Session 3. Instrumentation for Solar System Research

A COOLED PHOTOMULTIPLIER WITH AN InGaAs PHOTOCATHODE DEVELOPED FOR THE SPECTROPOLARIMETRY OBSERVATIONS

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The observations with a cooled InGaAs-photocatode photomultiplier were carried out in the Main Astronomical Observatory of the NAS of Ukraine. Astronomical objects were observed at the telescope AZT-2. We used an astronomical spectropolarimeter with the cooled photometric head and a photomultiplier tube with the InGaAs-photocathode working in the one-electron mode (Fig. 1).

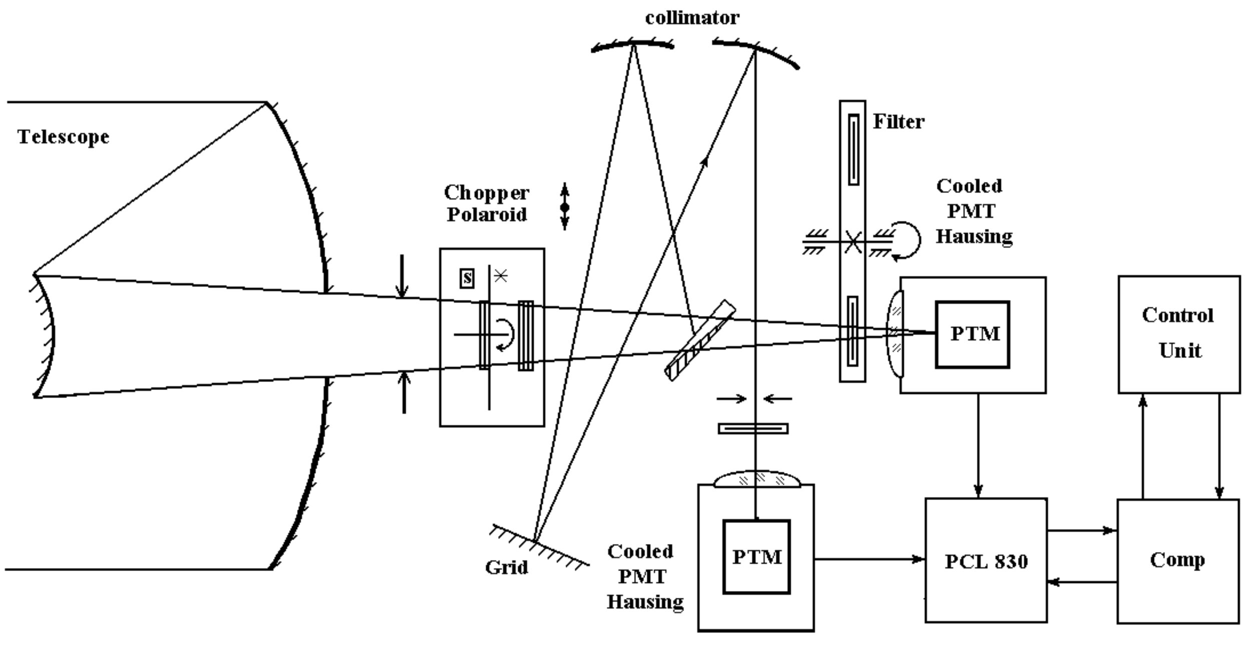

Figure 1: Structural scheme of our spectropolarimeter

The astronomical spectropolarimeter was developed and manufactured in the Main Astronomical Observatory. The device has two optical channels and can work in the modes of photometry, spectrometry, polarimetry or their combinations.

The spectral characteristics of photomultipliers with various photocathodes are presented in Fig. 2.

