Scanning Filter Photometer for Measuring the Sky Brightness in the Solar Almucantar

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Description

The operating prototype of an instrument has been developed and built up for measuring the scattered solar radiation and its polarization in the solar almucantar for azimuth angles A ranged from 0 to 170 degrees at different zenith angles Z. At A = 0 the direct sun light is measured. The view of the instrument is shown in Figure 1. The instrument calibration is supplied by the etalon Lambertian screen. The instrument consists of: (1) Sun-tracker with the accuracy of one angular minute, (2) photometer with three filters with centers at $\lambda_{1\text{-}3}$ in the visible spectral range and one filter at λ_4 in the infrared (IR) range (see Table 1 and Figure 2), (3) the system of azimuth angle choice with the accuracy of about five minute, (4) radiation sensor, (5) actinometer for continuous control of the air transparency, and (6) data acquisition unit.

The instrument is installed at 10 m height on the roof of the Optic Building at Zvenigorod Scientific Station of A.M. Oboukhov IAP RAS. One cycle of the direct and scattered solar radiation measurements in the full almucantar takes about 10 minutes. The mechanical and electric parts of the instrument may operate both in semiautomatic and fully automatic regimes. All-seasonal check of the instrument will be carried out during year 2001, including cold winter conditions. Figures 3 and 4 represent the 10-minute fragment of the test record obtained on March 9, 2001, at 13 hours of local time in clear-sky conditions at air temperature about t = -2°C. Figure 3 shows the relative sky brightness I_λ at angle A = 4° for wavelengths $\lambda_{1\text{-}4}$. Sinusoidal variations of the signals for $\lambda_{1\text{-}4}$ were produced by the polaroid modulation. Figure 4 presents an example of angular behavior of the relative sky brightness in the solar almucantar (Z = 57.5 ÷ 57.3, and A = 4 ÷ 170°). The instrument developed allows the estimation of the scattering phase function, its mean cosine and complex refractive index as well as the aerosol particle size distribution.

Acknowledgment

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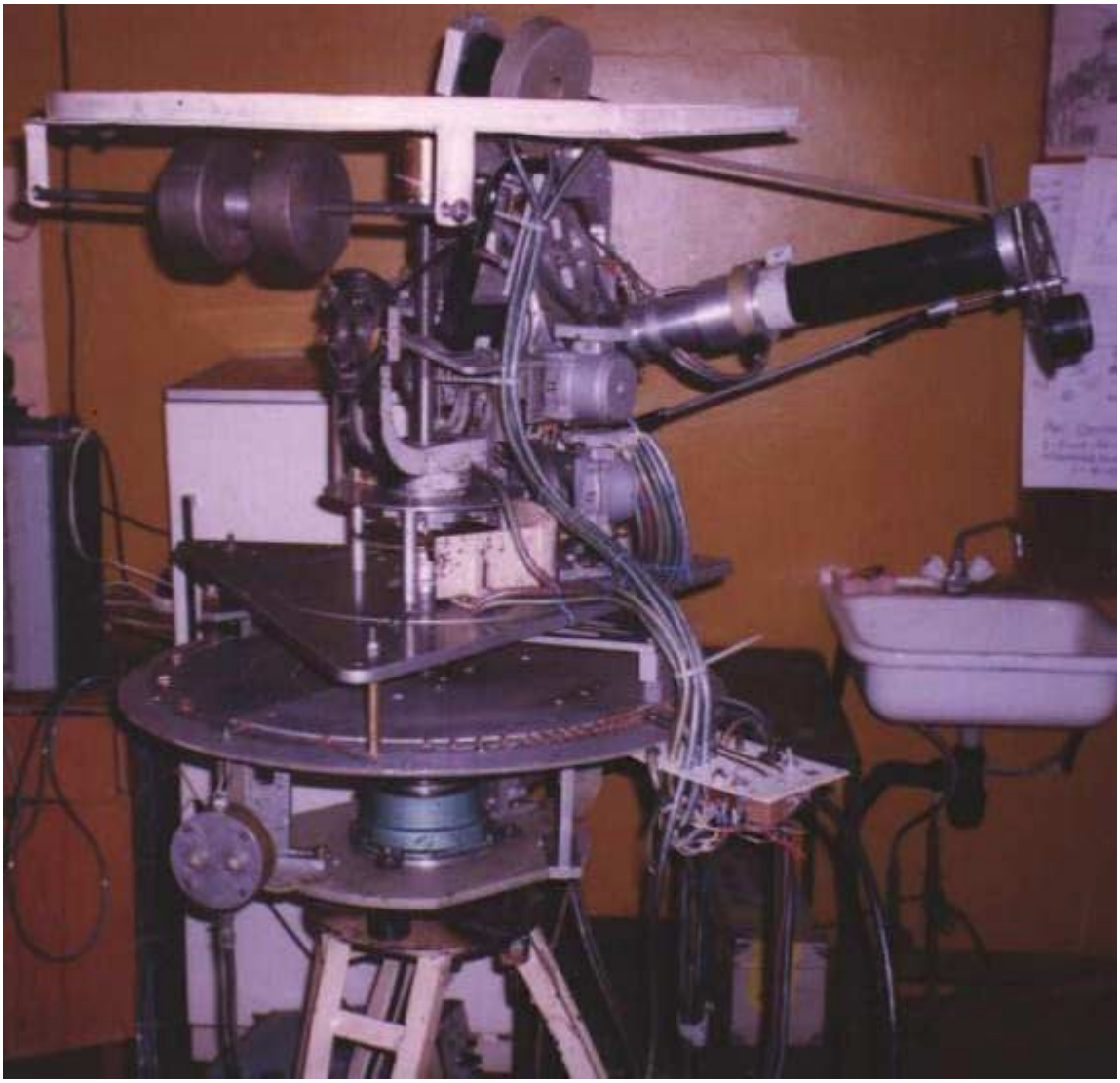

