Program for the 1999 August 11 eclipse

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Abstract. A study of the solar coronal fine structure up to 5–6 solar radii as an indicator of the global and local processes on the Sun. The experimental detection of fast changes in coronal structures. An investigation of the minimal and maximal coronal structure (streamer form) as a result of the plasma layer projection on the picture plane along the neutral line. Obtaining 8–10 images of the white-light corona with the radial neutral filter.

The special telescope was developed and manufactured. The telescope tube is directed to (or from) the polar star. The Sun's tracking is carried out by the whole telescope tube with the heliostat mirror around the polar axis. The lens of the telescope is a two-component Petzval type, the diameter is 120 mm, and the focal length is 1200 mm. The assumed angular resolution at the region $\pm 2.5^{\circ}$ is near $5''$. Data will be recorded either via an automatic 8-cm aerial camera or using a CCD-detector.

Key words: solar corona – solar eclipse – improved observations

1. Summary

The 1999 total solar eclipse observational program will be based on traditional, as well as on new, advanced experiments. First and foremost experiment is planed to obtain while-light corona pictures with the radial neutral filter to investigate the structure of coronal streamers up to a distance of 5–6 $R_{\odot}$. By comparing these streamer structures (may be better coronal streamers) with photospheric magnetic fields, coronal holes, and SOHO/EIT data, it is intended to identify the origin of streamers and their relation to heliospheric current structures. Analysis of obtained images will be a continuation of the work done in the Institute, e.g., Eselevich (1997); Eselevich (1998); Eselevich et al., (1998). Another experiment is aimed to study a fine structure of coronal features (streamers, loops, and polar plumes) in the lower corona at a distance of 1–2 $R_{\odot}$. It is supposed that the fine structure is the manifestation of processes that have a fundamental role in the physics of the solar atmosphere. Observations with the high spatial resolution, e.g., Kouchmy & Smartt (1988), show that the corona is highly structured with the filing factor of 10^2. Magnetic energy dominates over kinetic energy in the coronal plasma, and may be assumed that the formation of the fine structure in the height range of up to 2 $R_\odot$ determines the whole fine structure at heights over 2 $R_\odot$. The vibration of magnetic field lines can play a predominant role in the coronal plasma heating in this region. Theoretical calculations, e.g., Gordon & Hollweg (1983), showed that MHD waves with the frequency in excess of 0.1 Hz can transport a sufficient amount of energy required for the heating of the corona. Experimental investigations of high-frequency oscillations from coronal observations during eclipses, e.g., Pasachoff & Ladd (1987) revealed an increased oscillation power at 0.25–2.0 Hz frequencies. It is also planned to study small-scale structures in the lower corona and their fast changes using an advanced experiment, based on Scientific Grade CCD 2048×2048 pixel, 24×24 μm camera. It is intended to obtain a set of images of the inner corona with both the high temporal and spatial resolutions. For carrying out observations of the solar corona during the 1999 eclipse, the telescope with the radial neutral filter and the rotating polarizer was developed and manufactured. This instrument will be used to take pictures of the white-light corona and to carry out polarization measurements of the K-corona (Fig. 1). This telescope is in adjustment and testing stage.

