SOLAR SOFT X-RAY EXPERIMENTS UNDER DEVELOPMENT AT THE SOLAR PHYSICS DIVISION OF SPACE RESEARCH CENTRE POLISH ACADEMY OF SCIENCES WROCLAW

Our Team & heritage

Funded instrument projects

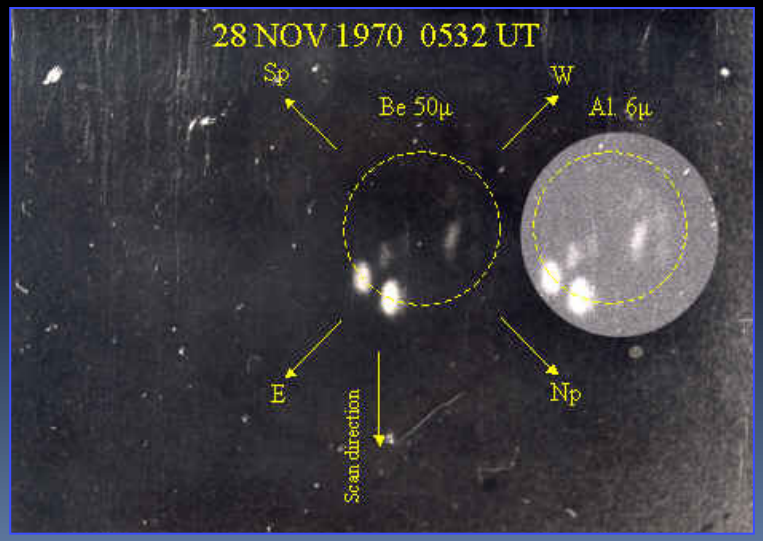
Instruments under design

Possible collaborations

Our Team now ~17 people
scientists, engineers & PhD students

- We are a Division of Polish Academy of Sciences Space Research Centre, Warsaw (~200 people)
- We are active in space experimenting since late 60-ties

The first space science related result published



Initiall political opportunities: creation of Intercosmos 1967 at no launch payments

At present, Poland just joined ESA

Kapustin Yar
Sounding rockets
7 launches

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

Plesetsk
Orbital
missions
4 launches,
5 intruments
1994
Coronas-I
1995
Interball-Tail
2001
Coronas-F
2009
Coronas-
Photon
2015
??

Science problems of interest for our group

- Temperature structure of EUV & X-ray emitting solar plasma
  - Determinations of plasma T and EM
  - DEM inversion
- Studies of elemental composition (relative & absolute)
- X-ray spectroscopy & atomic physics
  - Line identification
  - Processes: excitation, ionization, recombination
  - Non-equilibrium & (possibly) Non-Mawellian conditions
- Diagnostics of plasma heating in the corona
  - HD modelling (Palermo-Harvard code)

Previous collaborations

- Astronomical Institute, Wrocław University since 1967
  - Education, data interpretation (Prof.Prof. Jakimiec, Rompolt, at present Professors Tomczak & Rudawy)
- Spectroscopy Laboratory, PN Lebedev Physical Institute (FIAN), Moscow, since 1969
  - Post-doc education, data interpretation (Zhitnik, Kuzin)
  - Approx. 10 common space experiments launched (SphinX)
- Astronomical Institute, Czech Academy of Sciences, Ondrejov, since 1975
  - 4 common satellite experiments launched, many publications (Valnicek, Farnik)

Previous collaborations cd

- G. Vaiana Palermo Astronomical Observatory since 1985
  - HD modelling of flares (Prof.Prof. Serio, Reale) & SphinX callibrations at XACT facility
- IZMIRAN, Troitsk, since 1990 (Prof. VD. Kuznetsov)
  - RESIK and Diogeness Bragg spectrometers aboard Coronas-F, multiple common publications , ApJ
- UCL-MSSL, since 1979, (Prof.Prof. JL Culhane, KJH Phillips, dr RD Bentley)
  - Co-I status for BCS-XRP (NASA SMM), BCS on Yohkoh
- the results obtained will be shown during this Workshop

