Bragg X-ray spectroscopy of the solar corona

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Solar X-ray spectrum
Bragg’s law

\[ 2d \sin \theta_B = n \lambda \]
**Cons:**
- Individual wavelengths are not recorded at the same time!
- Long time needed to observe the whole spectrum (time proportional to the length of observed spectral range)
- Moving parts

**Pros:**
- Flat crystals are easier to obtain (than the alternative bent crystals)
- No need of position sensitive detector

**Previous instruments:**
- SOLFLEX on board the P78-1 (1979)
- Flat Crystal Spectrometer on-board the Solar Maximum Mission (1980)
- Solar soft X-ray bright line spectrum analyzer on-board the HINATORI (1981)
- DIOGENESS on-board the CORONAS-F (2001)
Cons:
• It is hard to obtain the perfect cylindrical shape
• Position sensitive detector is needed
• The position of lines on the detector can depend on the position of the source on the solar disk. Collimator or tracing system is needed
• Expensive

Pros:
• Long spectral ranges can be observed simultaneously
• No moving parts

Previous instruments:
• Bent Crystal Spectrometer on-board the Solar Maximum Mission (1980)
• Bragg Crystal Spectrometer on-board the Yohkoh (1991)
• Resik on-board the CORONAS-F (2001)
• The Bragg diffraction is very inefficient!
• Because the X-ray spectrometer had to be placed outside the atmosphere, in most cases strong restrictions to the weight or size of instrument are placed

• Fluorescence

• The signal measured by the X-ray spectrometer is the convolution of the solar radiation spectrum and the response function of the instrument. Precise knowledge of the properties of all elements in the path of the incident beam is needed to determine the instrument response function
• Calibration is needed
Laboratory characterization of bent monocrystal wafers for Bragg X-ray spectroscopy

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Silicon (400) crystal wafer bent convex to radius of $R = 984$ mm
The crystal length was 463 mm
**Future instruments**

**ChemiX**
for Interhelioprobe Mission

**SolpeX**
for KORTES modul on ISS


Thank you for your attention