

Report 4.1 InterHelioZond

IZMIRAN RAS – SRC Solar Phys. Division **Wroclaw**

November 2013 – May 2015

4. Исследование Солнца

4.1. Проект «Интергелиозонд» - Анализ и интерпретация солнечных данных, полученных на спутнике «КОРОНАС-Ф»;

Разработка предложений для Брегговского анализатора химического состава корональной плазмы («СНЕМ-Х»).

Организации - исполнители: от РАН - ИЗМИРАН; от ПАН - ЦКИ.

Координаторы:

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RESIK on CORONAS-F



- Designed to collect solar AR & flare spectra
- Operated in 2002 & 2003
- Two million spectra collected & presented as Spectral atlas available online
http://www.cbk.pan.wroc.pl/experiments/resik/resik_catalogue.htm
- Four important steps made over the reported period

Database of Level2 spectra created



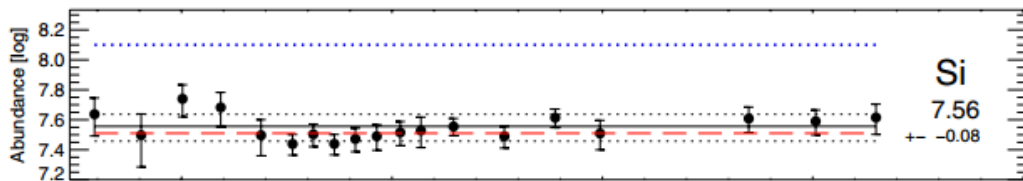
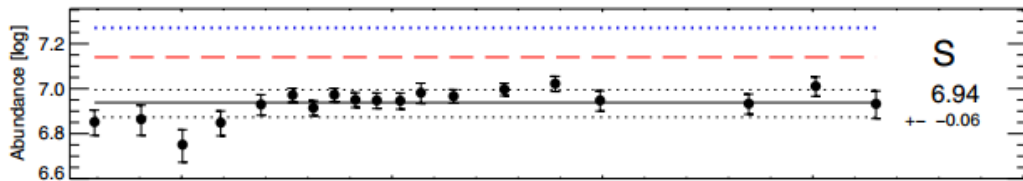
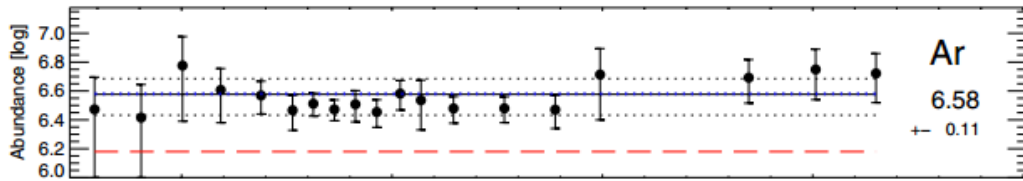
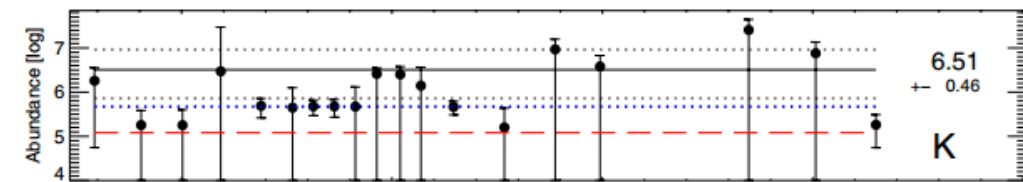
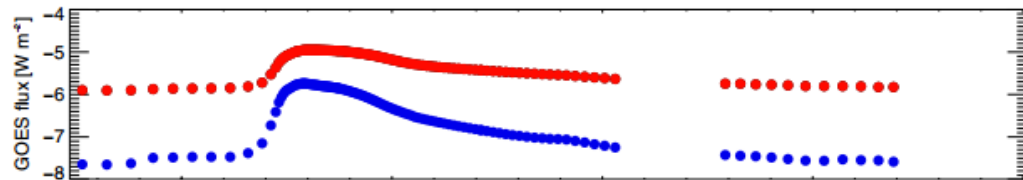
- Now contains 103 flares and the AR, more than 10000 individual spectra are in the public domain at the

http://www.cbk.pan.wroc.pl/experiments/resik/RESIK_Level2/index.html

Please click the appropriate date in order to get access to RESIK data of the selected flare

