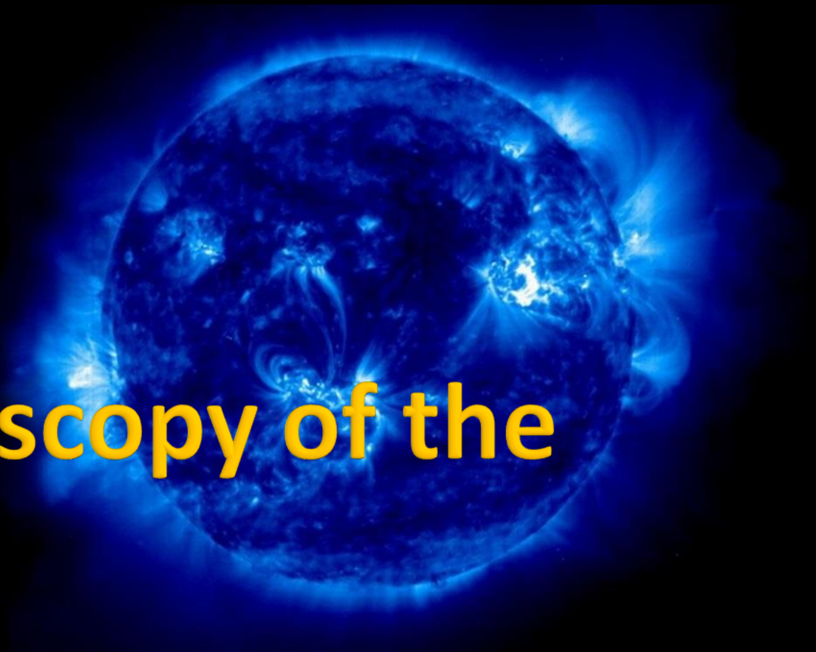
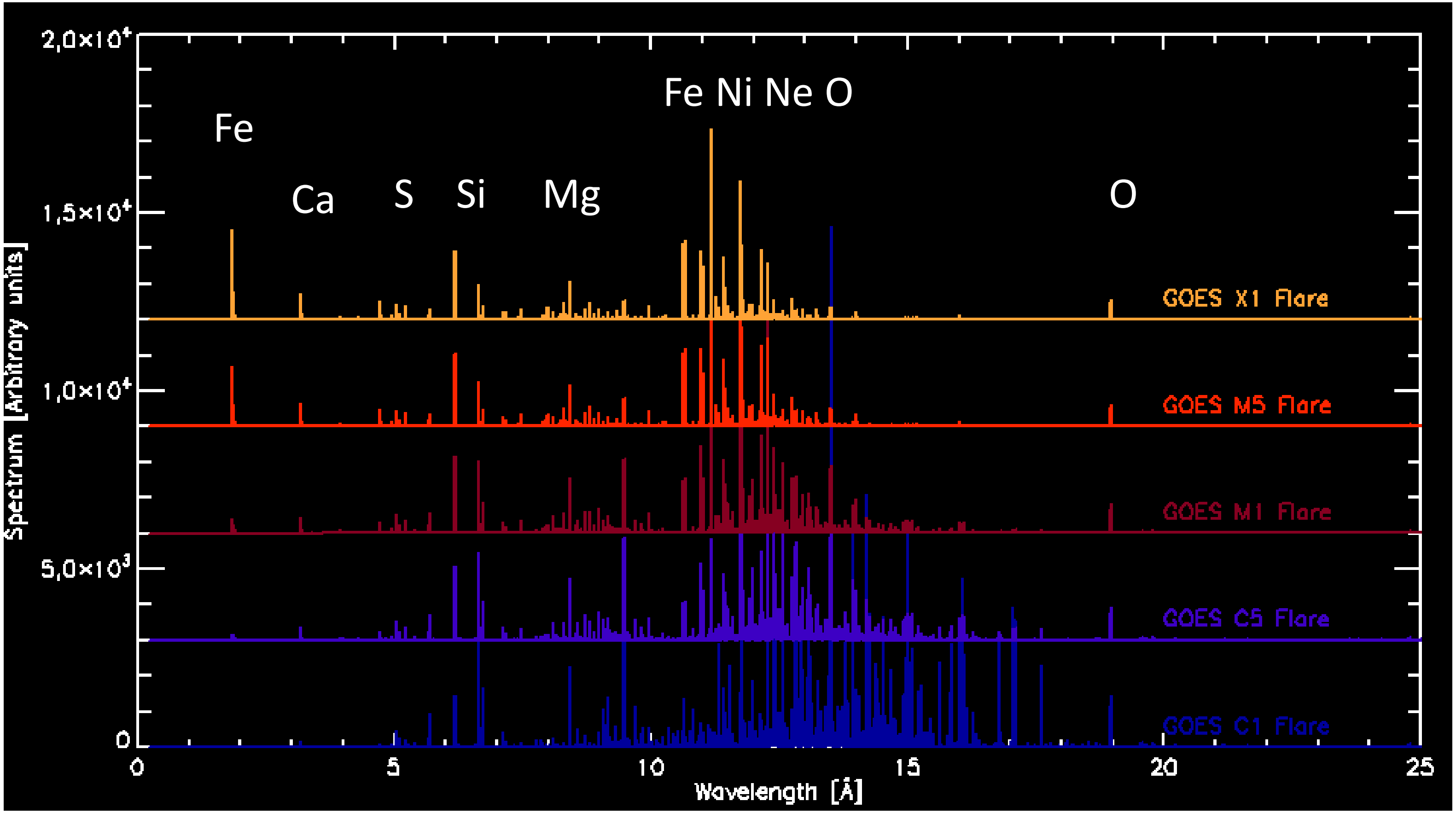
17th Ukrainian Conference on Space Research



