Space Research Centre in Wrocław
general informations

RESIK- recently obtained results on elemental composition

SphinX- patterns of soft X-ray variability for a very low solar activity

Janusz Sylwester

Polish Academy of Sciences

Space Research Centre

Solar Physics Division - Wrocław

Presentation for Czech-Polish-Slovak Consultation on Solar Physics (CoSP)
May 19 - 21, 2011, Ondřejov, Czech Republic, March 17: J. Sylwester

Outline

- Few words on history of Wrocław solar research and connections with „neighbours"
- Early sounding rocket experiments
- RESIK & Diogeness aboard CORONAS-F
  - Coronal Abundances from X-ray spectra
- SphinX aboard CORONAS-Photon
  - Solar variability at low levels – as seen for the first time
- Ongoing activities for future experimental advantures
  - RESPECT (Rentgenovski SPECTrometr) for ISS
  - **ChemiX** (Chemical composition from X-rays) for Interhelioprobe
  - STIX (X-ray imager) for Solar Orbiter

The past: political opportunities and Founders

- Intercosmos (1967) – no launch payments

Kapustin Yar
Sounding rockets
7 launches

1970
1971
1977
~~1979~~
1980
1981
1983
1984

Plesetsk
Orbital missions
4 launches

1994
Coronas-I

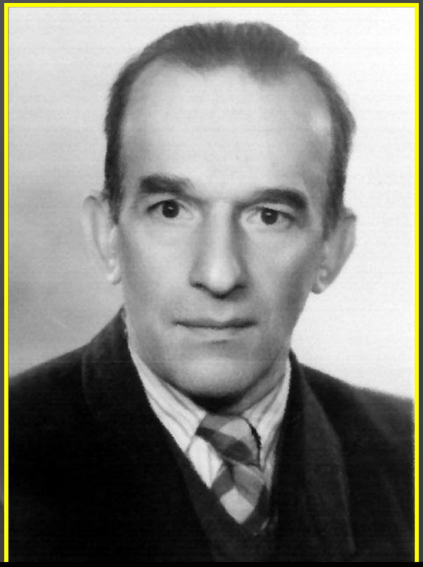
1995
Interball-Tail

2001
Coronas-F

2009
Coronas-F

The past: Founders

- The Professors:



Jan Mergentaler
(1901-1995, Lwów-Wroclaw)
in 1951 became interested in Solar Physics – organizer of Wroclaw heliophysical Centre, 1956 – solar monograph

Stefan Piotrowski (1910–85), supported the development of Wroclaw group remotely, as Head of Astronomical Division, PAS, Warsaw, where the group was initially assigned

Prof. Jerzy Jakimiec – overlooked from the beginning (30 years) the scientific aspects of the program

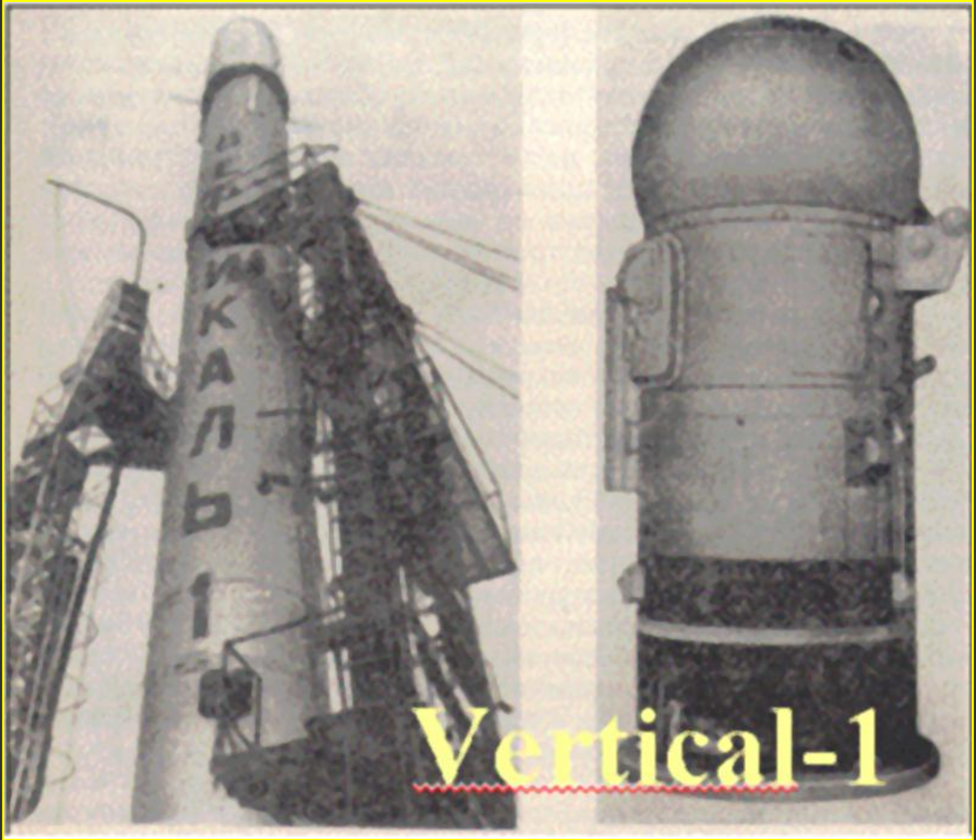
Dr. Zbigniew Kordylewski – was (and is) responsible for the hardware development over more than 35 years

Prof. Antoni Opolski took charge of the developing Laboratory in 70-ties

Prof. Stanislaw Grzedzielski and Prof. Zbigniew Klos, as Directors of Space Research Centre, of which the Solar Physics Division is now a part looked with an interest to the group development

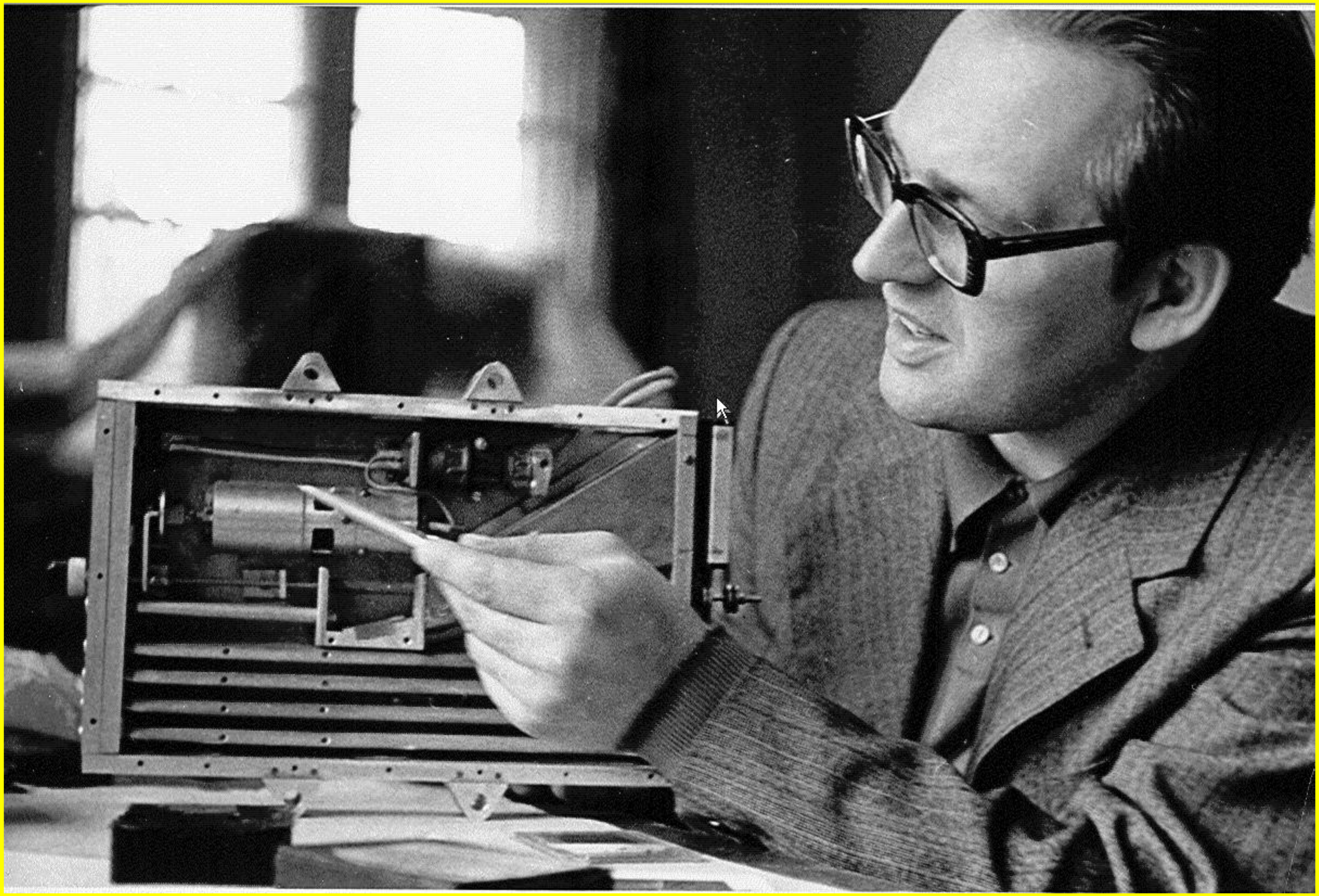
First Polish (and INTERCOSMOS) space experiment **28 November 1970**

At Kapustin Yar, early morning h = ~500 km, 10 min in space *(around 05:32 UT)*



Dr. Zbigniew Kordylewski

in 1971, presenting Polish part of Vertical-1 payload, after recovery

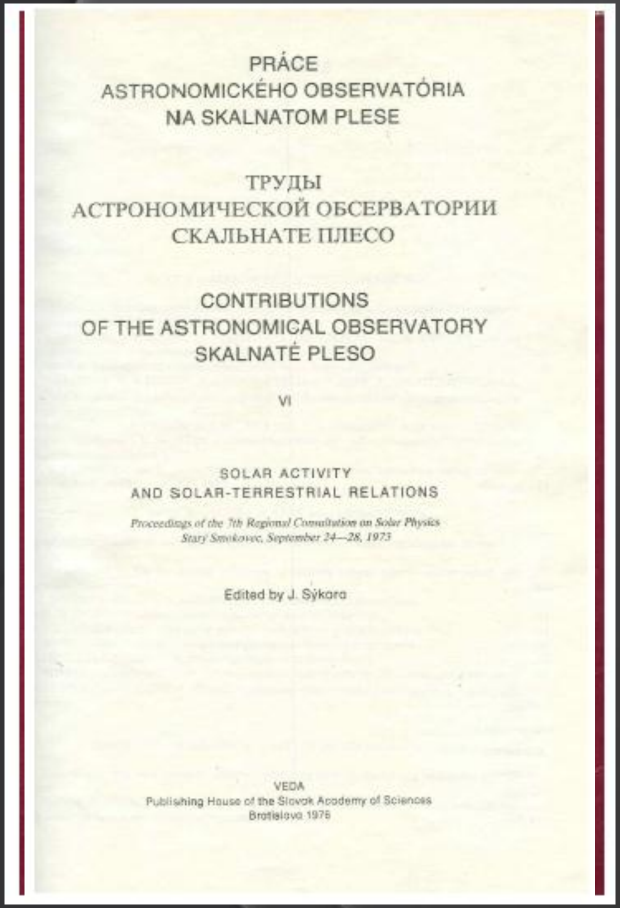


First Polish (and INTERCOSMOS) space experiment **28 November 1970**

The Be 50 μm and Al 6 μm filter images represent emissions from the hotter and cooler plasma. The "filetr ratio" technique allowed to determine the temperature structure within individual active regions. The spatial resolution in the images is rather low (1 arcmin), typical for pin-hole technique

Resutls were presented during 6th Consultations & COSPAR

B. Sylwester & J.Sylwester J. Jakimiec



PRÁCE
ASTRONOMICKÉHO OBSERVATÓRIA
NA SKALNATOM PLESE

ТРУДЫ
АСТРОНОМИЧЕСКОЙ ОБСЕРВАТОРИИ
СКАЛЬНАТЕ ПЛЕСО

CONTRIBUTIONS
OF THE ASTRONOMICAL OBSERVATORY
SKALNATÉ PLESO

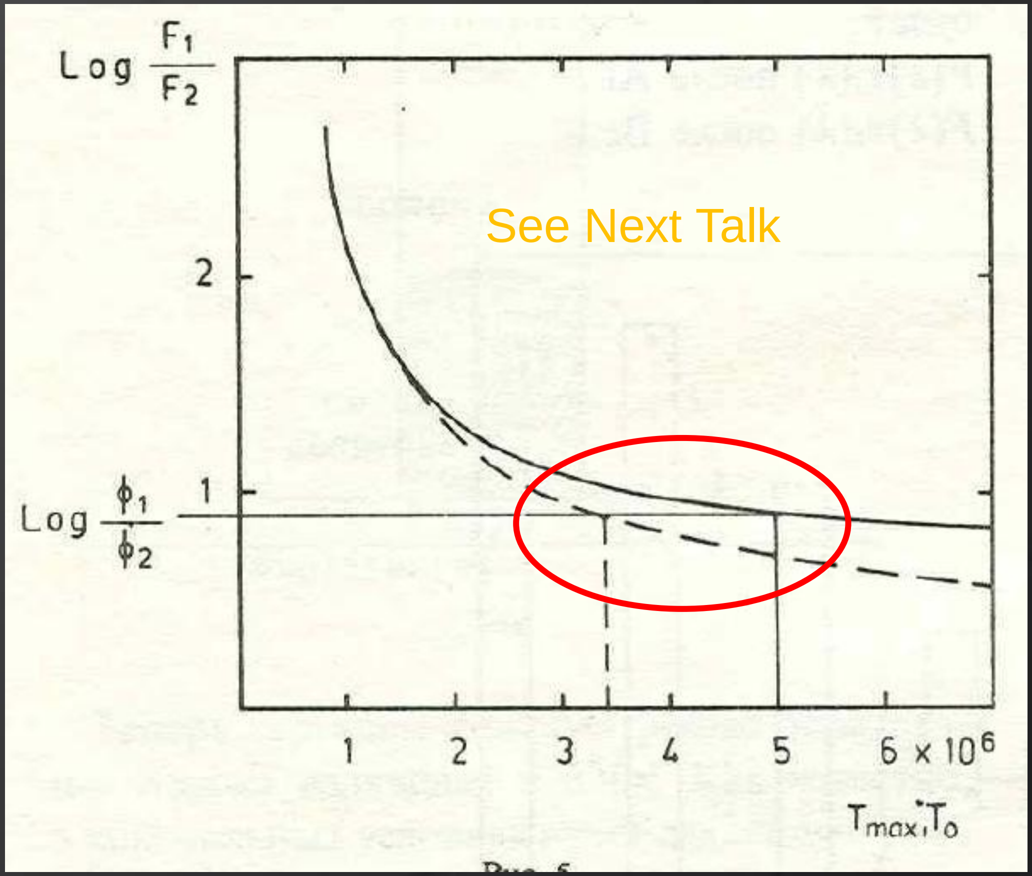
VI

SOLAR ACTIVITY
AND SOLAR-TERRESTRIAL RELATIONS

Proceedings of the 7th Regional Consultation on Solar Physics
Stary Smokovec, September 24—28, 1973

Edited by J. Sýkora

VEDA
Publishing House of the Slovak Academy of Sciences
Bratislava 1976

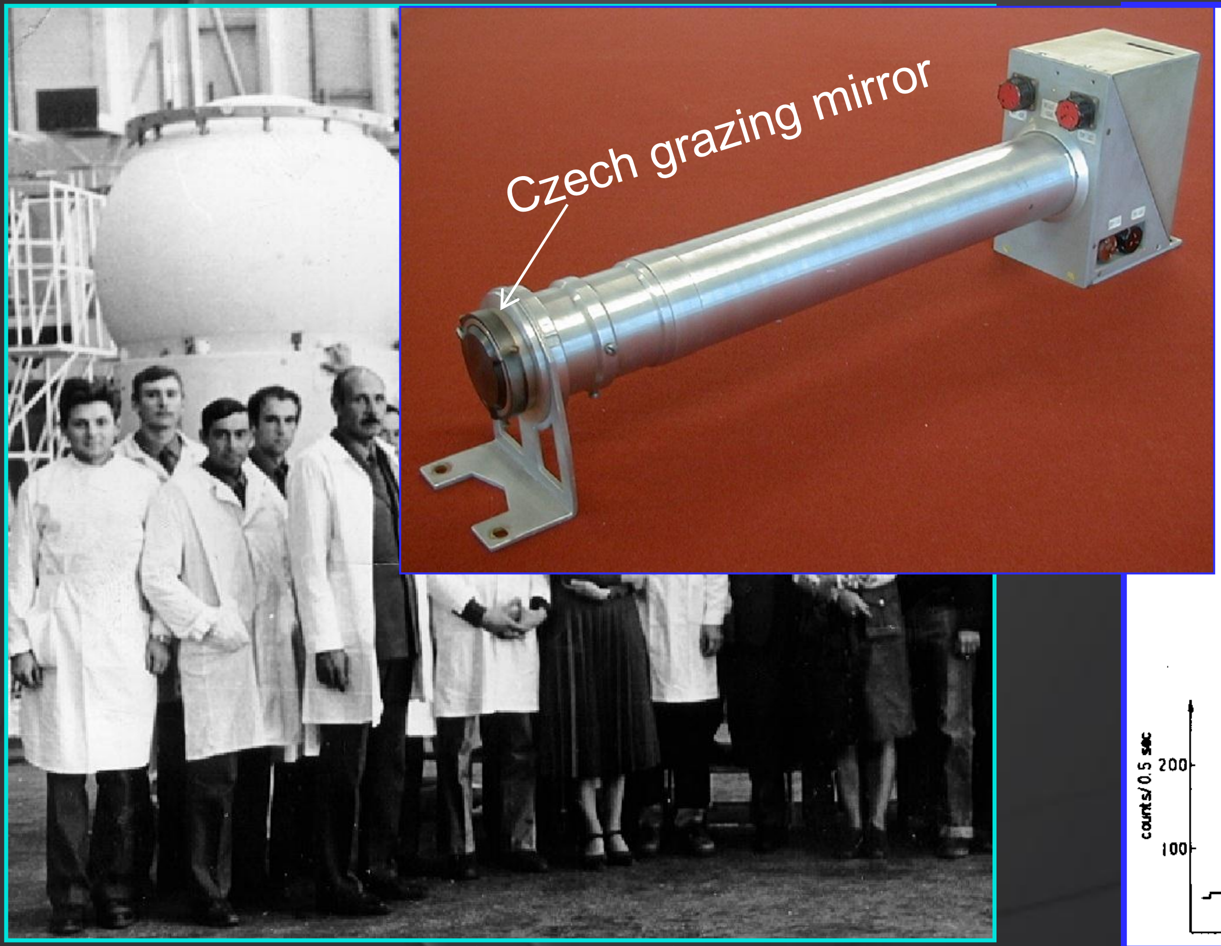


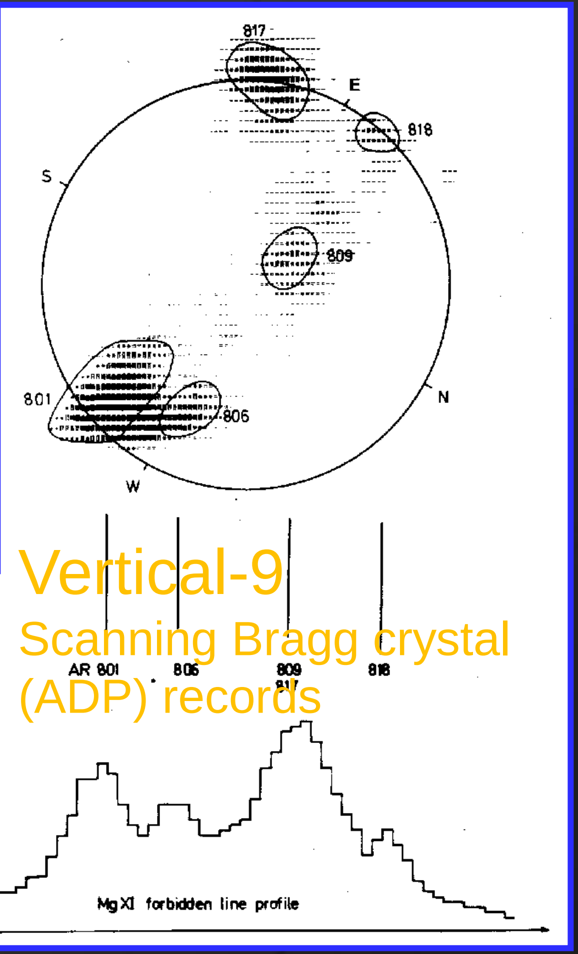
Science problems set by our Professors:

- Temperature structure of EUV & X-ray emitting plasma: Active regions and flares
  - Determinations of T and EM, multitemperaure plasmas
  - DEM inversion
- Elemental composition (relative & absolute)
- X-ray spectroscopy & atomic physics
  - Line identification
  - Processes: excitation, ionization, recombination
- Diagnostics of plasma heating in the corona
  - HD modelling (Palermo-Harvard codes)
  - Role of plasma kernels (basic constituents of the corona)

Following sounding rocket experiments

Grazing incidence soft X-ray telescope





Vertical-9

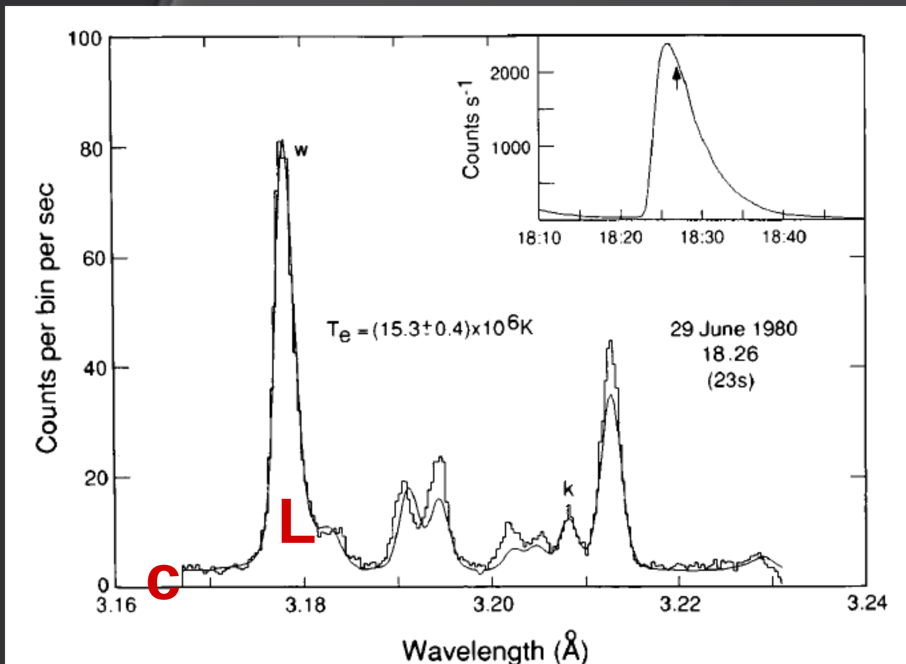
Scanning Bragg crystal (ADP) records

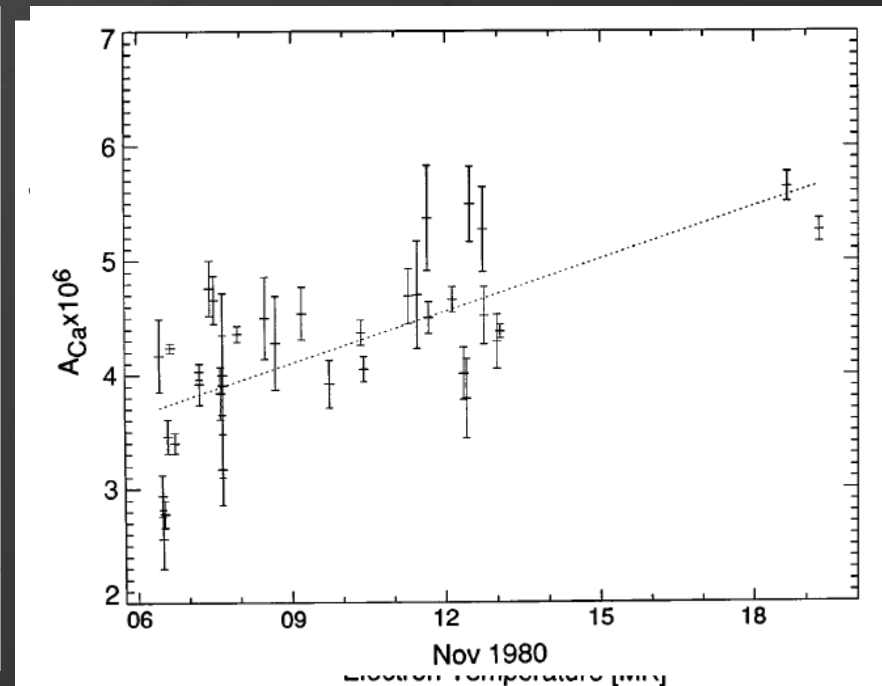
Contacts with strong groups from abroad: Czech Rep., Russia, Holland, USA, UK, Italy, Slovak Rep.