Flare	Date	GOES class	Location	Date file created
↓↑	↓↑	↓↑	↓↑←→	↓↑
SOL2002-04-15T02:51	15 April 2002 (max ~ 02:51 UT)	C9.8	N21W68	31 May 2014
SOL2002-04-15T03:55	15 April 2002 (max ~ 03:55 UT)	M1.2	S15W01	9 Dec 2010
SOL2002-05-07T03:46	7 May 2002 (max ~ 03:46 UT) ^f	M1.4	S09E28	26 Jan 2015
SOL2002-07-26T18:29	26 July 2002 (max ~ 18:29 UT)	C9.5	S22E17	13 Mar 2012
SOL2002-08-03T19:07	3 August 2002 (max ~ 19:07 UT)	X1.0	S16W87	4 Jun 2008
SOL2002-08-16T22:12	16 August 2002 (max ~ 22:12 UT)	M1.2	S05E06	27 Nov 2014
SOL2002-08-16T23:33	16 August 2002 (max ~ 23:33 UT)	M1.7	S05E05	15 Dec 2014
SOL2002-08-20T02:57	20 August 2002 (max ~ 02:57 UT)	M1.4	S08W35	19 Mar 2014
SOL2002-08-20T08:26	20 August 2002 (max ~ 08:26 UT)	M3.4	S11W38	26 May 2014
SOL2002-08-21T05:34	21 August 2002 (max ~ 05:34 UT)	X1.0	S10W50	18 Feb 2014
SOL2002-08-24T05:48	24 August 2002 (max ~ 05:48 UT) ^g	M1.8	S05E54	30 Jan 2015
SOL2002-08-24T07:47	24 August 2002 (max ~ 07:47 UT)	C4.3	S06W88	21 Apr 2015
SOL2002-08-24T09:28	24 August 2002 (max ~ 09:28 UT)	C4.7	N09W90	17 May 2015
SOL2002-08-24T09:40	24 August 2002 (max ~ 09:40 UT)	C4.0	N09W90	18 May 2015

Analysis of elemental abundances for 33 flares performed

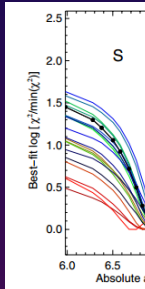


Start Time (14-Nov-02 22:14:41)

The results:

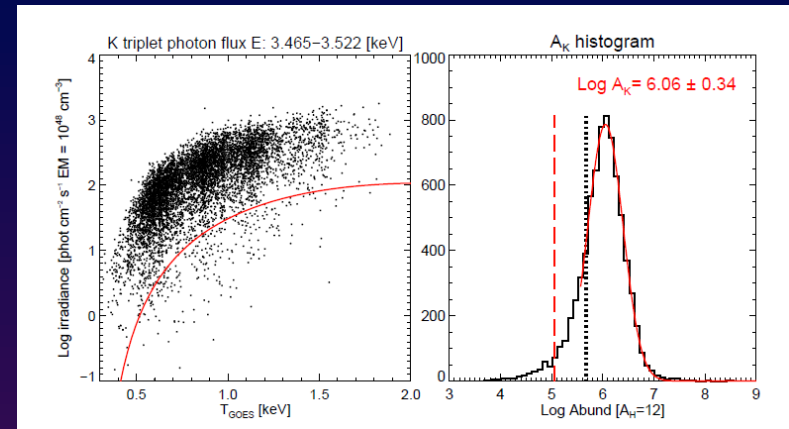
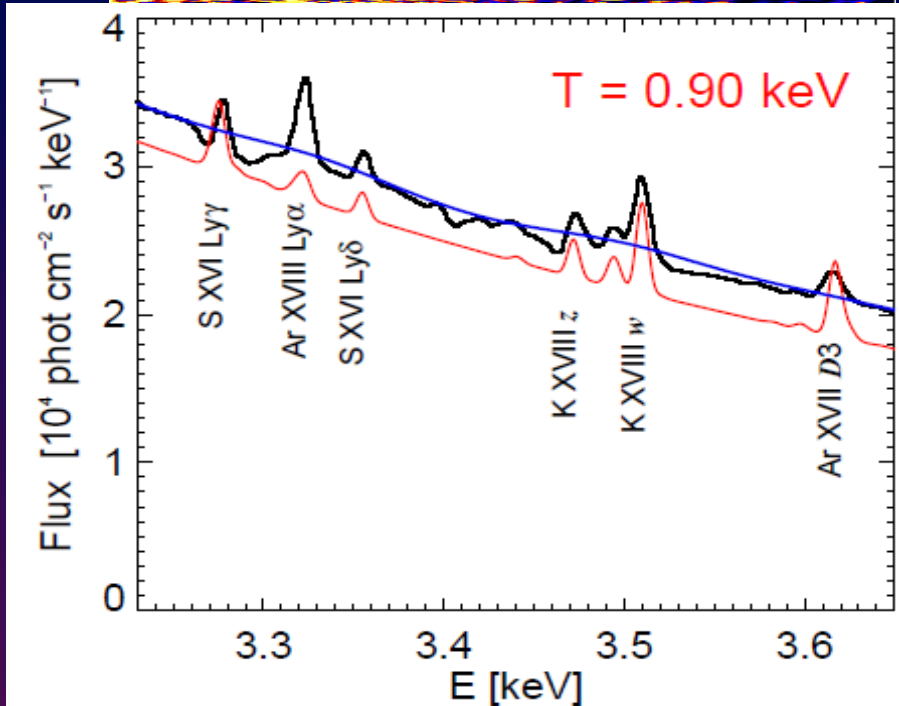
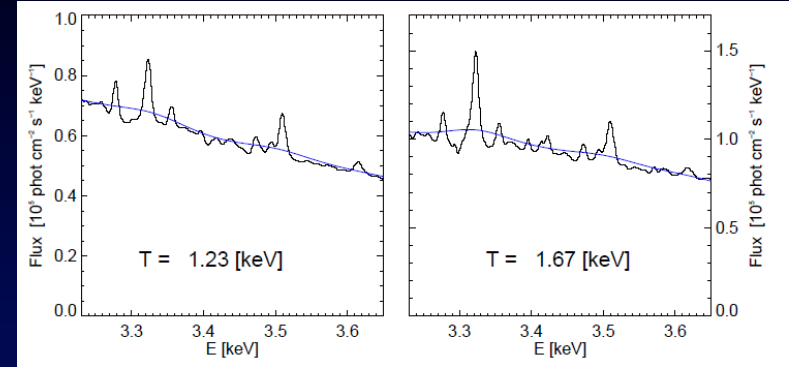
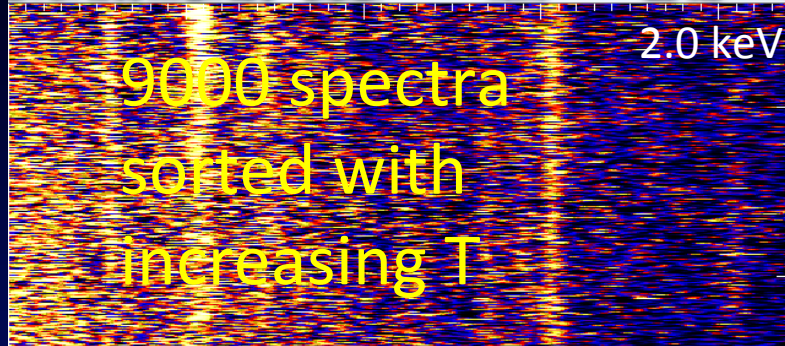
- First high-accuracy determinations of coronal abundances: K, Ar, S & Si
- No difference in composition between flares
- No clear change in abundance during flares

