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Mechanical, Electrical & Electronic construction of ChemiX for the Russian *Interheliozond* Mission

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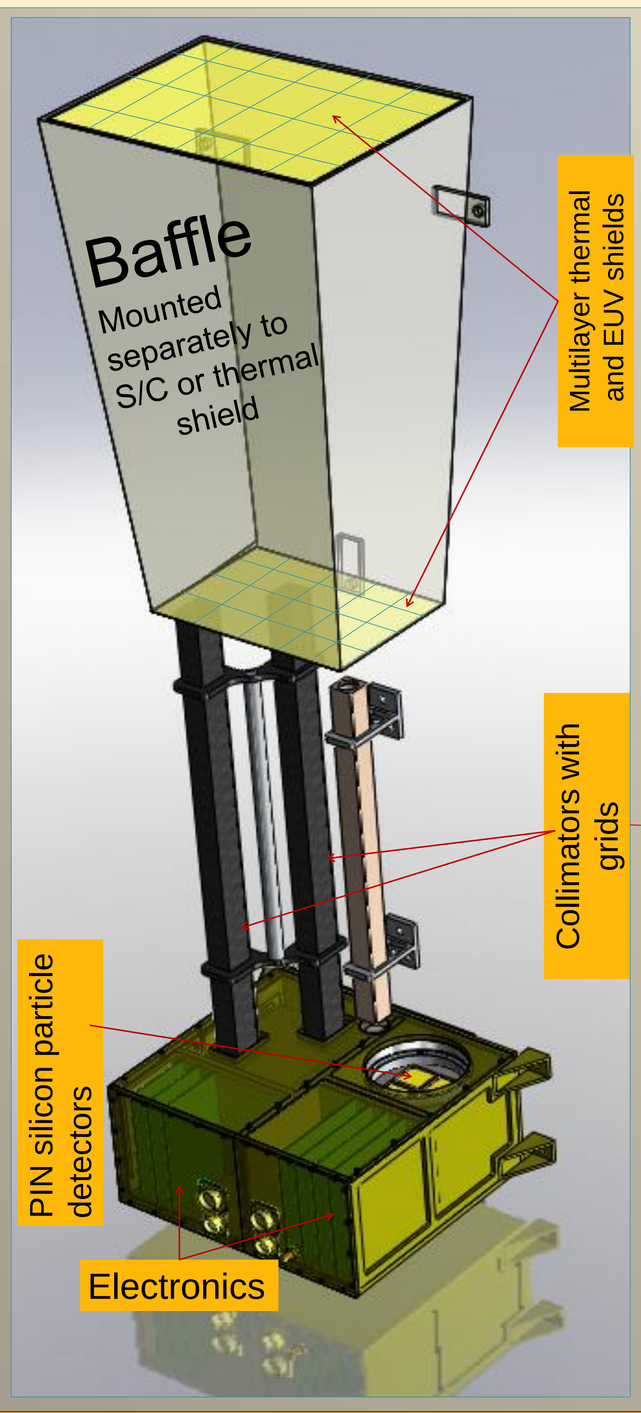
ChemiX is the Bragg crystal spectrometer for studies of Chemical composition of solar coronal plasmas based on measurements of *X*-ray spectra.

ChemiX will have characteristics superior to any spectrometers ever flown, as concerns spectral resolution, wavelength coverage, cadence, signal to noise ratio. Its sensitivity will be better than the sensitivity of its predecessor RESIK flown on CORONAS-F, thanks to a close proximity to the SUN (~0.2 a.u.) expected for the Interheliozond interplanetary probe.

