«SOT» Experiment
SOLAR-ORIENTED TELESCOPE

Gopasyuk S. I.

Crimean Astrophysical Observatory, Ministry for Education and Science of Ukraine
Naukove, Bakhchisarai, 98409 Crimea, Ukraine
Tel: (380) +655 +471166, Fax: (380) +655 +471754, e-mail: gopasyuk@crao. crimea.ua

Observations of magnetic field and plasma conditions of various formations on the Sun with the high resolution up to 0.2″, which has been never reached in previous experiments, are the purpose of the «SOT» experiment. The solar Gregory telescope with $D \approx 300$ mm (equivalent focal distance of 11 m) for carrying out observations in UV wavelengths (90—160 nm) will be manufactured and equipped with a spectropolarimeter with CCD camera. It allows detection of the processes involving high-energy release, and thus, provides a better understanding of the mechanisms of plasma heating and acceleration of particles up to high energies. The spectral measurements in Liaman continuum will be carried out as well to determine the density, temperature and small-scale structure of the plasma in solar flares.

«SOT» experiment pursues the following main objectives:

— manufacturing the UV telescope equipped with a spectropolarimeter incorporating a CCD camera together with guiding and solar disk scanning system;
— observations of the magnetic field, brightness and velocities in the solar formations at different spectral lines with high spatial and temporal resolution.

The Gregory telescope will monitor the solar disk on the slit of a spectropolarimeter with CCD camera designed for spectral and magnetic measurements. Polarization properties of Zeeman components will be determined to measure the magnetic field.

The afocal Gregory telescope has two sital mirrors with the special coating that provides considerable reflection of the UV radiation. The primary mirror diameter is equal to 300 mm. The telescope equivalent focal distance is $f_{eq} \approx 11$ m, the spatial resolution on the polarimeter slit is of about 0.2″.

Spectropolarimeter consists of diffraction grading, collimator and several chamber mirrors. Guiding and solar disk scanning systems employ the light reflected by the spectropolarimeter slit. The spectrometer slit coincides with the focal plane of the telescope. The light beam passes through the polarimeter set behind the slit to the collimator mirror, grading and chamber mirrors, consecutively. Spectral resolution of the spectropolarimeter equals a pixel of a CCD chip.

Registration system employs a CCD chip with 1024×1024 sensitive pixels for the spectropolarimeter and the one with 512×512 pixels for obtaining H_α images of the Sun. An onboard data acquisition system will be necessary, in view of the total duration of one set of observations of about 5 hours and overall amount of information of about 2 Gb.

A scientific data management system provides data acquisition, data reduction procedure and computer interface in two operating modes:
— data obtaining in real time and by the recording and reproducing system (RRS) simultaneously;
— data recording by the RRS only.

SOT control system has two operating modes:
— manual control (MC) of the unit by a ground-based observer or an astronaut; a video camera is envisaged for transmitting solar image to the Earth in the real time;
— automatic control (AC) in accordance with a preset program.

Being in AC mode, the control system will ensure to direct the telescope at any point of the solar disk with the accuracy of about 5″. The accuracy of stabilization is of about 0.5 arcsec/s. By using additional means the accuracy of the automatic stabilization of the Sun's focal image will be of about 0.001 arcsec/s during each set of observations (200 — 300 s). Scientific equipment control will be carrying out permanently by ground-based observers using relay control commands or code words.

Telescope optics weight is equal to 10 kg, total complex weight is 150 kg, and power of the scientific equipment is of about 1 Chat. The entire complex should be thermally insulated, and the optics should be protected from the influence of gaseous environment (mainly, from oxygen atoms and ions).

The most interesting active regions of the Sun, where instabilities could occur, as well as the non-active regions with the areas of high energy releases (bright knots), protuberances and filaments will be the objects of observations by the SOT. The SOT objects will be chosen from ground-based observations.

Successful performance of the SOT experiment will permit magnetic field and solar plasma observations in various formations of the Sun with the spatial resolution as high as 0.2″. Among others, the obtained data could detail the following:

— small-scale magnetic field and plasma activity;
— connection between the origin and evolution of non-stationary processes as powerful as for example, solar flares, and the magnetic field destabilization;
— problem of electric current generation in the outer solar atmosphere;
— role of small-scale magnetic activity and plasma instability in heating the plasma;
— acceleration of particles up to high energy, and energy transfer in magnetic structures.

«SOYA-M» Experiment

SOLAR BRIGHTNESS OSCILLATIONS MEASUREMENTS

Bruns A. V.

Crimean Astrophysical Observatory, Ministry for Education and Science of Ukraine
Naukove, Bakhchisarai, 98409 Crimea, Ukraine
Tel: (380) + 655 + 471166, Fax: (380) + 655 + 471754, e-mail: bruns@crao.crimea.ua

Most of our knowledge about the Sun has been derived from observations of visible solar surface layers: the photosphere, chromosphere and corona. One of the main problems of the modern solar physics is to develop the techniques for studying physical conditions in the solar interior and conduct continuous observations. Helioseismological research is one of the powerful means for studying the internal structure of the Sun by observations of its proper global oscillations. In many respects it has analogy to the seismological research of the Earth's internal structure.

Study of the internal structure of our nearest star, the Sun, is the goal of the SOYA-M experiment.

To meet the requirements of precise measurement of the proper frequencies of oscillations of a solar surface, it is necessary to provide a higher signal/noise ratio as well as continuity and long duration of observations. The experiment is intended for long-term measurements of the solar radiation flux with the subsequent calculation of the proper frequencies of its oscillations. The relative amplitudes of these oscillations are equal to $(1 - 10)\cdot 10^{-5}$. Stringent metrological requirements for stability of parameters of the radiation sensor and for the time interval precision are imposed to detect such a weak signal. Due to the atmospheric disturbances, measurement of such small brightness oscillations is possible only from a space station.

SOYA-M is the modified SOYA unit that was installed in «MARS-96» spacecraft, but this experiment was not realized by the reason of unsuccessful launch. It is a precise photometer measuring the solar radiation flux in a narrow spectral interval. Accuracy of discrete reading is up to 10^{-6} of the whole scale. Thermostabilization of measurement of circuits is used to decrease the drift of the photometer parameters because of the change of its temperature. Phase and amplitude of solar brightness oscillations strongly depend on the wavelength used. Choosing the wavelength for observations, the authors proceeded from their previous experience with a similar IRIR unit installed onboard the «FOBOS» satellite. Data processing revealed a strong degradation of filters in blue and green spectral regions and its absence in the red one. Thus, the interferential filter at λ = 800 nm will be applied in SOYA-M.

The ISS orientation system will introduce an additional error (modulation) in the measurements with the value of up to $(2 - 4)\cdot 10^{-3}$ of the whole scale (i. e., it exceeds the amplitude of oscillations