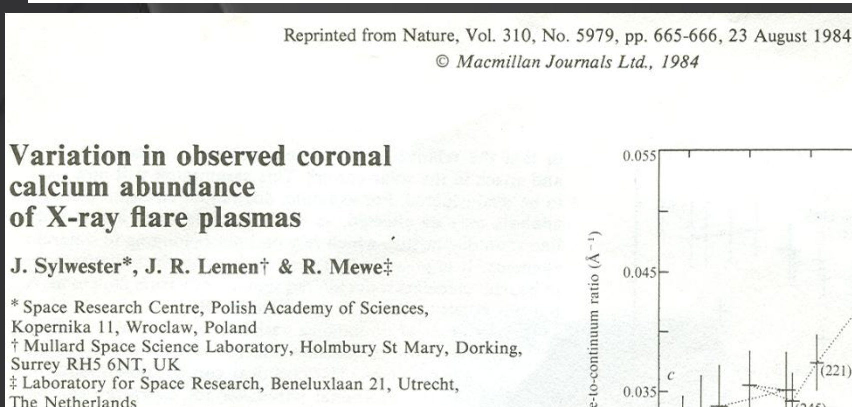
- Our visits to leaders:
  - Prof. Mandel’stam at FIAN (since 1974)
  - Prof. De Jager at Utrecht (since 1978)
  - Prof. Culhane at MSSL (since 1980)
- Work at the satellite operation centres
  - SMM at GSFC 1980-81
  - IZMIRAN with CORONAS – I & F 1994, 2001
  - RHESSI at GSFC 2004, 2005
- Important guests –
  - Prof. Pottash, 1973, Prof. Bumba, dr. Valnicek, Prof. De Jager, Dr. Loren Acton 1986, Dr. Farnik, Prof. Heinzel, Dr. Dzifcakova, Prof. Phillips (2000-2011), Dr. Kuzin (2000_now), Prof. Reale

Golden Age of Bragg solar spectroscopy 1970-1995,

Intercosmos-4,7,16, P-78, Hinotori, SMM-FCS, BCS, Yohkoh BCS





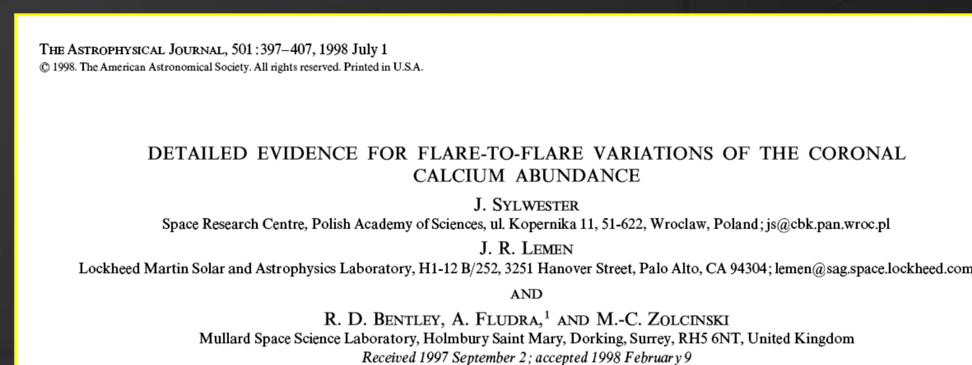


Reprinted from Nature, Vol. 310, No. 5979, pp. 665-666, 23 August 1984

Variation in observed coronal calcium abundance of X-ray flare plasmas

J. Sylwester*, J. R. Lemen† & R. Mewe‡

* Space Research Centre, Polish Academy of Sciences, Kopernika 11, Wroclaw, Poland
† Mullard Space Science Laboratory, Holmbury St Mary, Dorking, Surrey RH5 6NT, UK
‡ Laboratory for Space Research, Beneluxlaan 21, Utrecht, The Netherlands



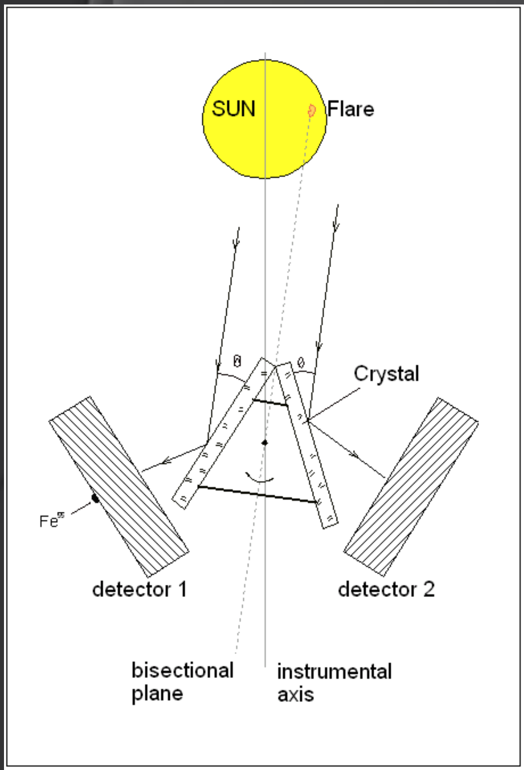
THE ASTROPHYSICAL JOURNAL, 501:397–407, 1998 July 1

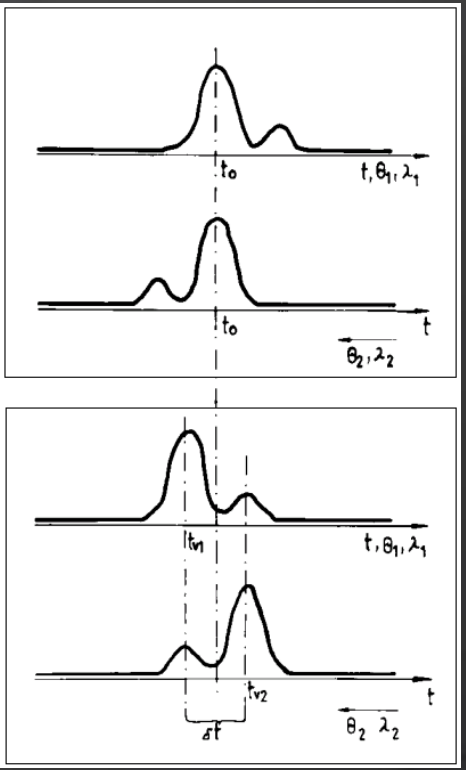
DETAILED EVIDENCE FOR FLARE-TO-FLARE VARIATIONS OF THE CORONAL CALCIUM ABUNDANCE

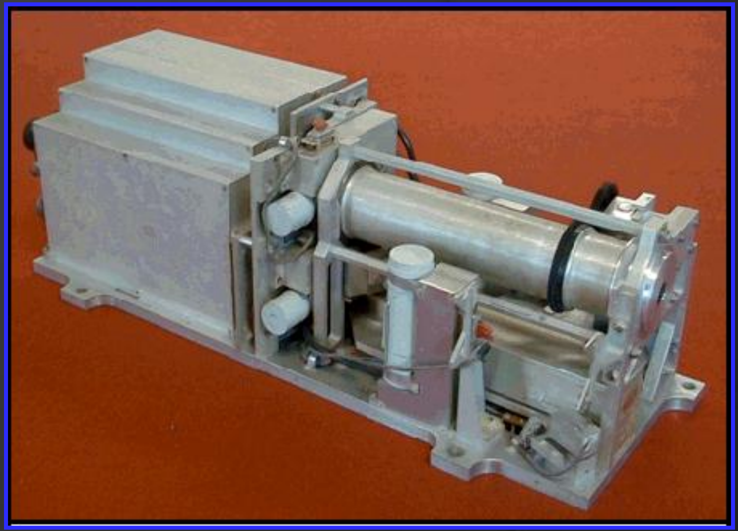
J. SYLWESTER
Space Research Centre, Polish Academy of Sciences, ul. Kopernika 11, 51-622, Wroclaw, Poland; js@cbk.pan.wroc.pl
J. R. LEMEN
Lockheed Martin Solar and Astrophysics Laboratory, H1-12 B/252, 3251 Hanover Street, Palo Alto, CA 94304; lemen@sag.space.lockheed.com
AND
R. D. BENTLEY, A. FLUDRA,[1] AND M.-C. ZOLCINSKI
Mullard Space Science Laboratory, Holmbury Saint Mary, Dorking, Surrey, RH5 6NT, United Kingdom
Received 1997 September 2; accepted 1998 February 9

New experiences - new designs – always in collaboration with AI C(S)AS

- X-ray Dopplerometer (~1980): absolute measurements of line shifts - together with AI CAS

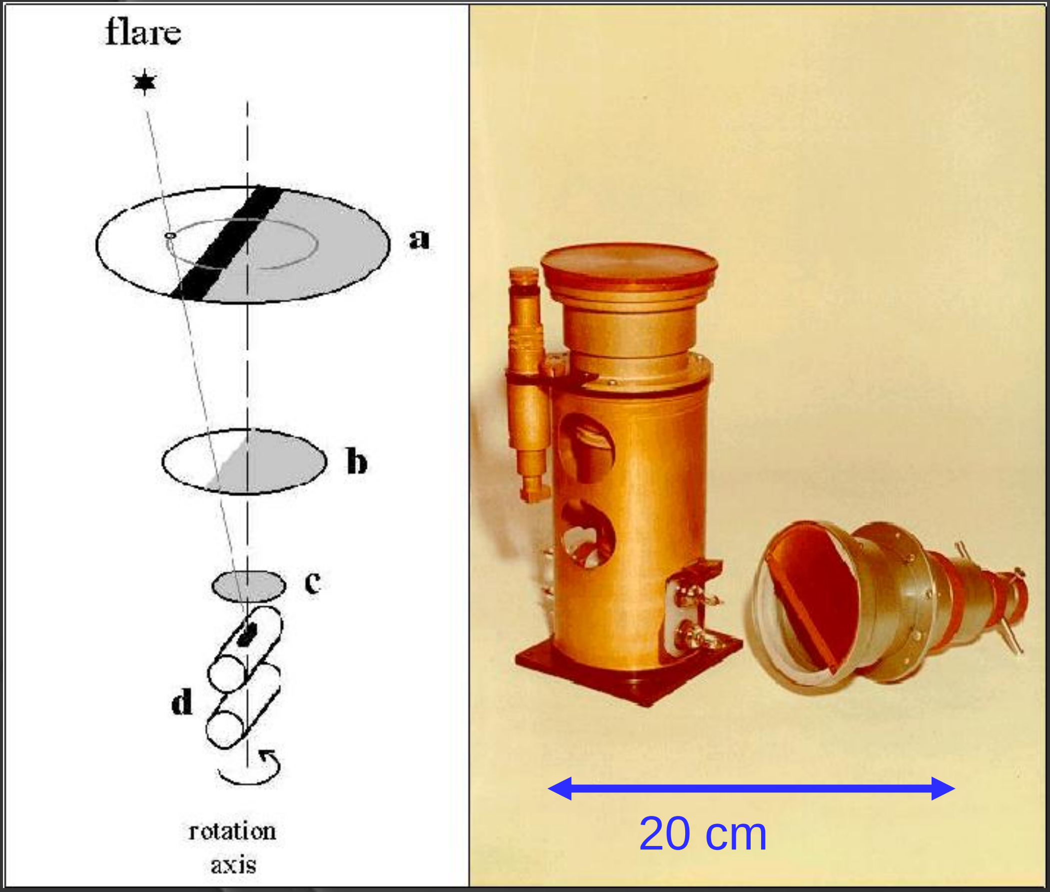


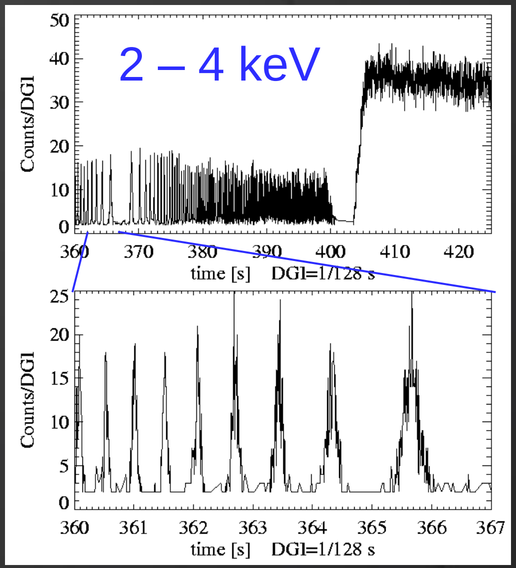


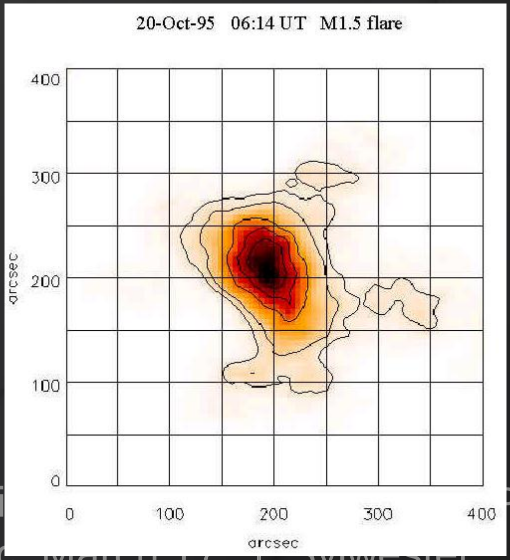


RDR – Rocket Dopplerometer flown aboard Vertical-11 sounding rocket
Made in one year, launched in 1983

Rotating modulation collimator on Czech RF15-I Interball-tail -1996 together with AI CAS RHESSI „solution”







RHESSI-Like Instrument, but the rotation period 120 s

10 arcsec resolution on numerically reconstructed images,

Sylwester et al., 2000, Solar Physics, 197/2 337

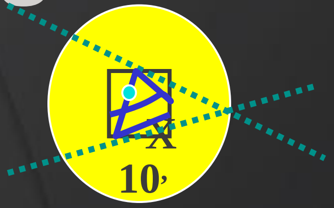
Present Solar Physics Division SRC PAS
13 people

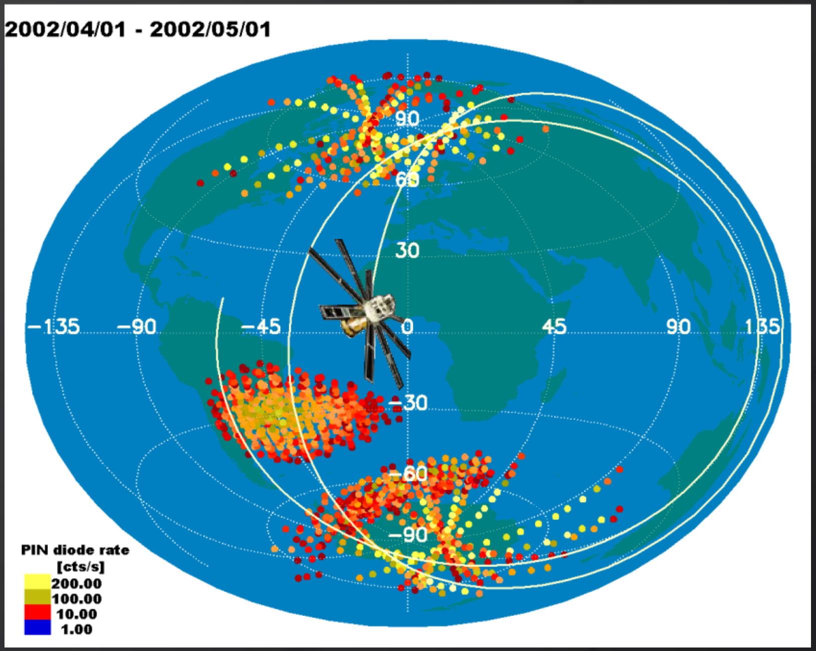
- One mechanical constructor (CAD Solid Works)
- One physicist (vaccum chamber, X-ray lamp & radioactive source)
- Three electronic engineers analogue, digital, FPGA
- Eight scientists with main responsibility of running experiment simulations, data reduction from our & external space instruments

RECENT

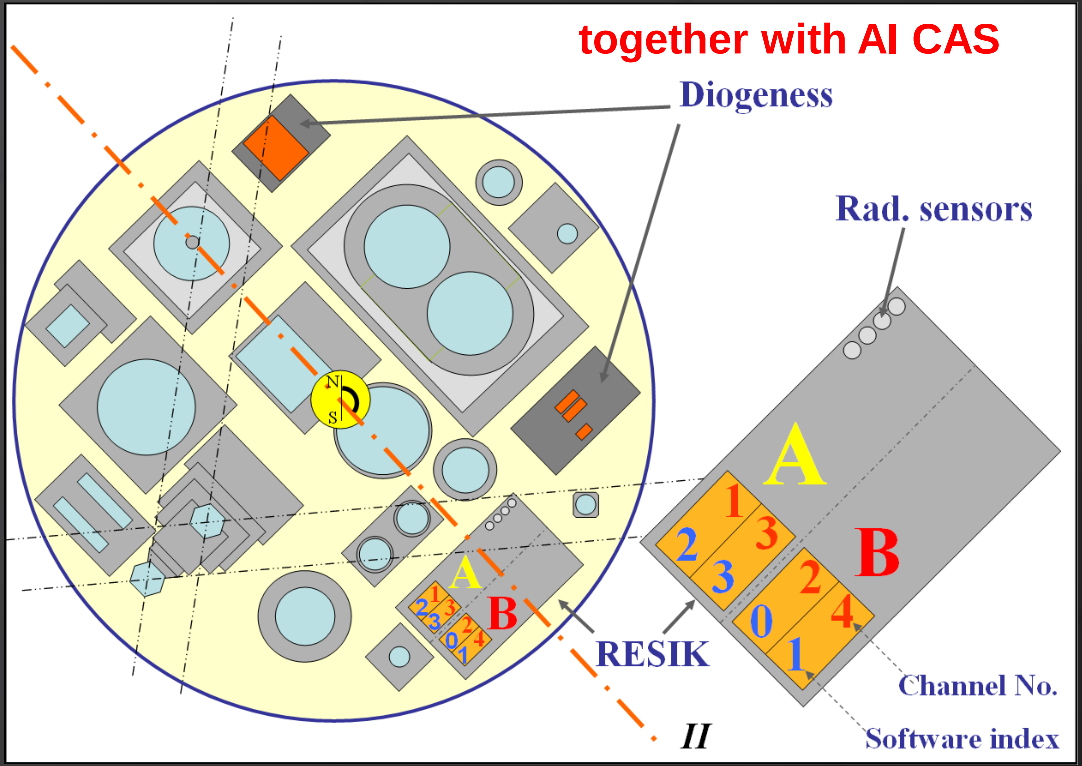
CORONAS-F launch, orbit & pointing – new alley for us

