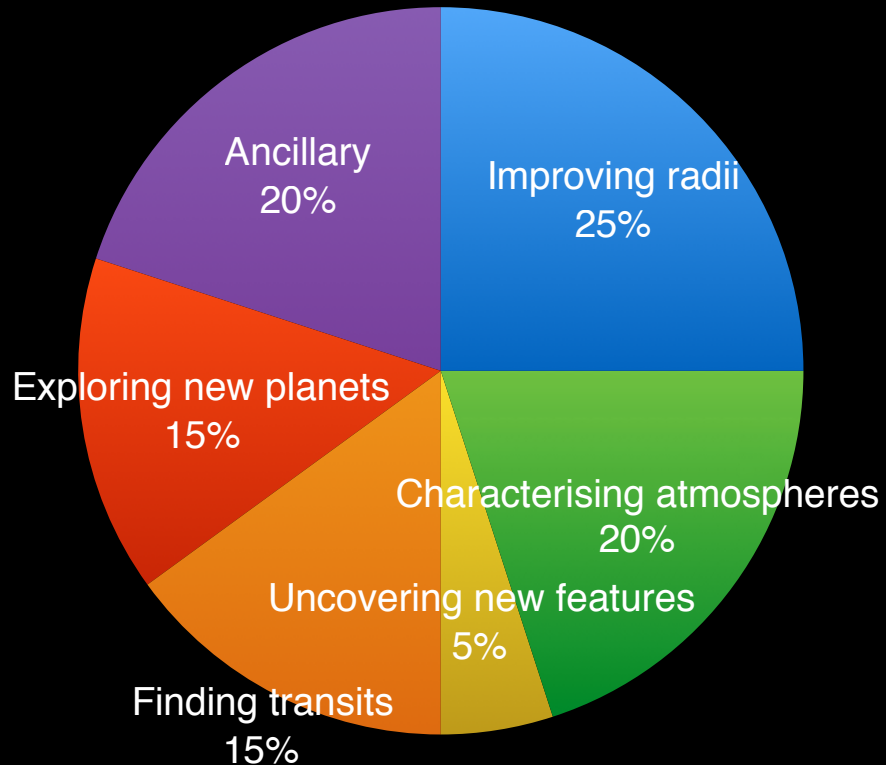


Complementary in
science goals and
sky coverage!



Science programme: 2 pillars

Garanteed time observing (GTO): 80%



Defined by the CHEOPS Science Team
(proprietary time: ~1 year)

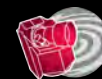
Guest observing (GO): 20%

- Open to all
- Two options for obtaining time:
 1. yearly ESA call for proposals (AO); selection on scientific merit by ESA appointed TAC
 2. director's time (DT, up to 25% of GO), will start after launch with a focus on new targets; proposals selected by ESA Director of Science
- Result of first AO: <https://www.cosmos.esa.int/web/cheops-guest-observers-programme/ao-1-programmes>
- Next AO: TBD (probably autumn 2020)

get more infos at:

<https://www.cosmos.esa.int/web/cheops-guest-observers-programme>
and poster at this conference