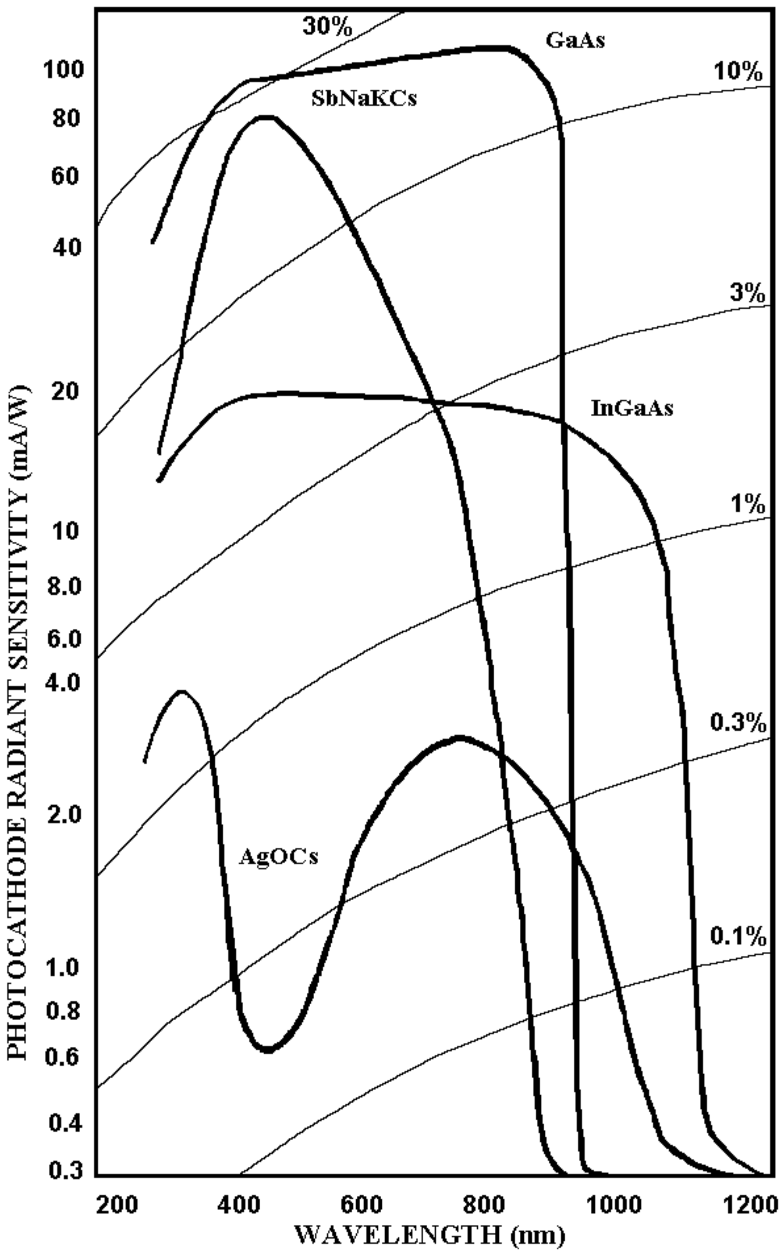

Figure 2: Reflection mode photocathodes

Advantages of a photomultiplier with the InGaAs-photocathode are:
1. Wide spectral range – 350–1060 nm.
2. Short anode pulse rise time – 3 ns.
3. A good quantum output in the near infrared (on λ = 1060 nm) – 0.2%.

Existing problem of photomultipliers with the InGaAs-photocathode are:
1. Large dark noise $\sim 100\times10^3$ pulses per second (at $T = 20^\circ$ C).
2. Small factor of amplification – 100×10^3.
3. Lateral optical input.
4. Monocrystal photocathode.

Features of work of our photomultiplier with the InGaAs-photocathode are:
1. Thermoelectric cooling of the photomultiplier for reduction of thermal noise.
2. One-electronic mode of operations of the photomultiplier.

OBSERVATIONS

1. Photometry

Object of photometric researches: β Ori, τ Ori and χ Ori.
Time of exposition: 20 s.
Photometry mode: "star" – "background".

2. Spectrometry

Object of spectral researches: Jupiter.
The spectrum of the whole disk of the planet (Fig. 3) repeats the variation of its reflectivity in visual range (the methane bands at 619 and 727 nm).
A possibility of research of celestial object with the astronomical spectropolarimeter in a range of wavelength 340–1070 nm is proved.

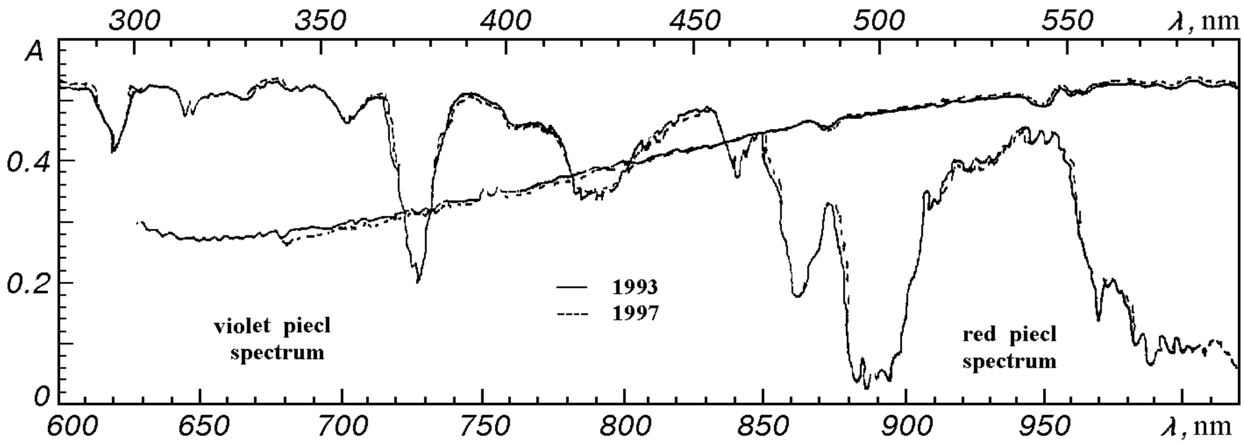

Figure 3: Spectrum of the whole disk of the Jupiter

3. Polarimetry

The spectropolarimetric measurement of Jupiter's disk was carried out.
Range of measurement: 340–1070 nm.
The Instrumental polarization of light for the system "telescope – polarimetry" is as follows:

$$Q = 0.012 + 0.016\%, \quad U = -0.031 + 0.016\%.$$