JOSO ACTIVITY REPORT 2004-2006 - BULGARIA

Peter Duchlev
Institute of Astronomy, 72 Tzarigradsko chaussee Blvd., BG-1784, Sofia, Bulgaria
e-mail: duchlev@astro.bas.bg

1. Introduction

After Prof. Dermendjiev's death Solar Physics Division in the Institute of Astronomy undergone some changes in relation to the priorities in the solar researches. The loss of the positions connected with the theoretical investigations, such as MHD interpretation, modeling and simulations of the solar dynamic phenomena, whose basic generator was Prof. Dermendjiev, enforced change of the priority in our solar researches. During the transition period, (2002-2003) a basic aim in activity of Solar Physics Section became the development of observational facilities in the solar tower at the National Astronomical Observatory (NAO) – Rozhen. The main goal was the building of 15 cm coronagraph in the frame of the collaboration with the Astronomical Institute of Wroclaw University, Poland and its coupling with the 13 cm solar refractor in the solar tower, as well as starting of an observational program for solar prominences and monitoring of the solar activity in white-light.

2. Stuff

Solar Physics Section consists of 5 scientists:

Peter Duchlev, e-mail: duchlev@astro.bas.bg
Momchil Dechev, e-mail: mdechev@libra.astro.bas.bg
Kostadinka Koleva, e-mail: koleva@libra.astro.bas.bg
Nikola Petrov, e-mail: nick@astro.bas.bg
Joanna Kokotanekova, e-mail: joanna@astro.bas.bg

3. Research Fields

The research topics in the Solar Physics Section were:

Total eclipse on March 29, 2006. Research of the solar corona and prominences during the total solar eclipse on March 29, 2006 from the territory of Turkey.

Dynamic and evolution of eruptive prominences. Research and comparison of the kinematics properties and the internal structure evolution of eruptive prominences of types I and II (Rompolt, 1984, 1990) by H-alpha filtergrams obtained in Astronomical Institute of Wroclaw University and NAO – Rozhen, Bulgaria.

Internal motions and oscillation in quiescent prominences. Research of line-of sight velocity fluctuations of quiescent prominences by high-resolution H-alpha spectra and filtergrams obtained in Astronomical Institute of Wroclaw University.

Fine structure in quiescent and active prominences. Processing and analysis of high-resolution H-alpha filtergrams and prominence spectra obtained in Astronomical Institute of Wroclaw University and NAO – Rozhen.

Physical processes leading to prominence eruption and CME. Research of dynamic processes related to eruptive prominence and associated coronal mass ejections, as well as the activity events in the neighbouring active regions by ground-based data from the Astronomical Institute of Wroclaw University, Poland and data from SOHO/CDS, SUMER and EIT.

4. Solar Tower at NAO – Rozhen

New Coronagraph in Solar Tower at NAO – Rozhen.

In the frame of the collaboration with Astronomical Institute of Wroclaw University, Poland detail investigations of the construction of the polish Small Coronagraph were made. On the base of these investigations, as well as of the useful advices of Prof. B. Rompolt and Dr. P. Rudawy, Nikola Petrov calculated the optical system and mechanical construction of the 15-cm Lyot-coronagraph with Hα filter (1.8 Å). The coronagraph was built in the workshop of the Institute of Astronomy during 2003-2004. The focal length of the main objective of the coronagraph is 225 cm and the effective focal length of its optical system is 450 cm. The coronagraph field of view is 15' and the mean diameter of the solar disk in the focal plane of the main objective is ≈21 mm.

Theoretical coronagraph resolution is 1".1. It necessary more long observations and additional investigations to estimate the real coronagraph resolution because it, as at another telescopes, strong depends on atmospheric conditions in the region of observation. The statistical data from the observations with telescopes in NAO- Rozhen show that the mean resolution for night observations is about of 2".

In the beginning of May 2005, the coronagraph was assembled in the Solar tower with 8-m dome built in the territory of NAO – Rozhen at 1750 m above sea-level. The initial rough adjustments connected mainly with the focusing of the coronagraph were made using black-white films KODAK P3200. The first successful image of a solar prominence was obtained on July 13, 2005 using digital camera Canon EOS 300D. In August 2005 the coronagraph was equipped with digital camera Canon EOS 350D. (8 Mpx) with digital matrix size 22.2x14.8 mm. In registration regime, at maximal camera resolution, obtained images have size of 3456x2304 pxs. The technical parameters of the digital camera allow obtaining of long series of filtergrams with high quality and small step in time.