31 July 2001,
polar orbit, 95min,
~500 km
semi-Sun-synchronous





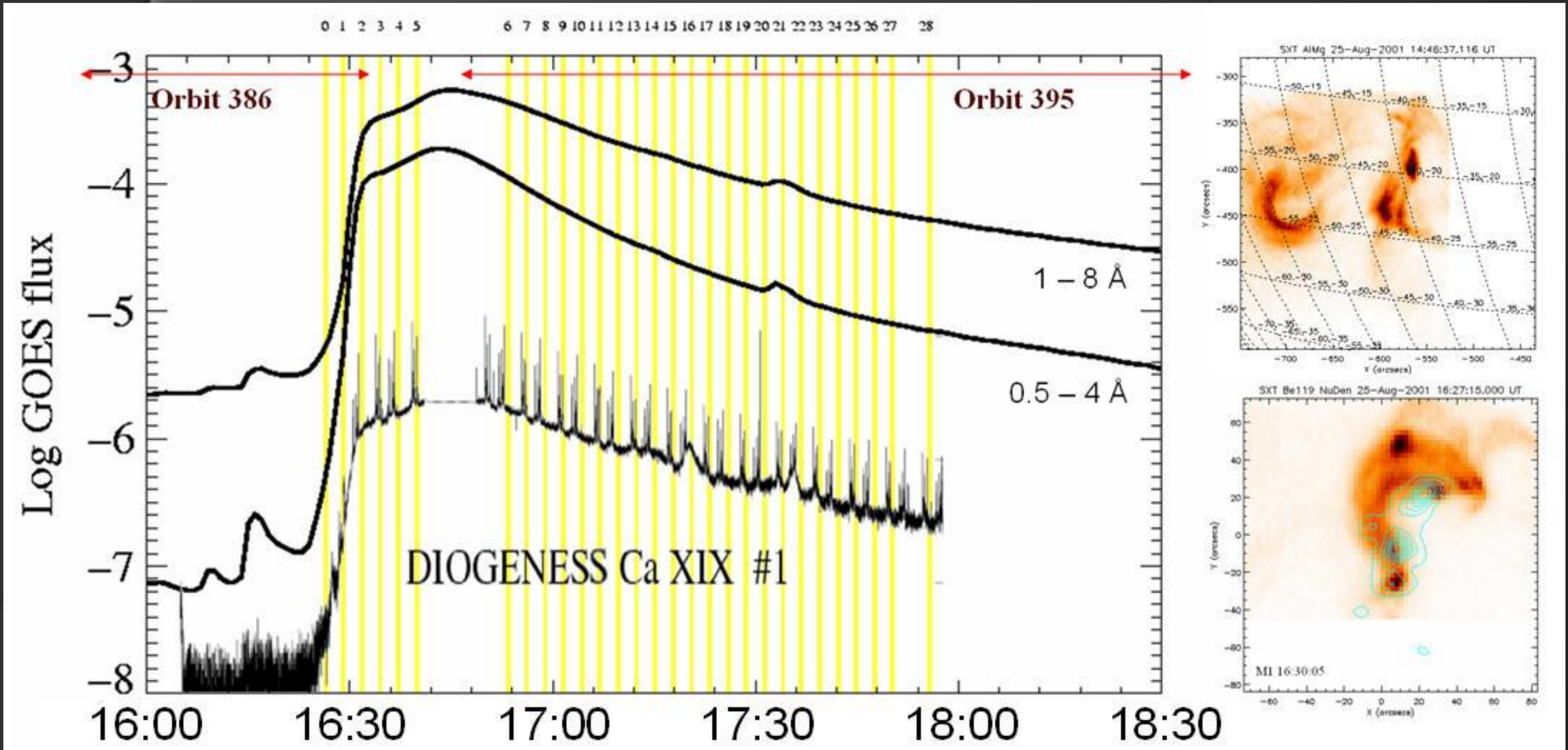
On the payload



Diogeness: scanning Flat Crystal Spectrometer
like on *P78-1* **Czech detectors**

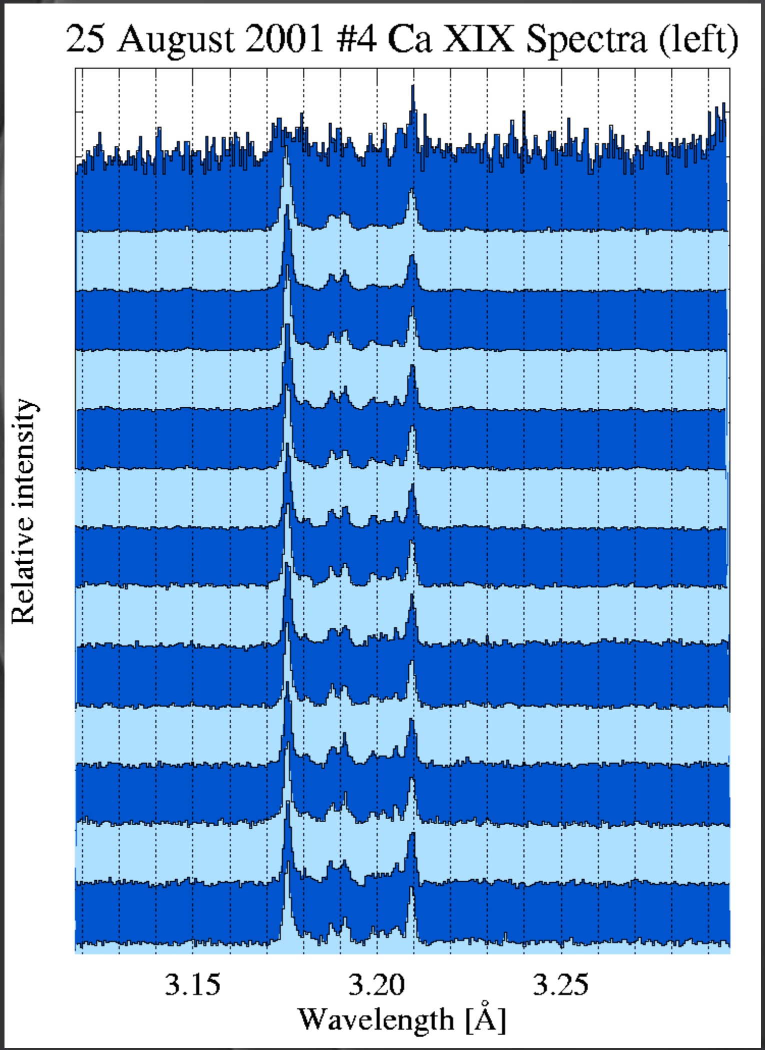
RESIK: Bent Crystal Spectrometer
like on *SMM* and *Yohkoh* UK, US, Russia

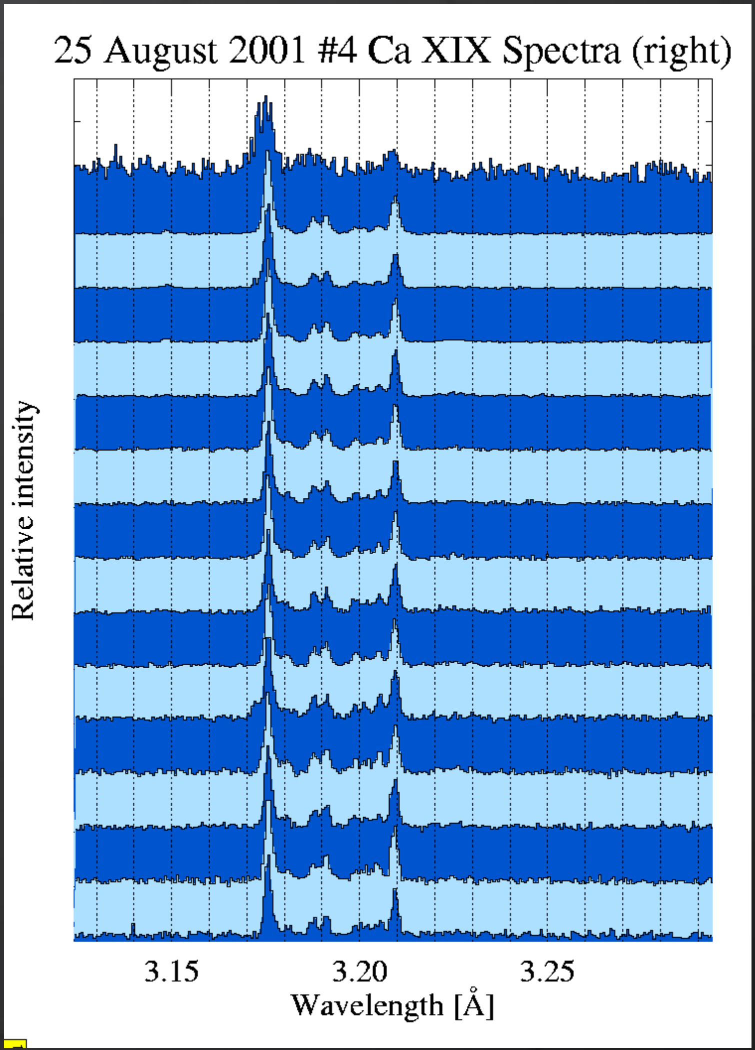
Satellite dopplerometer results CORONAS-F: 25 Aug 2001 3B/X5.3



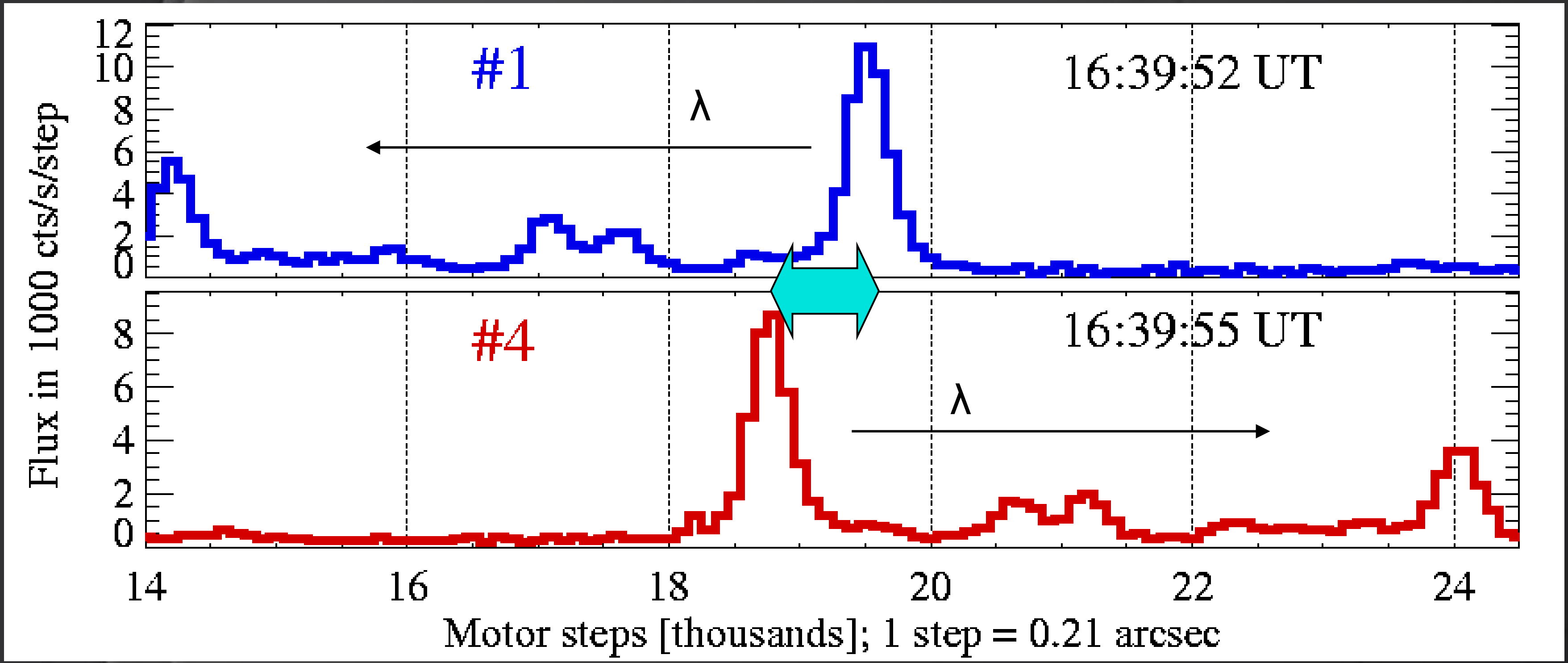
Presentation for Czech-Polish-Slovak Consultation on Solar Physics (CoSP)
May 19 - 21, 2011, Ondřejov, Czech Republic, March 17: J. Sylwester

Time Sequence of left & right scans



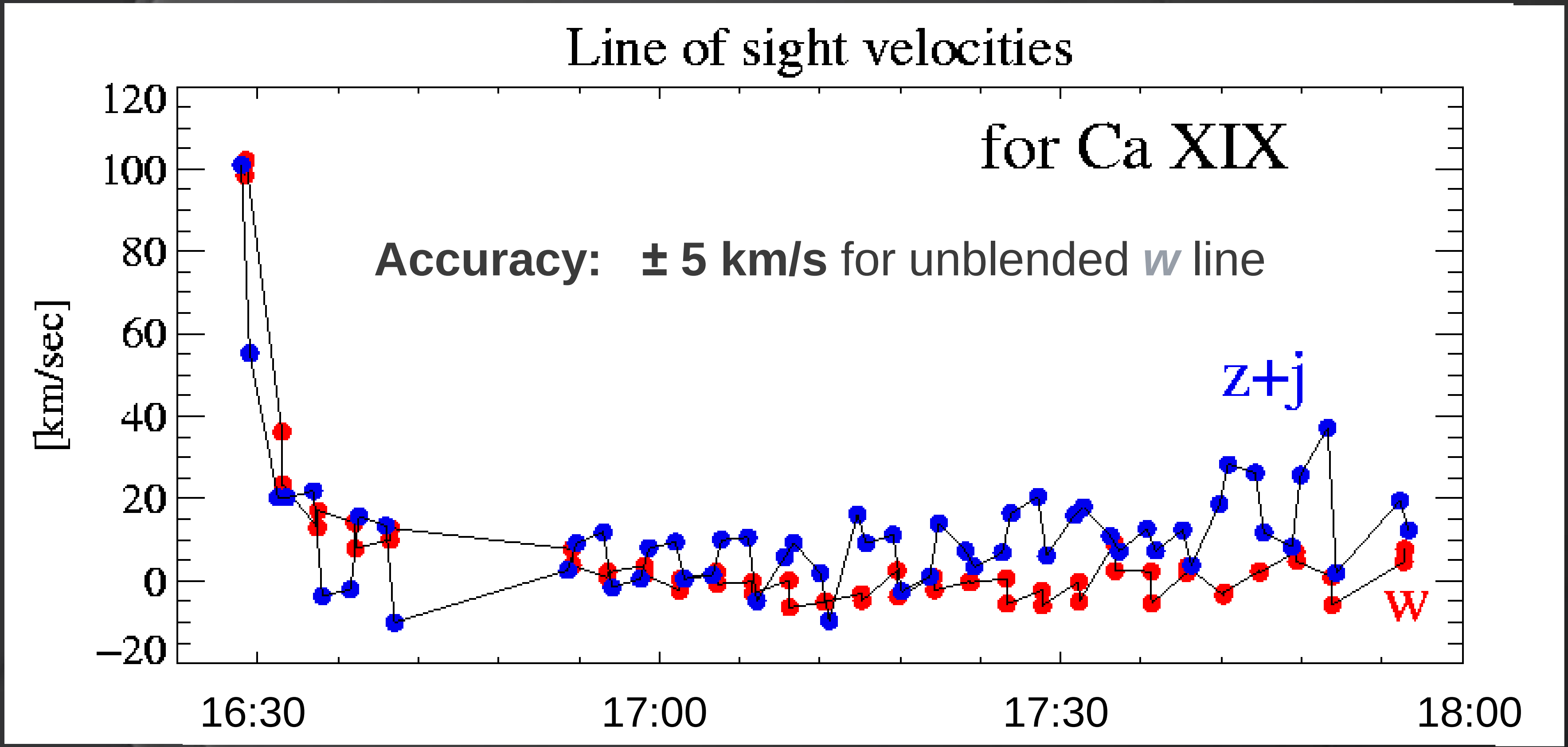


X-ray Dopplerometer results



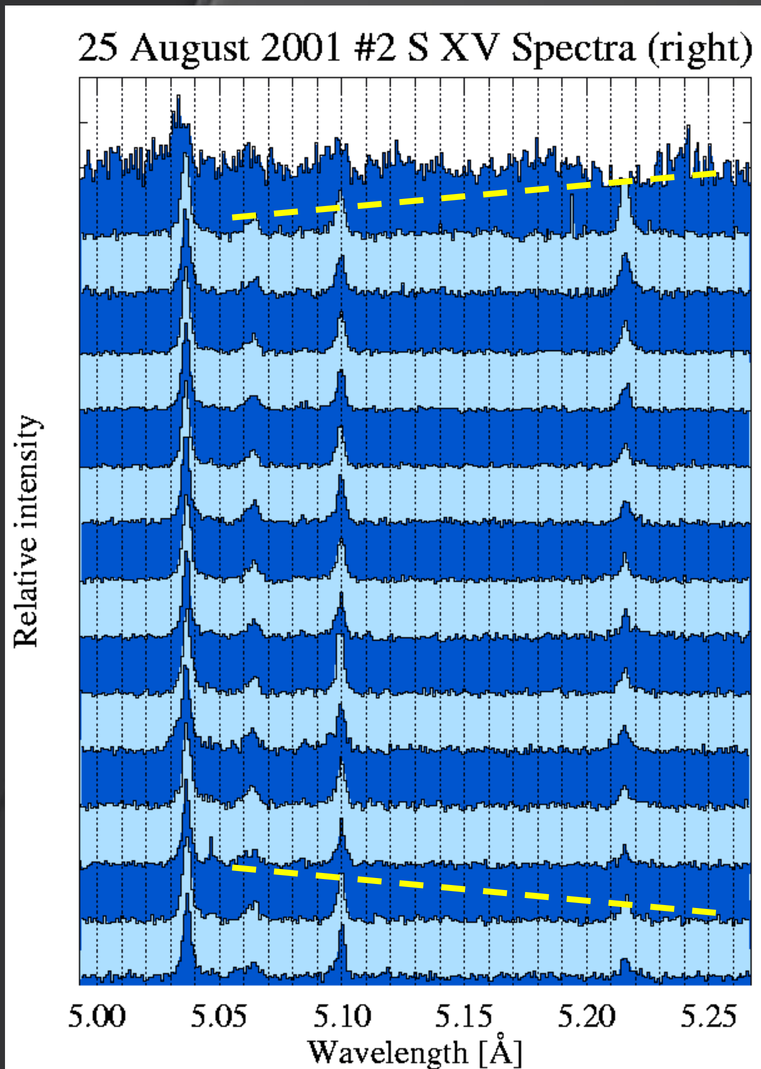
Spectra recorded nearly simultaneously in Channels #1 and #4 of Diogeness during the maximum phase of X5.3 flare on 25 Aug. 2001. The scanning in both channels is made in the opposite wavelength sense. Thus the intercombination and forbidden lines comprising the Ca XIX triplet are seen on the opposite sides of the presented range (recorded 20 s apart in time).

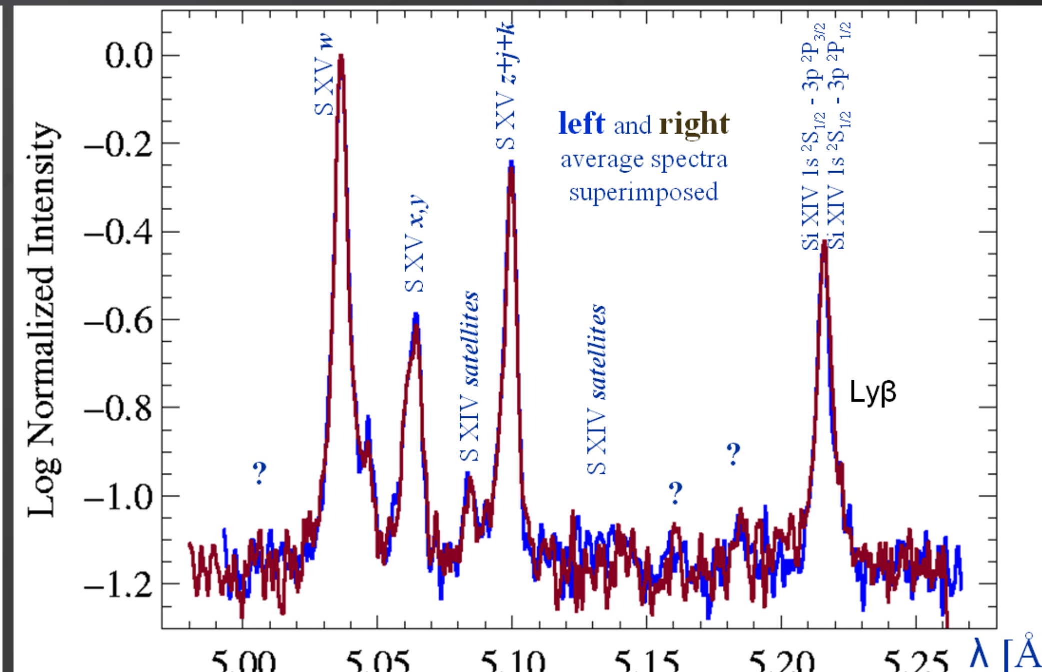
Velocities: entire spectra shifted

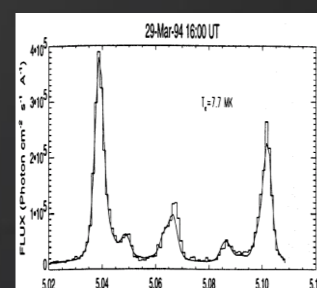


Velocities as determined for the resonance (*w*) and forbidden lines (*z*) of the Ca XIX triplet. The forbidden line is blended with a strong dielectronic satellite line (*j*) which might account for slightly different pattern of behaviour later in the flare decay.