ChemiX will revive plasma diagnostic offering direct insight to basic plasma properties: composition, differential emission measure, non-thermal excitations, turbulence, Doppler shifts → plasma heating

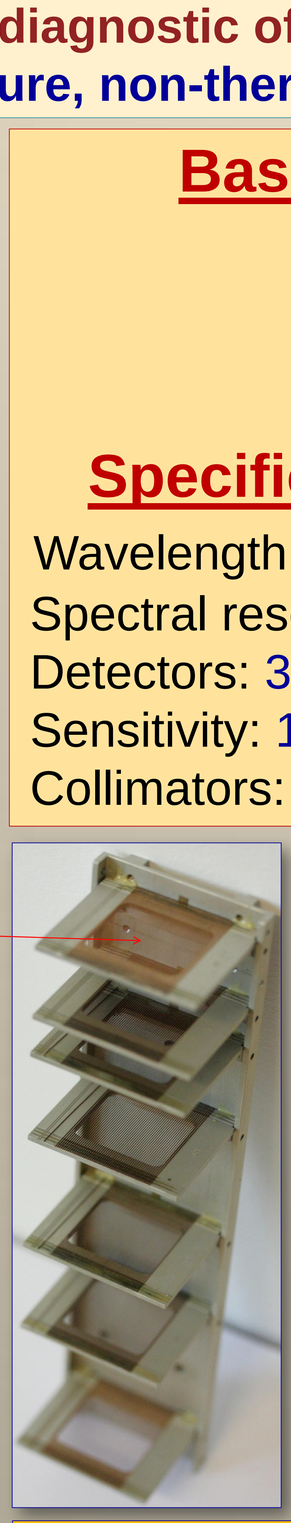


Basic Instrument parameters

Mass: ~5 - 6 kg
Power consumption: ~10 W
Size: 30cm x 30cm x 120cm
Telemetry: up to 12 kB/s