The coronagraph has been tested and adjusted during several months and in the end of September 2005, it was ready for regular observations. From October 2005 regular observations of solar prominences were carried out and high qualitative series of H-alpha prominence filtergrams were obtained.

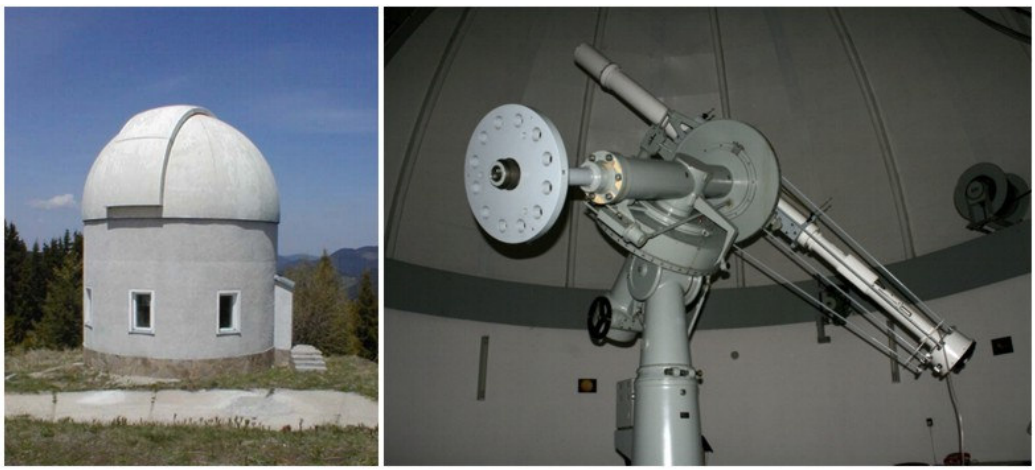

Figure 1. Solar tower with 8-meter dome at NAO – Rozhen (*left*) and the assembled 15-cm coronagraph (*right*)

Observational Program

The first results from prominence observations and obtained images with high quality and resolution encourage us to realize observational program in Hα hydrogen line that will carry out in the following basic directions:

- Fine structure and dynamics of quiescent prominences;
- Dynamics and internal structure evolution of eruptive prominences;
- Dynamics of active prominences (surge and spray);
- Monitoring of solar prominences.

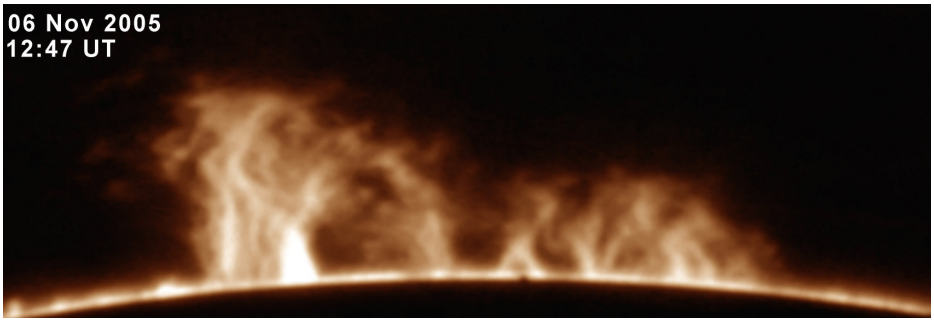

Figure 2. Quiescent prominence observed on November 6, 2005 (N. Petrov)

The equipment of the coronagraph and the building are not fully completed. In future, the coronagraph will be equipped with spectrograph that will allow registering of the line-of-sight velocity from fine internal structure of quiescent and eruptive prominences. Using digital camera for image registering we obtain images directly in digital format. That makes easy the creation of the archive of our observational data. A system of archiving of the solar images is developed.
Upgrade of the solar refractor (13 cm/160 cm) is coming that allows white-light observations of sunspots, active regions, white-light flares and faculae, as well as monitoring of the solar activity at the photospheric level.

5. Total eclipse on March 29, 2006.

According to the observational program for the total eclipse developed during 2004-2005 five basic experiments dedicated of the study of solar corona and solar-terrestrial influences were prepared.