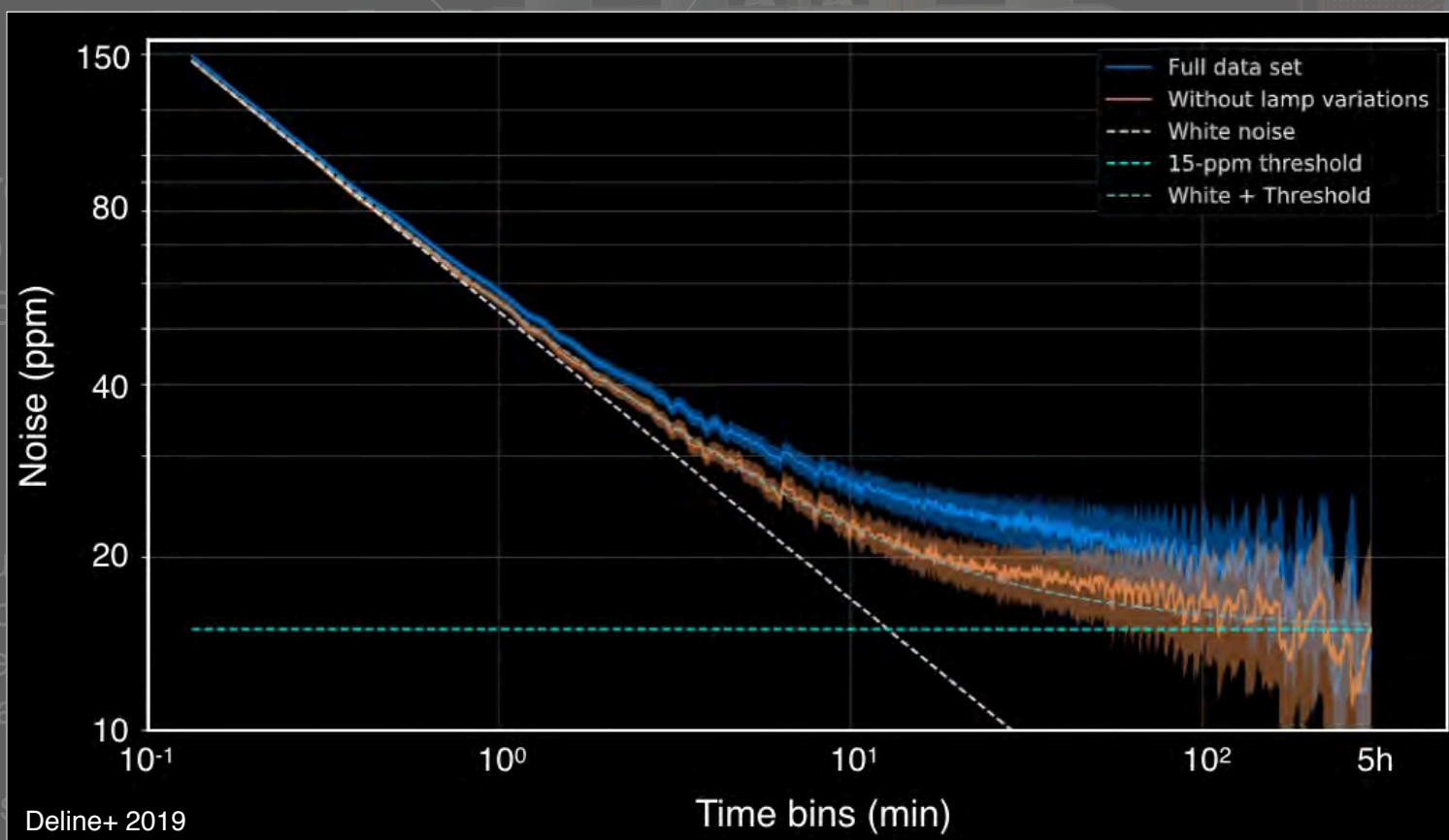
Defined by the community
(proprietary time: ~1 year)



Thermal vacuum tank

SEM

Noise curve of corrected and de-trended light curve



Deline+ 2019

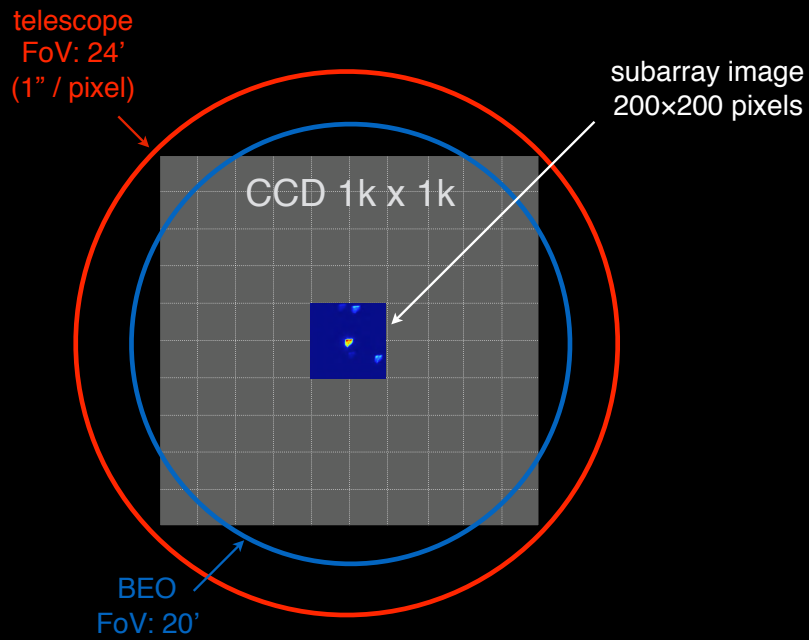
flat tip-tilt mirror

January - Mar
CHEOPS Lab
University of B

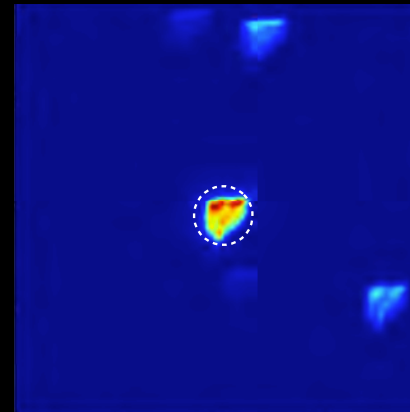
- Flat fields in mu
- PSF over field of
- Gain sensitivities
- Dark current ma
- Bad pixels / full
- Stability tests us