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Investigation of potassium spectra help to interpret nature of galactic 3.5 keV line



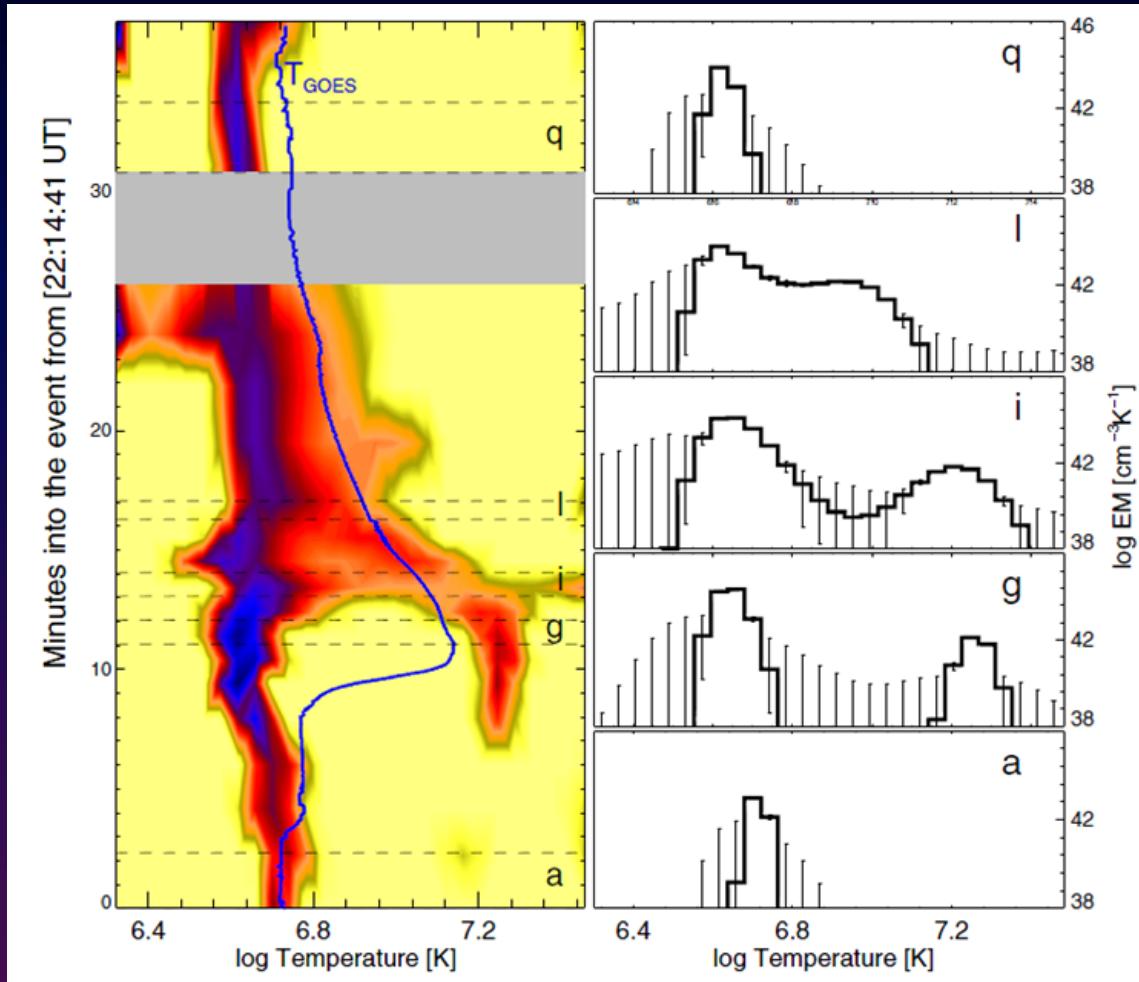
0.4 keV

Conclusion:

