

Annual Report to JOSO 2002/2003 - Czech Republic

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Solar research in the Czech Republic is performed at the **Astronomical Institute of the Academy of Sciences of the Czech Republic in Ondřejov**. The regular optical and radio observations are also carried out at the **Úpice** Observatory (east-northern Bohemia), photospheric and chromospheric observations are also regularly made at the **Valašské Meziříčí** Observatory (east-northern Moravia).

1 Ondřejov Observatory (E 14° 47' 01.1"; N 49° 54' 38"; 528 m above sea level)

Solar observations at the Astronomical Institute Ondřejov are made in visible, radio and X-ray wavebands. They are based on an optical and radio spectroscopy and on analysis and interpretation both of the own data and on the experiments carried out in the frame of a broad international cooperation. Many of these activities are supported by a close cooperation with institutions in France, Croatia, Italy, Japan, Germany, Holland, Hungary, Poland, Austria, Russia, Slovakia, Spain and USA. This cooperation includes an exchange of various data and their theoretical interpretation. At the end of year 2003 the scientific staff in the Solar Department consists of 15 scientists and 3 PhD students. More details about staff, instrumentation and scientific activities are available on <http://www.asu.cas.cz/english/department/solar/>.

Altogether 11 IDL installations are available in the solar department, 3 of them are new versions 6.0. One IDL 6.0 installation on server is a floating multilicence for 5 users. Since year 1996 until now we purchased new licenses in total cost about US\$ 6310 and for maintenance we payed together US\$ 9320. In the years from 2001 to 2003 was from this amount was given for new licenses US\$ 3750 and for maintenance US\$ 5500.

1.1 Solar Flare Research

1.1.1 Plasma processes in solar flares and prominences.

Solar flares and prominences as well as related plasma processes are studied as concerns the theory, modeling, observation and data interpretation. Observations are regularly made in radio, X-ray and optical (solar patrol and spectra) wavebands.

Computer controlled Multichannel Flare Spectrograph (MFS) allows to make a simultaneous registration of three spectral lines: $H\alpha$, $H\beta$ or He D3 and CaII 854.2 nm. The slit-jaw $H\alpha$ pictures are also registered on the videotape with a cadence of 25 images per second. The MFS was involved in most of international coordinated observing campaigns. Lots of the data were also obtained by a direct digitization way using a DIPIX frame grabber. Examples of the data are available at the MFS homepage <http://sunkl.asu.cas.cz/~pkotrc/archive.html>.

Data are archived at the S-VHS videotapes and information about the archive from the years 1998-2003 is available on <http://www.asu.cas.cz/~pkotrc/archive.html>. Since year 2001 the data registration system was improved by digital video recorder, and a processing device consisting of an image editor card and related software. Everybody, to whom it may concern, can contact us e.g. via the MFS home page for his/her interest in processing the data in common scientific projects. Some of the data are subjects of a thorough investigation. A simple device for linear polarization measurements in $H\alpha$ flare spectrum was installed in the MFS. List of observations from time interval 29.05.1998 - 28.11.2003 with examples of the data can be found on the above mentioned www page.

A modernization of two Carl-Zeiss-made large horizontal telescopes with spectrographs HSFA1 and HSFA2 continued. It concerns mainly the improvement of all the controlling electronics and some parts of mechanics, optics and data registration. The HSFA2 instrument is planned to be used as a multichannel spectrograph, equipped with CCD cameras in up to 5 spectral lines. After first step of reconstruction, first spectra have been obtained. The device will be put in operation in summer 2004, see <http://www.asu.cas.cz/~pkotrc/observation.html>. The HSFA1 is still inactive. They will provide magnetogram measurements and will start its operation probably a year later.

1.1.2 Radio flare emission

The main activity of the solar radio astronomy group is devoted to the analysis of the fast dynamic phenomena in the solar corona - the solar radio flares. For their observation we currently use two basic instruments:

- Radio spectrograph 0.8-4.5 GHz, consisting of two independent instruments covering frequency bands 0.8-2.0 GHz and 2.0-4.5 GHz, each with 256 frequency channels and 0.1 s time resolution.

- High time resolution 3.0 GHz radiometer for observing fine time structures with 0.01 s time resolution.

The observations are fully automated, running daily while the sun is higher than 5 degrees above the horizon. As the amount of observed data is enormous, only data containing some active events are archived. The information about the archived data (date, time interval) as well as overall images of individual archived events in GIF format are available at the web site address: <http://sunk1.asu.cas.cz/~radio>.

Presently, an upgrade project for our spectrographs is under way with the goal to achieve a better time resolution and higher dynamics.

1.1.3 X- ray measurements from space.

Hard X-Ray Spectrometer (HXRS) on board of the U.S. Department of Energy Multispectral Thermal Imager (MTI) satellite.

On March 12, 2000, a Hard X-Ray Spectrometer (HXRS) was launched onboard the U.S. Department of Energy Multispectral Thermal Imager (MTI) satellite.

HXRS observed integrated flux from the whole solar disk with time resolution of 1 second during quiet period and 0.2 second during flares in 10 energy bands covering the energy range from 12.6 to 249,5 keV. Instrument was active during about 3 years period from March 12, 2000 until February 17, 2003.

