PARALLEL MEASUREMENT OF UV EMISSION Lα 121.6 nm AND THE OXYGEN EMISSION OI 130.4 nm AND 135.6 nm.

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Abstract

The device contains 3 independent channels for simultaneous measurement of spectral line Lα emission 121.6 nm, and emitted from the oxygen OI 130.4 nm and 135.6 nm. As a sensor for measuring of such weak light fluxes, high performance Photomultiplier R10825 is used. The latter has very high sensitivity, high gain and operational range in the far ultraviolet spectrum. When the light beam becomes so weak that fall on the cathode as single photon, then the output of the FEU receives impulses away from each other. The number of the output pulses is in direct correlation to the amount of incident light. This technique is known as the method of counting photons and is used for amplification and processing of electrical signals. The device is designed with enhanced characteristics for operation in the severe conditions of the space environment.

Introduction

The measurement of the spectral emission line Lα at 121.6 nm and the oxygen emissions OI 130.4 nm and 135.6 nm provides an essential information for the physical and chemical processes ongoing in the geocorona space. Being the outermost layer of the atmosphere, this region is subjected to extreme solar radiation and cosmic rays. As a result different phenomena as magnetic storms, glowing clouds, circular current, existence of plasma composed mainly (80%) from the protons of H^+, O^+, N^+, He^+ O_2^+, H_2^+ are observed. The resonance transition 2P-2S of the atomic hydrogen (line Lα at 121.6 nm) is the strongest and stunning emission in the solar FUV spectrum.

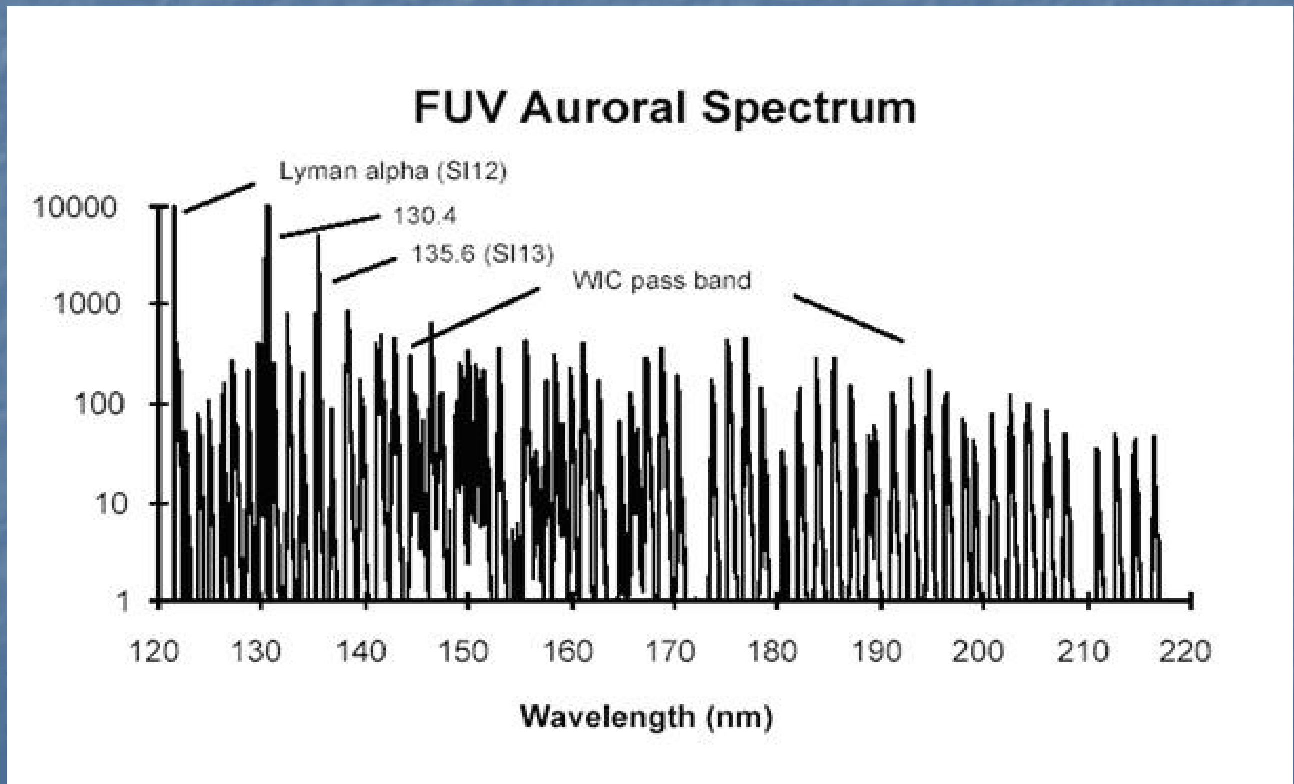

Fig. 1. Aurora spectrum of geocorona.