Bragg X-ray spectroscopy of the solar corona

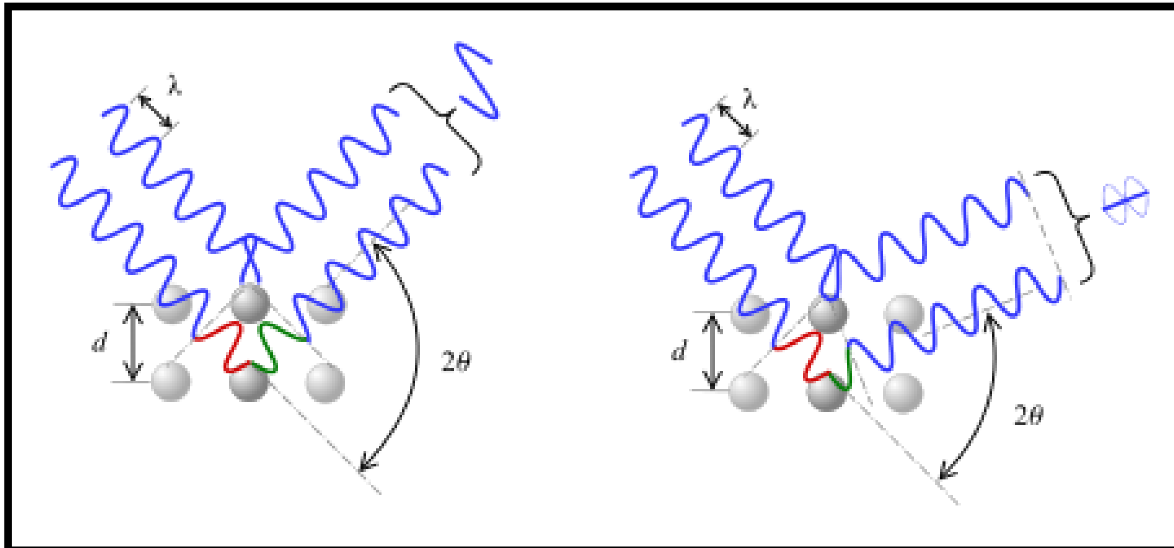
Żaneta Szaforz, Stefan Płocieniak, Janusz Sylwetrer, Jarosław Bąkała, Mirosław Kowaliński, Daniel Ścisłowski, Piotr Podgórski, Marek Siarkowski, Barbara Sylwester, Marek Stęślicki, Zbigniew Kordylewski