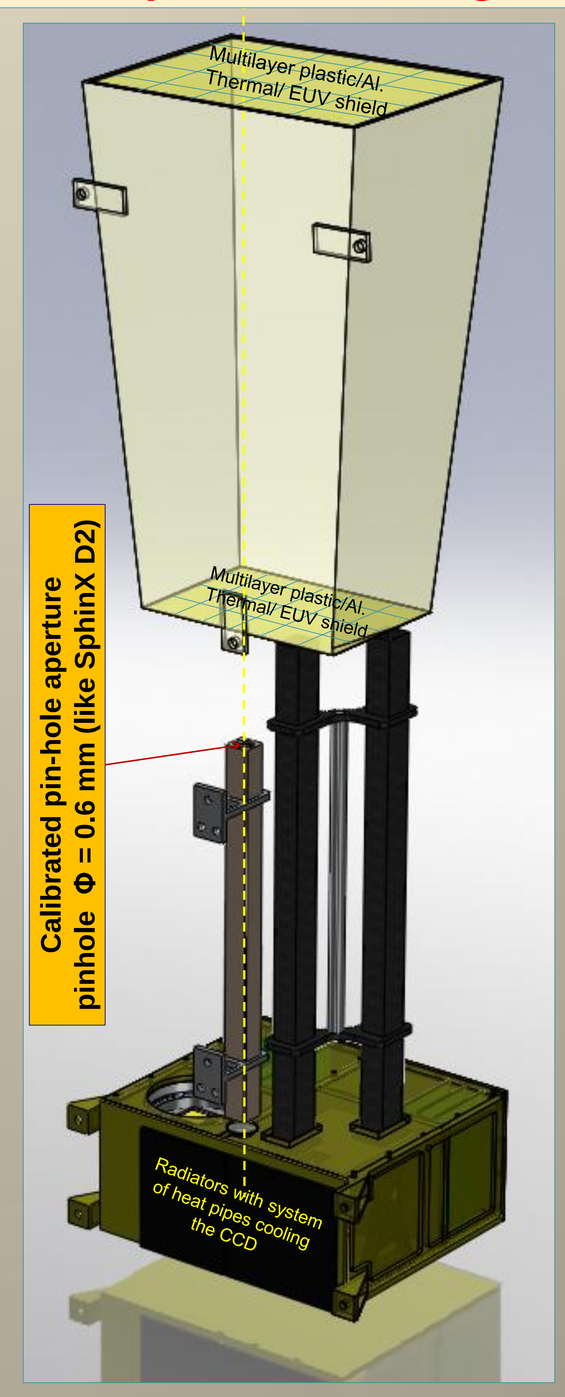
Specific instrument Characteristics

Wavelength coverage : 1Å – 7 Å, Quartz and Si
Spectral resolution : better than 0.0005 Å
Detectors: 3 CCD back illuminated & particle PIN
Sensitivity: 1.5 – 2 x RESIK, S/N: 10 x RESIK
Collimators: multi-grid, slit, Electronics: FPGA based

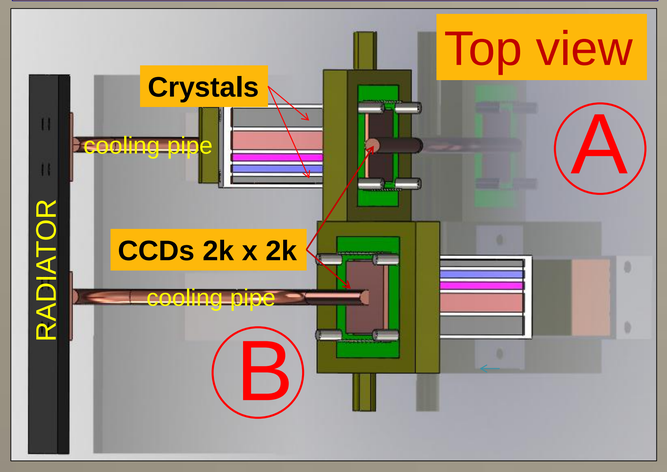


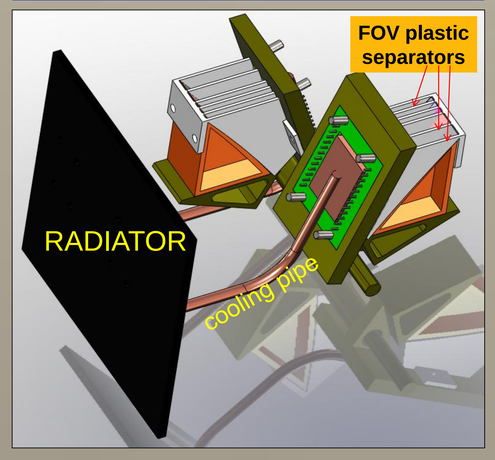
In front of the crystals the multigrid slit, rotating ±1.5 deg collimators are placed, limiting the source size to 2 arcmin or 20 arcsec respectively for wider and thinner crystal strips. This allows to study thermal line shapes and microturbulent broadening for active regions and flares. Construction of the collimator blocks illumination from the other directions within ± 2.5 deg, preventing overlap of spectra from multiple sources.
The collimator is directed to the selected, usually the brightest, source of the corona seen on the pin-hole image.

In a separate optical channel, a pin-hole camera equipped with 0.6 mm hole, is projecting the solar X-ray image on the third CCD. The Be filter of 12 μ thickness is used to limit the spectral range of the imaging to the band common with the spectrometer. The size of the full solar disc (2.5 deg) at closest proximity to the Sun covers roughly 80% of the CCD. The image is being constantly monitored for presence of flares and active regions. Their light-curves and positions are being monitored with the resolution sufficient to distinguish individual sources of typical AR size. Flare flags are being issued and coordinates of the brightest emission determined. Flare flags & coordinates can be passed to SNNI.