Spectral blob seen on the spectra is rather due to K & **NOT** due to sterile neutrino Bulbul 2014, ApJ

26 - 27 May 2015, Moscow

Differential Emission Measure



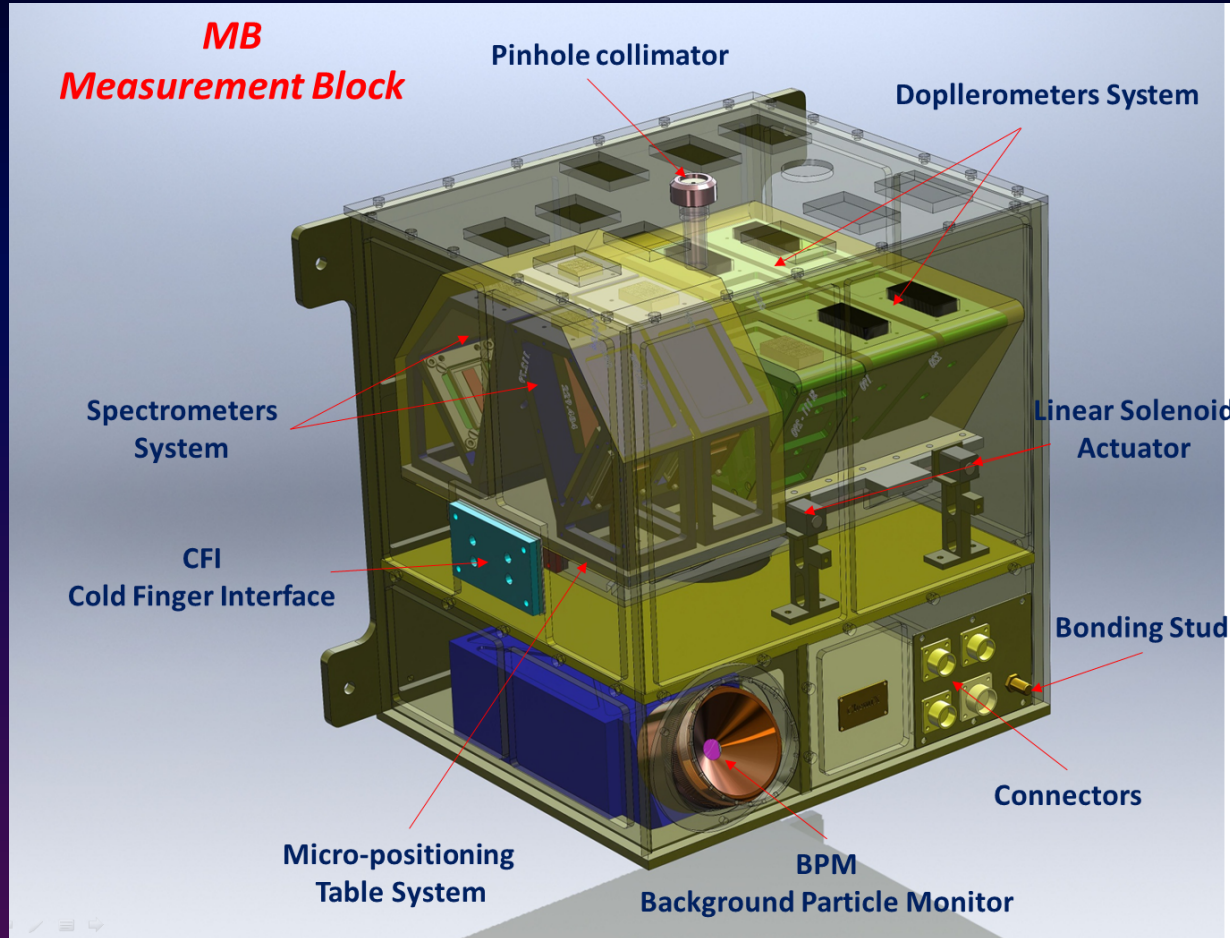
Left: contour plot of the differential emission measure during the SOL2002-11-14T22:26 flare, darker colors indicating greater emission measure. The horizontal scale is the logarithm of temperature, and time increases upward, measured from 22:14:41 UT. Horizontal dotted lines define the time intervals a, g, i, l, and q (see Figure 2) and the smooth curve running from top to bottom is the temperature derived from the ratio of the two GOES channels on an isothermal assumption. Right: emission measure distributions for the intervals indicated in the left plot, derived from the Withbroe–Sylwester routine. Vertical error bars indicate uncertainties. A cooler (temperature ~4–5 MK) component is present over all the time intervals shown, with the hotter component (~18 MK) at the peak of the GOES light curve.

