Small-Telescope Astronomy on Global Scales
ASP Conference Series, Vol. 246, 2001
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Development of the Far-ultraviolet Imaging Spectrograph on KAISTSAT-4

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Abstract. The Far-ultraviolet IMaging Spectrograph (FIMS) is a small spectrograph optimized for the observations of diffuse hot interstellar medium in far-ultraviolet wavebands (900–1150Å and 1335–1750Å). The instrument is expected to be sensitive to emission line fluxes an order of magnitude fainter than any previous missions. FIMS is currently under development and is scheduled for launch in 2002.

1. Introduction

The preliminary scientific objectives of FIMS are: 1) to trace the energy flow through the hot plasma found on scales ranging from supernova bubbles to galaxies and galactic coronae, 2) to map the distribution of the local and global structures of hot plasma, and 3) to investigate the earth aurora at various FUV wavelengths. FIMS will be the primary payload on the first Korean Science Satellite (KAISTSAT-4), which will provide both an all-sky survey and a targeted pointing program. FIMS system is being developed by a joint research project of KAO, KAIST and U. C. Berkeley. The development of the qualification model of the instrument is in progress.

2. Instrument Development

FIMS is a dual band imaging spectrograph, optimized for faint diffuse radiation. FIMS employs an off-axis parabolic cylinder mirror in front of a slit that guides lights to a diffraction grating (See Figure 1). The reflective grating is an ellipse of rotation, which provides angular resolution. The FIMS design is derived from the two flight-proven EURD instruments (Bowyer, Edelstein, & Lampton 1998). The imaging performance allows for a large field with an imaging resolution (arc minute scales) similar to other important interstellar all-sky surveys.

https://doi.org/10.1017/S0252921100078702 Published online by Cambridge University Press

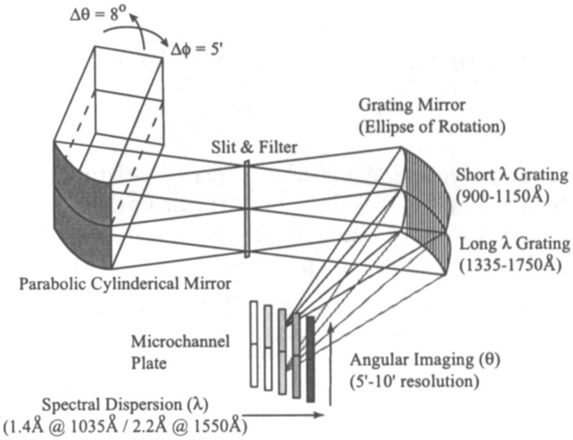

Figure 1. Schematic Diagram of FIMS Optics

The instrument will yield far-UV emission-line sensitivity that is an order of magnitude fainter than any previous instruments. Monte-Carlo simulation has been performed to verify the detection sensitivity of O VI and C IV emission lines, which are brightest emission lines predicted to occur in galactic plasma cooling models. A simulation of the FIMS observation planning has been performed to ensure spacecraft health and safety and to maximize observation efficiency and instrument performance.

A parabolic cylindrical mirror has been manufactured and its surface profile and micro-roughness is being measured for the final polishing. The design of the ellipsoidal gratings for long and short wavelength bands is finished and the gratings are being manufactured. A drawing of the overall layout of the FIMS system has been completed. The detailed designs of the detector and the shutter modules including the mounting scheme of the detector have been finished.

A Z-stack MCP detector has been adopted because of its high gain. A double delay line (DDL) readout system has been developed and tested for its resolution characteristics. A new cross delay line (XDL) readout system has been designed to overcome resolution limits of the DDL system.

The FIMS electronics system consists of four units, a low voltage power supply, the detector electronics, a digital signal processing unit, and signal monitoring and controlling electronics. Electrical and data interfaces between the spacecraft and FIMS have been designed to meet the specifications . The ETB (Engineering Test Bed) of the FIMS electronics system has been developed and its performance verified. The development of the opto-mechanical and electronics systems of FIMS are in progress for the CDR (Critical Design Review). The mission is scheduled to be launched in 2002 into a low earth polar orbit.

References

Bowyer, S., Edelstein, J., & Lampton, M. 1998, ApJ, 485, 523