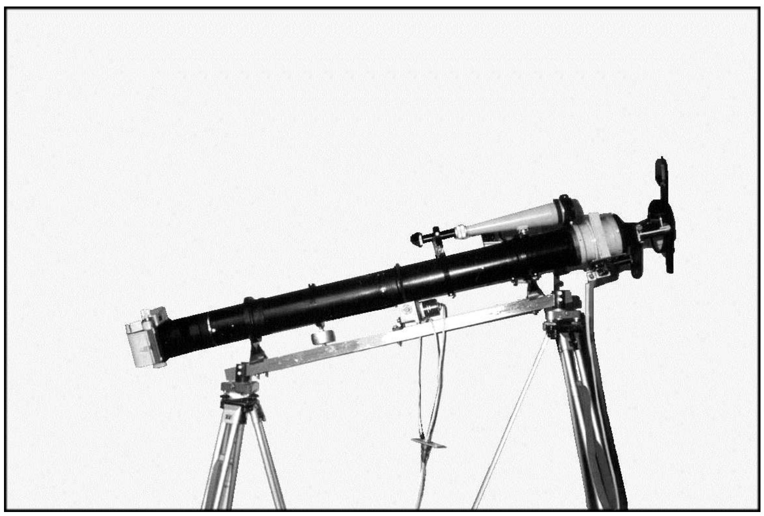

Figure 1. Telescope for observation of the solar eclipse.

A lens of the telescope, that embodies the doublet system, contains two achromatic two-lens components of positive optical force. They are 120 and 100 mm in diameter. The surface one of them is retouched to reduce the residual spherical aberration. A focal length of the lens is 1200 mm. Theoretical resolution of this lens in the visible range of the spectrum is constant in the field of 4 angular degrees and is not worse than 5″. The radial neutral filter will be laid out close to the focal plane of the lens, and an aerial camera film of width 80 mm will be used. It is intended to reduce the reflection factor of the filter to 5%. We hope that we will be able to manufacture a non-asisymmetric radial neutral filter, the density in which varies not only radially (by 4 orders of magnitude) but also azimuthally as well. To manufacture a such filter, it is necessary to forecast the distribution of coronal streamers and their brightness with regards to the heliographic latitute on the eclipse day. The concepts of the coronal structure described above may be useful for manufacturing the filter. The rotating polarizer will be laid in front of the radial neutral filter. It will have three fixed positions from the driving motor. Thus, the inside of telescope tube contains (along the line-of-sight): shutter, lens, radial neutral filter and automatic photographic camera. A guider is installed on the tube. Such a tube with the coelostat showed itself to advantage in the 1997 eclipse observation in the settlement of Yerofei Pavlovich. To reduce the size, the coelostat mirror is attached to the tube of telescope according to the polar siderostat system (Fig. 2). Solar tracking is carried out by rotating the tube of telescope together with the mirror about the tube axis, directed to the celestial pole. The structure supporting the bearings of the tube rotation and the hour-angle driver with a stepping motor, is installed on tripod or on a special platform.

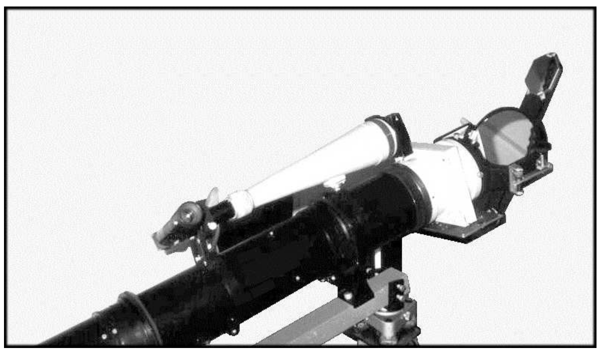

Figure 2. The telescope for observation of the solar eclipse. The lens.

The telescope is conveniently adjusted for the polar star. Such a design removes the field of view roation. The polarization matrix of the telescope is unchanged during 24 hours.

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Discussion

Question (S. Koutchmy): *From your prediction the corona should be symmetric at the time of the solar maximum and the next eclipse of 1999 will be close to the solar maximum. Why to use a non-axisymetric radial filter? Such filter should be more usefull at time of solar minimium, or not?*
Answer (L. Kashapova): I have not say that it will be 'maximum' or symmetric corona. We have not done prediction yet.
Question (V. Rušin): *What is the focal length of your telescope?*
Answer (L. Kashapova): The focal length is 1200 mm.
Question (M. Sobotka):*Do you plan to use coronal observations from the space shortly before the eclipse to make your prediction more accurate?*
Answer (L. Kashapova): Yes, of course. We will use the SOHO data and also about coronal holes from ground-based observatories for prediction as well.