

STSM TITLE: “A step towards solar flare X-ray polarimetry”

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COST Action: MP1104
Reference : COST-STSM-MP1104-14090
Location: Solar Physics Division, Space Research Center of the Polish Academy of Sciences, 51-622 Wrocław (PL) (SRC-PAS)
Host: Dr. Szymon Gburek (SRC-PAS)
Granted: Dr. Sergio Fabiani (INAF-IAPS)

1 Introduction

I visited the Solar Physics Division of the Space Research Centre Polish Academy of Sciences 51-622 institute in Wrocław, Kopernika 11 st. to discuss about solar flares X-ray polarimetry science. Thanks to this visit I had the opportunity to exchange scientific experiences from modeling to experimental activities, establishing a new fruitful collaboration within the framework of the COST Action MP1104 “Polarization as a tool to study Solar System and beyond”.

I was introduced to the theoretical and experimental research activity that SRC-PAS is carrying-on X-ray polarimetry. I described the research activity that is carried on at INAF-IAPS in the field of both photoelectric and Compton X-ray polarimetry.

We, from both the institutions, intend to establish a collaboration for the preparation of a mission proposal which payload will comprise the photoelectric polarimeter GPD and the upgrade of the SPHINX solar photometer.

We agreed that possible founding opportunities for the payload development are given by the ESA calls of the Innovation Triangle Initiative (ESA I.T.I.) and we look with great interest to the Cubesat mission program of ESA as opportunity to apply for the mission proposal.

1th Day

I described the research activity carried-on at INAF-IAPS in Rome about X-ray polarimetry, with particular regard to the Gas Pixel Detector (GPD) in the framework of the national and international collaborations. I explained the progress in photoelectric polarimetry and principles of its possible use in the solar flare observations.

We discussed about the present situation of the GPD proposed as a solar X-ray polarimeter (including the Cubesat project in collaboration with the “Tor Vergata” University of Rome).

I showed also the research activity about Compton polarimetry at INAF-IAPS and its present early state of the experimental activity. I illustrated also the possible use of a Compton polarimeter in the solar flare observations.

2th Day

I was introduction by Prof. Janusz Sylwester, Dr. Szymon Gburek and the SRC-PAS research group to the research activity carried-on at the SRC-PAS about solar flare X-ray polarimetry and spectroscopy, with particular regard to the studies of solar corona physics in X-rays.

During the meeting we have agreed that simultaneous measurements of the polarization degree and the other characteristics (eg. evolution of the spectra) constitute the last, rather unexplored area of solar X-ray spectroscopy providing substantial diagnostic potential. The polarized emission is generally expected to originate in various types of highly anisotropic emission sources. Among

them are for instance magnetically confined beams of accelerated non-thermal particles interacting with denser plasma layers. These types of scenarios are predicted by so-called standard flare models.

I was introduced also to the solar X-ray polarimetric experiments under development at SRC-PAS with particular regard to the concept of new Bragg polarimeter (SOLPEX) recently under development at SRC-PAS.

During my visit I discussed with Prof. Paweł Rudawy of the Astronomical Institute of the University of Wrocław about the connection between H alpha and X-ray emission during solar flares with particular regard to the implications about polarization. This issue was discussed during a visit to the Białków Observatory of the University of Wrocław (Poland). Prof Paweł Rudawy showed me the H alpha camera and the Multi-channel Subtractive Double Pass Spectrograph and he performed a live demonstration of the use of the instrumentation. We discussed also the general impact of the most important results obtained by means of such instrumentation about the physics of the solar corona..

3th Day

We discussed about the key issues for possible proposals of solar flare polarimetry X-ray missions from the scientific point of view outlining the scientific goals priorities and the science requirements (relevant energy bands, imaging/non-imaging polarimetry, timing, etc.). We discussed also about solar flares effective observability and forecasting to the aim of evaluating properly the observational expectations of a mission for solar flare.

4th Day

We discussed about the key issues for possible proposals of solar flare polarimetric X-ray missions from the instrumentation point of view.

We argued how some specific instrument concept set-up can match the science requirements within the framework of different mission classes:

- ESA Small Mission-like,
- Mission of Opportunity,
- Cubesat.

We agreed that a Cubesat mission is, at the present, a good opportunity for our instrumentation.

We decided to proceed taking into account a mission profile defined by a Cubesat of 3 Cube units. The Cubesat will carry a soft-hard solar spectrometer and a medium energy polarimeter based on the GPD technology. One satellite unit will be used for the spectrometer and another one for the polarimeter. The third unit will be for satellite systems. Mission duration will be one year long with possible one year extension.

We agreed about tests and calibration related issues.

Mechanical vibration, and acoustic test may be covered by ESA resources of the Cubesat launch program and they may be performed in ESA facilities.

Termo-vacuum and climatic tests can be done in SRC-PAS or in Rome at INAF-IAPS.

The calibration of the spectrometer and polarimeter units may be performed at PTB lab at BESSYII synchrotron in Berlin (Germany). Possible test of the instrument operation to carry-on in Palermo (Italy) at the XACT facility are under consideration. It is necessary to check the energy range in which these facilities can operate.

Also PANTER X-ray test facility could be used to testing purposes.

SRC-PAS and INAF-IAPS can perform initial calibration for energies up to about few tens of keV.

5th Day

We defined a schedule for further work. The proposal will start to be prepared after the ESA call release.

At the moment we plan that Institutions involved in the project could be:

SRC-PAS, Wrocław, Poland;

University of Wrocław, Poland;

INAF-IAPS of Rome, Italy;

INFN of Pisa, Italy;

University of Rome Tor Vergata, Italy.

Possible participation of Lebedev Physical Institute of Moscow (Russia) is under consideration.

Possible fellowships could be available in the framework of the ESA educational program for Cubesat launch.

Conclusion

This STSM was successfully completed, since a new collaboration started with the SRC-PAS in Wrocław aimed to define a payload to propose for future missions about solar physics.