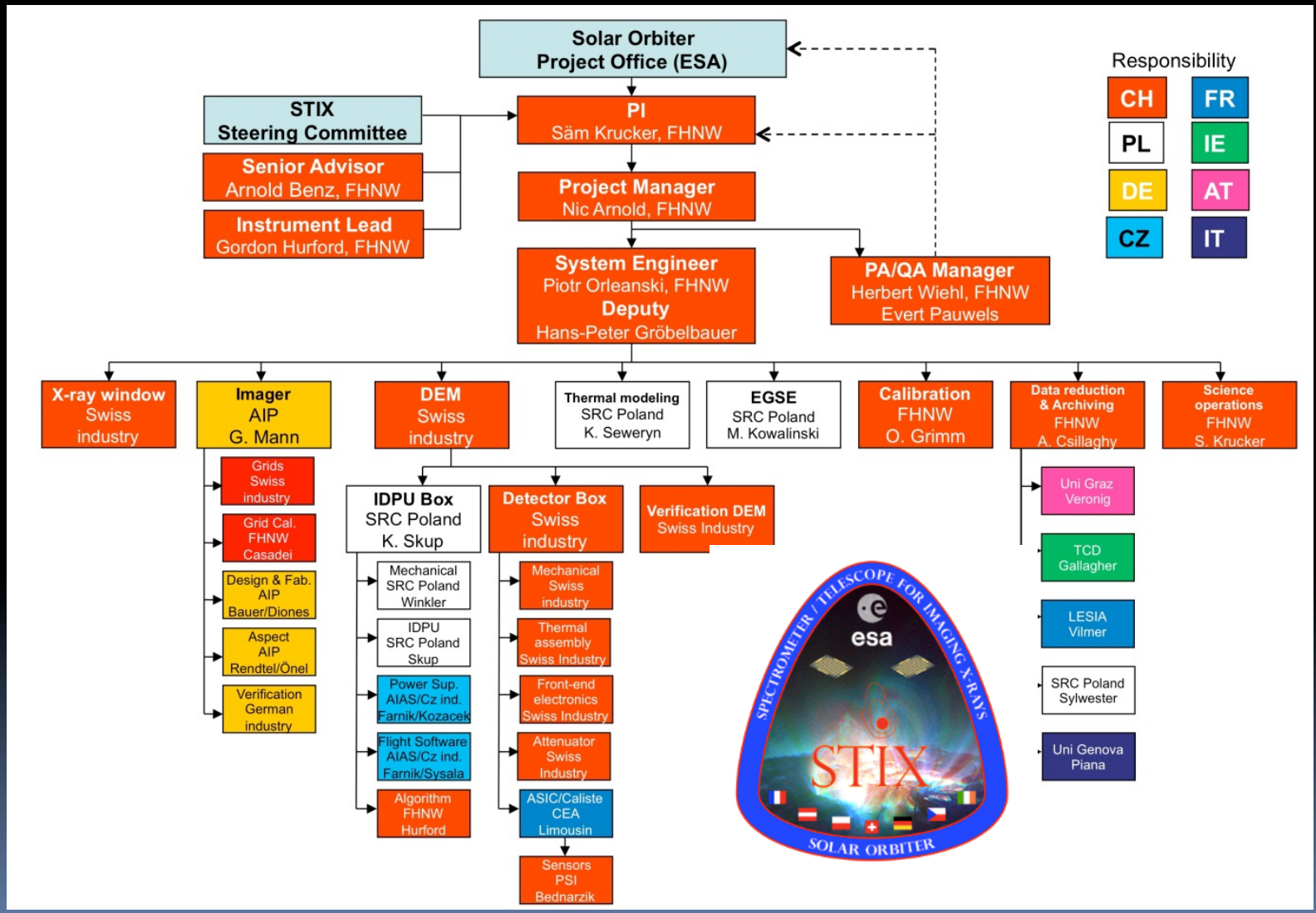
Recent vital links

- Spectroscopy Laboratory, PN Lebedev Physical Institute (FIAN), Moscow,
  - SolPEX – launch ~2015, Prof. S. Kuzin
- FHNW, Windish, Switzerland, Profs. A. Benz & S. Krucker
  - STIX- launch ~2017
- IZMIRAN, Troitsk, Prof. VD. Kuznetsov
  - ChemiX aboard the Interhelioprobe mission to the Sun- launch ~2018
- UCL, Prof. KJH Phillips
  - Abundance & DEM determinations from RESIK and SphinX spectra
- Kharkiv University, Ukraine, Dr. O. Dudnik
  - Interpretation of magnetospheric measurements
  - Development of partcle detector for ChemiX launch 2018
- G. Vaiana Palermo Astronomical Observatory
  - HD modelling of flares, Prof. Reale,
- AI Czech Rep., Ondrejov,
  - Study of non-Maxwellian excitation conditions in coronal palsmas Prof. Dzifcakova

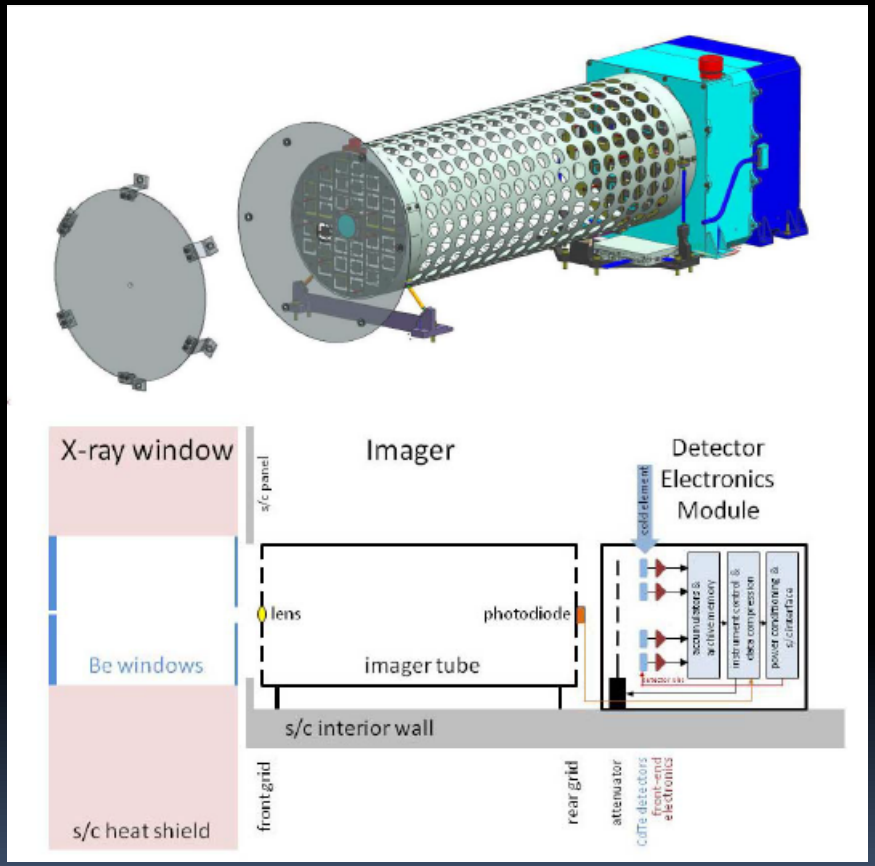
Funded projects we take part at

- STIX on ESA Solar Orbiter cornestone mission to the Sun (funded through PECS and Polish national grants), to be launched 2017/2018, PI Arnold Benz & Säm Krucker (CH)
- ChemiX on Russian Interhelioprobe mission to the Sun (funded for initial 3y phase B study from national grant) PI Marek Siarkowski
- RESIK data reduction & analysis environment, PI Barbara Sylwester
- eHeroes EU 7FP on studying space & magnetospheric impact on instrument & detectors, responsible scientist Szymon Gburek