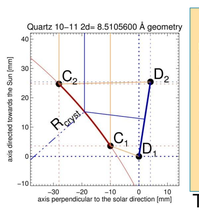


Crystal & detector System | **Isolated units** | **Crystal-Detector geometry** | **Pin-hole & PIN units**





One of 10 pages of crystal modelling exercise

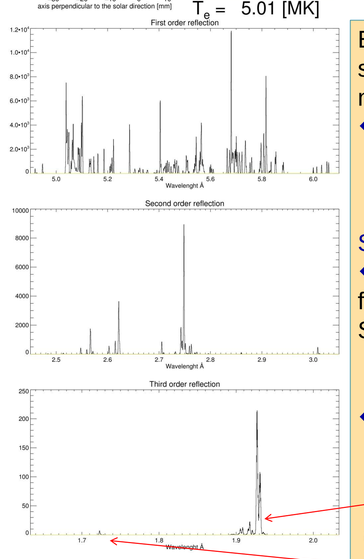


Example geometry of the crystal-detector section (one of ten) 5 of which illuminating each **CCD**

T_e = 5.01 [MK]

[4.900, 6.102] Å

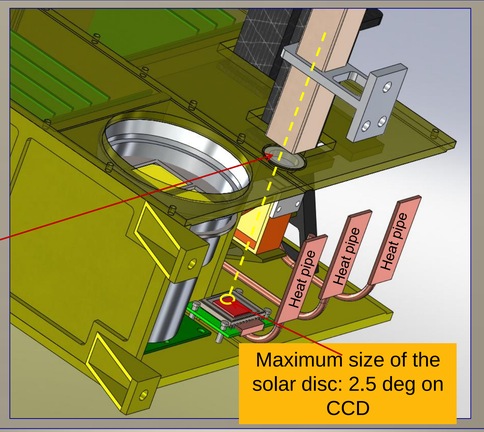
$theta_{B(min)}$	:	35.153 [deg]
$theta_{B(max)}$	:	45.787 [deg]
det. angle	:	99.060 [deg]
R_{cryst}	:	150.000 [mm]
C_{length}	:	27.842 [mm]
$C_{1(x,z)}$	:	[−10.000, 3.580] [mm]
$C_{2(x,z)}$	:	[−28.045, 24.730] [mm]
$D_{1(x,z)}$	:	[0.000, 3.580] [mm]
$D_{2(x,z)}$	:	[4.055, 24.730] [mm]
D_{length}	:	25.753 [mm]
D_{angle}	:	99.060 [deg]
$D_{pixel\ No.}$	:	2048
$D_{pixel\ size}$	:	12.575 [microns]
$D_{sr\_resolution}$	:	0.00059 [A/pixel]
$D_{sr\_diamb/dtheta}$	:	0.11246 [A/degree]

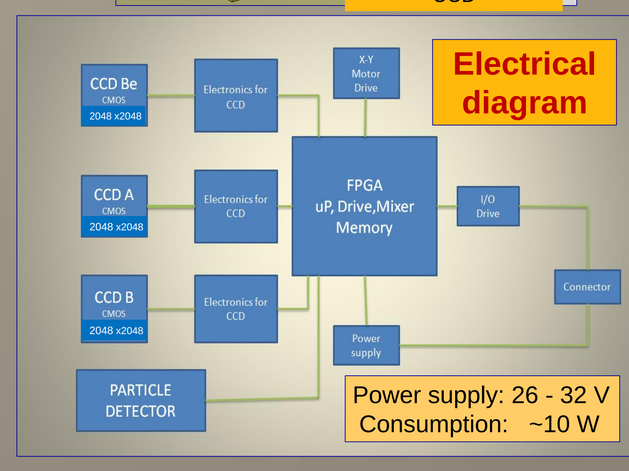


Example spectra to be measured in
← first order

Second order ← reflection, forbidden for Si 111 plane

← Third order reflection for Fe XXV and Fe XXVI





Each CCD is illuminated by X-rays diffracted from the Si or Quartz monocrystals, bent do desired cylindrical shape. Five crystal strips, two wider ~5mm and 3 thinner of 3mm thickness. The wider crystal strips cover spectra in the full range~, while three thinner are for high-resolution spectroscopy purposes, being identical for the two crystal sections A and B which diffraction planes have opposite sense. This allows for absolute Line Doppler shifts to be measured.