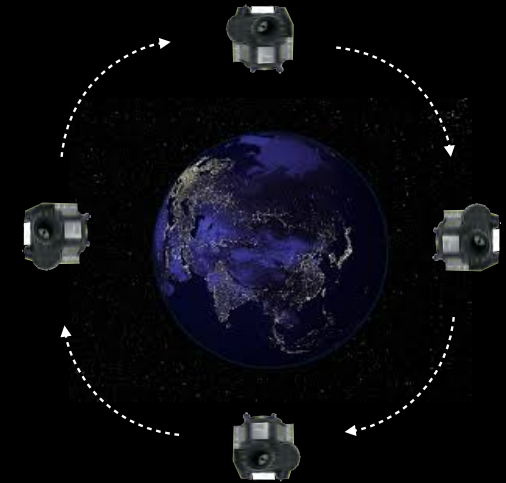
Data acquisition



Defocused image
90% of energy in 24 px
S/C jitter 4" rms



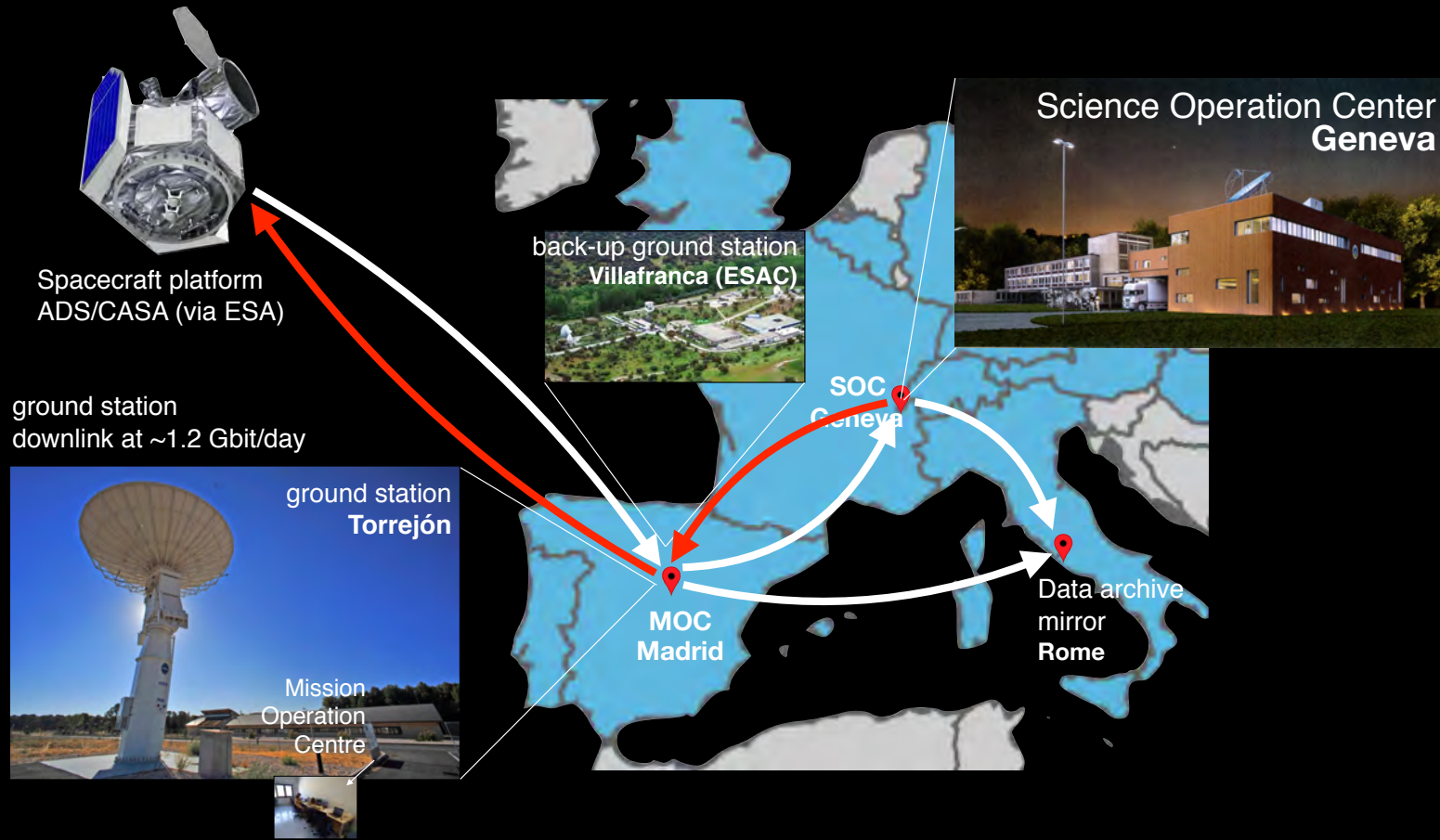
sun-synchronous polar orbit
measuring overnight side
radiators always pointing to space