Polish involvement in STIX Consortium 20% -30% share, 10% located in Wroclaw



STIX flare Hard X-ray imager

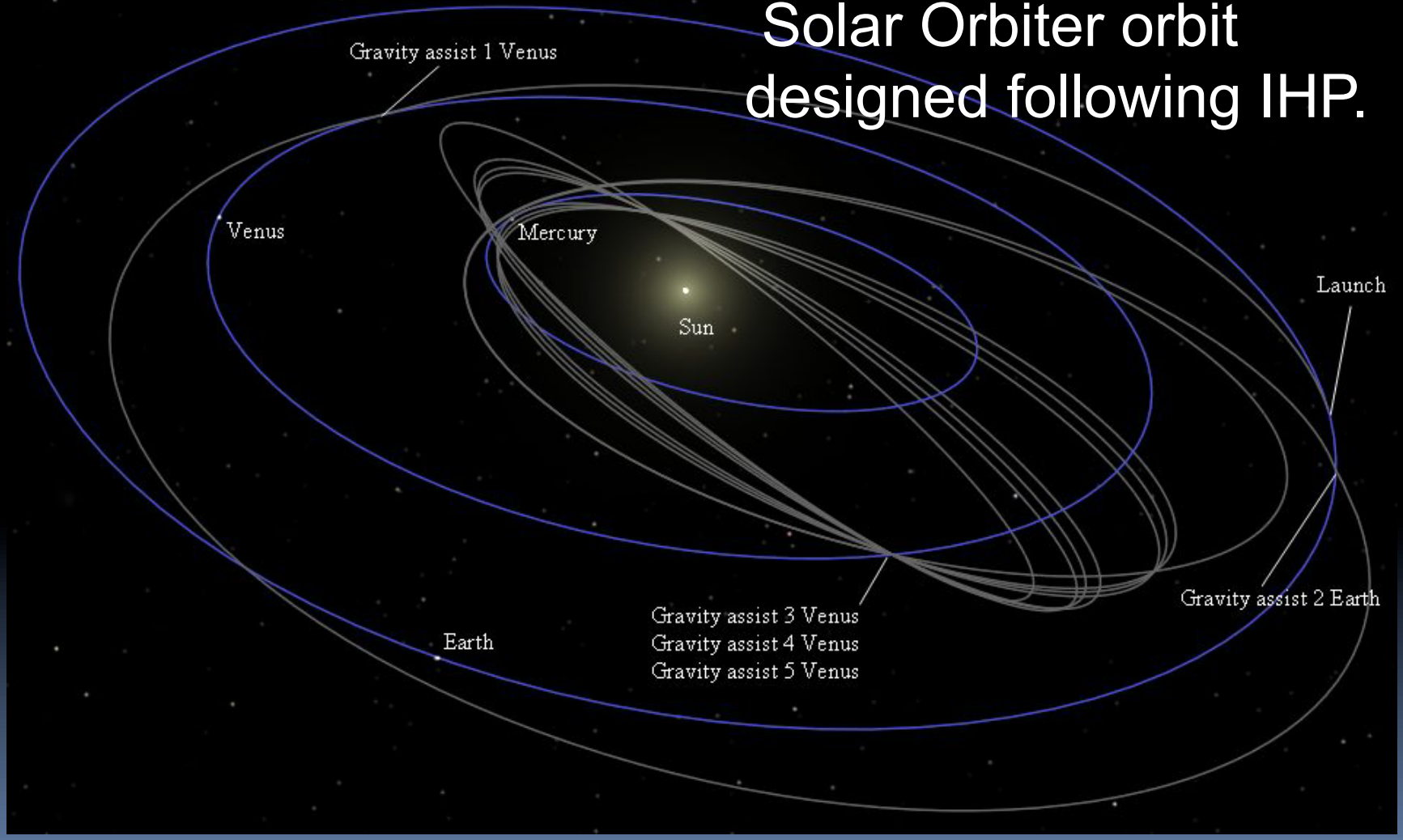


The Spectrometer Telescope for Imaging X-rays (STIX) provides imaging spectroscopy of solar thermal and non-thermal X-ray emissions from ~ 4 to 150 keV. STIX is based on a Fourier-transform imaging technique.

