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THE MICROCHANNEL PLATE INTENSIFIER FOR INTENSIFIED CCD PHOTON-COUNTING SYSTEMS

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Abstract. A proximity-focussed, microchannel plate intensifier using a quartz input window has been developed. The intensifier is important for use in the image photon-counting systems in the ultraviolet. Some of the most important manufacturing techniques are described, along with the results of tests of the performance characteristics of the tube.

Key words: instrumentation: microchannel plates, photon counters

1. Introduction

Despite the increasing importance of CCDs, photon counting systems continue to offer advantages for certain types of astronomical observations, including high-dispersion spectroscopy at blue and ultraviolet wavelengths, time-resolving imaging and speckle applications. Recent development of the photon-counting systems (Timothy 1988) has concentrated on the use of microchannel plate (MCP) intensifiers, combined with electronic readout systems or CCDs.

In an MCP image intensifier tube, the photoelectron is accelerated into a MCP channel, releasing secondaries and producing an output charge cloud of about 10^3 to 10^4 electrons. These electrons are then accelerated by a potential of 5 to 7 kV, impacting a phosphor and producing an output pulse of about 10^5 photons. The photons are then directed to the CCD by a fiber-optic array. The main characteristics of this type of photon-counting systems depend on the parameters of the output photon pulse and, consequently, on the characteristics of the image intensifier.

In this paper we describe the development of a proximity-focussed, microchannel plate intensifier using a quartz input window.

2. Description of the image intensifier

Our image intensifier has a 25 mm diameter bialcali photocathode, a 36 mm diameter microchannel plate with 15 μm channels and a P20-type output phosphor screen. The image intensifier is fully glass-made and its development is based on optical processing technology which allows us to receive high stability in the geometric characteristics such as the photocathode–MCP and MCP–phosphor gap. Precision of these parameters defines the resolution and output pulse characteristics along the image field.

The glass components of the image intensifier are hermetically connected to each other by a new vacuum sealing technology elaborated at the Institute of Physics. A photocathode of the intensifier is being produced in the installation for fabrication of photocathodes (Vilkaitis et al. 1992). The new vacuum sealing technology permits us to make various types of input and output windows (glass, quartz, fiber-optic plate, etc.) without changes in design of the image tube. In this way, a possibility to coordinate characteristics of the image intensifier and CCD appears.

The main performance characteristics of the image intensifier are:

Spectral response range	200–650 μm
Photocathode quantum efficiency at 400 μm	15 %
Magnification factor	1
Limiting spatial resolution	20^{-1} mm
Useful photocathode/phosphor area (diameter)	25 mm

References

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