Figure 1

Table 1.

	λ_1	λ_2	λ_3	λ_4
Filter's wavelength, λ (nm)	466.5	595.1	724.3	1004.7
Width at half intensity, $\Delta\lambda$ (nm)	10	7.5	10	9

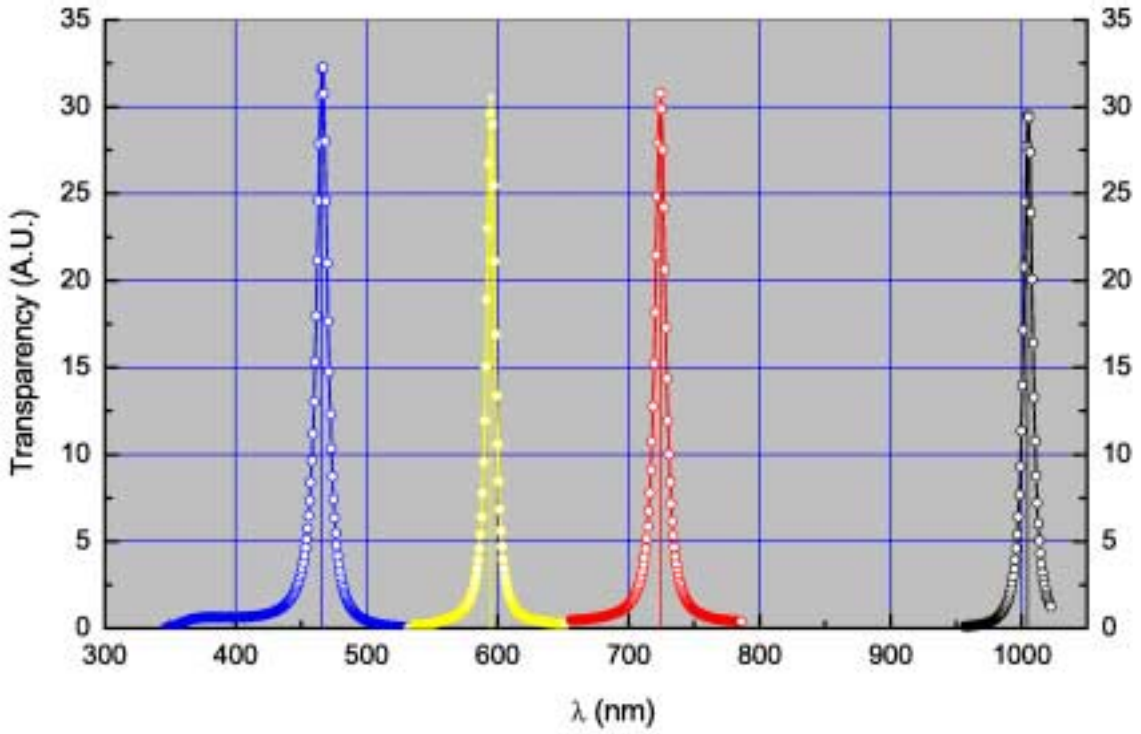