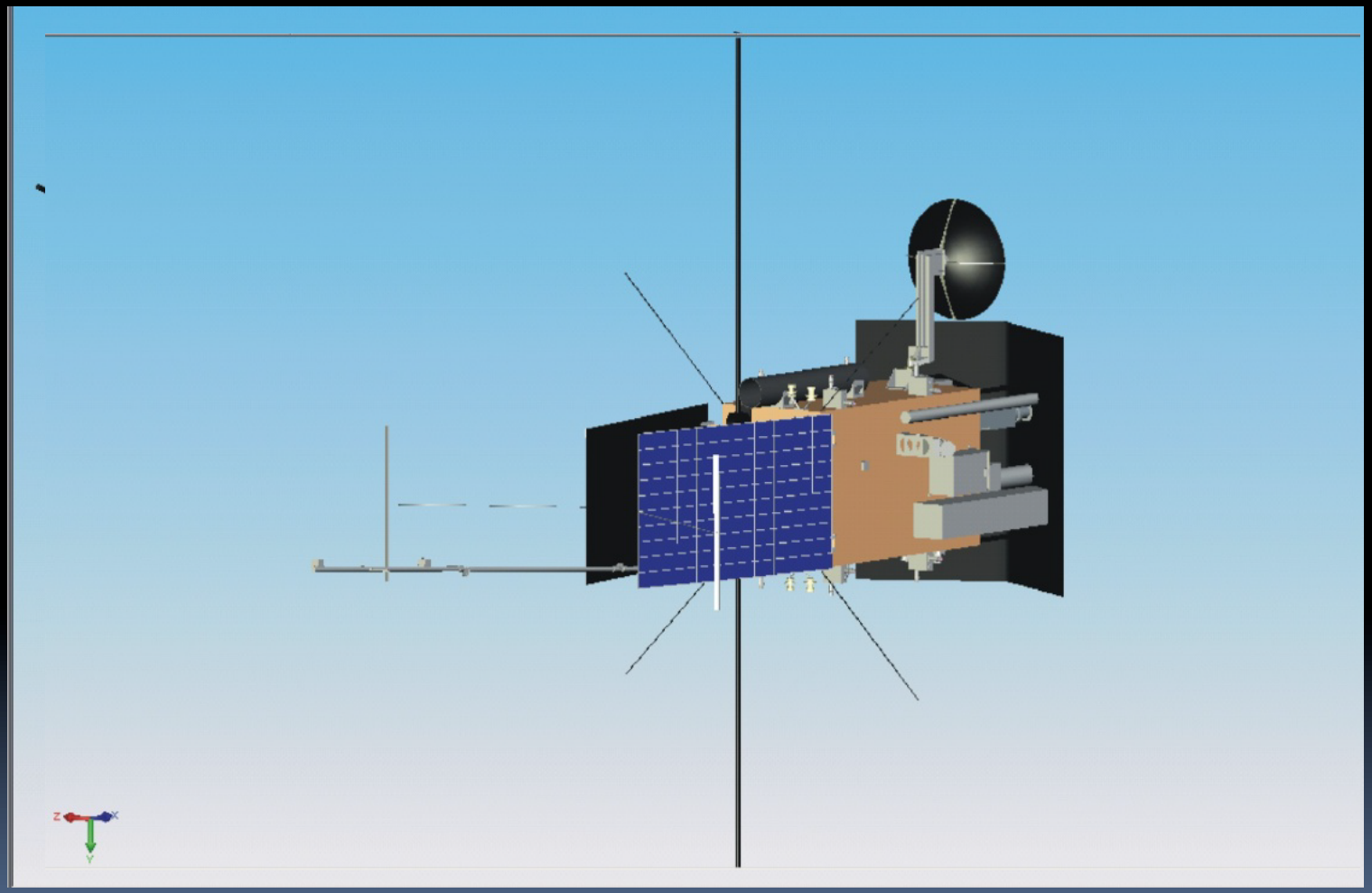
See Karol Seweryn talk Wednesday

Russian Interhelioprobe ИНТЕРХЕЛИОЗОНД mission

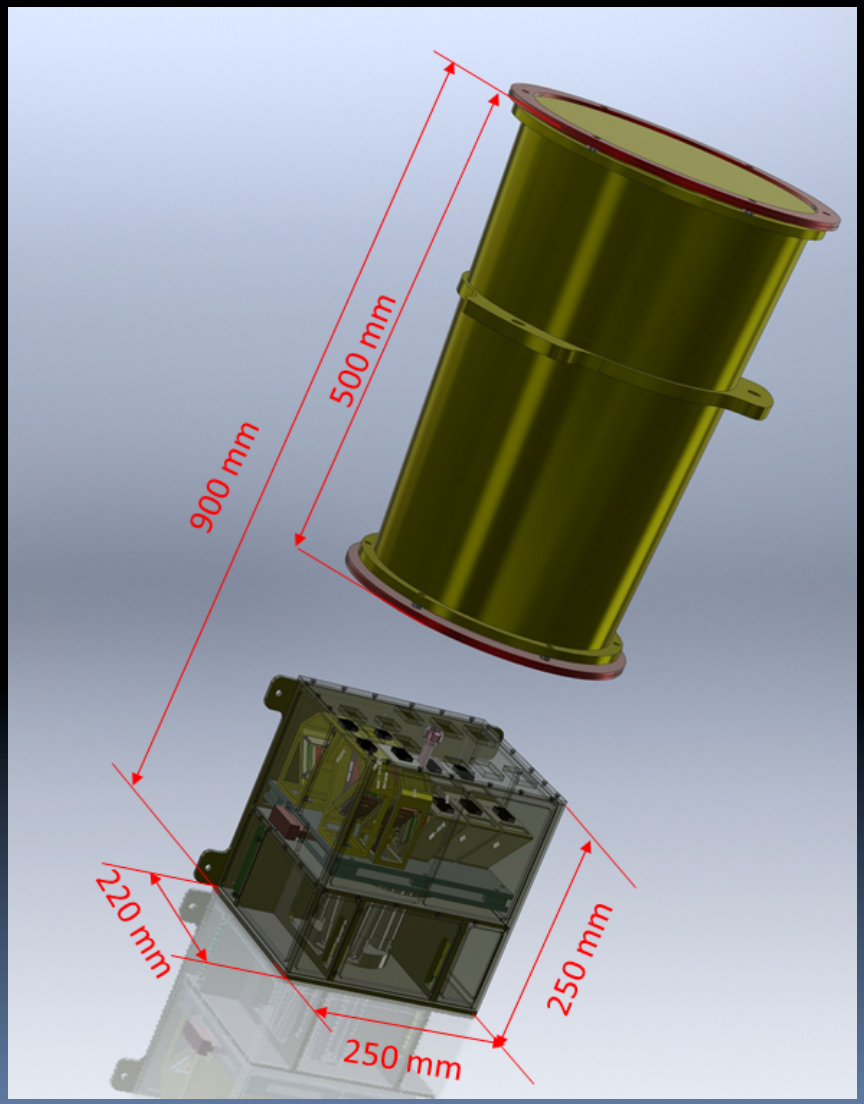
Solar Orbiter orbit designed following IHP.