The field is rotating around the target star because CHEOPS is nadir-locked



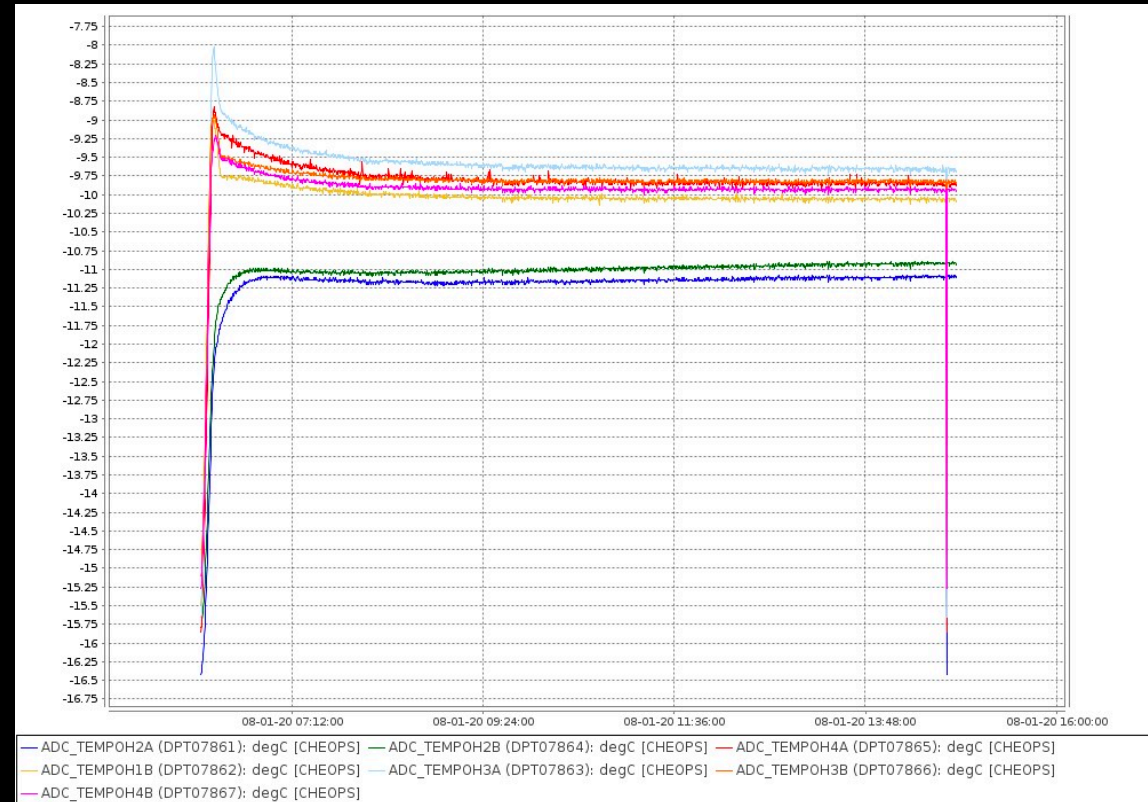
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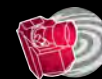




Latest news

- Launch and Early Orbit Phase (LEOP) concluded successfully
- January 8: Beginning of in-orbit commissioning
 - Instrument switched on successfully, health-check passed
 - telescope temperature stabilisation successfully achieved





Latest news

- January 9:
 - First dark (cover closed) image taken and successfully transmitted to ground station
- January- March
 - In-orbit calibration of CCD and read-out electronics
 - opening of the cover
 - Testing all requirements, determining performances
- ~ April 1
 - Nominal start of science operation