ChemiX on Interhelioprobe



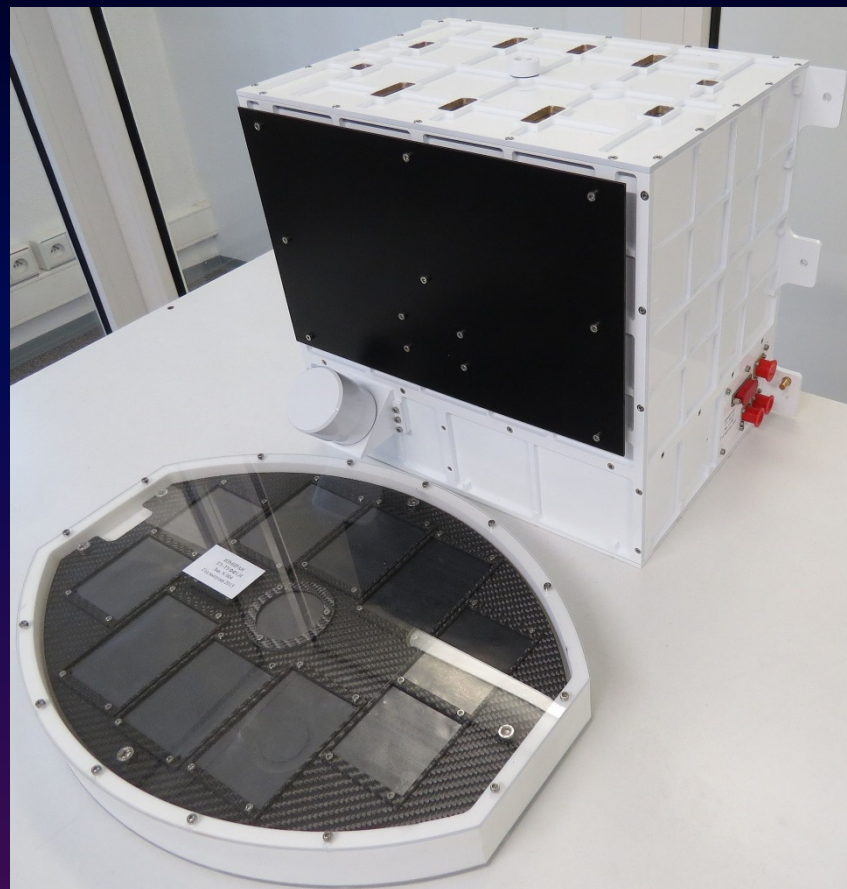
- To be placed on both spacecraft
- The only high resolution Bragg crystal spectrometer for solar X-ray diagnostics
- The best-ever construction with reduced fluorescence- X-ray continuum in high resolution
- Dopplerometer configuration for hot plasma motions diagnostics