Solar X-ray spectrum



Bragg's law

$$2\,d\,\sin\theta_B = n\,\lambda$$

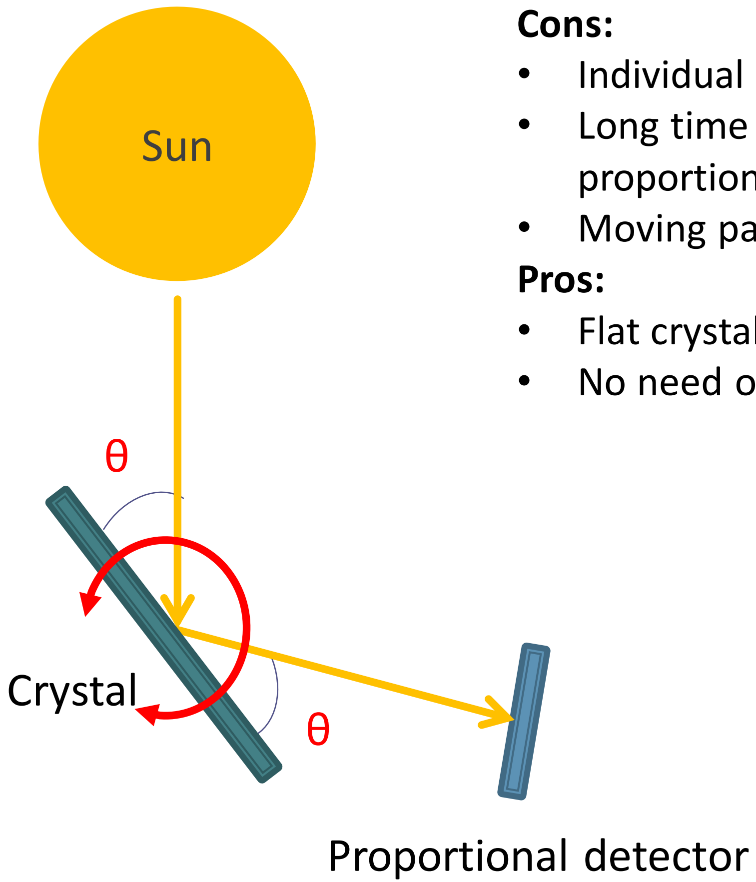


Max von Laue

William Henry Bragg

William Lawrence Bragg

Flat crystal spctrometers



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

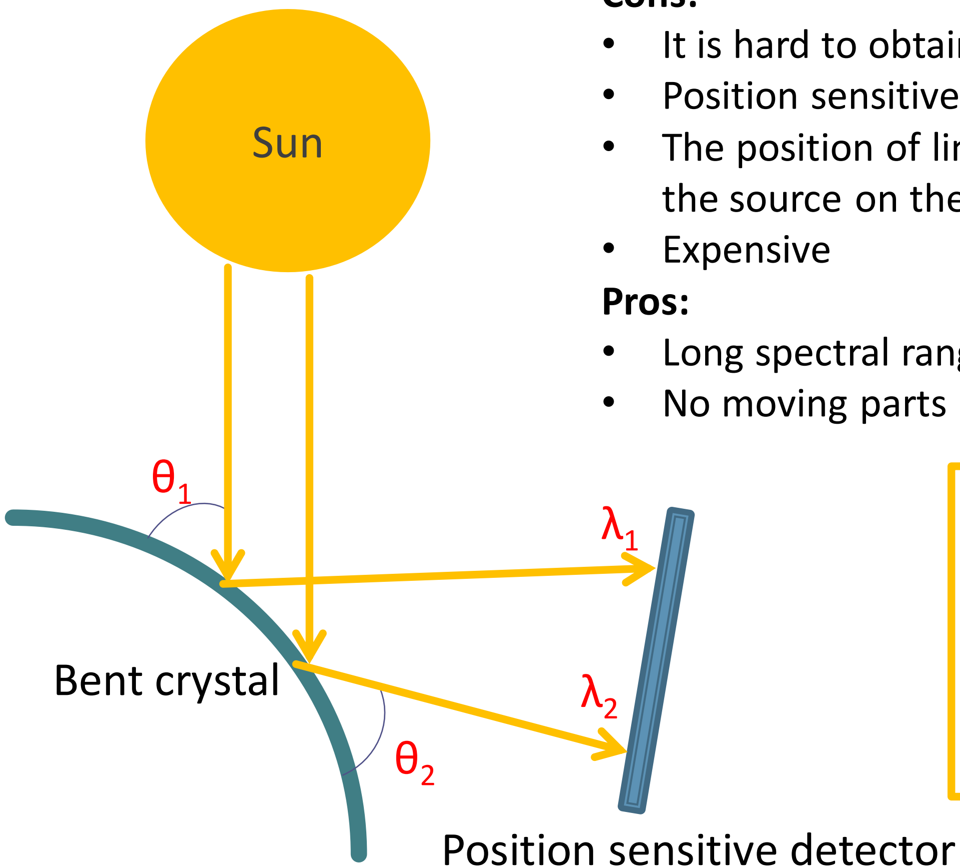
Pros:

- 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)

Bent crystal spctrometers



Cons:

- It is hard to obtain the perfect cylindrical shape
- Position sensitive detector is needed