- Registration and investigation of regions of solid material sublimation near the Sun (between 4 and 20 solar radii). (In collaboration with IZMIRAN, Russia)
- Spectral investigation of the solar corona. (In collaboration with Department of Astronomy of the Faculty of Physics, Sofia University)
- Registration and investigation of the solar corona polarization at distance up to 5 solar radii. (In collaboration with Public Astronomical Observatories in Haskovo and Dimitrovgrad)
- Registration and investigation of the white-light corona and prominences. (In collaboration with Public Astronomical Observatories in Haskovo and Dimitrovgrad)
- Registration of the phenomenon “Shadow Bands” (In collaboration with Public Astronomical Observatories in Haskovo and Dimitrovgrad).

The scientific expedition consisting of 33 persons was carried out in the period from 24 to 31 March 2006. The eclipse observations were performed in territory of Side, Turkey. The suitable observation place, atmospheric conditions and good preparation of the expedition allow successful implementation of all experiments.

6. Virtual Solar Observatory

During the period 2004-2006 first steps to Virtual Solar Observatory (VSO) was made.

- The basic concepts of VSO are taken into consideration at the future development of the archives of solar data that will be obtained by instruments in the solar tower at NAO – Rozhen.
- Basic development of the hardware and software for searching, obtaining and analyzing of solar data that are distributed at many different observatories around the world was made.
- First results of VSO component, including analysis software, data visualization tools and visual programming interface, was presented at the international conference "VIRTUAL OBSERVATORIES: Plate Content Digitization, Archive Mining and Image Sequence Processing", Sofia, April 27-30, 2005.

7. Collaborations

- Astronomical Institute of Wroclaw University, Poland under a joint research project "Fine Structure and Dynamics of Solar Prominences: Observations and Analysis"
- IZMIRAN, Russia under a joint research project "Observation and Spectral Analysis of Zodiacal Light"

8. Other Institutions

A part of regular researches by different problems on solar physics and solar-terrestrial physics are carried out at the Department of Astronomy of the Faculty of Physics, Sofia University, Section of Solar-Terrestrial Physics of the Solar-Terrestrial Influences Laboratory, Section of Ionosphere and Geo-electricity of the Geophysical Institute and Plasma Astrophysics Group of the Faculty of Physics, Sofia University.

Department of Astronomy of the Faculty of Physics, Sofia University

Spectral investigations of the solar corona during total solar eclipses.

Section of Solar-Terrestrial Physics of the Solar-Terrestrial Influences Laboratory

Modeling the influence of the corpuscular and electromagnetic radiations (cosmic rays, energetic particles, XUV- rays etc.) with solar origin on the planetary ionospheres and atmospheres.

Modeling the planetary ionospheres by disturbed conditions in the solar-terrestrial relationships (proton flares, coronal mass ejections, geomagnetic storms and magneto-ionospheric disturbances, eclipses etc.).

Behaviour of the important for ecology ozone component in dependence on solar and geomagnetic activity.

Section of Ionosphere Plasma Physics of the Geophysical Institute

Investigations of solar wind's interactions with Earth's magnetosphere that supply the magnetosphere-ionosphere-thermosphere system with remarkable amount of energy much more frequently - during geomagnetic storms and sub-storms.
The long-term solar (geomagnetic) modulation effects on the planetary wave signatures and non-linear wave-wave coupling between quasi-periodic oscillations of solar, geomagnetic and mesosphere/lower thermosphere origin are investigated

Plasma Astrophysics Group of the Faculty of Physics, Sofia University

This group continued to study dispersion characteristics of MHD waves traveling in the magnetic flux tubes and its work on the propagation of fast MHD waves in bounded solar wind plasma

Acknowledgements

The author is grateful to CNSys Computers & Networking, Sofia and OPTICOELECTRON GROUP, Panagyurishte for financial support of the coronagraph building. The coronograph realization was particularly supported by National Scientific Foundation under Grants F1510/2005 and D0-406/2005. The author is grateful to Prof. B. Rompolt and Dr. P. Rudawy for useful advices, as well as to the constructors I. Parov, V. Marinkov and I. Pamukchiev from the workshop of the Institute of astronomy, for the building and mounting of the coronagraph.

References

Rompolt, B.: 1984, *Adv. Space Res.* **4**, No. 4, 357.
Rompolt, B.: 1990, *Hvar Obs. Bull.* **14**, 37.