Observing with CHEOPS

David Ehrenreich
CHEOPS Consortium Mission Scientist
• Low Earth orbit (~700 km)
• 1 orbit ≈ 100 min
• Sun-synchronous w/ LTAN 6:00 am
Exclusion angles

The Sun must not enter this zone

Sun exclusion angle (120°)
Exclusion angles

The Sun must not enter this zone. The Sun exclusion angle is 120°. The ecliptic pole is excluded from the line of sight. The ecliptic plan is favoured.

SUN EXCLUSION ANGLE

-150° -120° -90° -60° -30° 0° 30° 60° 90° 120° 150°

-75° -60° -45° -30° -15° 0° 15° 30° 45° 60° 75°
Exclusion angles

Sun exclusion angles

excluded

favoured

The Sun must not enter this zone
Exclusion angles

The Sun must not enter this zone

Sun exclusion angle (120°)

CHEOPS

line of sight

target
Exclusion angles

Local Time of Ascending Node 6:00 am → polar inclination

Earth occultations = main source of interruptions!
Requesting less interruptions will narrow down the CHEOPS sky on this band!
Exclusion angles

Stray light contamination has orbital & seasonal dependence (cf. A. Fortier’s Performance talk)
Sky coverage
Sky coverage

(50% interruptions of light curves)

Observable time in a year (days)
Kepler field coverage

Scheduling Feasibility Checker required!
CHEOPS + TESS
Simulated yield from Sullivan et al. (2015)

Observable time in a year (days)
CHEOPS + K2

Observable time in a year (days)

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CHEOPS + JWST

CVZ = continuous viewing zone around the ecliptic poles

****FIGURE TO BE UPDATED ****

****FIGURE TO BE UPDATED ****
CHEOPS + JWST

Maximum continuous visibility duration over one cycle

DEC (in degrees)

RA (in degrees)

-150 -100 -50 0 50 100 150

48 84 120 156 192 228 264 300 336

Maximum continuous visibility duration (in days, continuous, non-constant orientation)

JWST

CHEOPS
CHEOPS + JWST

Maximum continuous visibility duration over one cycle

JWST × CHEOPS

Maximum continuous visibility duration (in days, continuous, non-constant orientation)

Ferruit & Isaak
‘Instant’ sky coverage
Exclusion angles (end)
South Atlantic Anomaly interruptions

700 km altitude

www.spewvis.oma.be
Programmes, ORs, visits

- GO/GTO
  - Programme 1
  - Programme 2
  - Programme 3
    - Observation Request 1
    - OR 2
    - OR 3
      - Visit 1
      - Visit 2
        (identical)
      - Orbit 1
      - Orbit 2
      - Orbit 3
Nominal visit

target acquisition

100 min

end of obs. sequence
end of science time in last orbit

Orbit 1

2 3 4 5 6 7 8 9

- science images are acquired
- light centroid delivered to spacecraft

stellar light curve

planet orbit
time

transit contacts

transit duration (e.g. 3h)

target star
Nominal visit

- science images are acquired
- light centroid delivered to spacecraft

target star

transit contacts

transit duration (e.g. 3h)
Nominal visit

Interruptions can be anticipated w/ the Scheduling Feasibility Checker
Interruptions

~1-day observation

SAA

Earth occultations

FEASIBILITY

<table>
<thead>
<tr>
<th>06:00:00</th>
<th>12:00:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visits</td>
<td>Visits</td>
</tr>
<tr>
<td>10min</td>
<td>20min</td>
</tr>
<tr>
<td>90 min</td>
<td>30min</td>
</tr>
</tbody>
</table>

SAA

Earth Occultation

David Ehrenreich

CHEOPS Open Time Workshop: 26-27th July, Schloß Seggau
Time-constrained visit

\[ T_c = T_0 + nP \]

- \( T_{\text{start},1} \) to \( T_{\text{start},2} \) for duration of observations (time requested in orbits)
Time-constrained visit

\[ T_{\text{start},1} \quad T_{\text{start},2} \]

\[ T_c = T_0 + nP \]

easier to schedule
Time-constrained visit

\[ T_{\text{start,1}} \quad T_{\text{start,2}} \]

harder to schedule

\[ T_c = T_0 + nP \]
Time-constrained visit

optimisation of in/out of transit time

\[ T_{\text{start},1} \]

\[ T_{\text{start},2} \]

\[ T_c = T_0 + nP \]
Time-constrained visit

$T_c = T_0 + nP$

optimisation of in/out of transit time
Time-constrained visit

\[ T_{\text{start,1}} \quad \leftrightarrow \quad T_{\text{start,2}} \]

\[ T_c = T_0 + nP \]

Constraints not expressed in **dates** but in **planet orbital phase**
Phase 2 preparation
David Ehrenreich (Mission Scientist)

Presentation
tomorrow 10:20

Hands-on session w/ N. Billot
tomorrow 11:25