Russian Interhelioprobe ИНТЕРХЕЛИОЗОНД mission



ChemiX – a part of Interhelioprobe payload
For details attend Zaneta Szoforz talk



- ChemiX is an advanced Bragg bent crystal spectrometer for measuring solar soft X-ray spectra in the range 1- 8 Å (1.2-10 keV)
- 7 CCD detectors, 13 wafer monocrystals
- Science: **determination of absolute coronal abundances with accuracies better than ever**

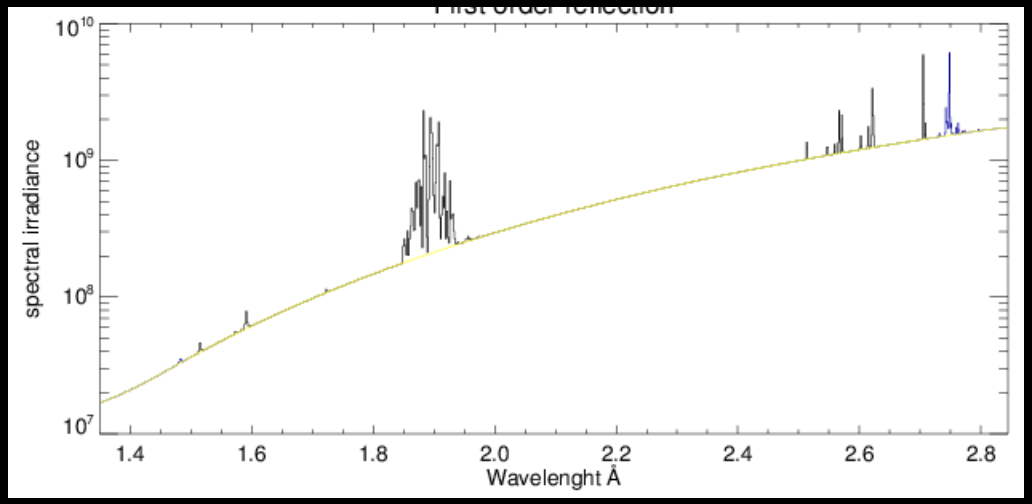
ChemiX – a part of Interhelioprobe payload

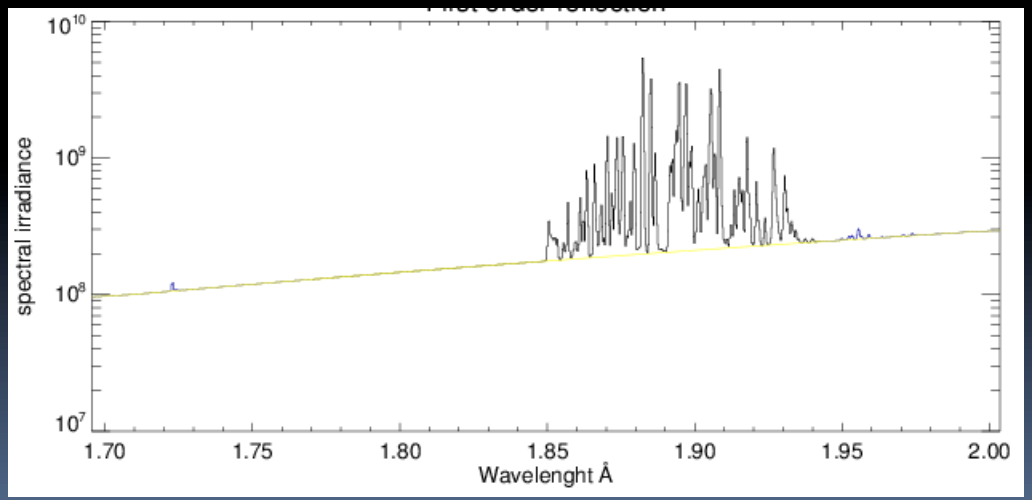
Will visit immediate vicinity of the Sun

ChemiX will observe spectra between 1- 8 Å (1.2-10 keV) with unprecedented spectral resolution:

- line intensities
- line braodening
- Doppler shifts
- Continuum intensities
- 1 sec time resolution

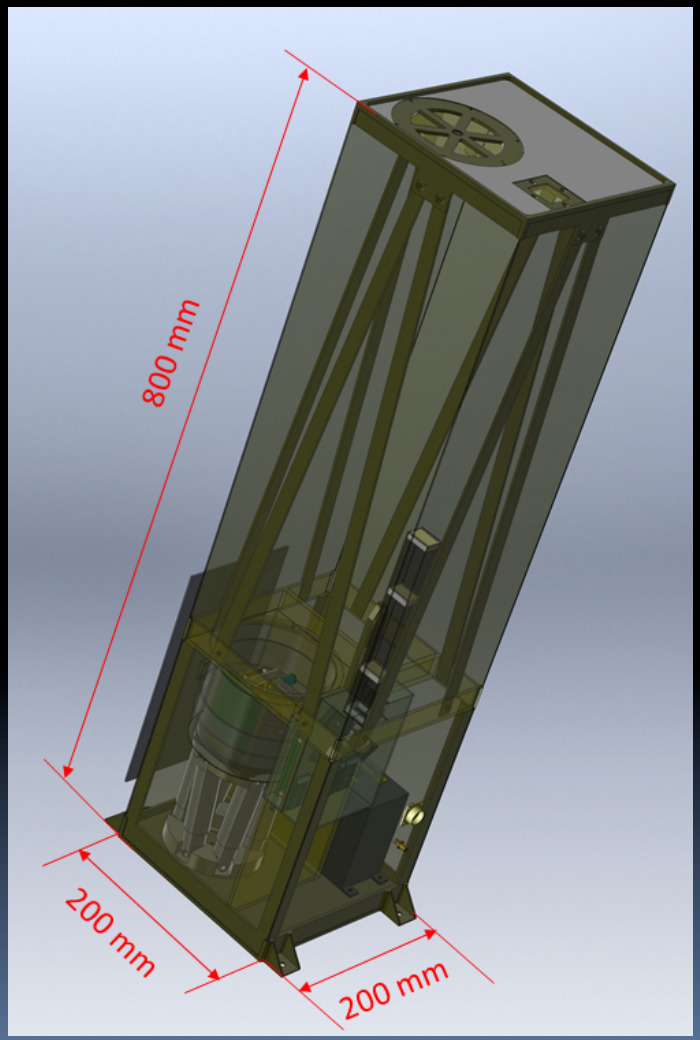
Russian Interhelioprobe ИНТЕРХЕЛИОЗОНД mission