Diogeness: new spectroscopy







These observations Still awaits for the analysis

Yohkoh BCS, Harra et al. AA 308, 670, 1996

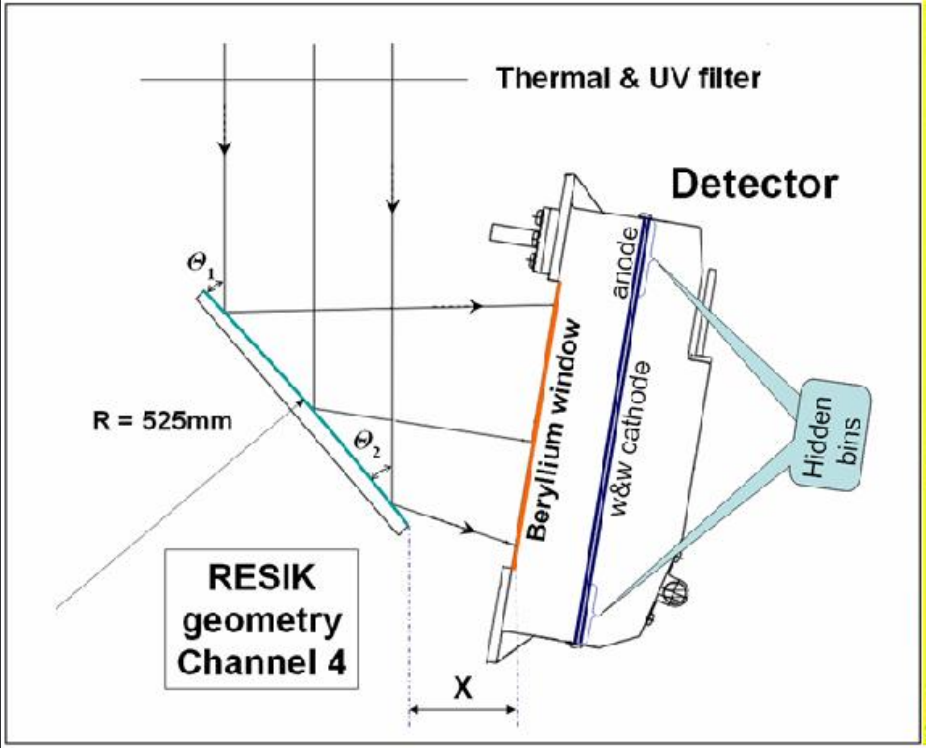
Siarkowski et al., 2002, ESA-SP-506, p753

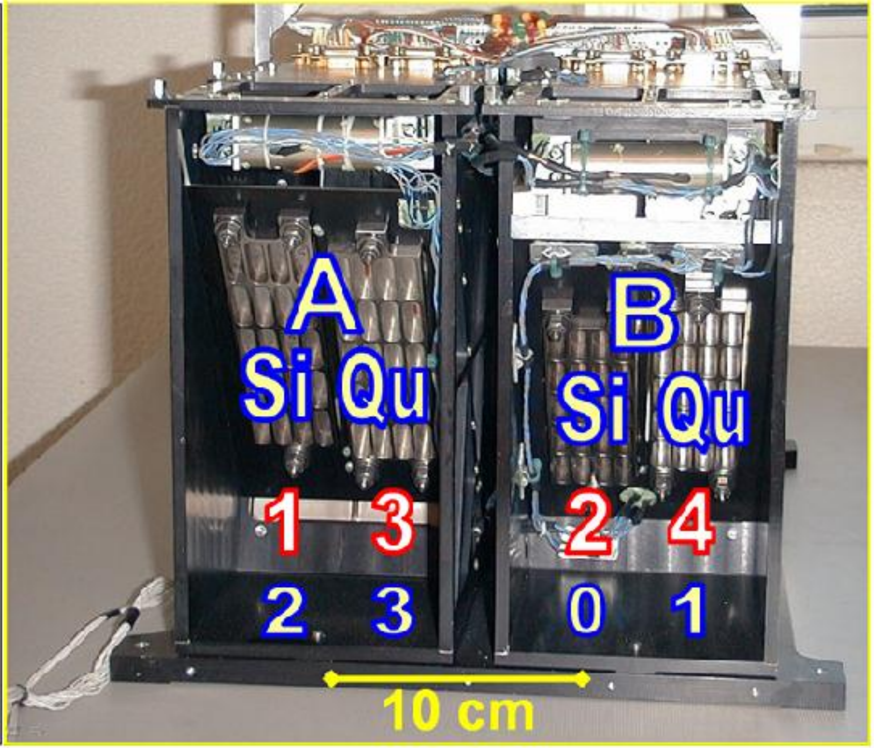
RECENT

Bragg spectrometer: $k\lambda = 2d \sin\Theta$

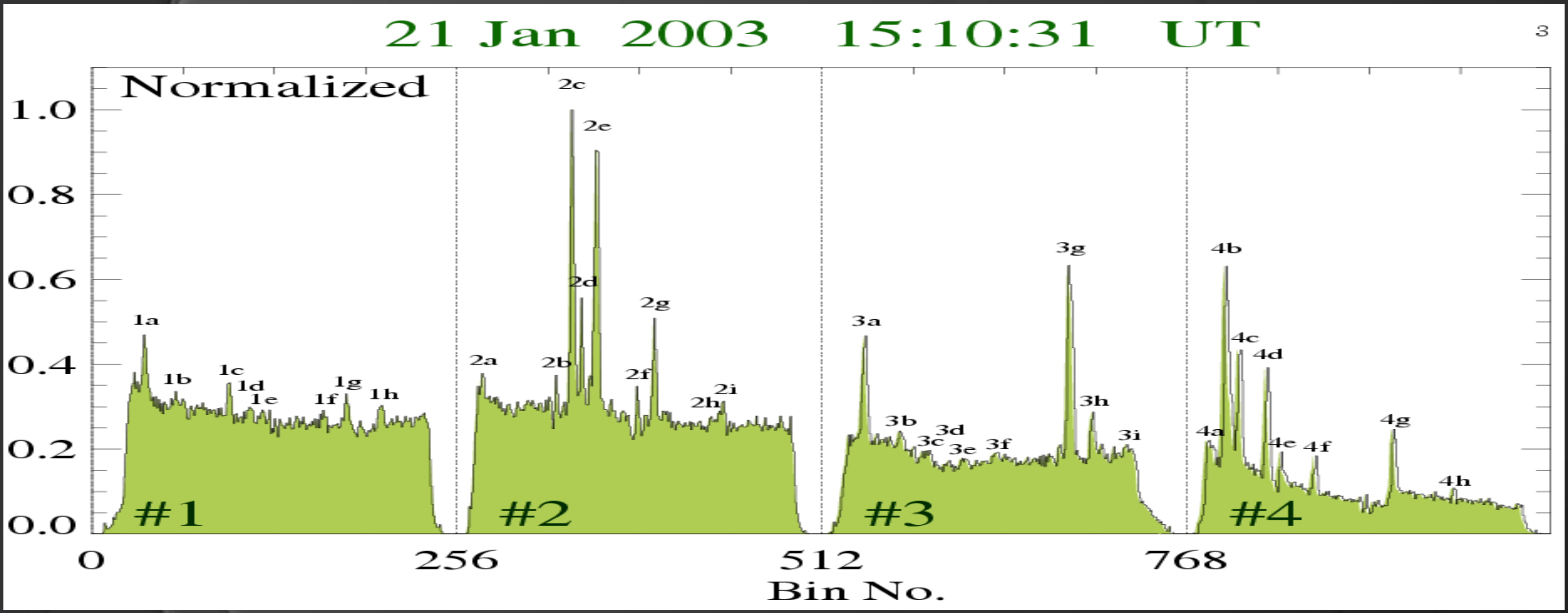
Рентгеновский Спектрометр с Изогнутыми Кристаллами

Measures spectra in range: 0.335 nm – 0.610 nm, instantly in all λ





Line identification



Key	λ [Å]	Ion	Transition
Ch. #1			
1a	3.367	Ar XVII	$1s^2\,{}^1S_0 - 1s3p\,{}^{(1,3)}P_1$
1b	3.422	?	
1c	3.532*	K XVIII	$1s^2\,{}^1S_0 - 1s2p\,{}^1P_1$
1d	3.548	K XVIII	$1s^2\,{}^1S_0 - 1s2p\,{}^3P_{1,2}$
1e	3.571	K XVIII	$1s^2\,{}^1S_0 - 1s2s\,{}^3S_1$
1f	3.689	S XVI (?)	$1s\,{}^2S_{\frac{1}{2}} - 5p\,{}^2P_{\frac{3}{2},\frac{1}{2}}$
1g	3.733*	Ar XVIII	$1s\,{}^2S_{\frac{1}{2}} - 2p\,{}^2P_{\frac{3}{2},\frac{1}{2}}$
1h	3.798	S XVI (?)	$1s\,{}^2S_{\frac{1}{2}} - 4p\,{}^2P_{\frac{3}{2},\frac{1}{2}}$

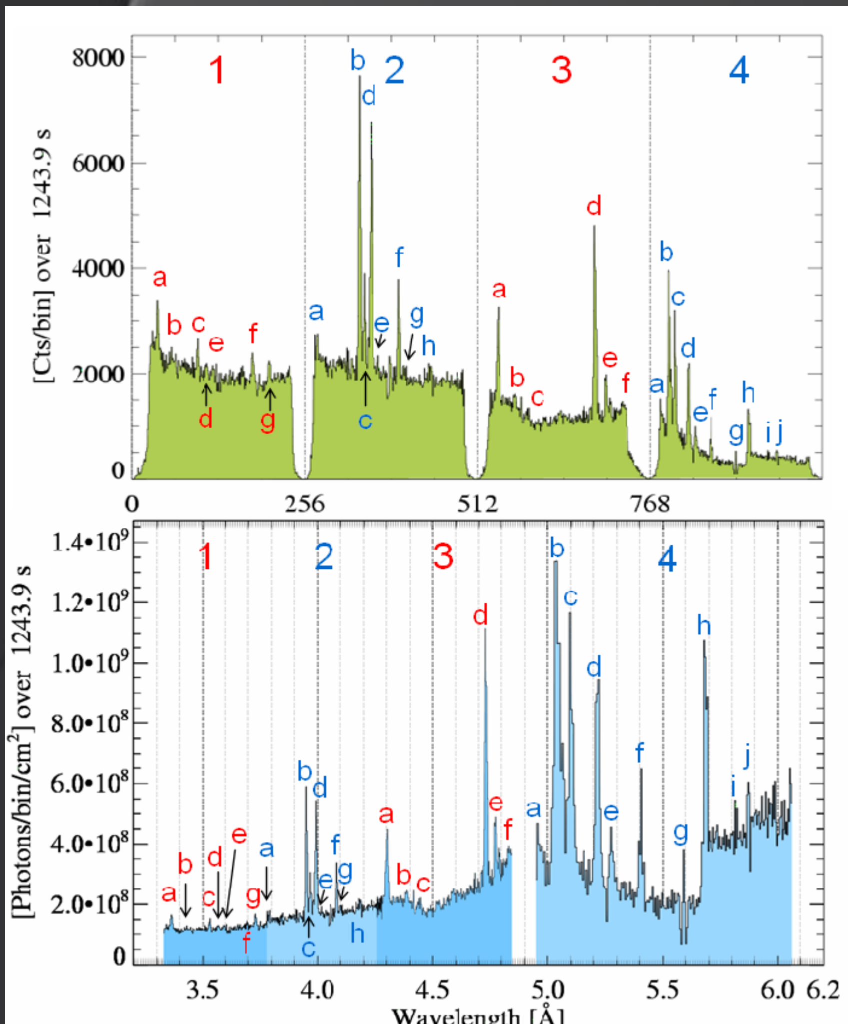
Key	λ [Å]	Ion	Transition
Ch. #2			
2a	3.805	S XVI (?)	$1s\,{}^2S_{\frac{1}{2}} - 4p\,{}^2P_{\frac{3}{2},\frac{1}{2}}$
2b	3.919	?	
2c	3.949*	Ar XVII	$1s^2\,{}^1S_0 - 1s2p\,{}^1P_1$
2d	3.967	Ar XVII	$1s^2\,{}^1S_0 - 1s2p\,{}^3P_{1,2}$
2e	3.994	Ar XVII	$1s^2\,{}^1S_0 - 1s2s\,{}^3S_1$
2f	4.055	?	
2g	4.088*	S XV	$1s^2\,{}^1S_0 - 1s4p\,{}^1P_1$
2h	4.186	Cl XVII	$1s\,{}^2S_{\frac{1}{2}} - 2p\,{}^2P_{\frac{3}{2},\frac{1}{2}}$
2i	4.197	?	?
2j	4.299*	S XV	$1s^2\,{}^1S_0 - 1s3p\,{}^1P_1$

Key	λ [Å]	Ion	Transition
Ch. #3			
3a	4.299*	S XV	$1s^2\,{}^1S_0 - 1s3p\,{}^1P_1$
3b	4.376	?	
3c	4.444	Cl XVI	$1s^2\,{}^1S_0 - 1s2p\,{}^1P_1$
3d	4.466	Cl XVI	$1s^2\,{}^1S_0 - 1s2p\,{}^3P_{1,2}$
3e	4.496	Cl XVI	$1s^2\,{}^1S_0 - 1s2s\,{}^3S_1$
3f	4.578	?	
3g	4.729*	S XVI	$1s\,{}^2S_{\frac{1}{2}} - 2p\,{}^2P_{\frac{3}{2},\frac{1}{2}}$
3h	4.775	?	
3i	4.855	Si XIV	$1s\,{}^2S_{\frac{1}{2}} - 5p\,{}^2P_{\frac{3}{2},\frac{1}{2}}$

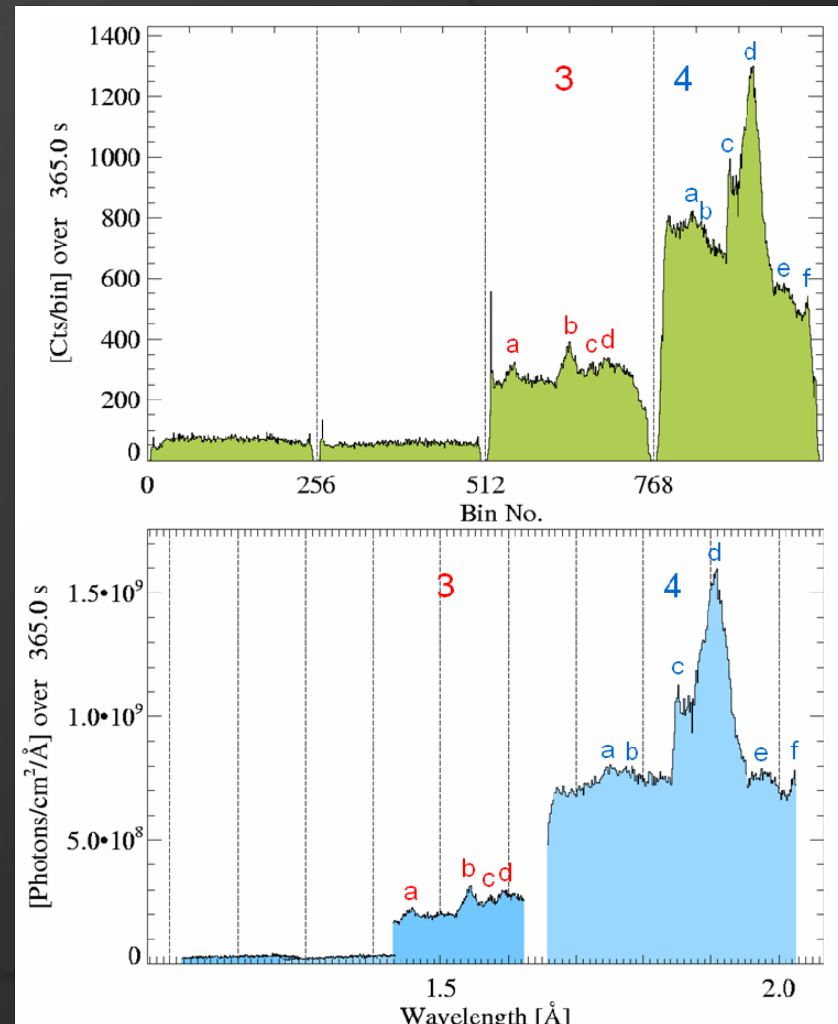
Key	λ [Å]	Ion	Transition
Ch. #4			
4a	4.968	Si XIV	$1s\,{}^2S_{\frac{1}{2}} - 4p\,{}^2P_{\frac{3}{2},\frac{1}{2}}$
4b	5.039*	S XV	$1s^2\,{}^1S_0 - 1s2p\,{}^1P_1$
4c	5.102	S XV	$1s^2\,{}^1S_0 - 1s2s\,{}^3S_1$
4d	5.194	Si XIV	$1s\,{}^2S_{\frac{1}{2}} - 3p\,{}^2P_{\frac{3}{2},\frac{1}{2}}$
4e	5.253	Si XIII	$1s^2\,{}^1S_0 - 1s5p\,{}^1P_1$
4f	5.384	Si XIII	$1s^2\,{}^1S_0 - 1s4p\,{}^1P_1$
4g	5.681*	Si XIII	$1s^2\,{}^1S_0 - 1s3p\,{}^1P_1$
4h	5.919	Si XII d	$1s^2 2p\,{}^2P_{\frac{3}{2}} - 1s2p\,({}^3P)3p\,{}^2D_{\frac{5}{2}}$