On Fig.1 is presented the form of FUV aurora spectrum of geocorona. The radiation flux of L α emission is composed by direct L α emission and the one obtained from the resonance scattering of the atmospheric hydrogen atoms. Furthermore, of considerable interest is the radiated emission from oxygen OI 130.4 nm and 135.6 nm. The simultaneous observation of those three emissions provides additional information for the processes that occur in the magnetosphere, as well as an opportunity for modeling of the spatial image. The purpose for the magnetosphere investigation is to get complete knowledge on how the charged particles, the magnetic and electric fields interacted and how this interaction is additional modulated, for example, by an external influence of solar wind or magnetic field.

Method for measurement of light flows with very weak intensity.

On Fig.2 is presented a block-scheme for light flux measurement using the method of impulse counting. The electronic photomultiplier is applied for transformation of the light flux into electric signal – current or electrical energy. When the light flux is very weak, so that only single photons fall on the cathode, the separated impulses are registered at the outlet of FEU. In this way, the amount of the falling light is directly proportional to the registered impulses at the outlet of FEU per unit time. This technique is known as Method for phonons counting [4].

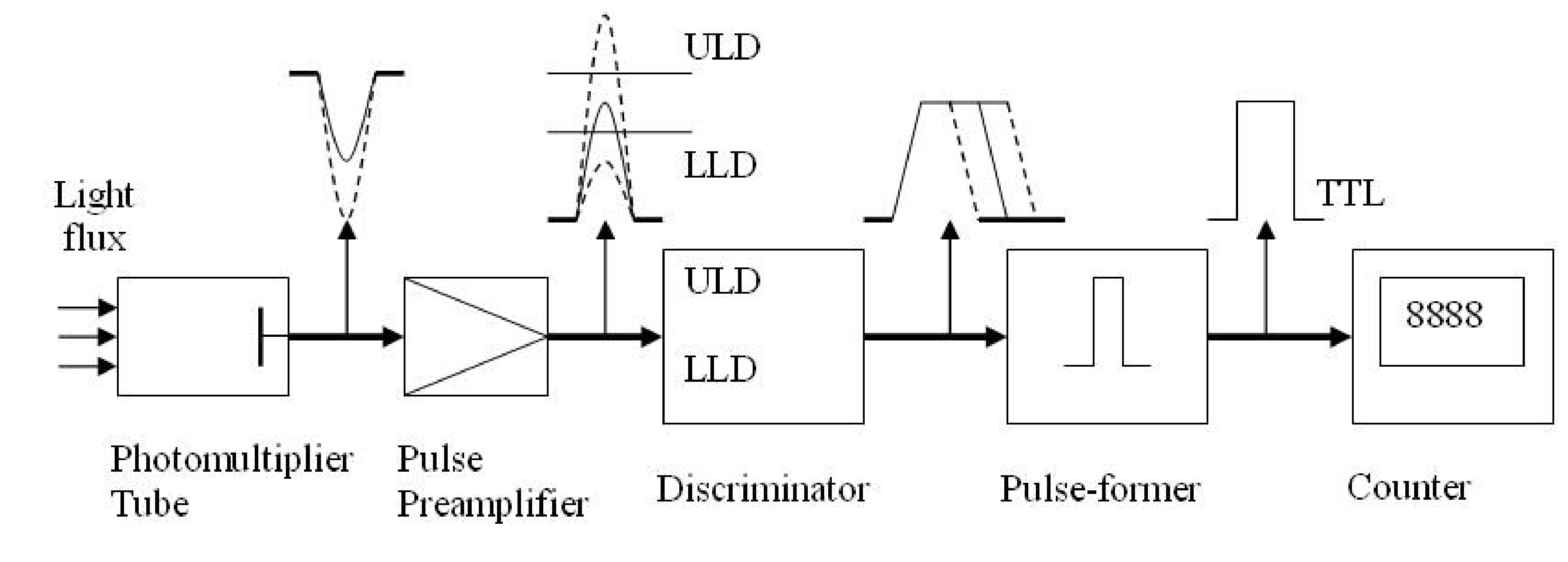

Fig.2 A block-scheme for a weak light flux measurement using the method of impulse counting.