- The position of lines on the detector can depends of the position of the source on the solar disk. Colilmator 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)

Designing a spectrometer

- 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

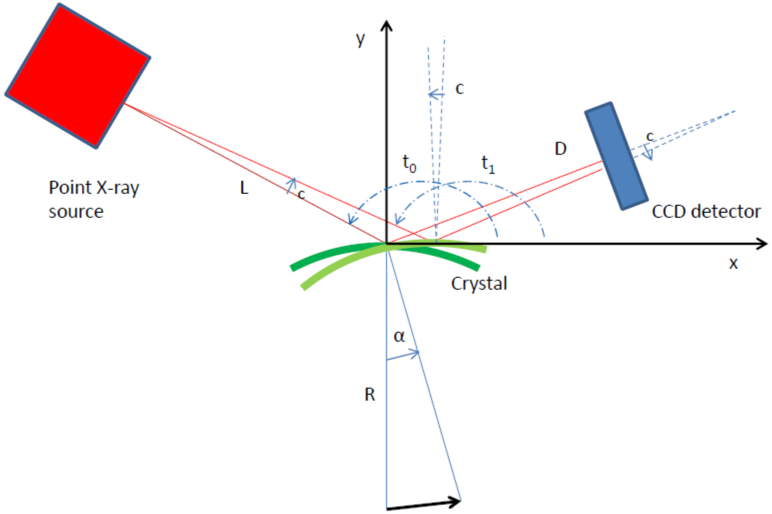
- Fluorescence

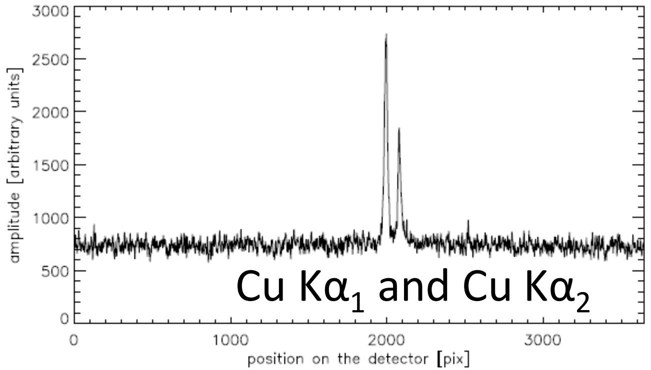
- The signal measured by the X-ray spectrometer is the convolution of the solar radiation spectrum and the response function of the instrument. Precise knowledge of the properties of all elements in the path of the incident beam is needed to determine the instrument response function
- Calibration is needed