Reduction of spectra – high accuracy of absolute flux determinations

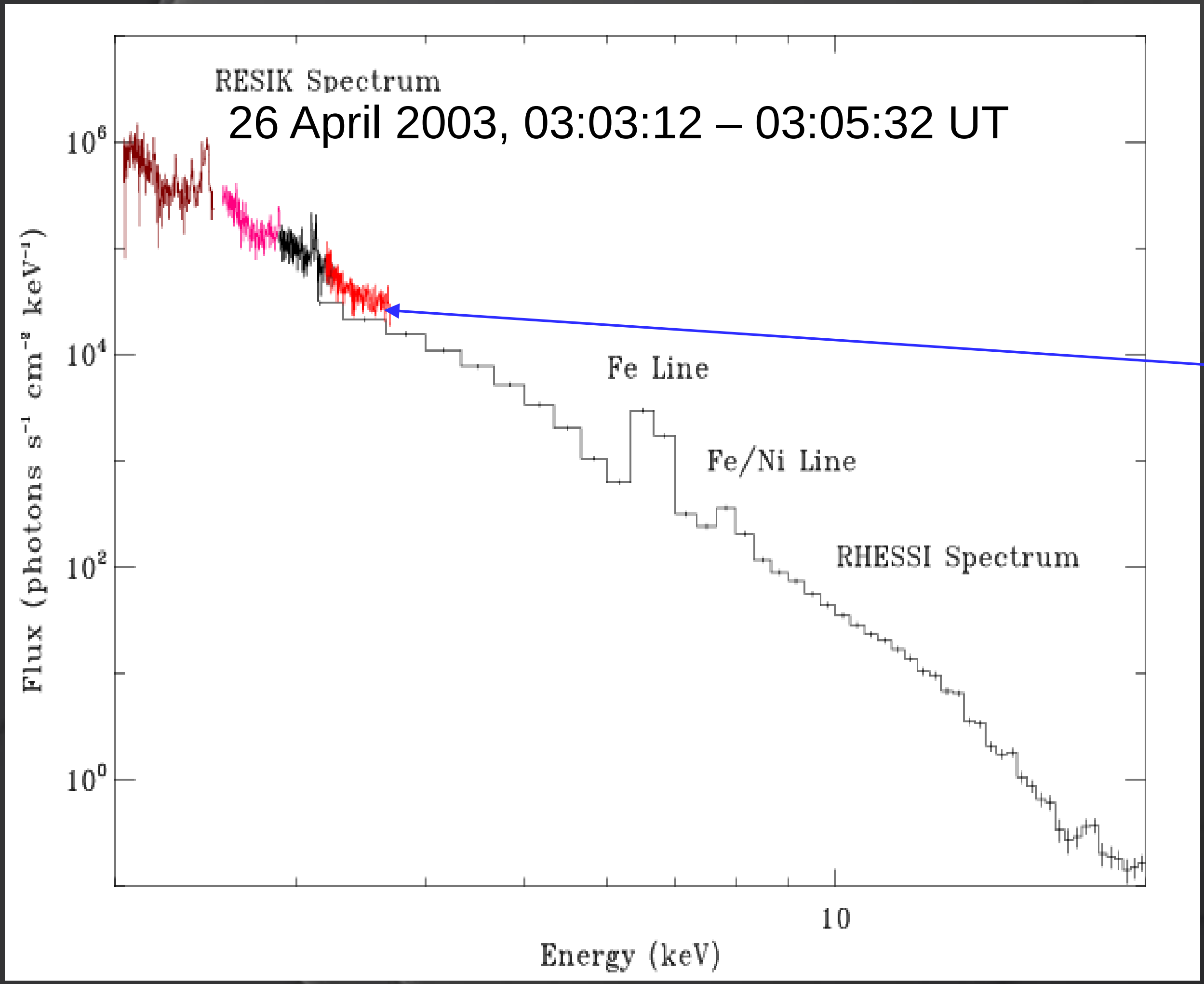
First order reflections



Third order reflections

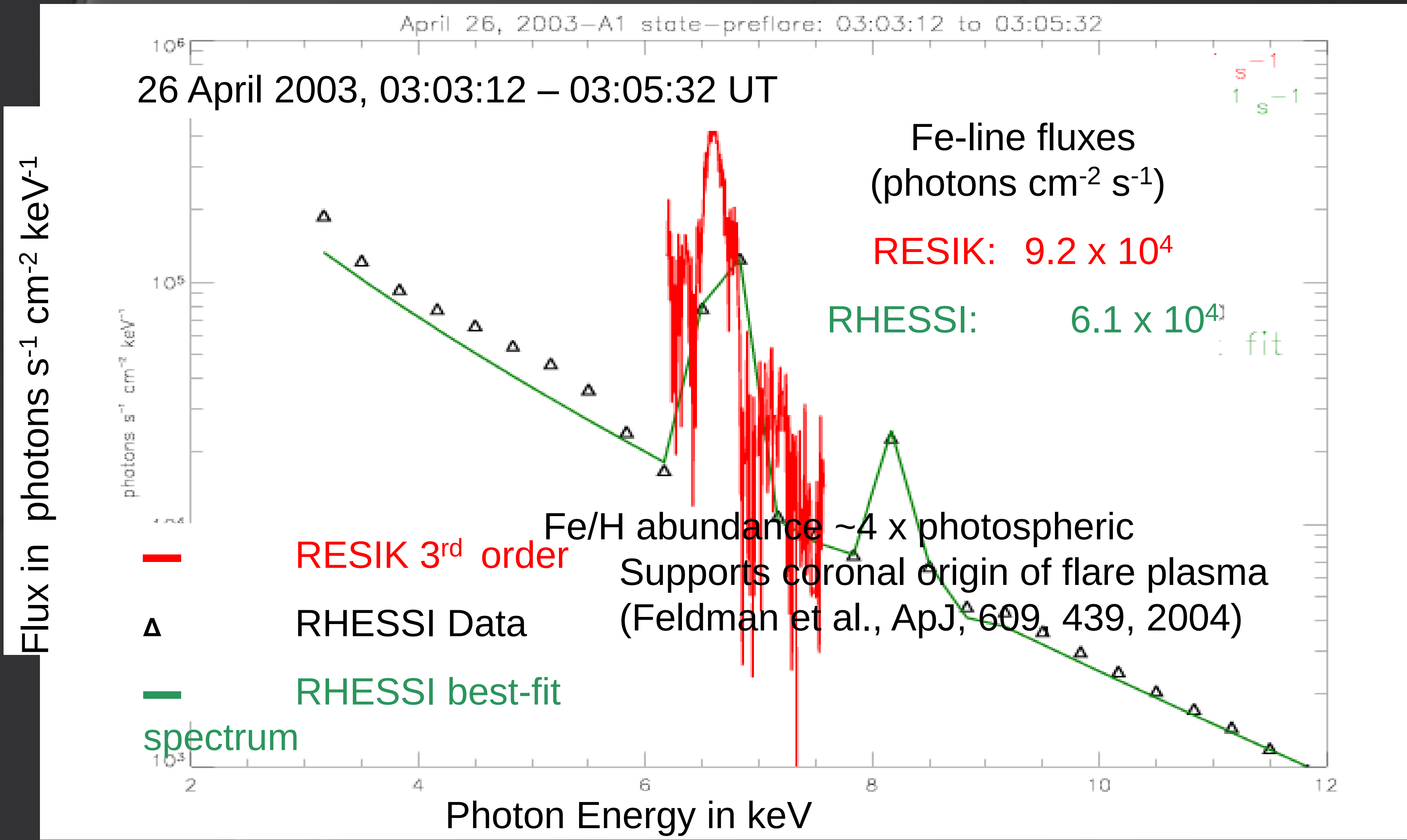


RESIK & NASA RHESSI



Without attenuators ~10% agreement

RESIK & RHESSI Iron group



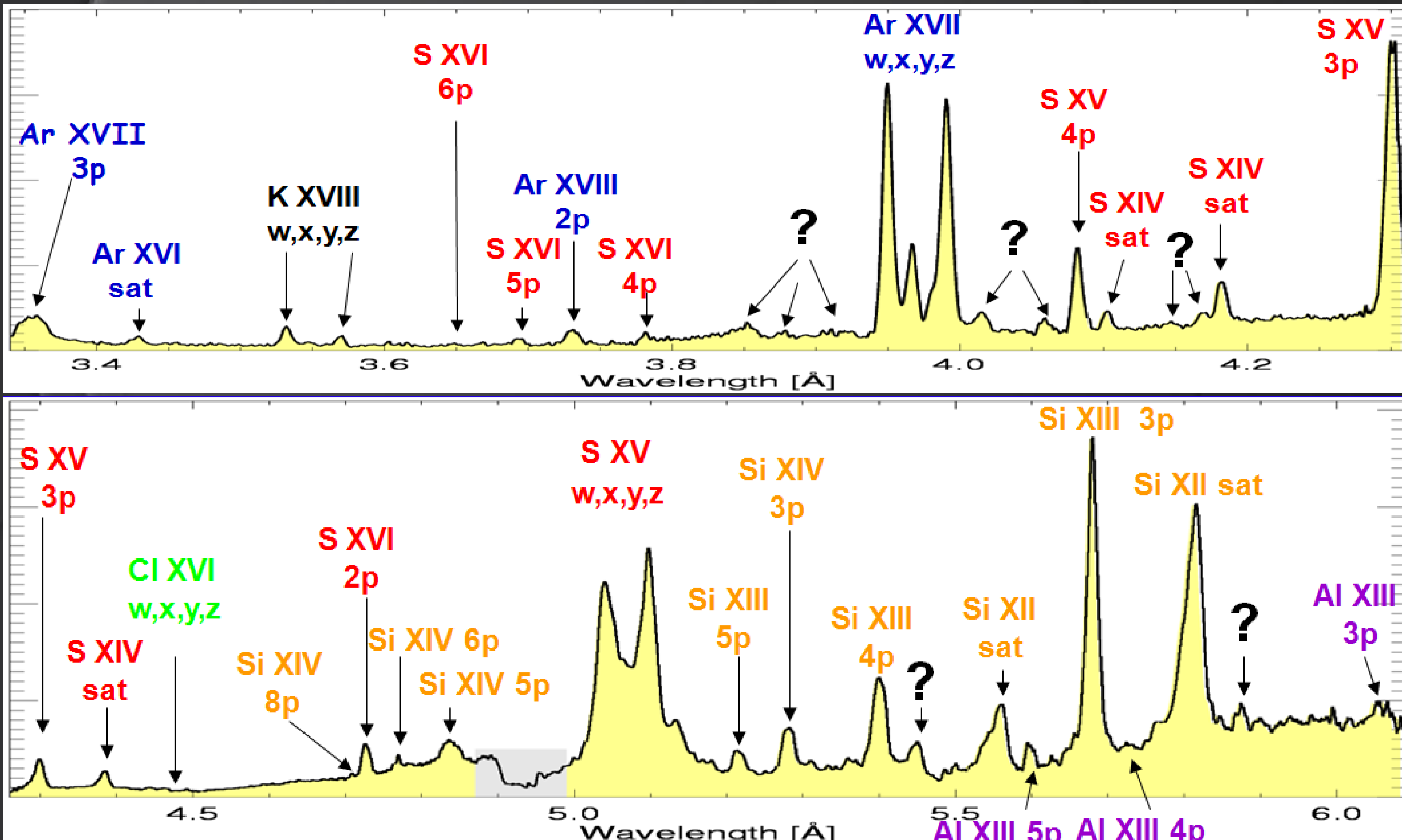
~1 mln spectra collected between Aug

New Line Identifications aver

Available online at www.sciencedirect.com
ELSEVIER ScienceDirect
Advances in Space Research 38 (2006) 1534–1537
ADVANCES IN SPACE RESEARCH (a COSPAR publication)
www.elsevier.com/locate/asr

Lines in the range 3.2–6.1 Å observed in RESIK spectra

B. Sylwester [a,*], J. Sylwester [a], M. Siarkowski [a], K.J.H. Phillips [b], J.L. Culhane [c], J. Lang [d], C. Brown [e], V.D. Kuznetsov [f]



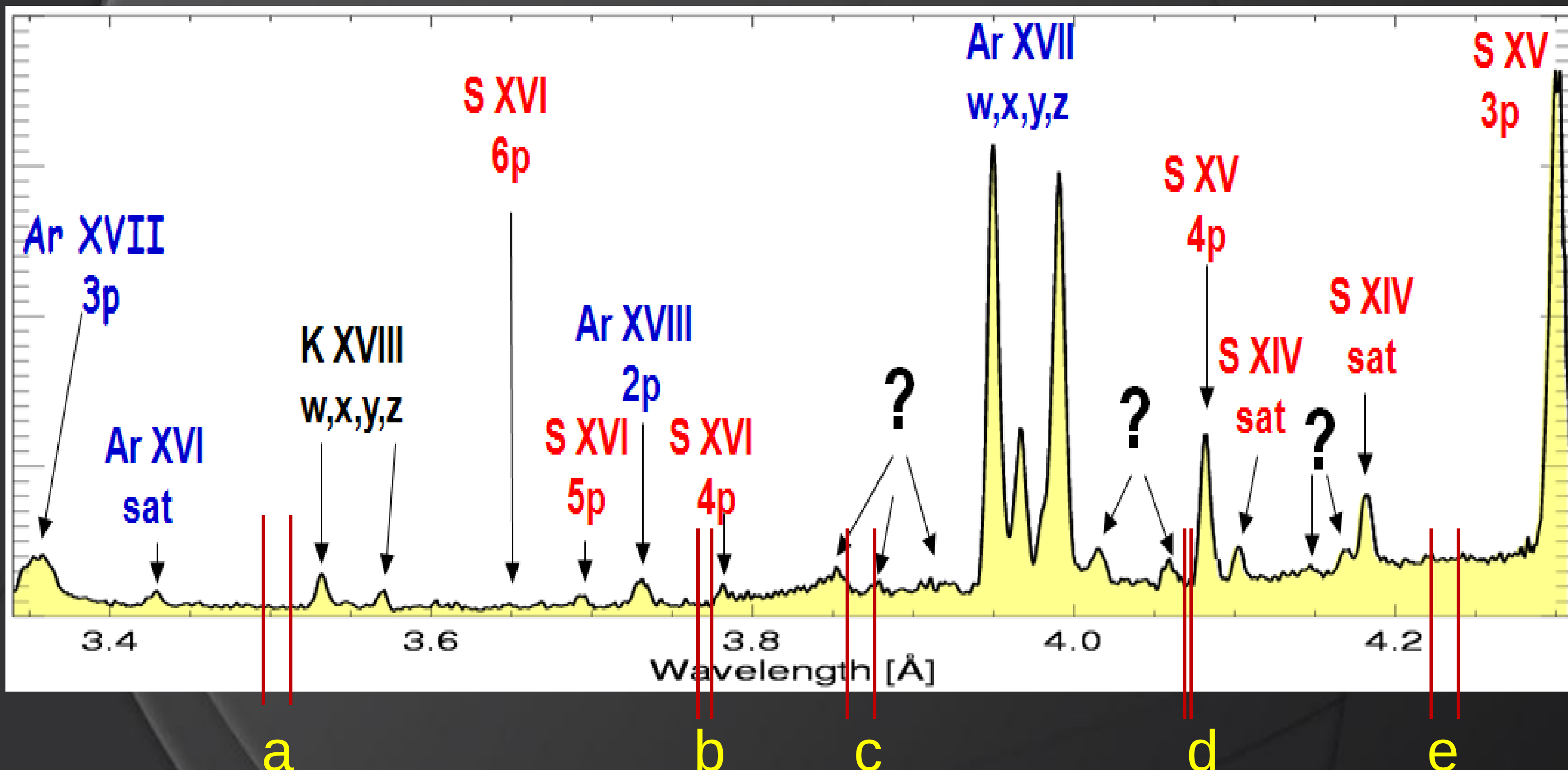
The solar X-ray continuum measured by RESIK

Phillips, K. J. H.; Sylwester, J.; Sylwester, B.; Kuznetsov, V. D.

ApJ, 711, 179-184, 2010

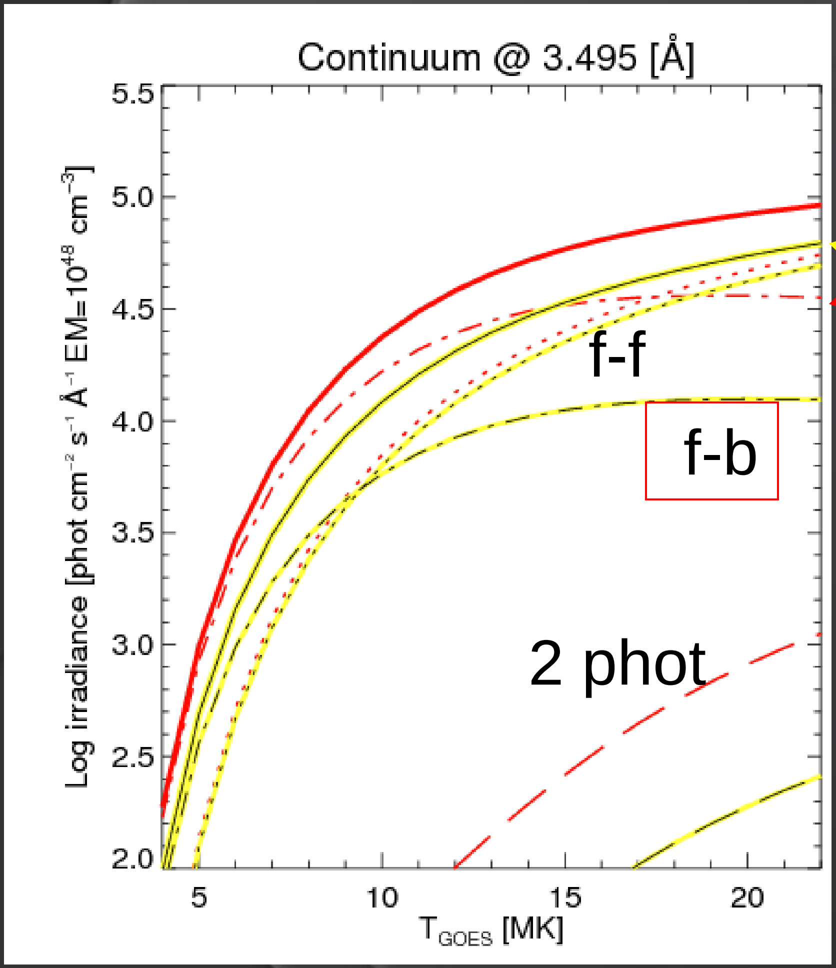
Data: level2 reduced RESIK spectra available on the web:
http://www.cbk.pan.wroc.pl/experiments/resik/resik_level2.php
~3000 flare spectra, 20 flare events mostly from times in 2002 & 2003
Please check, whether RESIK data are available if studying events from this time interval

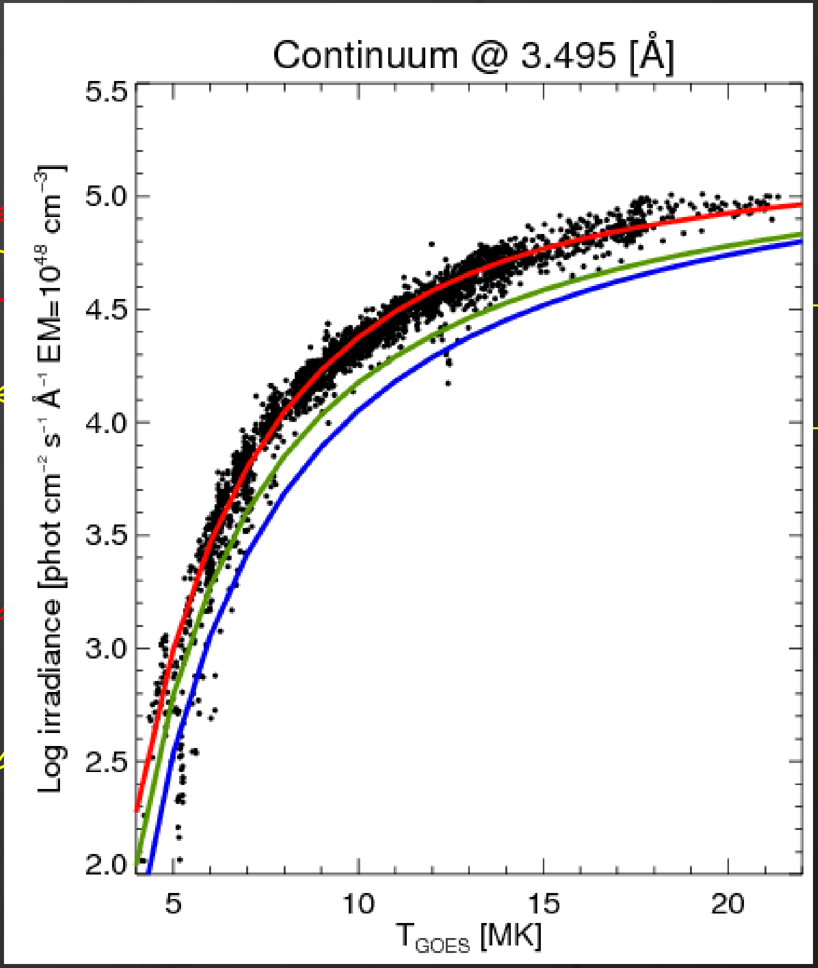
Continuum band selection



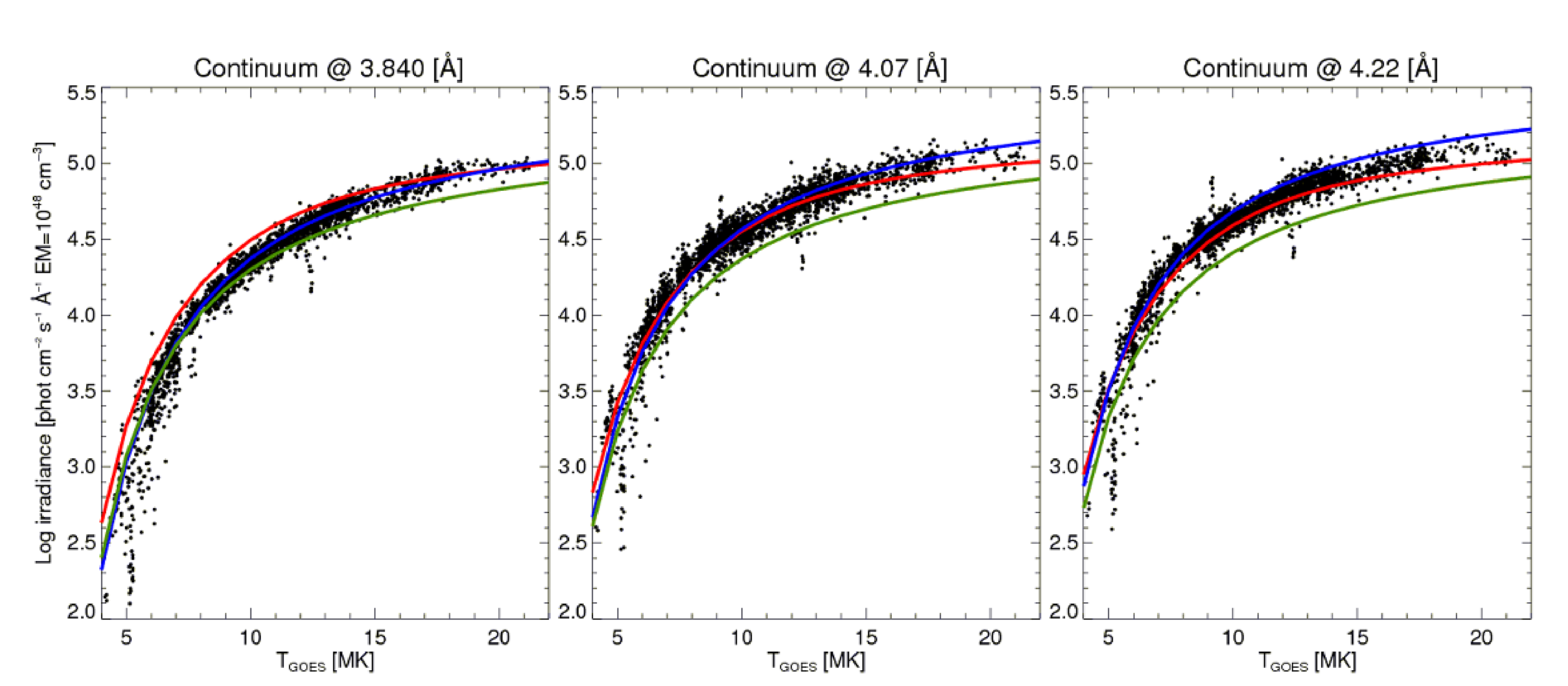
no obvious lines or line groups, no theory-predicted lines

RESIK Continnum Chan. 1 & 2





Continuum bands c, d & e



Look into continuum shape vs lambda for the rise phase of flares

Note: Isothermal aprox. All points icluded also from rise phase

Conclusions- continuum paper

- coronal rather than photospheric set of abundances is adequate for this sample of flare spectra.
- An isothermal plasma assumed in this work appears to be justified in the narrow wavelength bands studied here.
- *GOES* T and EM values satisfactorily describe the continuum emission in the investigated spectral range (based consistently on CHIANTI atomic database)
- Important for *RHESSI* and *Hinode* XRT

