DEVELOPMENT OF OPTICAL MESOSPHERE THERMOSPHERE MEASUREMENTS IN STARA ZAGORA STATION

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Abstract

Ground-based instruments for measurement of variations of the O_2 Atmospheric nightglow emission and the OH band in Stara Zagora Station are described. The block diagrams of the two photometers are shown, using a personal computer to control the operation modes and data recording. The basic or technical parameters are presented. Results of the measurements and the determination of the rotational temperature of the mesopause altitude are shown.

1. INTRODUCTION

In the last years the investigation of the upper atmosheric dynamics has been intensively developed. The International Programme Planetary Scale Mesopause Observing System (PSMOS), the main purpose of which is the improvement of the atmosheric models, uses widely the atmospheric optical measurements.

The ground-based station in Stara Zagora (φ=42,4^{0}N, λ=25,7^{0}E) develops and uses within the terms of PSMOS photometric night measurements, connected with the determination of the temperature [1,2] and the dynamics of the mesopause altitude. It includes a zenith tilting photometer (ZP), measuring the emissions O(^{1}D), O(^{1}S) and the OH(8-3) band and a photometer with meridional scanning (MSP) for emission OH(8-3). The determination of irregular fluctuations of these emissions intensity presents useful information when studying the seismo-ionospheric interactions [3].

2. INSTRUMENTATION

The ZP block diagram is drawn in Fig.1. The light from the night sky falls into the interference filter and photomultiplier by 5,6/1000 Zeiss Spiegel objective, which gives the instrument an annular field of view of 2^0. The interference filters are selected so that to include spectral regions which are especially sensitive to the source temperature. ZP utilizes three interference light filters located on a step-motor driven disc. For O(^{1}S)

Atmospheric emission the instrument operates at a center wavelength λ_0=558,2nm and bandwidth 1,5nm. For O(^{1}D) emission λ_0=630,5nm and the bandwidth is 2,5nm. The OH channel uses λ=730,0nm and bandwidth 1,2nm for Q-branch, and λ=722,6nm and 1,4nm bandwidth for P-branch. The position of each filter and filter-tilt angle in relation to the photometer optical axis is

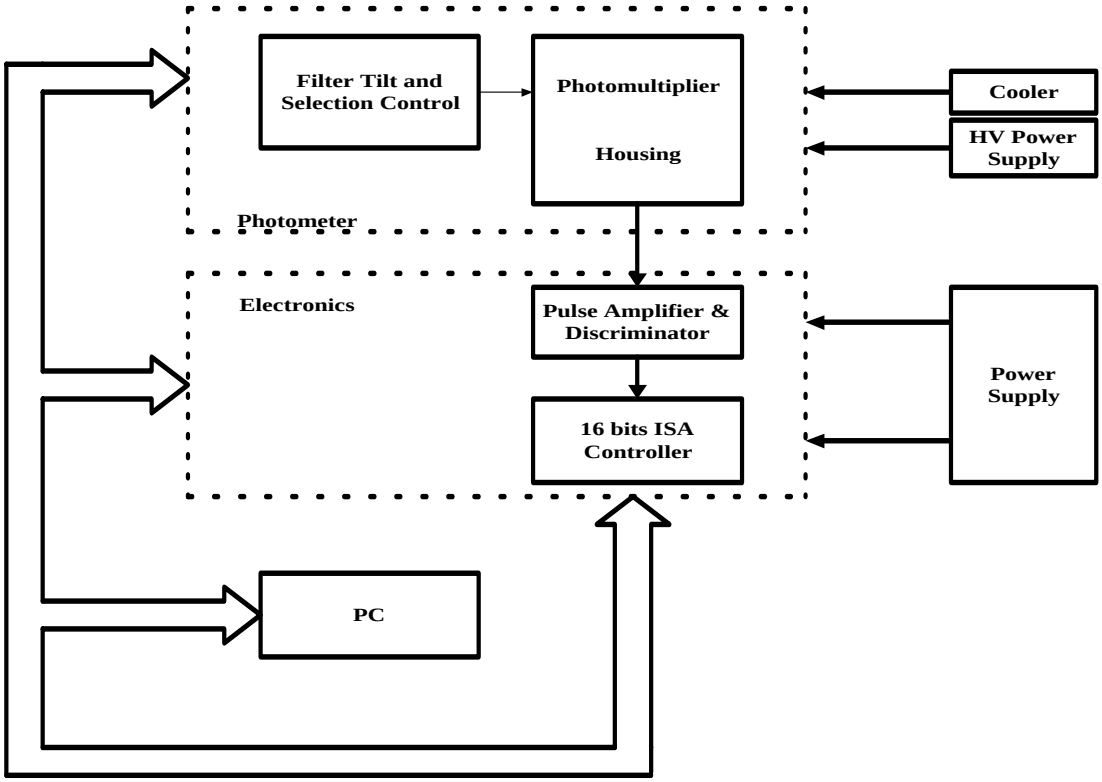

Fig. 1: Block diagram of the zenith tilting photometer in Stara Zagora Station

controlled by Hall's sensors. The cooled photomultiplier type EMI 9558A with S20 photocatode operates in pulse mode and its amplifier is with frequency band of 500 MHz. A 16-bit controller synchronizes the measurement time (1s) for each filter position and the data recording in a PC. The time resolution of measurement is 28 s.