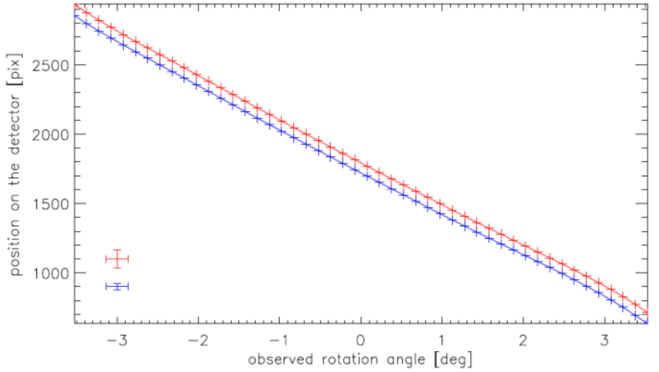
Crystal's properties measurments

Laboratory characterization of bent monocrystal wafers for Bragg X-ray spectroscopy

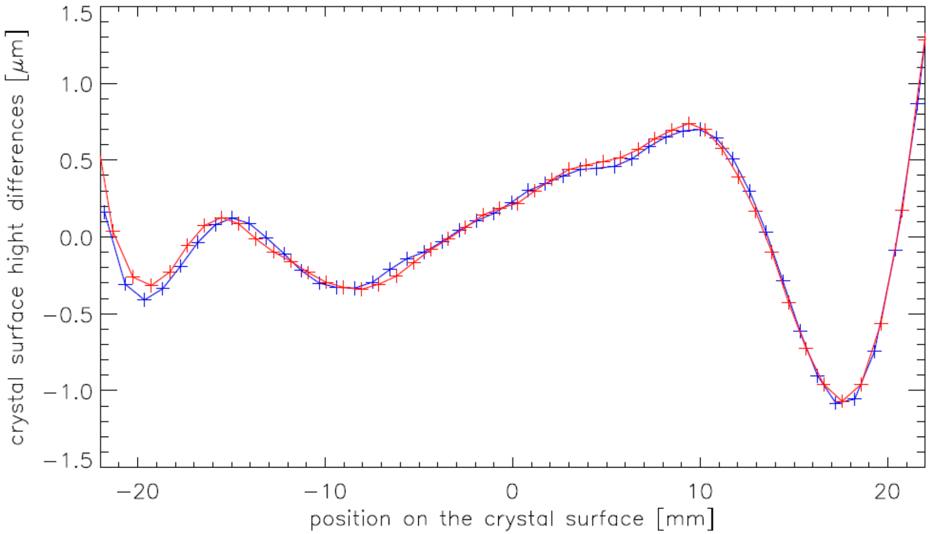
Stefan Płocieniak · Żaneta Szaforz

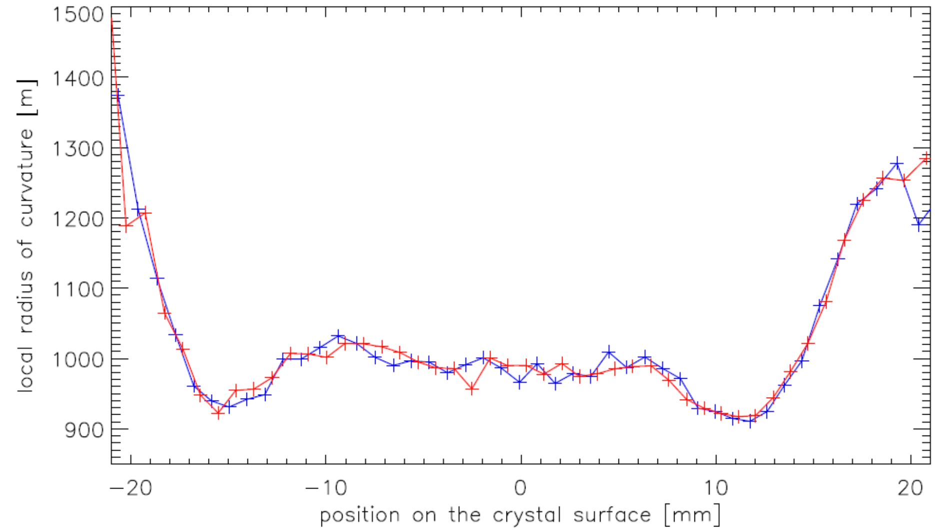






Crystal's properties measurments



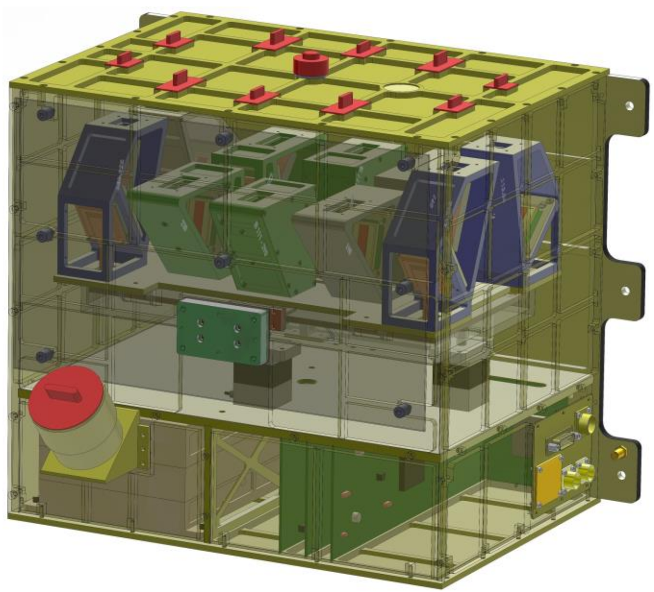