ChemiX on Interhelioprobe general outlook

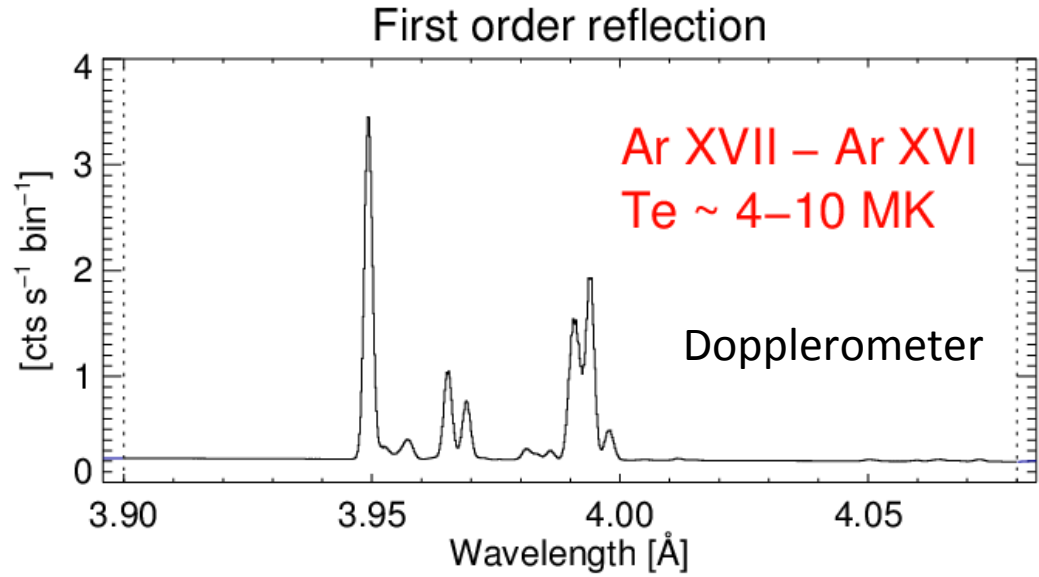
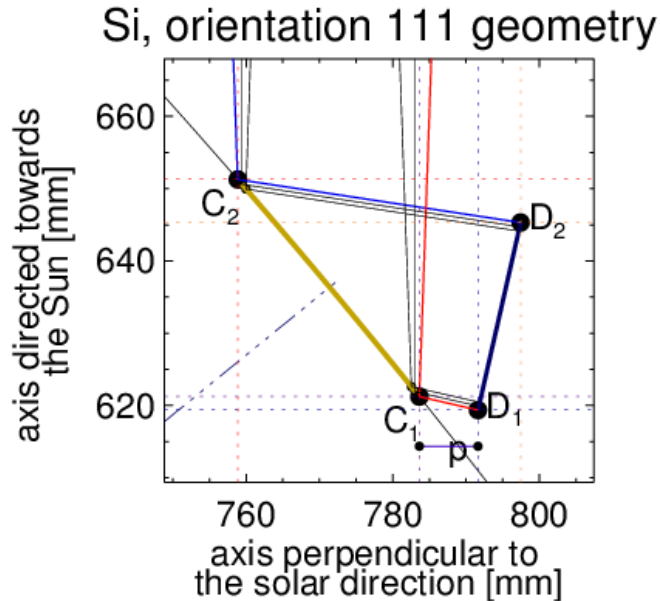


- 4 crystals to record spectra in the 1.5 – 9 Å range
- 3 pairs (6) of identical crystals to observe Doppler motions of AR and flare plasmas
- Background particle detector (Kharkov)