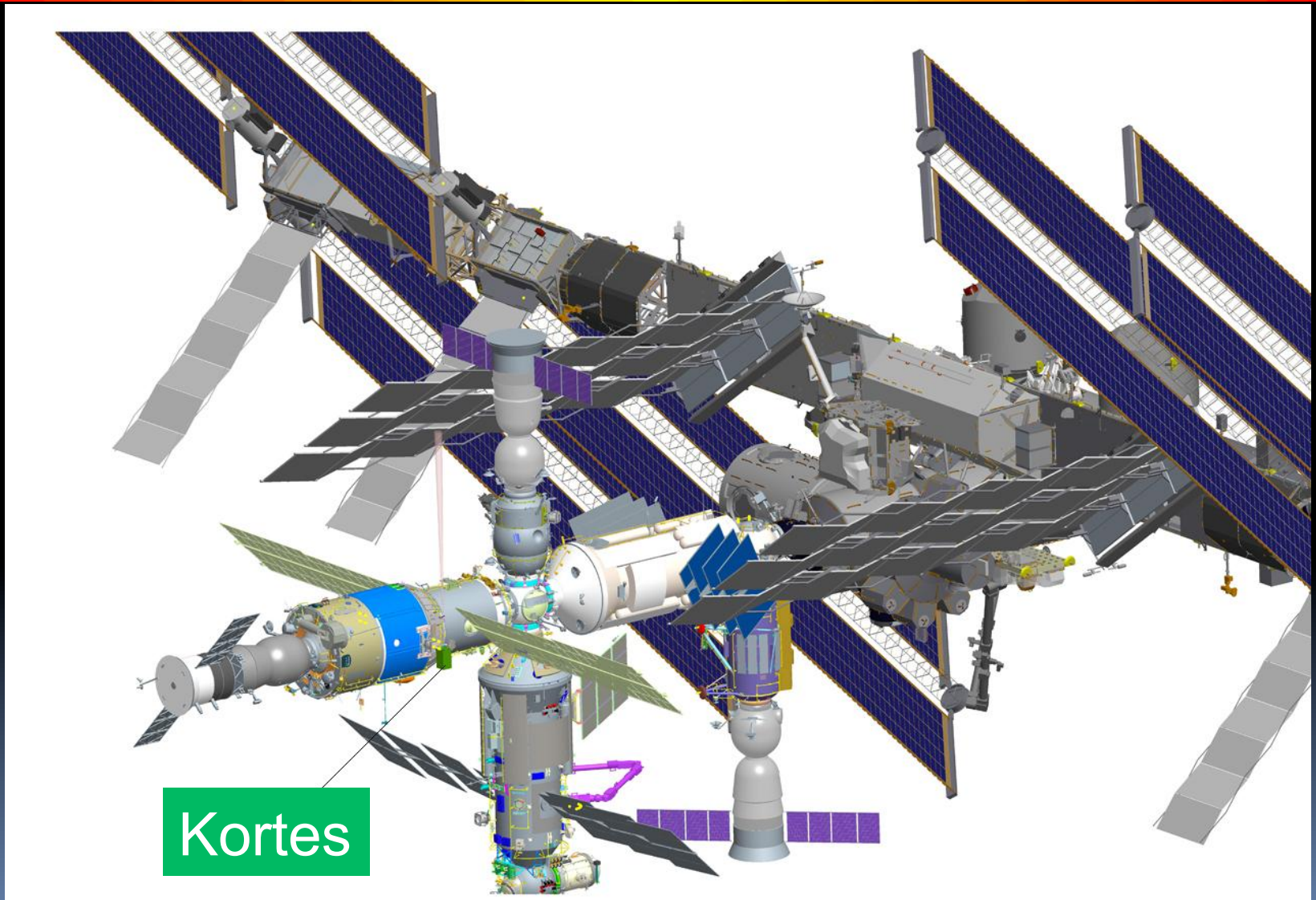
- An important part of ChemiX is the particle detector unit being under development in collaboration with Kharkiv University Laboratory led by dr. Oleksiy Dudnik