Figure 2

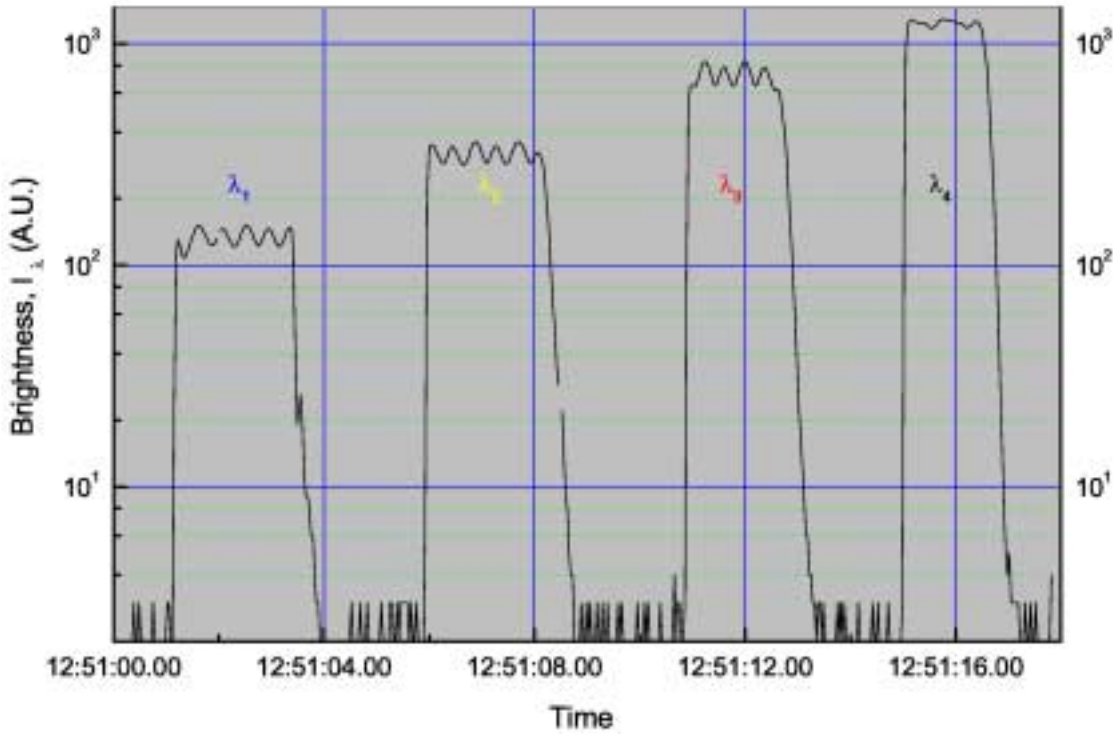

Figure 3

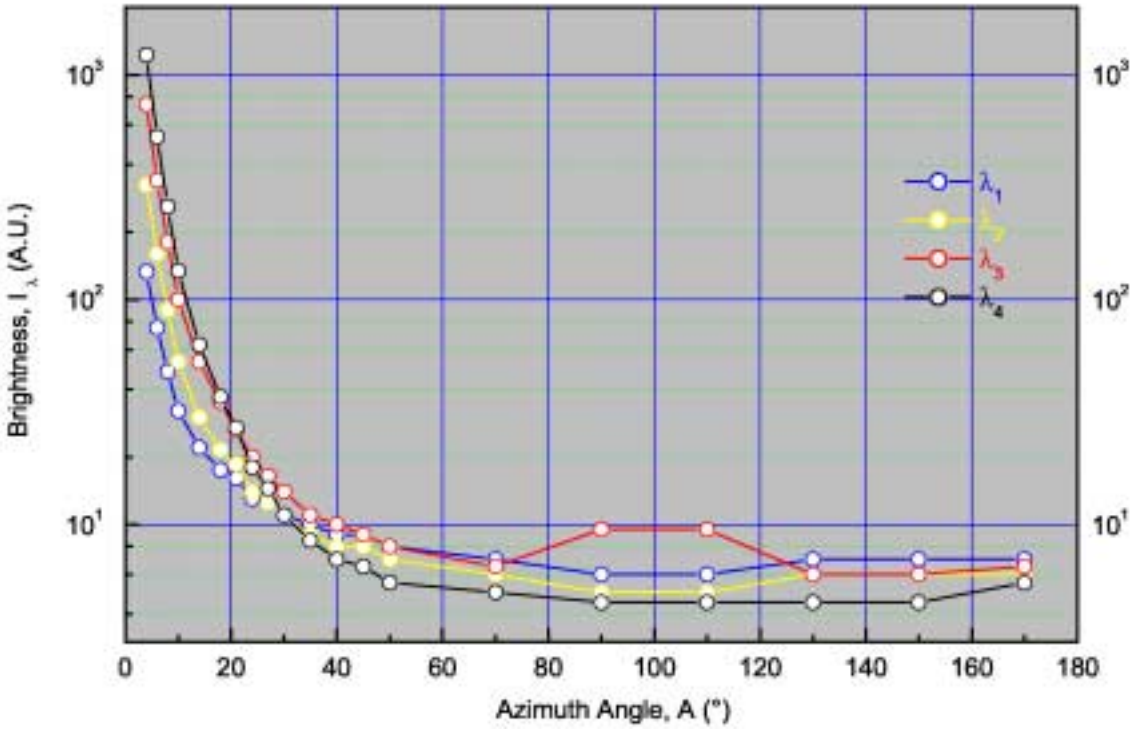

Figure 4

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