A Solar Spectroscopic Absolute Abundance of Argon from RESIK

ApJ, 720, 1721-1726, 2010

Argon is a high-FIP (15.6 eV) element

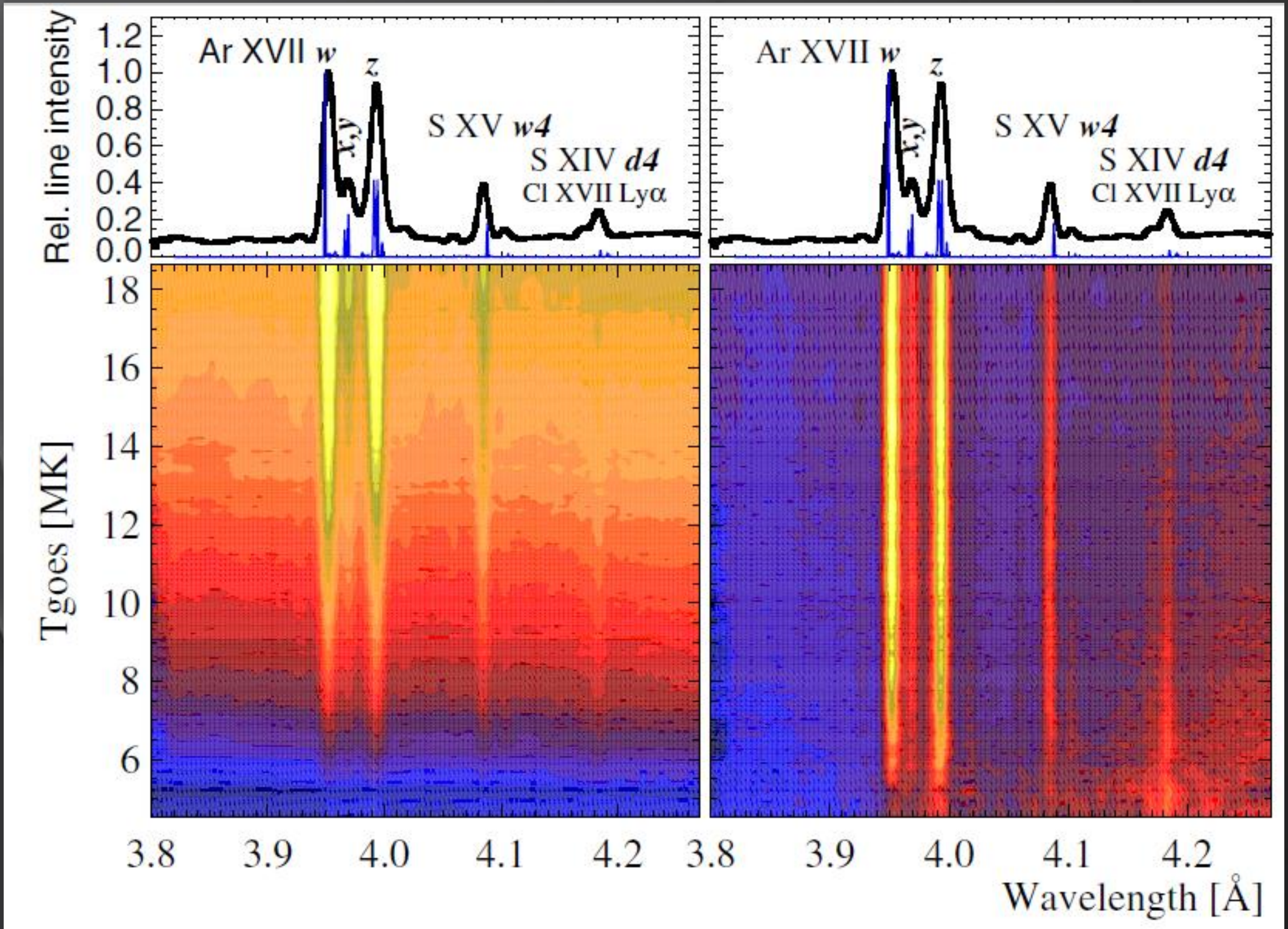
Data: level2 reduced RESIK spectra available on the web:

http://www.cbk.pan.wroc.pl/experiments/resik/resik_level2.php

~3000 flare spectra, 20 flare events mostly from times in 2002 & 2003

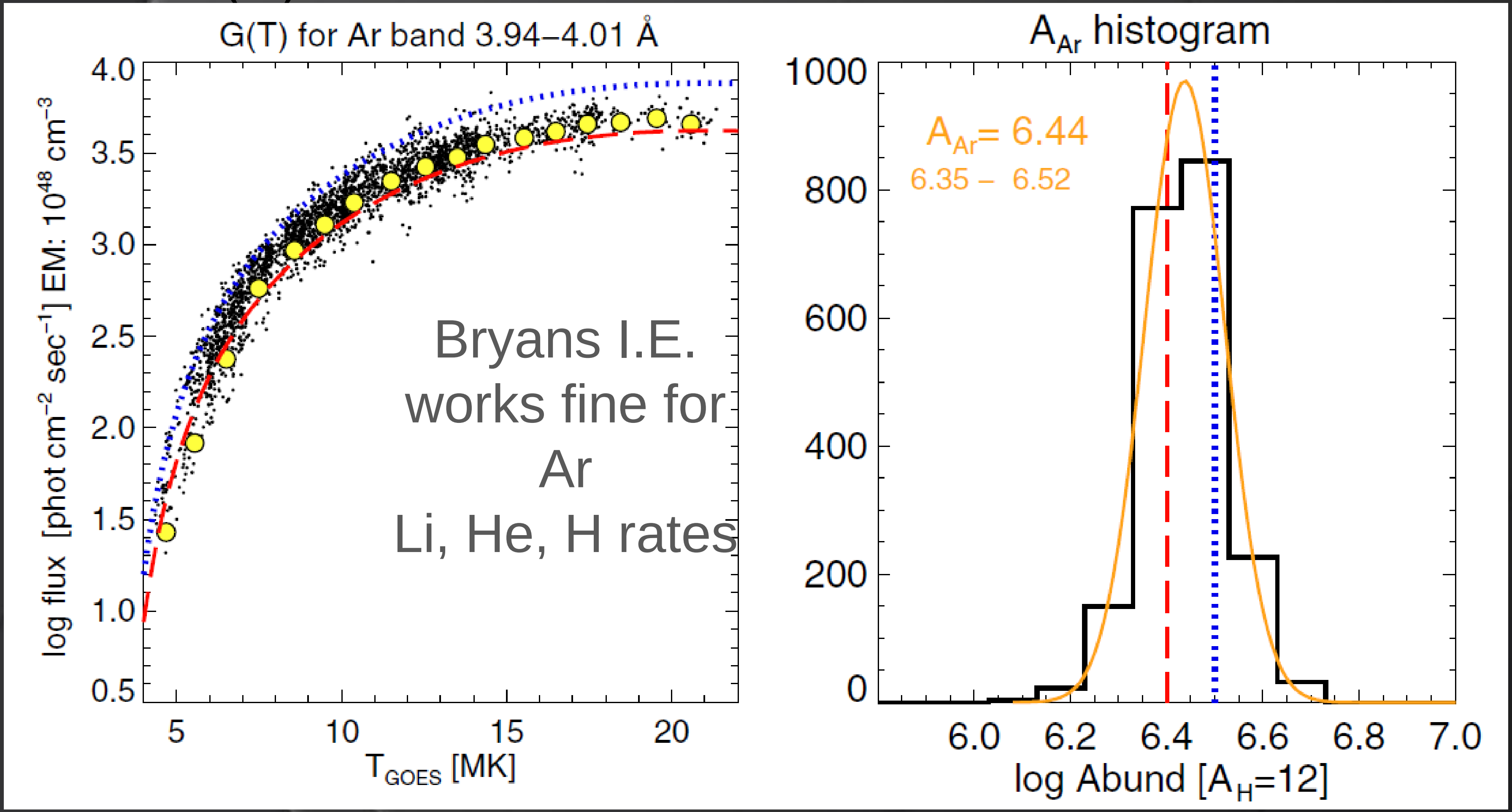
Please check, whether RESIK data are available if studying events from this time interval

The same analysis methodology



Theory compares v. well with observations

first direct observational test of „atomic theory" for line G(T)'s

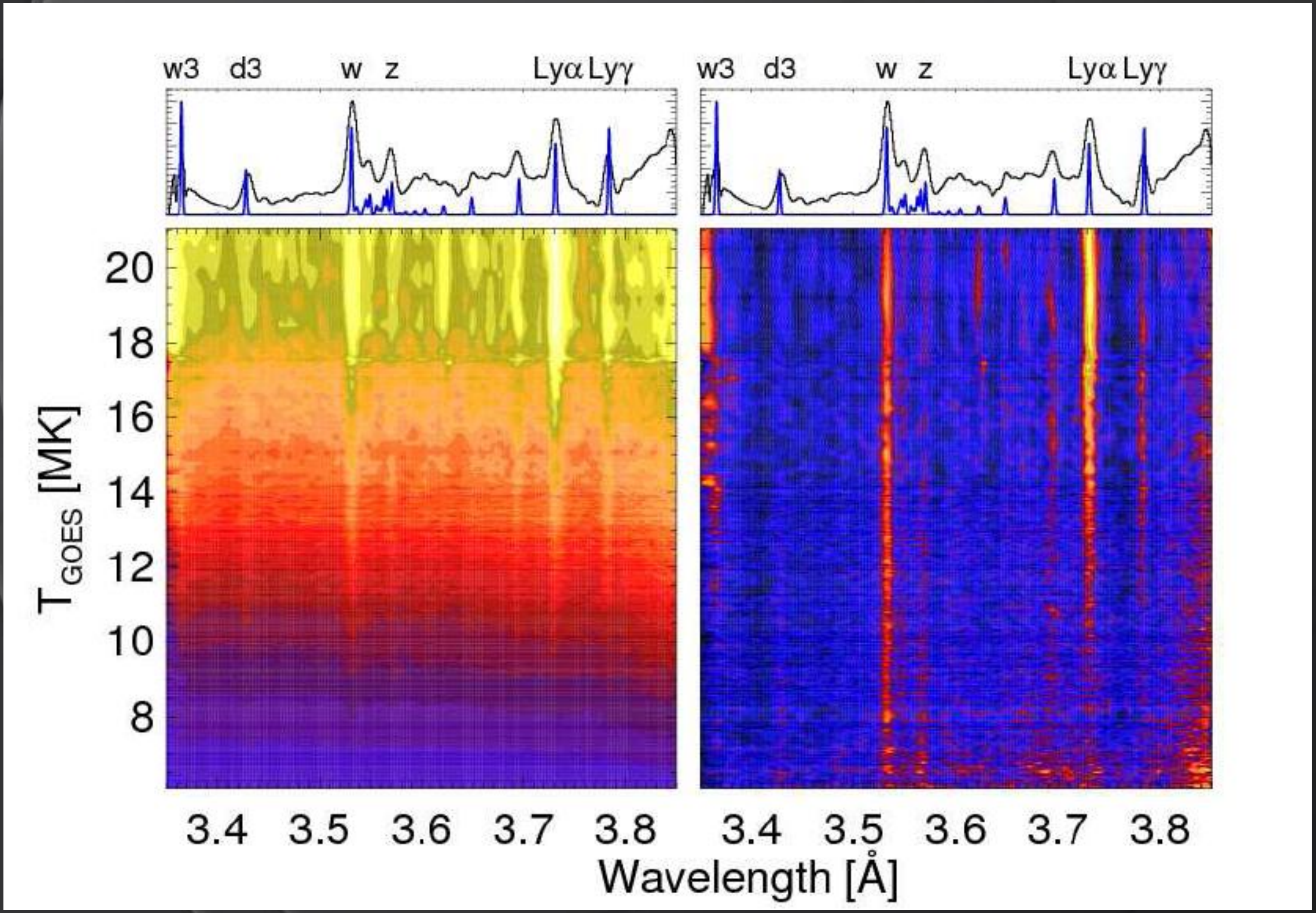


Highly Ionized Potassium Lines in Solar X-ray Spectra and the Abundance of Potassium

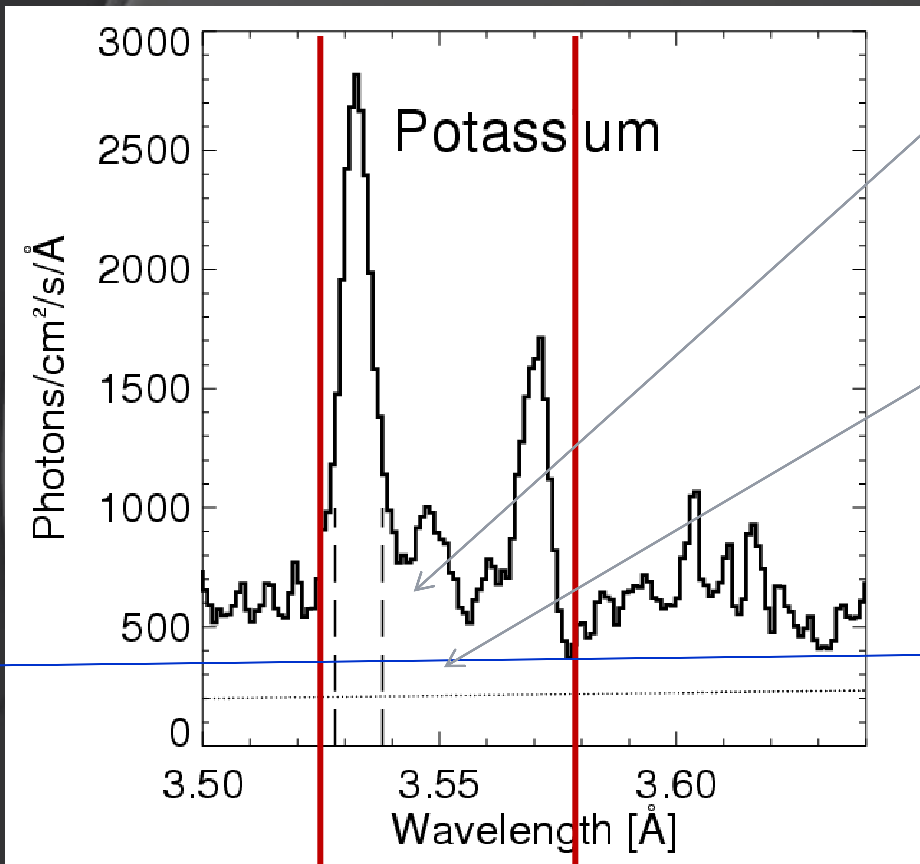
Phillips, B & J Sylwester,
ApJ, 710, 804-809, 2010

Data: level2 reduced RESIK spectra available on the web:
http://www.cbk.pan.wroc.pl/experiments/resik/resik_level2.php
~3000 flare spectra, 20 flare events mostly from times in 2002 & 2003,
also the non-flaring spectra (312)

RESIK channel 1 Dependence on T



K XVIII He-like ione spectrum low FIP (4.34) element



Line Flux (area)

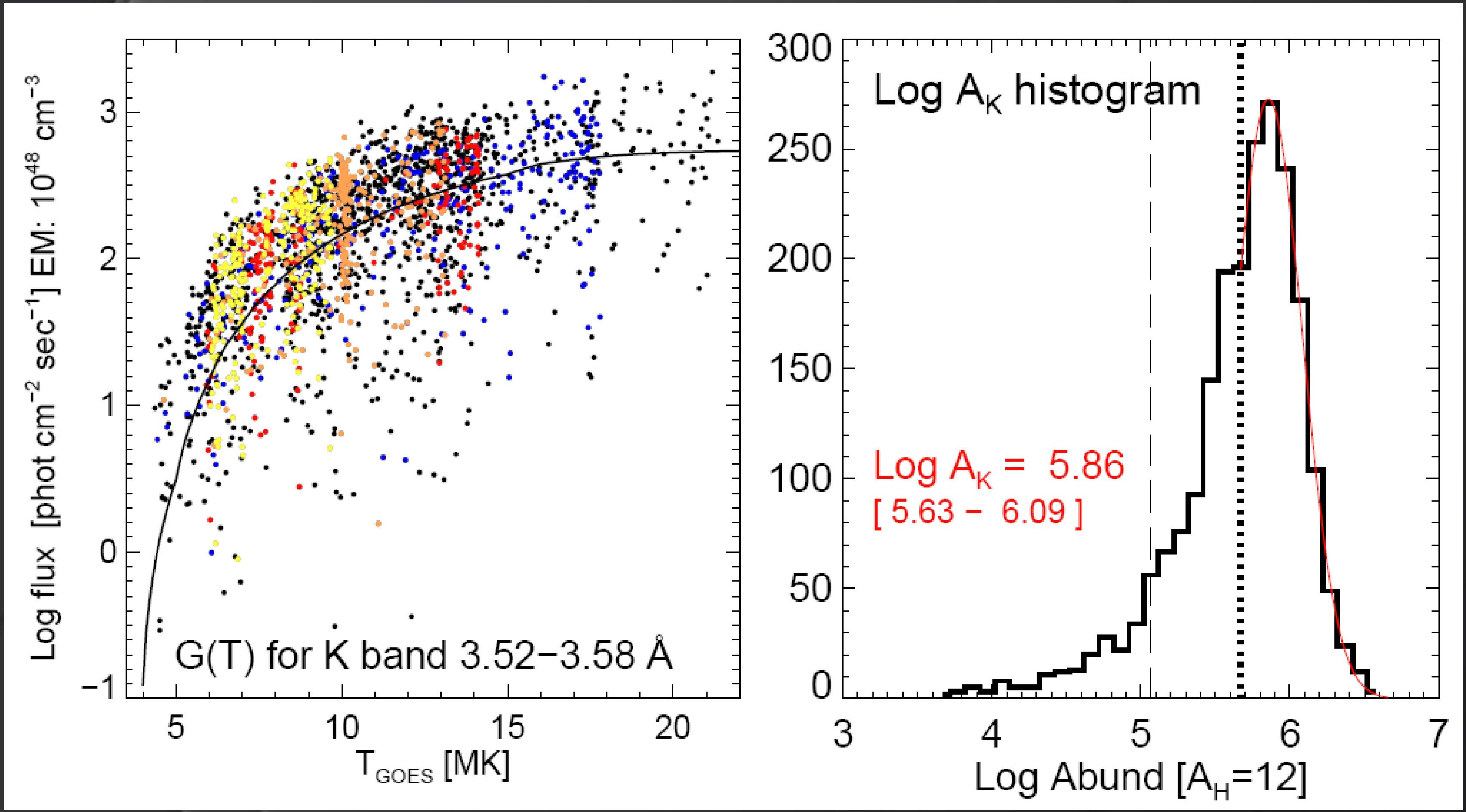
above

the continuum

Is divided by emission measure determined in the isothermal approximation

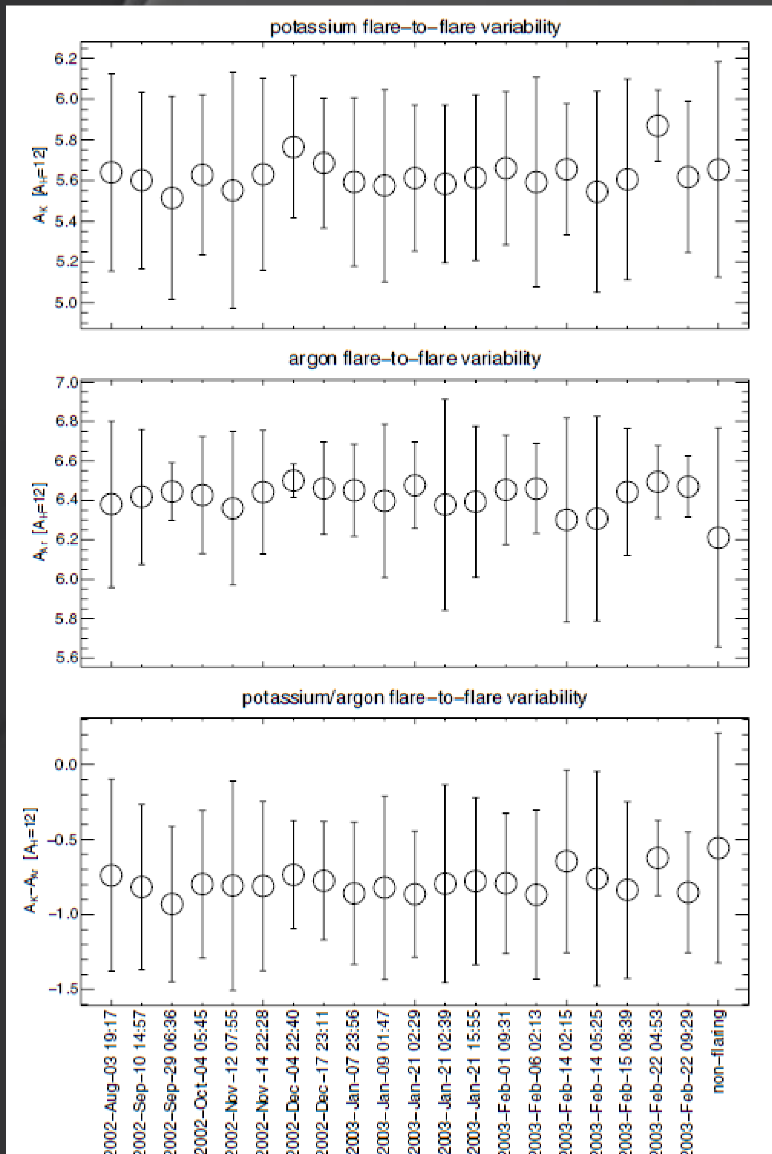
How potassium line group contribution has been accounted for

Normalized K line group intensities



First Absolute spectroscopic K abundance in the corona has been determined !!!