Experiments under development --- we are seeking the funding

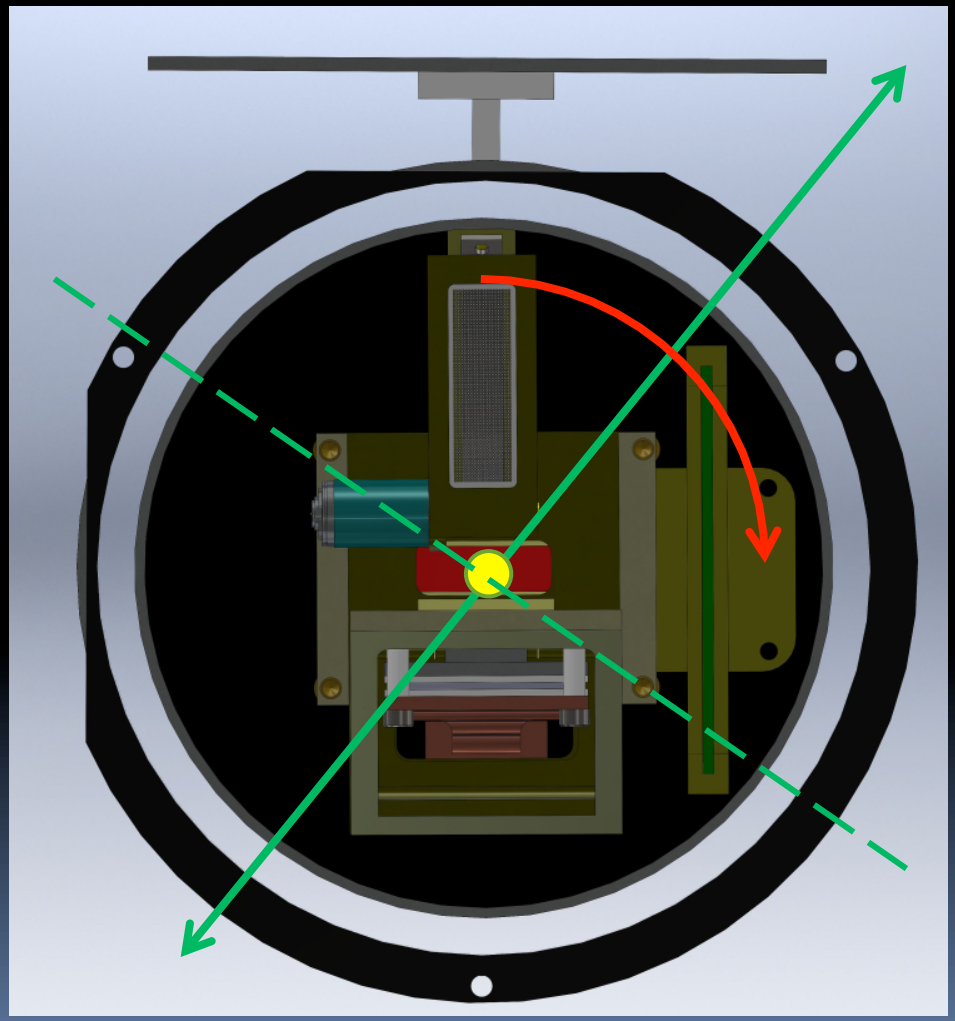


- SolPEX (solar spectro-polarimeter experiment in X-rays)
- Study the polarisation of soft X-ray emission at ~4 Å (3 keV) in the continuum and line emission.
- To be placed within the Kortes experiment package atop Nauka Russian ISS module

