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The design study of optics and opto-mechanics for Lyman-α sun camera of scientific satellite

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The optics and opto-mechanics are designed for imaging the sun at Lyman-α line for scientific satellite. The optics are composed of conic mirrors. In order to block stray light, the new baffle design method is suggested. And we will present the opto-mechanics for this scientific satellite.

1. Introduction

Recently, in order to secure not only international competitive power but also national security, many a developing nations including an advanced nations makes an every efforts for the satellite technology. This research describes the optics and baffles of scientific satellite nember 2 which is the first satellite launched in Goheung-county, Joennam, Korea.

2. The design of optics

The optics parts of scientific satellite number 2 are composed of three Lyman-α filter and two conic mirrors coated with Al + MgF_2. Lyman-α filter is used to cut off all spectrum from the sun except near 121.6 nm. We present the characteristics of Lyman-α filter following Fig. 1 and Table 1.

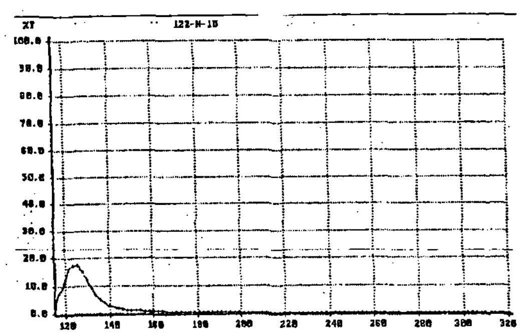

Figure 1. Single Lyman-α Filter Transmission Characteristics According to Wavelength

Number of Filter	% Signal from Ly-α	% Signal from others
0	0.00003	99.99997
1	0.235	99.765
2	89.37	10.63
3	98.11	1.89

Table 1. Transmission Values of Three Lyman-α Filters.

The surface shapes of mirrors are designed to paraboloid for primary mirror and hyperboloid for secondary mirror to obtain more than CCD Nyquist frequency(38.5 cycles/mm). The conic surface equation is as follows:

$$z(r) = \frac{cr^2}{1+\sqrt{1-(1+k)c^2r^2}}$$

$$r^2 = x^2 + y^2$$

c : shperical curvature, k : conic constant

k > 0, -1 < k < 0 : Ellipsoid,

k = 0 : Sphere, k = -1 : Paraboloid,

k < -1 : Hyperboloid

The positions of the focus for the conic surfaces are functions of r and k and are given by the following relations:

Focal point $F = \frac{r}{2}$ in paraboloid

Focal point $F_1, F_2 = \frac{r}{k+1}(\sqrt{-k} \pm 1)$ in hyperboloid

We present the data of designed mirror system(Table 2), the optics layout(Fig. 2), and MTF performance(Fig. 3).

Surface	Radius	Thickness	Glass
Object	∞	∞	
1 (Stop)	-915.42 mm	-300 mm	Reflection
	k = -1 (Paraboloid)		
2	-574.05 mm	350 mm	Reflection
	k = -6.38 (Hyperboloid)		

Table 2. The Data of Designed Mirror System

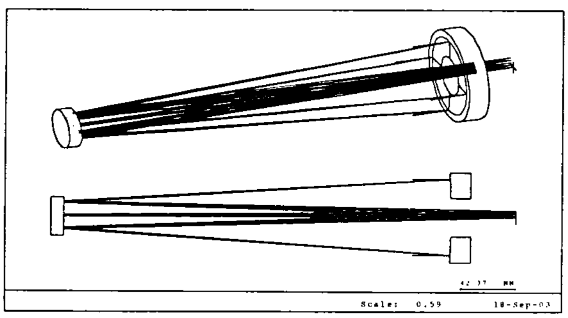

Figure 2. The Optics Layout