

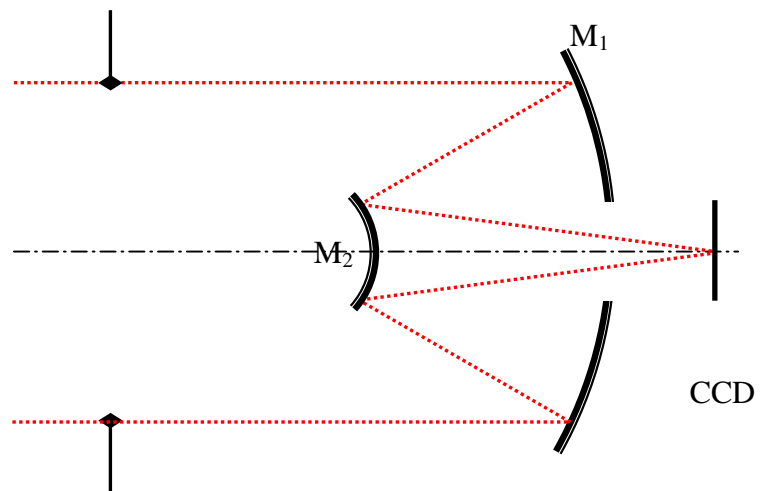
Ray optics problem n°8

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Video camera with a telephoto “lens” made of mirrors

Characteristics of the objective :

- Cassegrain configuration
- Primary mirror M_1 concave with radius $R_1 = 250$ mm
- Secondary mirror M_2 convex with radius $R_2 = 100$ mm
- Focal length = 500 mm
- F-number $N = 5$
- Entrance pupil : aperture stop 250mm in front of M_1
- CCD detector with 512 x 512 square pixels 20 μ m in size.



In the whole problem, the telephoto « lens » is used for an object at infinity.

A. Positions of the elements

1. Using a drawing, determine the sign of the focal length of the telescope.
2. What is the distance between the two mirrors (S_1S_2) ?
3. Calculate the position of F' , second focal point of the system. Make a drawing of the whole system (scale $\frac{1}{2}$ along the axis, scale 1 in the transverse direction). Trace a bundle of rays from an object on axis at infinity through the whole system.
4. Calculate the position and diameter of the exit pupil of the system.

B. Field of view and diameters of the optical elements

5. What should be the radius of the bright field in the image space to cover the whole surface of the detector ? Trace a bundle of rays from an object at infinity corresponding to one edge of the bright field.
6. Calculate the minimum diameter for the circular aperture that should be made at the center of mirror M_1 and the minimum diameter for the mirror M_1 .
7. Calculate the minimum diameter for mirror M_2 , as well as the minimum diameter for the mechanical mount of mirror M_2 .
8. What is the central obturation of this system ?