SphinX
aims construction and first results

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SphinX: Solar Photometer in X-rays, PI-SRC-PAS
FIAN, MEPhI - RU, AI Ondrejov - CZ, Palermo University - I

Mass ~2500 kg, 8.2 GB/day
96 min 550km
Polar orbit 7 years

Launched 30 Jan. 2009 at 13:30 UT from Plesetsk Cosmodrome


SphinX: A Fast Solar Photometer in X-rays

SphinX: Solar Photometer in X-rays
Polish concept, design & manufacture

Measure the X-ray fluence of the Sun
0.8 – 15 keV with unprecedented

- Time resolution
  \(\sim 0.00001\) s

- Sensitivity 100 x better than GOES XRM

- Energy resolution 3x RHESSI

The construction

- EUV filters (doubly aluminized Mylar)
- Photometer
  - Collimators (+-2.5 deg)
  - Three apertures
  - D1, D2, D3
- Shutter
  - Stepper motor
- FFU
  - Filters
  - Targets
  - D4
- Electronics
  - Front end Amptek
  - Digital „our”
- Controller
  - Software
  - reprogramming
- Heat sink
- Alignment mirror

Total cost of the project  ~1 mln Euro

SphinX characteristics:
- Mass ~ 3.7 kg, Power ~10 W,
- Telemetry: ~ 60 MB/24hours of (10x) compressed data → 0.5 GB/day

## Measurement channels

<table>
<thead>
<tr>
<th>Measurement channels</th>
<th>Photometric</th>
<th>FFU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \phi ): 5 mm</td>
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<td></td>
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<tr>
<td>( A ): 13.0 mm(^2)</td>
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<tr>
<td>8 ( \mu s )</td>
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<tr>
<td>Up to</td>
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<tr>
<td>60 000 cts/s</td>
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<tr>
<td>FWHM: 490 eV</td>
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<td><strong>D2</strong></td>
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<tr>
<td>( \phi ): 4 mm</td>
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<tr>
<td>( A ): 0.26 mm(^2)</td>
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<tr>
<td>25 ( \mu s )</td>
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<td>Up to</td>
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<td>20 000 cts/s</td>
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<tr>
<td>FWHM: 290 eV</td>
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<tr>
<td><strong>D3</strong></td>
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<tr>
<td>( \phi ): 4 mm</td>
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<tr>
<td>( A ): 0.0052 mm(^2)</td>
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<td>25 ( \mu s )</td>
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<tr>
<td><strong>D4</strong></td>
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Detectors (four units): \( 256/1024 \) energy bins
Amptek, Peltier cooled (-50 deg C below the support T) Si PIN diodes.
Detectors’ support plate passively cooled through the heat sink pipe to external radiator
Photon arrival time measured to within 2\( \mu s \) (in Time Stamping Mode)

How it looks from the tests

BESSY Berlin Synchrotron:
- All detector linearity: perfect (0.1%) over 0.8-14.5 keV; dynamic range $10^4$.
- Absolute response known to better than 5% against reference synchrotron source.
- Pile-up matrices known as measured from X-ray 4 crystal monochromator spectra obtained at 8 energies between 1.5 and 8 keV.

First ever seen: X-ray lightcurve of extremely quiet corona

http://www.cbk.pan.wroc.pl/js/lightcurves/

150 preliminary plots

100 x better
Time resolution

Present X-ray fluence
20 x below
GOES Sensitivity threshold

Precise control of orbital background

Fluence for: SPHINX_20090220.224813_0.sav

Present threshold of detection GOES

Polar Oval
X-ings

D1 rate ~100 cts/s

Spacecraft Night

Particle background

One orbit 96 min

Start Time (20–Feb–09 19:14:55)

Soteria Workshop, 23–24 March 2009, Saariselkä, Finnish Lapland J. Sylwester
Never seen before: X-ray spectrum of extremely quiet corona

5 GB collected at ~400 MB/24h

Typical catalogue page out of ~200 already in preparation

D4 X-ray spectra in four detectors
D3 available each second
D2
D1 form 1 -15 keV vertically

Fluence, each second D1- black
D2- blue, D3- yellow, D4-magenta
In red is orbital background
the orbital background fluence atop the position of
the Koronas-Foton In geographic and magnetic coord.

Temperatures on Peltier coolers
and amplifiers
Clock of the processor against UT
~0.5 s difference
Will be improved (Szymon)
Predicted behaviour of activity during operation of Koronas-Foton

http://science.nasa.gov/headlines/y2006/10may_longrange.htm
What **SphinX** data are available for **Space Weather**

- Solar X-ray luminosity 5% absolute level for GOES classes: \( S_{\text{new class}} \), A, B, C, M, X, \( \rightarrow X30 \)
- Time variability from 0.00001 s \( \rightarrow \) 25 min, each orbit during heavily occulted portions
- Uninterrupted solar fluence up to 20 days (except for polar ovals & SAA crossings) during the non-shadow portions (this **March 31-April 18** will be the first)
- Particle flux densities while crossing ovals & SAA (monthly images)
- General background flux mapping in geomagnetic coordinate system (each month maps)
What would be welcomed from SOTERIA

- Support for manpower to do
  - Data reduction, reformatting, archiving
  - Data visualization (environment maps)
- Support for LAN upgrade
  - Routers, switches, cabling up to 1 Gb/s from 10 Mb/s
  - New workstations
- Access to auxiliary data (through the SOTERIA database) for physical interpretation
SphinX & TESIS

Great Thanks to TESIS team for „letting us in” to their fantastic instrument