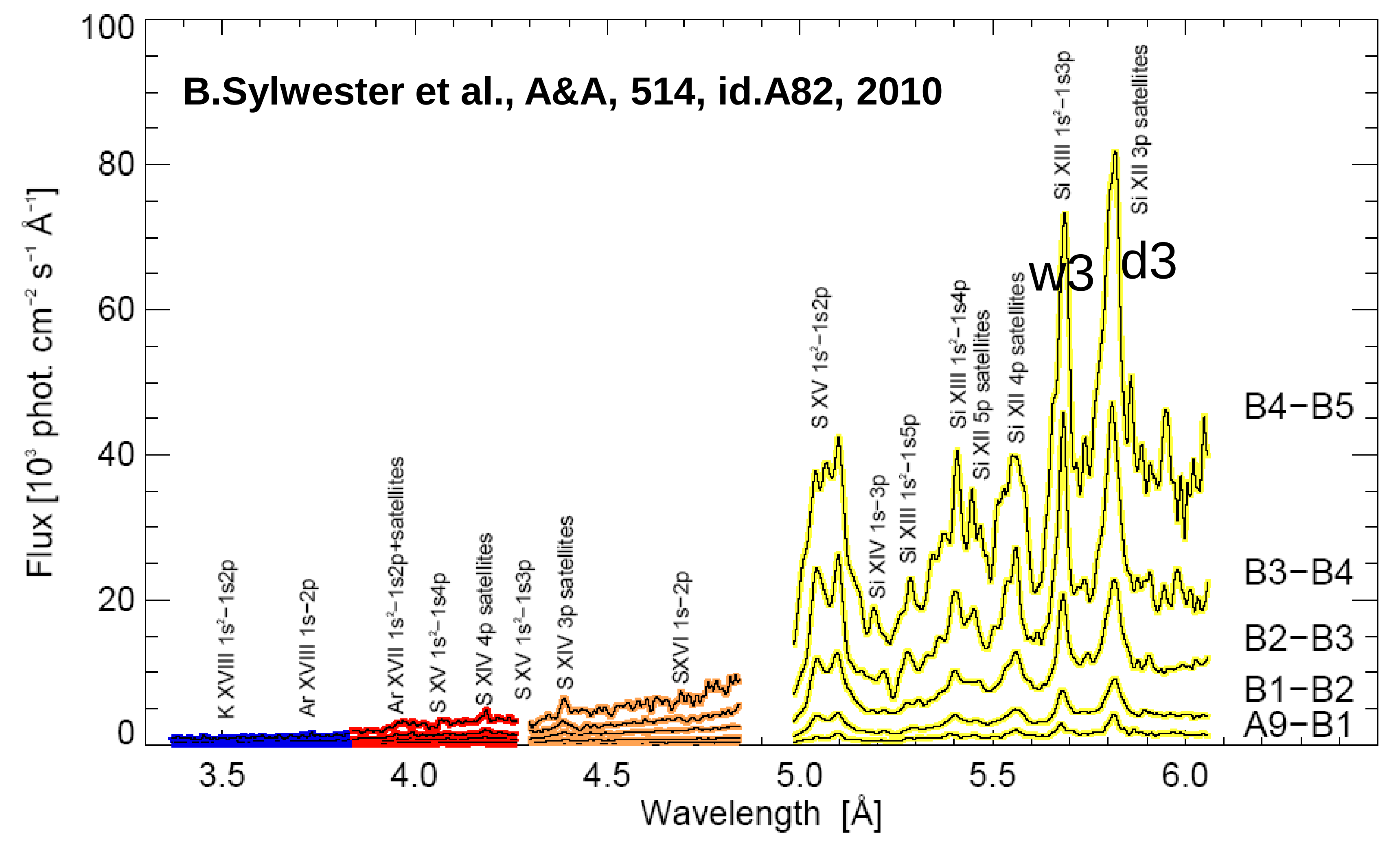
Event–to-event changes



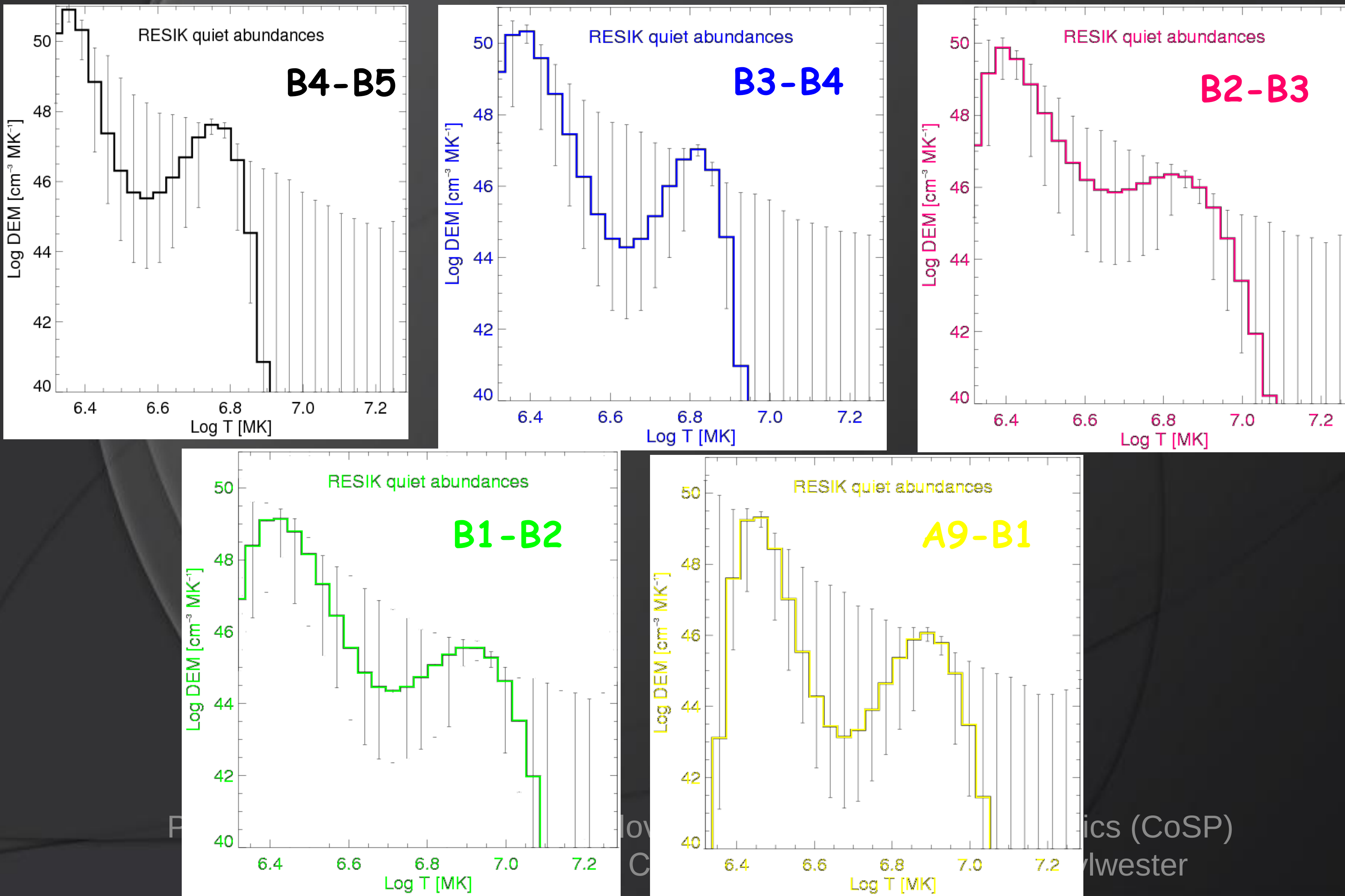
- No K event-to-event variability
- No Ar event-to-event variability
- No K(4.6eV)/Ar(16eV) event-to-event variability

RESIK Quiet Sun Spectra

first ever at such low activity levels



DEM vs activity level of non-flaring Sun



Conclusions

- The first ever spectroscopic determination of solar Ar abundance has been made (no Ar lines are available in the visible)
- Ar abundance is in agreement with the indirect estimates of Lodders, 2009 and close to Greevese Ar/O from in situ…SEP, sol wind
- No flare-to-flare or AR variability of low-to-high FIP aundance ratio unvieled- further events need to be analysed
- First positive detection of non-Maxwellian distribution functions performed (Dzifcakova et al.)
- First measurements of X-ray spectra at very low levels of activity (A9-B4)

RECENT

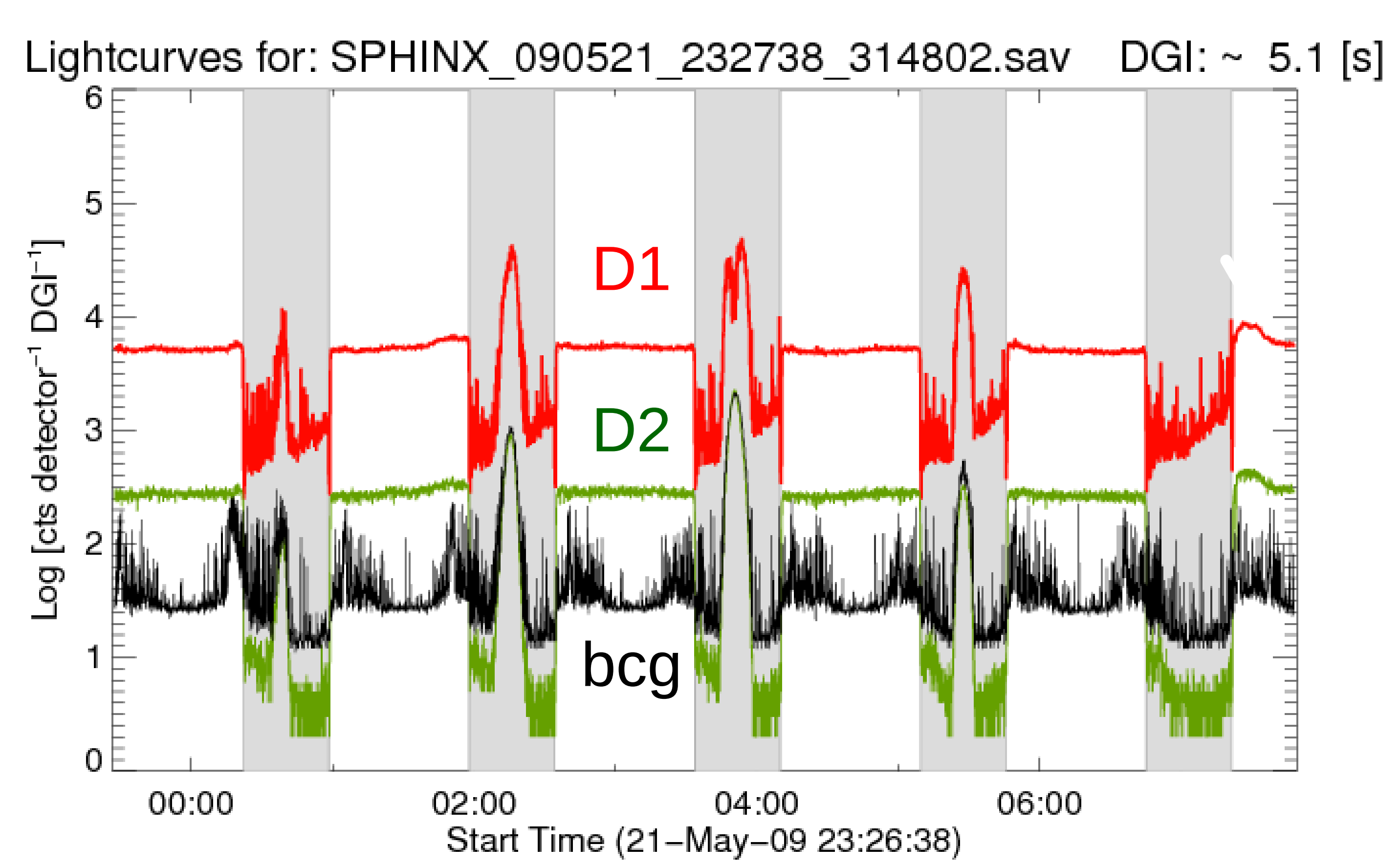
SphinX aboard Coronas-Photon

- Located within Russian TESIS complex developed by FIAN

SPHINX (Solar Photometer in X rays) is common endeavour with

- PN Lebedev Physical Institute RAS
  - Sergey Kuzin
- AI CAV Czech Rep
  - Franta Farnik
- Palermo University
  - Fabio Reale
- MSSL, UK
  - Ken Phillips

Example data record



SphinX early data (PIN diode detectors)

EOS

IN THIS ISSUE: News: USGS Would Fare Well in Proposed Budge
Forum: Informatics and European Geosciences, p.
Meeting: Precipitation Database for the Mediterr
About AGU: Leadership Election Results, p. 77
About AGU: Volunteer Nominations Sought, p. 77
About AGU: Huybers, Ishii, and Weiss Receive Macel
Book Review: The South China Sea, p. 80

EOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION — VOLUME 91 NUMBER 8

Committee of Visitors Advises NSF Division of Ocean Sciences

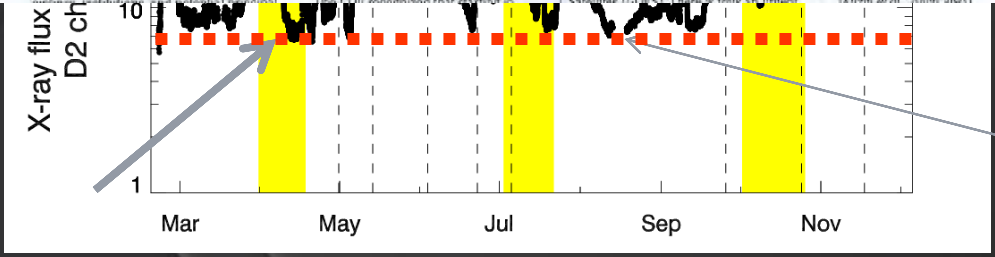
The U.S. National Science Foundation (NSF) relies on external Committees of Visitors (COV) convened every 3 years to assess the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions. Members of COVs are chosen by program officers and division directors to represent scientific diversity, in terms of dis-

Further, OCE processes approximately 1500 proposals per year. It obtains at least three reviews by scientific peers for each proposal and conducts panel reviews for 86% of submitted proposals to the science sections. Program officers informed 78–86% of applicants about a funding decision within 6 months of proposal receipt, well exceeding the NSF-wide performance goal.

The Sun's X-ray Emission During the Recent Solar Min

The Sun recently underwent a period of a remarkable lack of major activity such as large flares and sunspots, without equal since the advent of the space age a half century ago. A widely used measure of solar activity is the amount of solar soft X-ray emission, but until recently this has been below the threshold of the X-ray-monitoring Geostationary Operational Environmental

placed behind three diff (D1, D2, and D3, with an and 0.0101 square millim sensitive to X-rays with e 15 kiloelectron volts (0.8 detectors are silicon wafe windows, which results i tion significantly better t spacecraft spectrometers



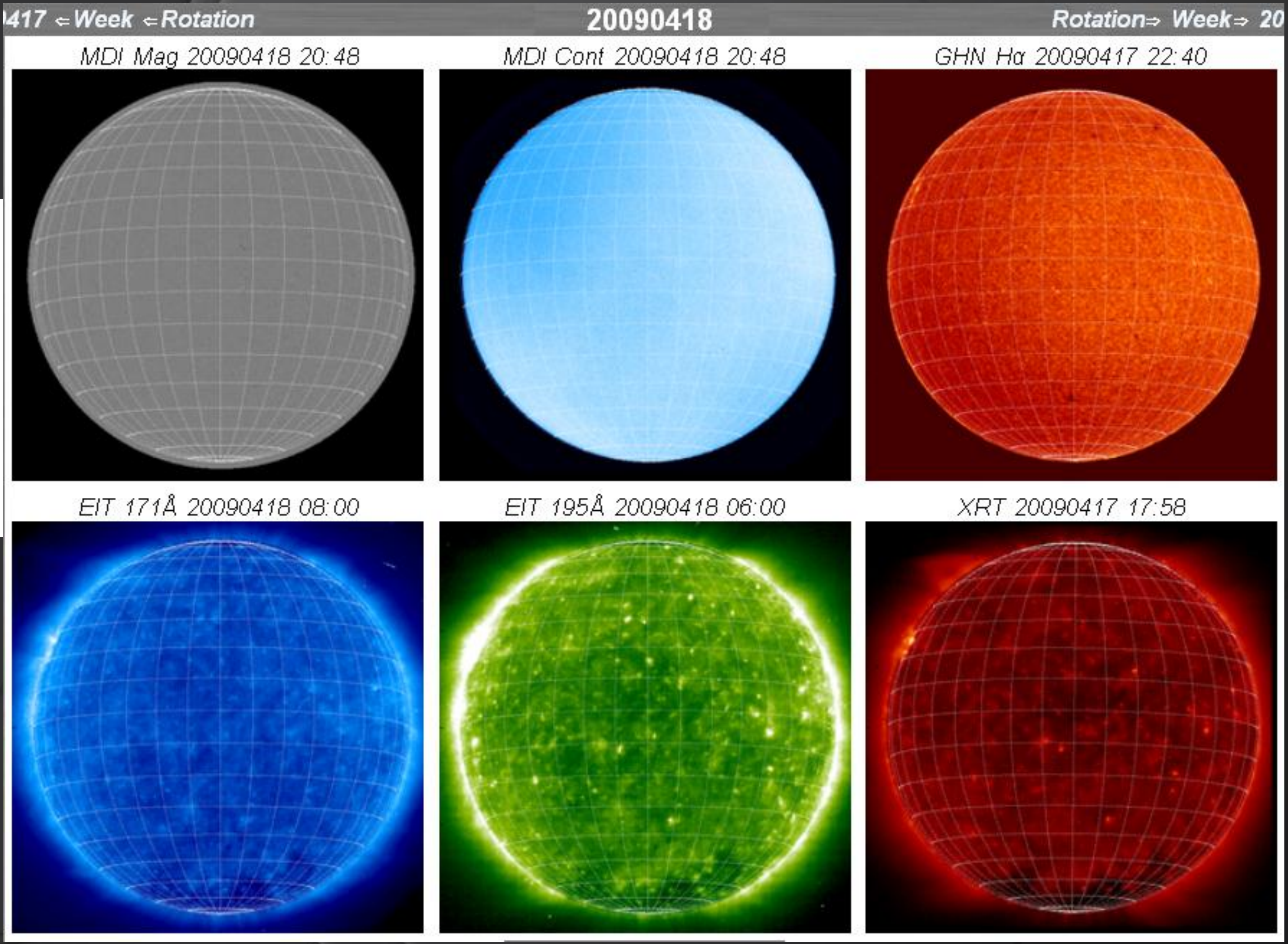
- There is a lower limit for solar X-ray flux of the Sun in the energy range

E > 1 keV

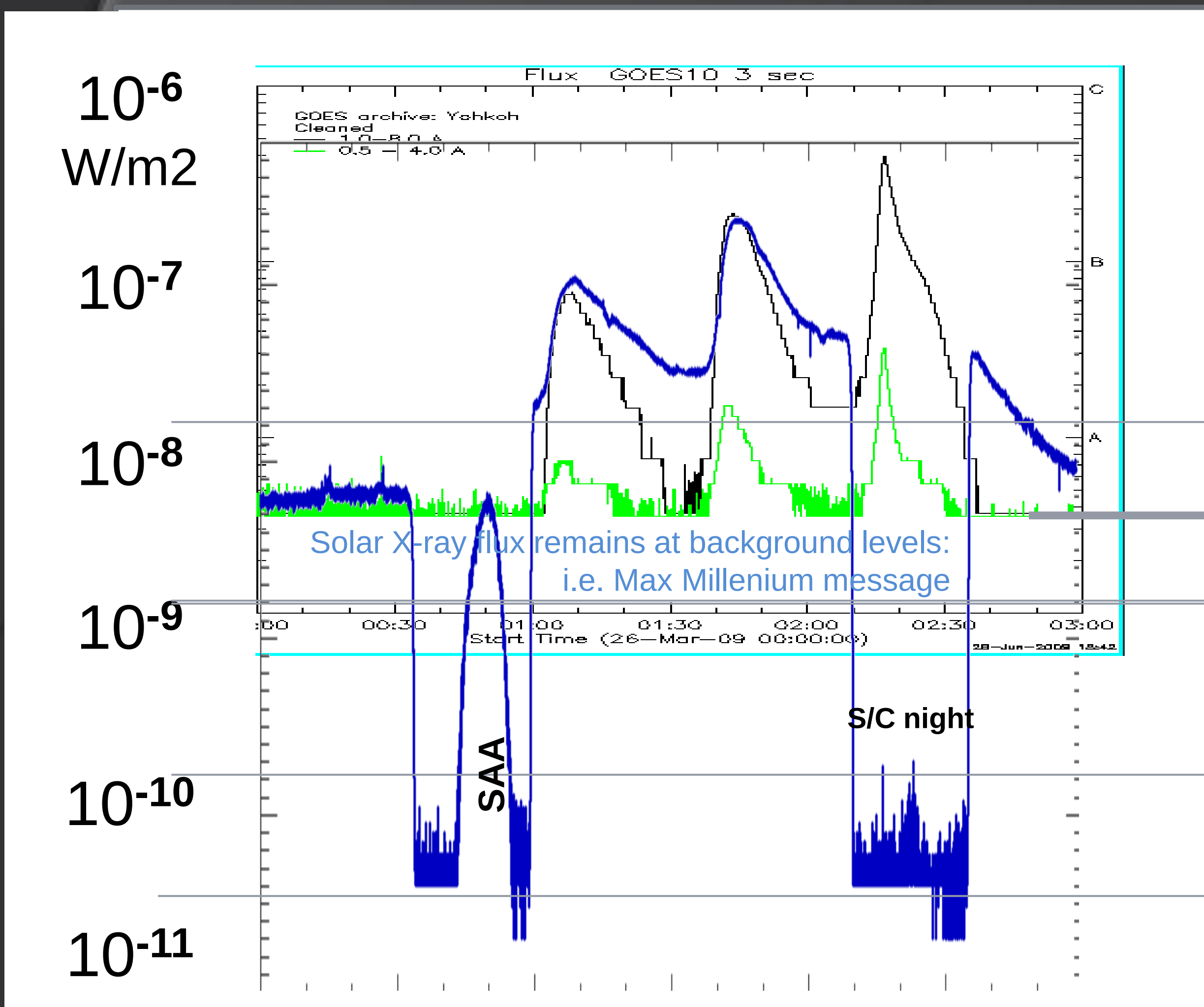
$\sim 5 \times 10^{-10}$ W/m^2

No measurements after November 2009 ☹

Only full-Sun spectra


417 ⇐Week ⇐Rotation
20090418
Rotation⇒ Week⇒ 20
MDI Mag 20090418 20:48
MDI Cont 20090418 20:48
GHN Hα 20090417 22:40
EIT 171Å 20090418 08:00
EIT 195Å 20090418 06:00
XRT 20090417 17:58