The signals obtained at the outlet of every block are shown on fig.2. Pulses with lower amplitudes are eliminated from the lower reference level of the discriminator (LLD) and the pulses with higher amplitudes are eliminated by the high reference level (ULD). They must be removed because they are a result of noise.

Electric scheme of the device

The block scheme of one device channel is shown in Fig. 3.

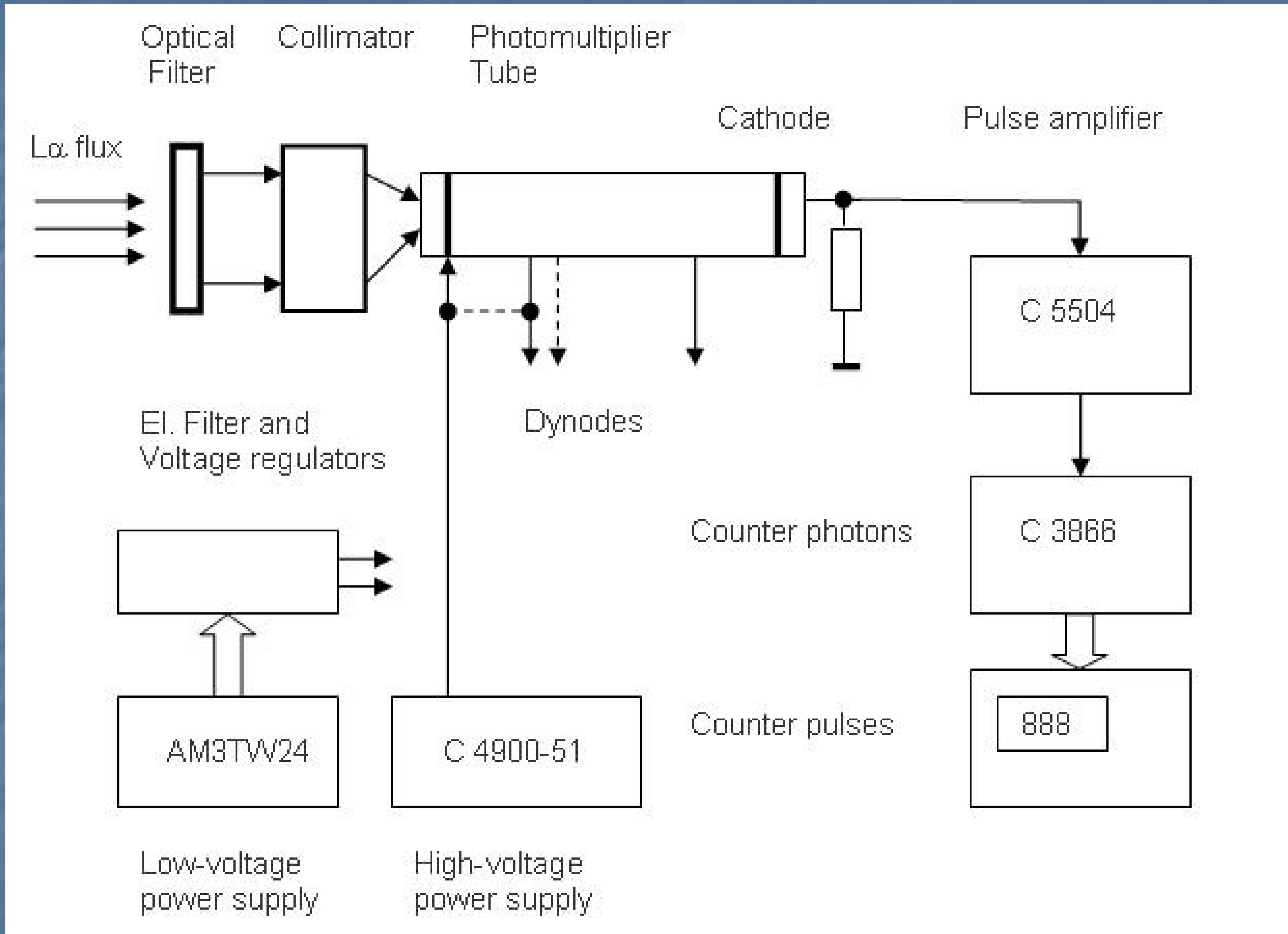

Fig 3. Block scheme of a channel for measuring the Lα emission

Lyman-alpha radiation enters in the collimator through an optical interference filter with a pass band of about 10 nm (FWHM) centered at approximately 120 nm. The collimator is made of blackened aluminum honeycomb material (porous), 2.54 cm in length and pitch of 1.53 mm cage, defining a nearly cylindrical field.

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