SolPEX placement to be agreed next week

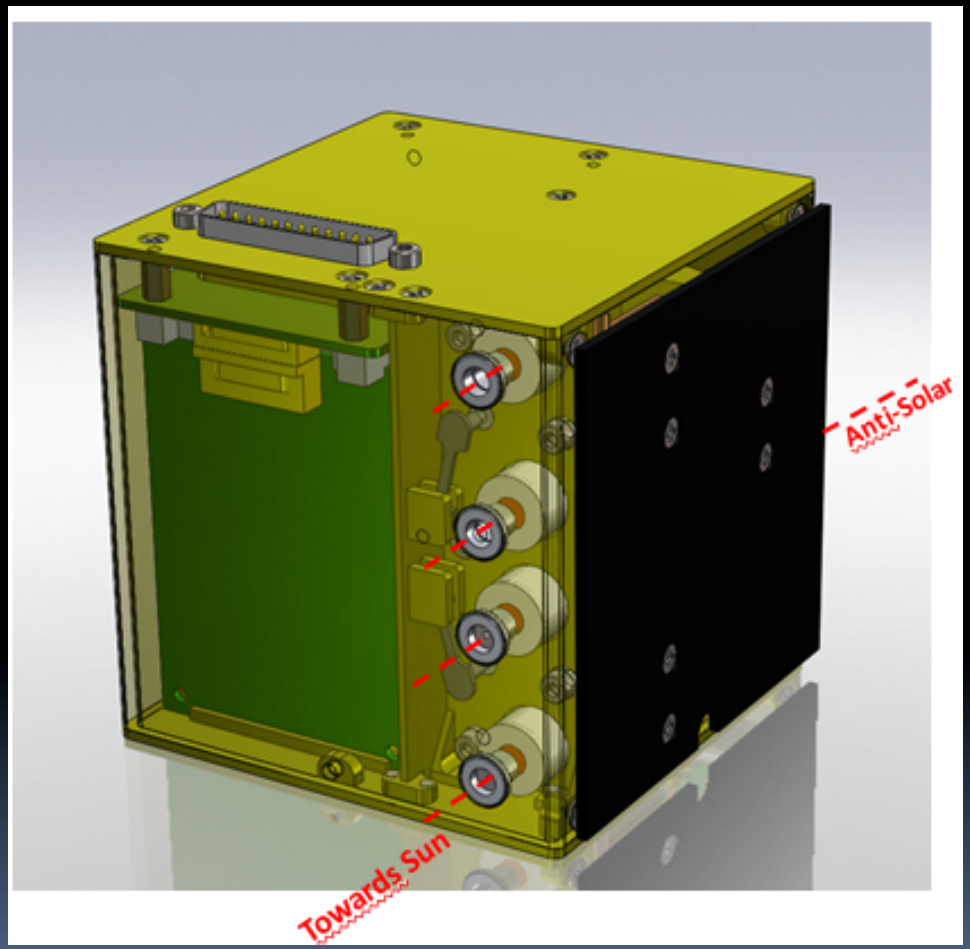


SolPEX aims
Attend my talk tomorrow



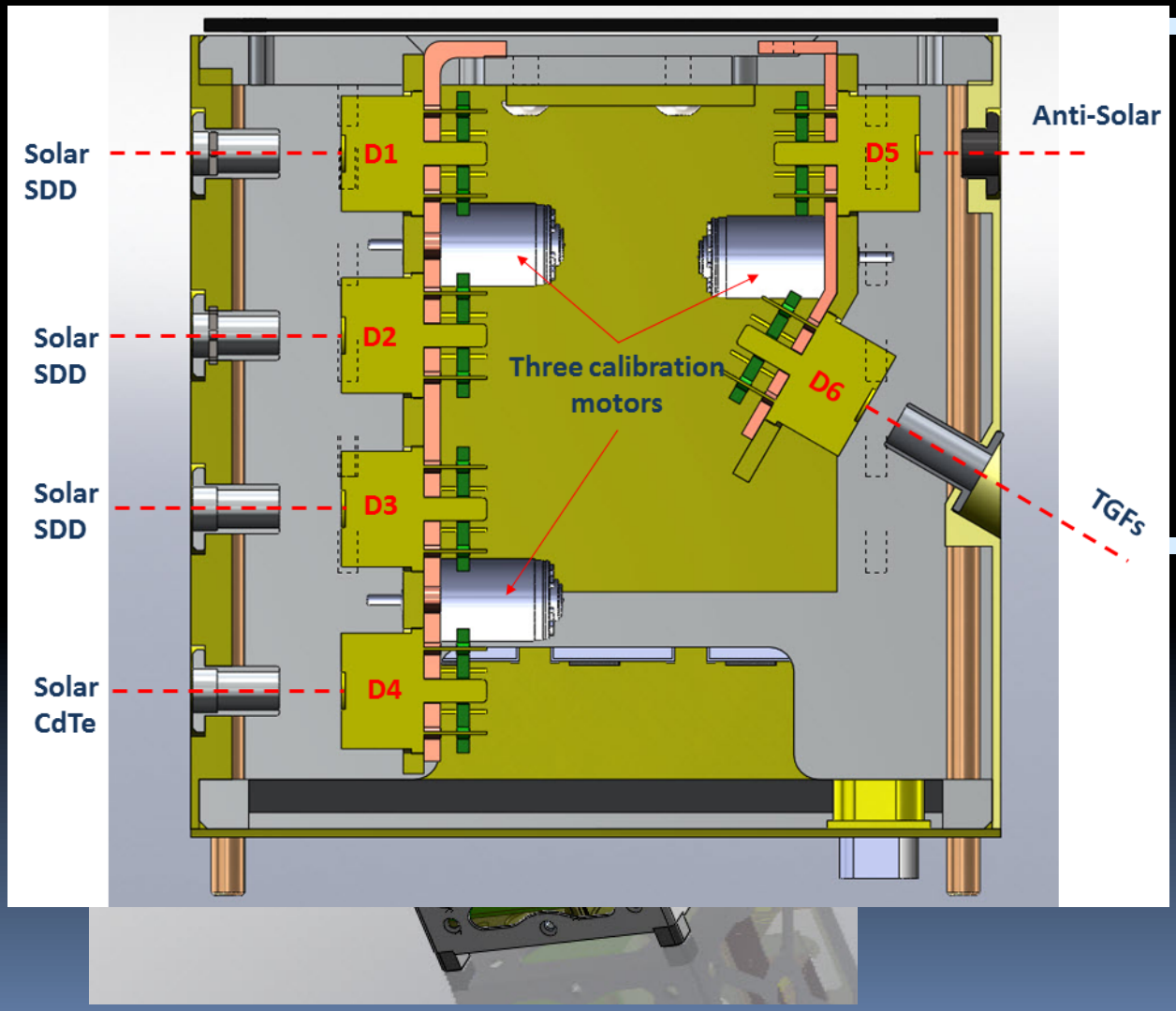
- Detect polarisation of X-ray emission in lines & continuum at the 2% detection limit
- Study spectra with a very hight time resolution (0.1 s for flares)
- Determine elemental abundances: S, Ar, Cl

Under development: SphinX-NG for the nanosatellite (GSFC & WPI, US, IA UWr , Poland Prof. Rudawy)



- Is a new-generation miniature 10 cm^3 cube SphinX-type spectrophotometer
- Will record spectra in the 1-15 keV range, 200 eV energy resolution (2 x better)
- Every photon arrival will be stamped

Under development: SphinX-NG

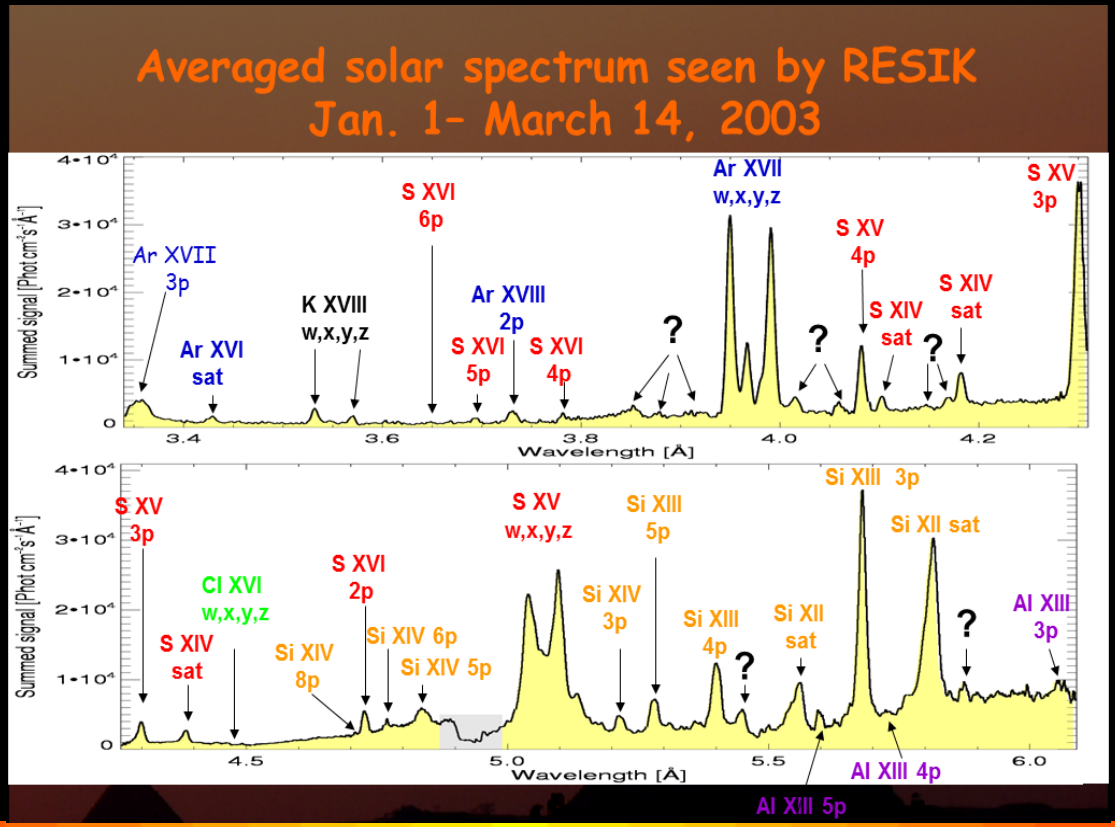


- Can also measure the spectra of TGF by using a dedicated CdTe detectors pointed at Earth.
- TGF spectra were not measured yet at energies lower than 100 keV

Summary

- We are a vigorous group devoted to do experimental and theoretical solar X-ray science
- We encourage international collaboration, vital for evolution of every scientist
- We hope this gathering will result in developing further experimental ideas to be tested
- Most of mentioned projects will be explained in the following dedicated talks

Thanks
Barbara



THANK YOU