GOES X class range → to be extended down



A = 10^{-8} W/m^2

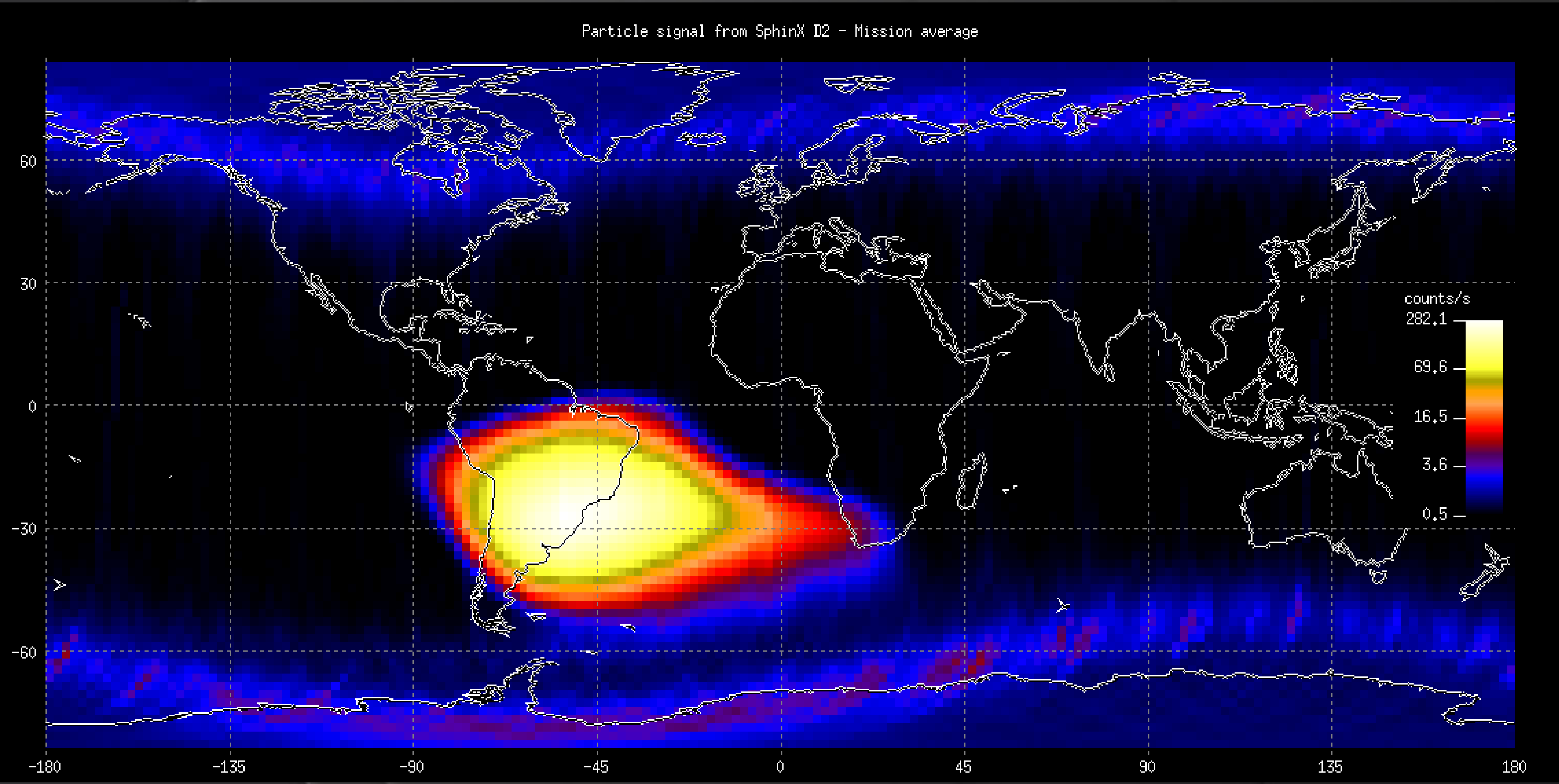
S = 10^{-9} W/m^2

Q = 10^{-10} W/m^2

SphinX detection threshold

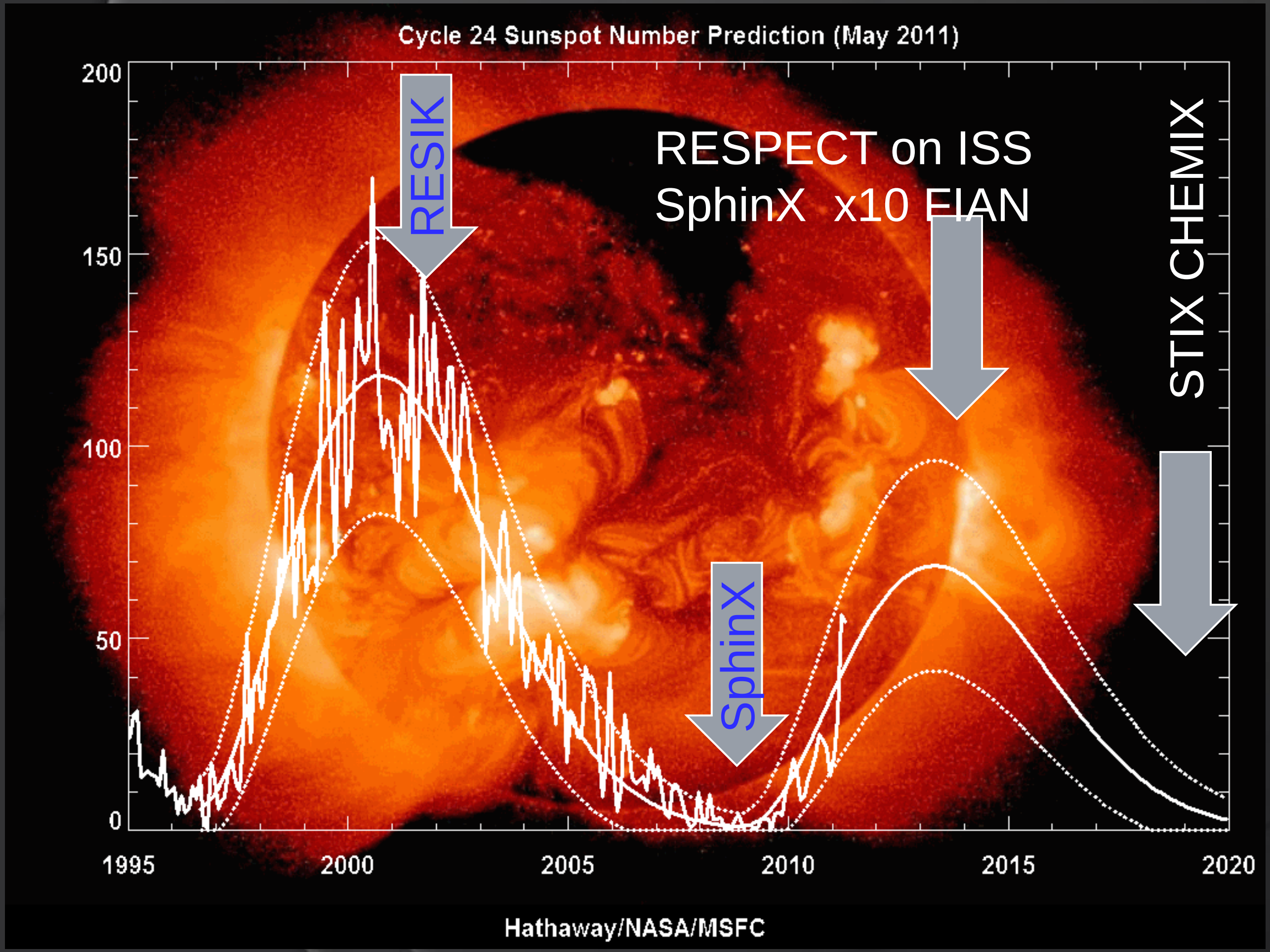
Reconstruction of Earth's particle environment from SphinX D2

Particle signal from SphinX D2 in geographical coordinates (whole mission, one plot for ascending and descending phase). The signal was averaged over rectangle areas of 2x2 deg.



Future experimenting:

http://solarscience.msfc.nasa.gov/images/ssn_predict_l.gif

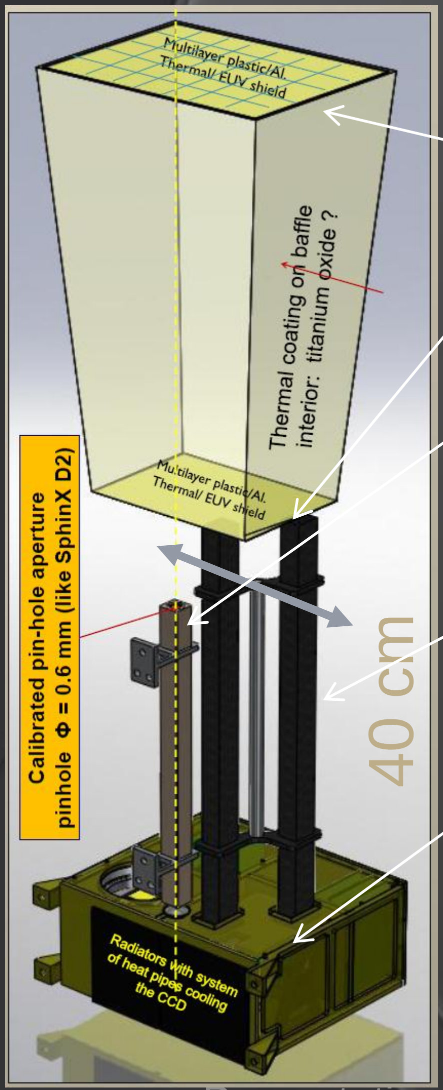


- RESPECT (CCD base SphinX)
- STIX (20%) of the work coordinated by Tomek Mrozek
- ChemiX on Interhelioprobe (Roskosmos)

So, what is ChemiX

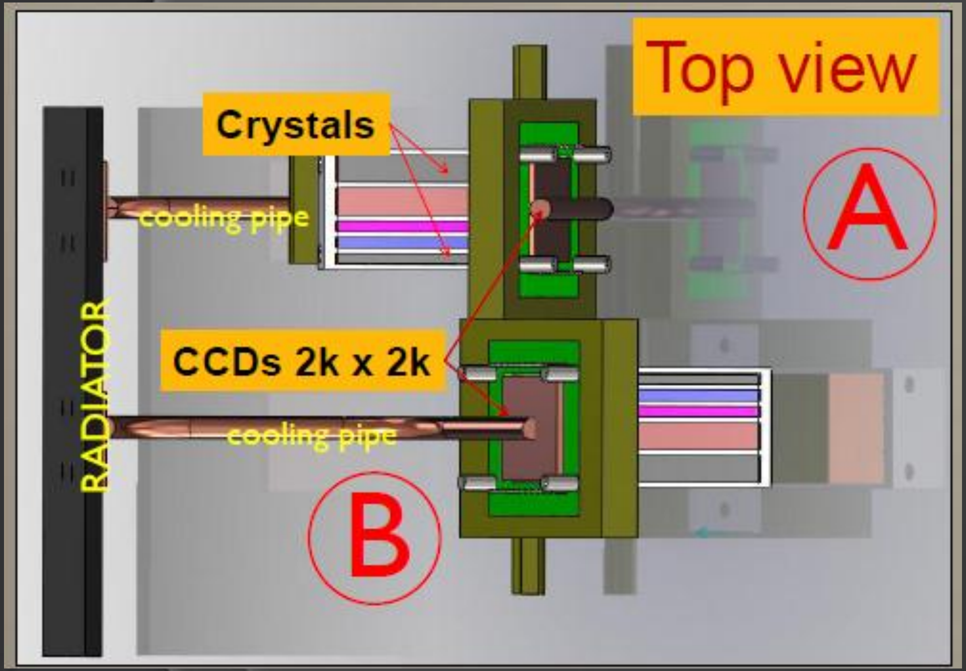
- Two CCD back illuminated detectors like these used in TESIS ~2000 position resolution
- One X-ray CCD pin-hole imager
- 5 crystals illuminating the detectors:
  - 2 larger areas with crystal radiai ~50-70 cm
  - 3 smaller areas for specific physical tasks
- Smaller area crystals working in Dopplerometer orientation

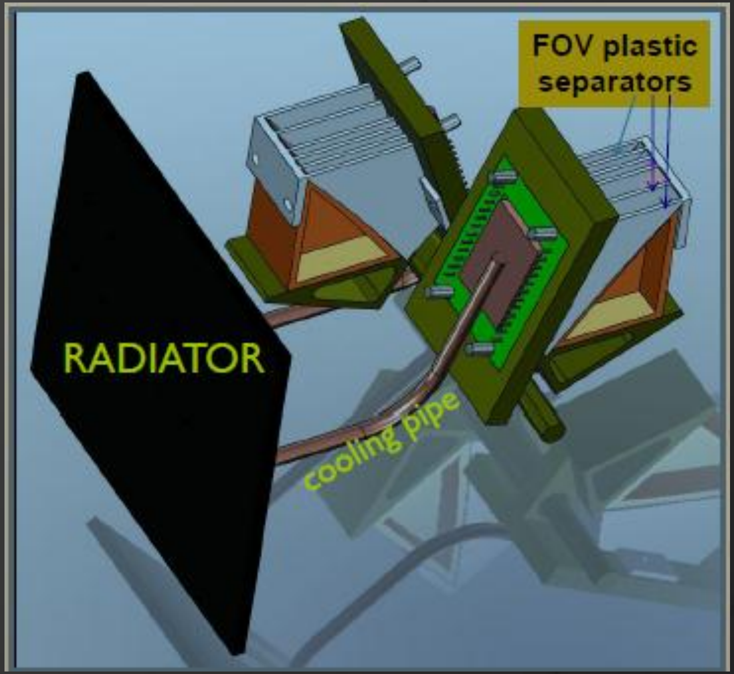
Just a view on ChemiX



- Thermal & EUV blocking section (from 250C to 90C)
- Stationary Pin-hole X-ray Camera
- Moving slit collimatots
- Two crystal and detector sections (5pieces of the illuminating crystals) oriented in the opposite sense of dispersion

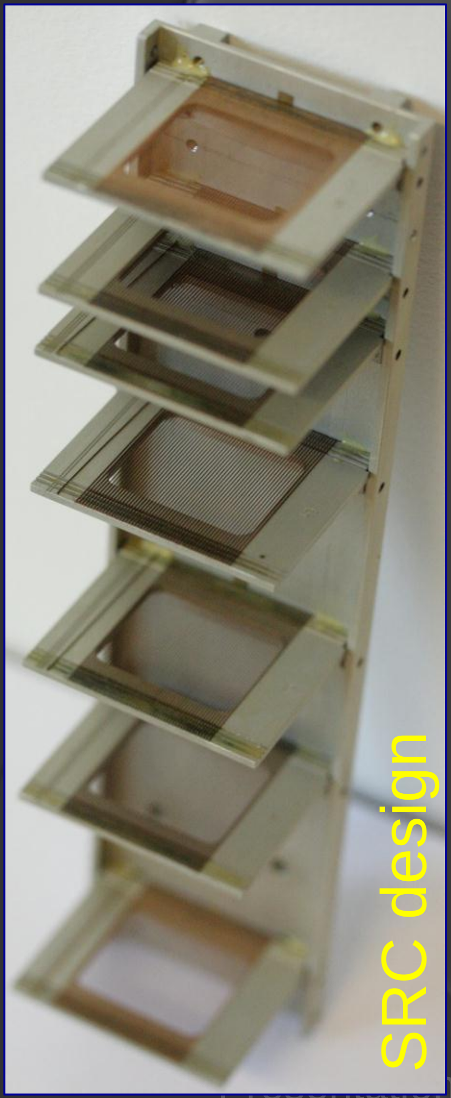
Crystal-detection sections 1 – 7 Å in four pieces using Si & Quartz cryst.





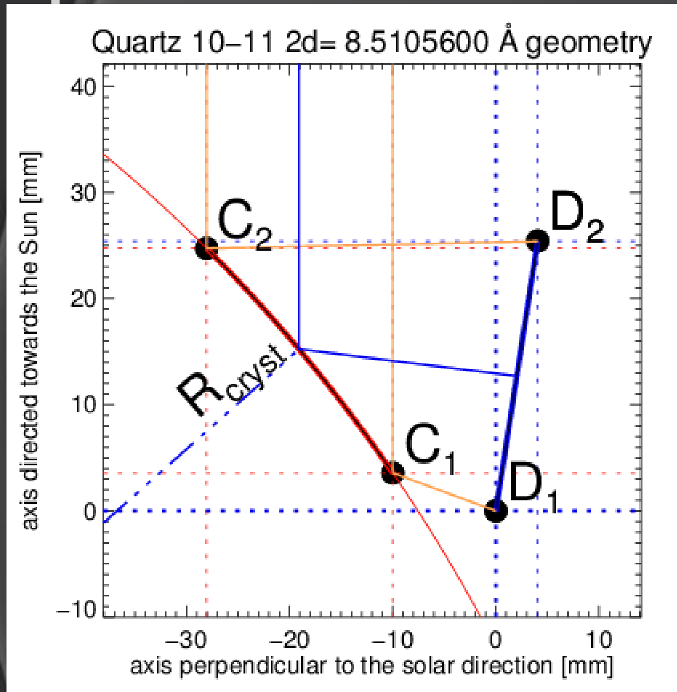
CCD: e2v 2048 x 2048 pixels like in TESIS MgXII channel
High efficiency active colling pipes – gas/condensation
5 spectral ranges on each CCD, 3 in the Dopplerometer configuration;
Recccomendations are being asked forom the community: FIAN, Ken Phillips Elena Dzifcakova,, Helen Mason, Giulio del Zanna

Why the collimatosr? → selects just a single AR



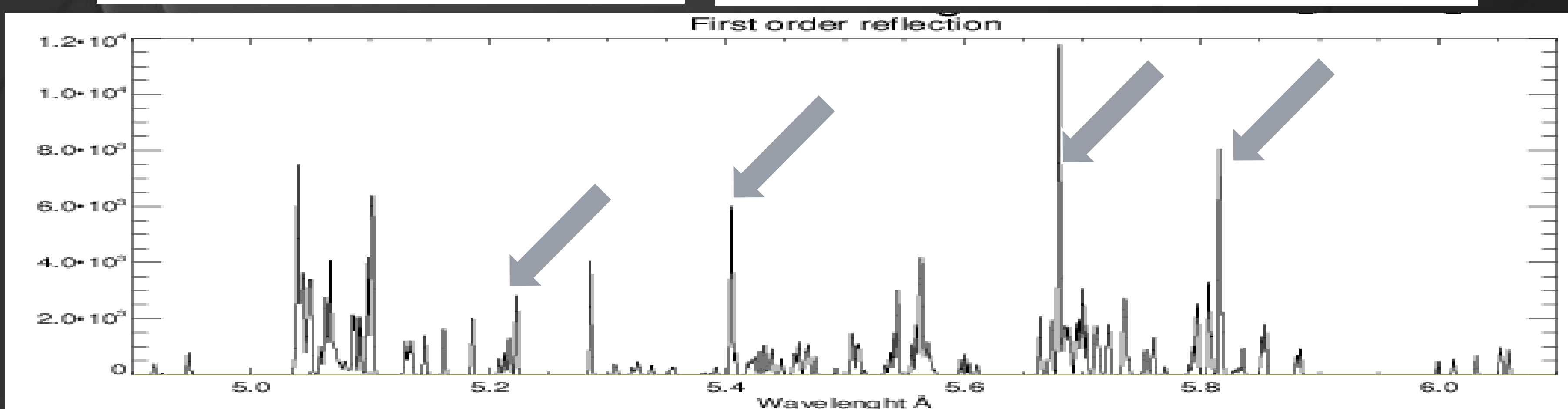
- Fixes beam FOV to desired angular range
  - 100 thousand km? on the Sun for AR at close distance
  - 30 thousand km? for flare kernels, good for AR at larger distances
- Prevents side illumination to within 2.5 deg
- Flight tested on Vertical-11 and Interball-tail
- GENETIC algorithms now in use
- Experience present in aligning and transmission measurements

Spectral Coverage 5 - 6 Å

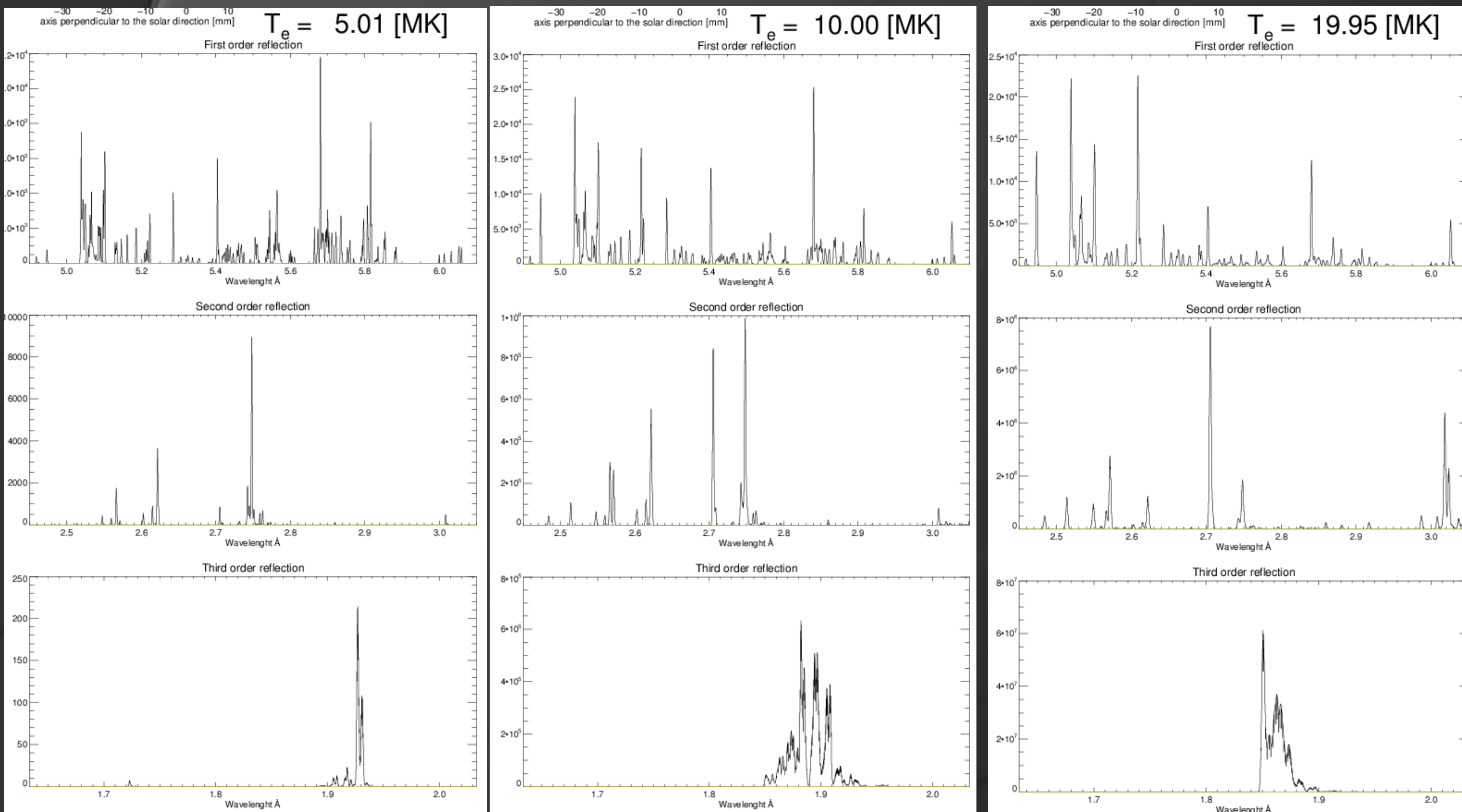


[4.900, 6.102] Å

$theta_{1(min)}$:	35.153 [deg]
$theta_{2(max)}$:	45.787 [deg]
det. angle :	99.060 [deg]
R_{cryst} :	150.000 [mm]
C_{length} :	27.842 [mm]
$C_{1[x,y]}$:	[−10.000, 3.580] [mm]
$C_{2[x,y]}$:	[−28.045, 24.730] [mm]
$D_{1[x,y]}$:	[0.000, 3.580] [mm]
$D_{2[x,y]}$:	[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]
$D_{av\_resolution}$:	0.00059 [A/pixel]
$D_{av\_dlamb/dthet}$:	0.11246 [A/degree]



Higher orders of reflection..



5 MK 10 MK 20 MK

Possible science outcome again

- Line and continuum intensities → Absolute elemental abundances to within 0.01-0.02 in log scale, i.e. many times better than from optical range, meteorites etc, evenet to event variability. The accuracy will be best ever-superior to photosperic determinations
- Non-thermal component of line excitation
  - Behaviour of distribution function for electrons below 10 keV
  - Diagnostics of interaction regions plasma velocities & Doppler shifts & ion temps & el Temps & PDF’s possibly
  - Detection of bumps on PDF for particles (wave-particle interactions)
- Turbulent properties of flaring plasmas kernels
- Absolute line positions & detailed studies of Doppler line shifts during flares (obs vs, evaporation theory) comparison with results of hydrodynamic modelling (we have running codes of NRL & Palermo-Harvard)

Cooperation is highly desirable !!!

- Key groups
  - Elena Dzifcakova group
  - Ken Phillips
  - PN Lebedev group
  - CHIANTI group
  - UWr group
  - ....please get aboard

Thanks for the initiative to revive the Consultations Tomek & Pavel!

Thanks to AI CAS for Support,

thanks Petr ☺

End of the talk