Silicon (400) crystal wafer bent convex to radius of R = 984 mm
The crystal length was 463 mm

Future instruments

ChemiX

for Interhelioprobe Mission



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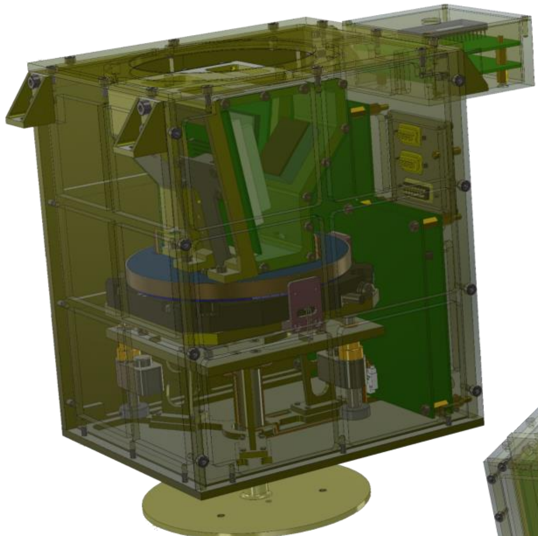
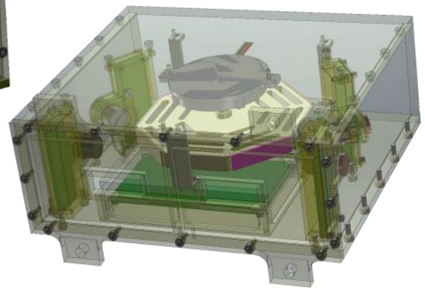
SolpeX

for KORTES modul on ISS





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Thank you for your attention