ChemiX on Interhelioprobe delivery of size & Thermal models to Lavochkin

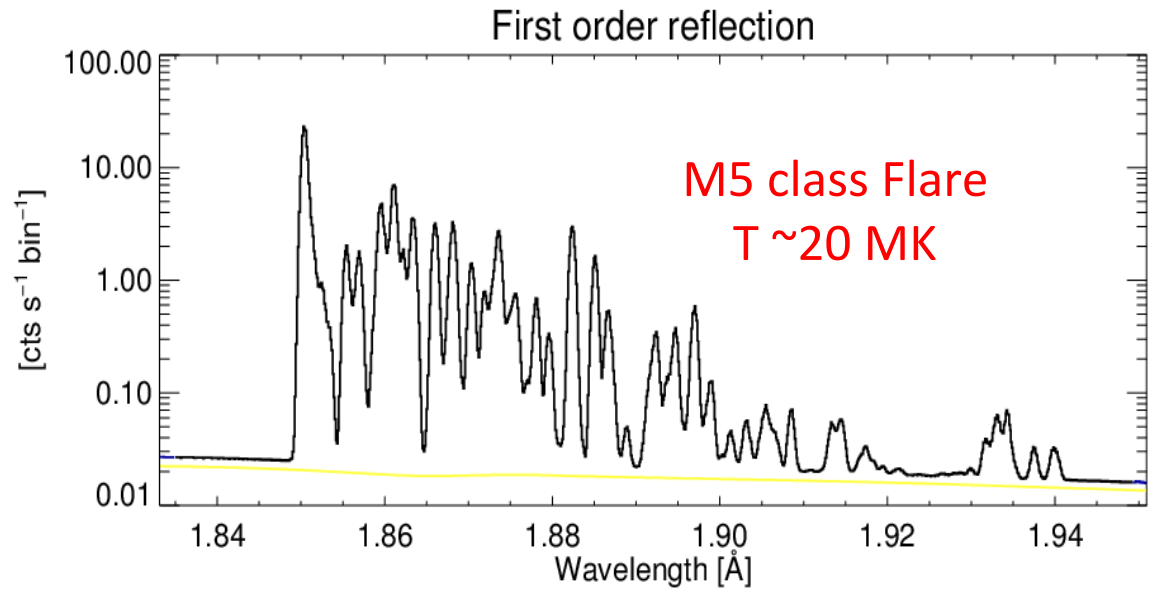
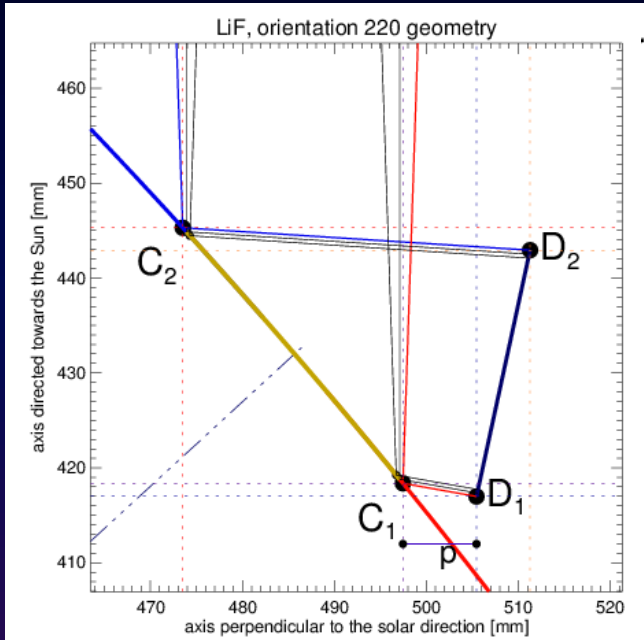


ChemiX on Interhelioprobe spectra synthesis



- Two such units mounted so, that their dispersion axes oppose each other $v \sim 3-5$ km/s

ChemiX on Interhelioprobe spectra synthesis



- Will allow to test evaporation scenario for impulsive flare phase

Papers published/submitted

ChemIX: the new Bragg soft X-ray spectrophotometer for determination of active region and flare plasma composition

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SOLAR FLARE COMPOSITION AND THERMODYNAMICS FROM RESIK X-RAY SPECTRA

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RESIK SOLAR X-RAY FLARE ELEMENT ABUNDANCES ON A NON-ISOTHERMAL ASSUMPTION

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SOLAR AND STELLAR FLARES

X-ray Flare Spectra from the DIOGENESS Spectrometer and Its Concept Applied to ChemIX on the Interhelioprobe Spacecraft

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Conclusions:

- RESIK is the most successful solar Bragg spectrometer ever flown!
- Analysis of RESIK spectra is continuing, many new papers are in preparation !
- Construction of ChemiX is in progress, all components are selected, phase B development nearly finished
- Synthetic spectra are modelled → all science tasks can be achieved
- Further modelling necessary → new grant application
- All members of Wroclaw Solar Laboratory are taking weekly lessons of Russian language (for 3y by now)