The MSP block diagram is presented in Fig.2. MSP uses a scanning device for 30 positions with a step motor and a stationary interference filter. The instrument has an annular field of view of 2^0 and a full scanning angle of 60^0. The remaining part of the photometer and the data PC recording is constructed as ZP.

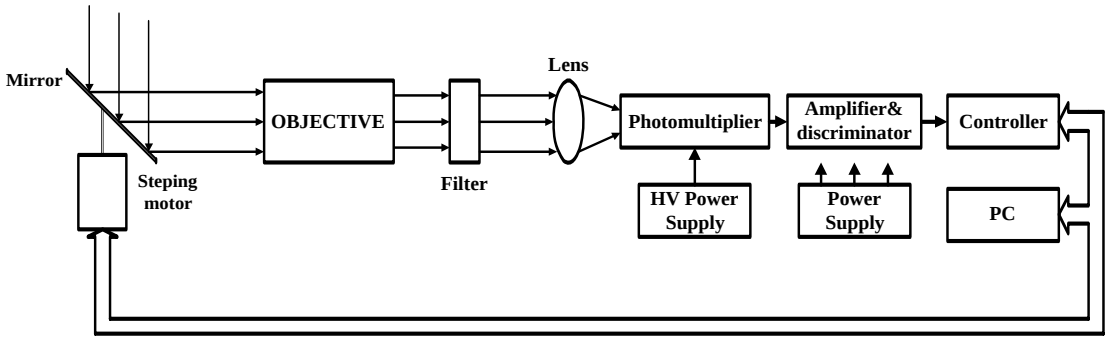

Fig. 2. Block diagram of the meridian-scanning photometer

3. RESULTS AND CONCLUSIONS

Examples of data taken over Stara Zagora Station from ZPmeasurements are presented in Fig.3. The same figure shows the rotational temperature by R and Q branches of the

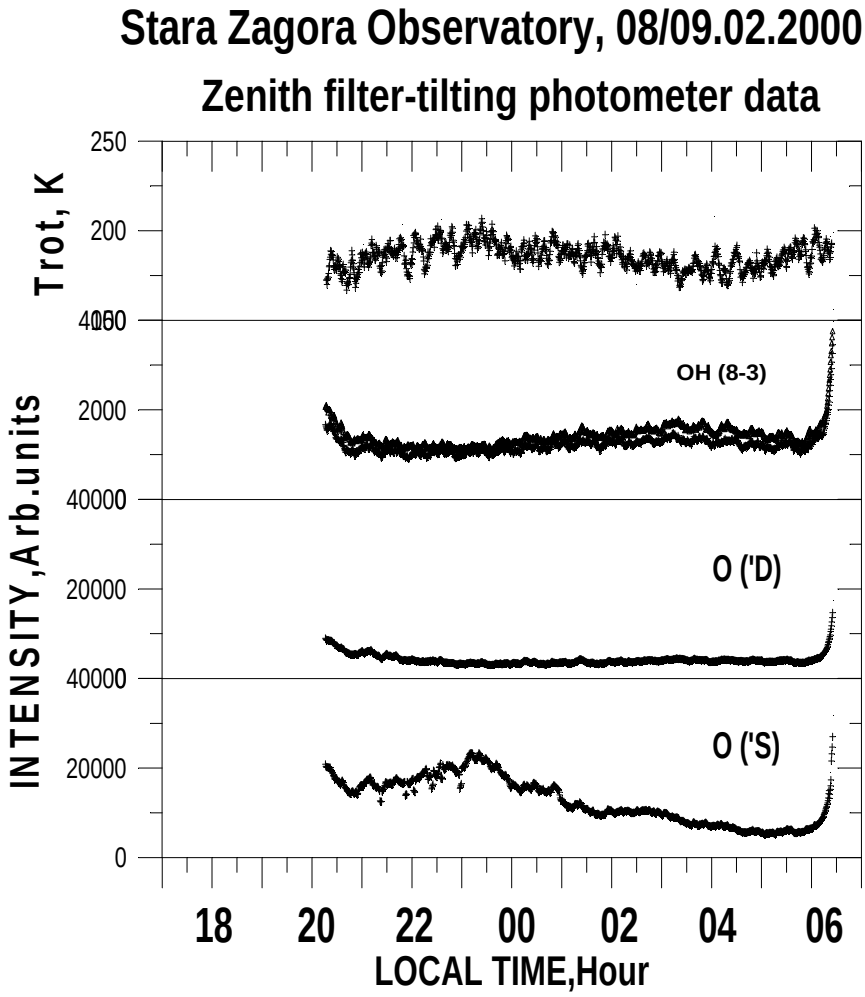

Figure 3.

OH(8-3) band, computed by the formula:

$$Trot = 207{,}06/\ln 2{,}642(I_Q/I_R).$$

IQ, IR – intensities of Q and R branches

Regular night photometric measurements have been conducted since January 2000.

The $O(^1S)$ emission is characterized by a night course with maximum around midnight and for $O(^1D)$ – with minimum around midnight.

The MSP measurements are in a process of completion and are necessery to determine the parameters of the internal gravity waves and the occuring dynamical processes at seismo-ionospheric interaction.

The selected time resolution allows to make an analysis and to evaluate the atmospheric small-scale dynamics at altitude of 85 – 250 km. The comparison of the obtained results to the data for the magnetic field, the electron concentration and temperature will allow to confirm the assumption that the course of the emissions in the interval 21.00 – 21.30 local time corresponds to the wave process.

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