A brief technical description of the instrument as well as information on the project can be obtained at http://www.asu.cas.cz/english/new/HXRS_descr.htm.

The event list provided in the HXRS data catalog (<http://www.asu.cas.cz/HXRS/events.html>) contains only MTI daytime flare events minimally impacted by particle contamination.

The data are available on the <http://www.asu.cas.cz/HXRS/> in three different formats. The additional technical information will be provided on request.

1.2 Dynamics of active phenomena in solar photosphere

The Ondřejov magnetograph with an enhanced sensitivity to Doppler velocity measurements enables medium-resolution observations of longitudinal components of magnetic and velocity fields in active regions and quiet photosphere.

Archive of all the data obtained with the Ondřejov Observatory magnetograph in the years 1990 - 2002 is located on <http://www.asu.cas.cz/~solmag/>.

The measurements were made in several different spectral lines, most often in FeII 525.347 nm. The actual space resolution of our measurements is close to 3 seconds of arc, the sensitivity of the instrument is better than 10 G, 10 m/sec, and 0.1of the spectral continuum.

The magnetic data archive contains the charts of the longitudinal component of the magnetic field, of the Doppler velocities, of the intensity obtained in the spectral continuum, as well as the localization of the measured area on the solar disk. There is no possibility to get the digitized data of the magnetographic

measurements directly on the Internet. To get the digital data files of the measured magnetic and velocity fields in a FITS format it is necessary to contact via e-mail: mklvana@asu.cas.cz.

In collaboration with the Institute for Geophysics, Astronomy, and Meteorology of the Graz University, observations of sunspots were made at the new 1-m Swedish Solar Telescope, La Palma. Several time series of frames with spatial resolution of $0''.15$ were acquired simultaneously in blue and red continua, together with complementary frames in the line Ca II H.

During the last two years the participation in GREGOR project (<http://gregor.kis.uni-freiburg.de>) continued. Construction of the image derotator is in progress and the technological test are planned on the summer 2004.

1.3 Solar activity monitoring and forecast

Patrol observations of the Sun in the white light and H α are made daily. The results are used for the support of a research work in the Solar Department and the statistical values contribute to the world net IUWDS (as station No. 31516) and to SIDC in Bruxelles. For detail observation of the solar photosphere and chromosphere the double solar refractor is used (205/2830 mm and 210/3410 mm + H α DayStar filter 0.06 nm) with CCD-cameras, computer image analyzer, digitization of the image and registration on videotape. Besides solar observations the accessible data on the actual state of the solar activity are collected. Archive of the observations in H α and white light is located on <http://www.asu.cas.cz/sunwatch/index.html>. Based on our complex observing materials the weekly solar-activity forecast is compiled and published since 1990. The forecast for a week in advance is available in electronic form via [www http://sunkl.asu.cas.cz/~sunwatch/forecasts.html](http://www.sunkl.asu.cas.cz/~sunwatch/forecasts.html).

2 Observatory Úpice (E 16° 00' 43.5", N 50° 30' 26.6", 416 m above sea level)

Atmospherics on the 27 kHz (SEA) and cosmic radio noise at 33 MHz (CN) are registered daily and provided to SGD in Boulder. Pictures of solar active phenomena in white-light, H α and CaII-K lines on whole disc and also details are observed regularly. The primary data transformed into computer database are deposited in Úpice Observatory (e-mail: hvezdarna@obsupice.cz). All the whole disc data are available on <http://www.obsupice.cz>. Pictures of the eclipsed Sun are on <http://www.zam.fme.vutbr.cz/druck/Eclipse/Index.htm>. Two astronomers and two technicians participate on the solar observations.

Archives of Observatory Úpice observation are located on <http://www.obsupice.cz/slunce/sun.htm> (observation from 1997), H α pictures from 1966 to 1978 are available in photographic form and radio registrations since 1964 are also available in paper registration tapes.

3 Valašské Meziříčí Astronomical Observatory (E 17° 58' 31"; N 49° 12' 15"; 338 m above sea level)

Location: East part of Czech republic, Moravia

The observatory is equipped for regular observations by three solar instruments oriented on the: -

- the whole solar disc is photographed in white light with the Zeiss refractor E 120/1920 mm (mean diameter of the solar disc on the negative is about 66 mm) Whole Sun regular observations started on October 4, 1957. -
- photographs of the details of the sunspot groups (Zeiss 200/3000 mm) Observation archives: photographs of sunspot groups started April 7, 1981
- photographs of the solar prominences (coronagraph with Zeiss E 150/1950 mm objective with H α Šolc filter. All the archived negatives of photographic observations are signed with the necessary data. Regular observations began on July 24, 1984 (since 1991 we have done our observations more intensively) (now TV CCD camera is used) - Non-regular photographic observations of active prominences started from May 1991 (now TV CCD camera is used)
- TV CCD observations of the solar chromosphere details (refractor 110/1600 mm). Regularly made observations were started from year 2002. All type of observations have continued until today.

Examples of observational results are presented on http://www.astrovm.cz/op_slunce_foto.php. Many video sequences (S-VHS format) of prominence observations and series of digitally observed images of the solar prominences are available on the requests (e-mail: libor.lenza@astrovm.cz). Reports about the observations are provided also to SGD. Transformation of the old photographic observations to modern electronic format was started.