

$$\frac{1}{p} - \frac{1}{q} = -\frac{2}{R} = -\frac{1}{f} \text{ specchio}$$

$$1/n = \sin \theta_L \text{ angolo limite in aria}$$

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f} \text{ lente sottile in aria}$$

$$\frac{1}{f} = (n-1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} \text{ lenti sottili accoppiate}$$

Snell

$$\theta_i = \theta_r$$

$$n_i \sin \theta_i = n_t \sin \theta_t$$

alimentatore

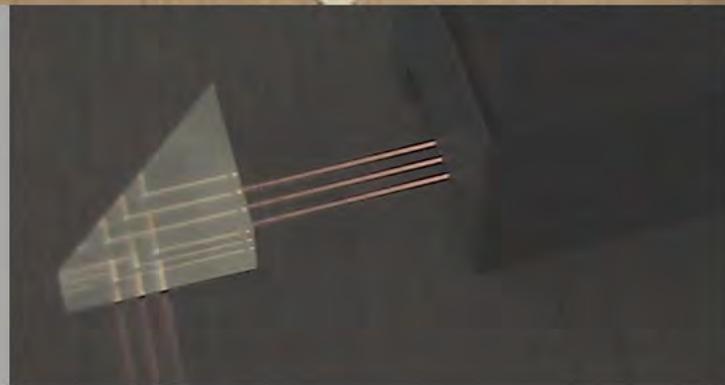
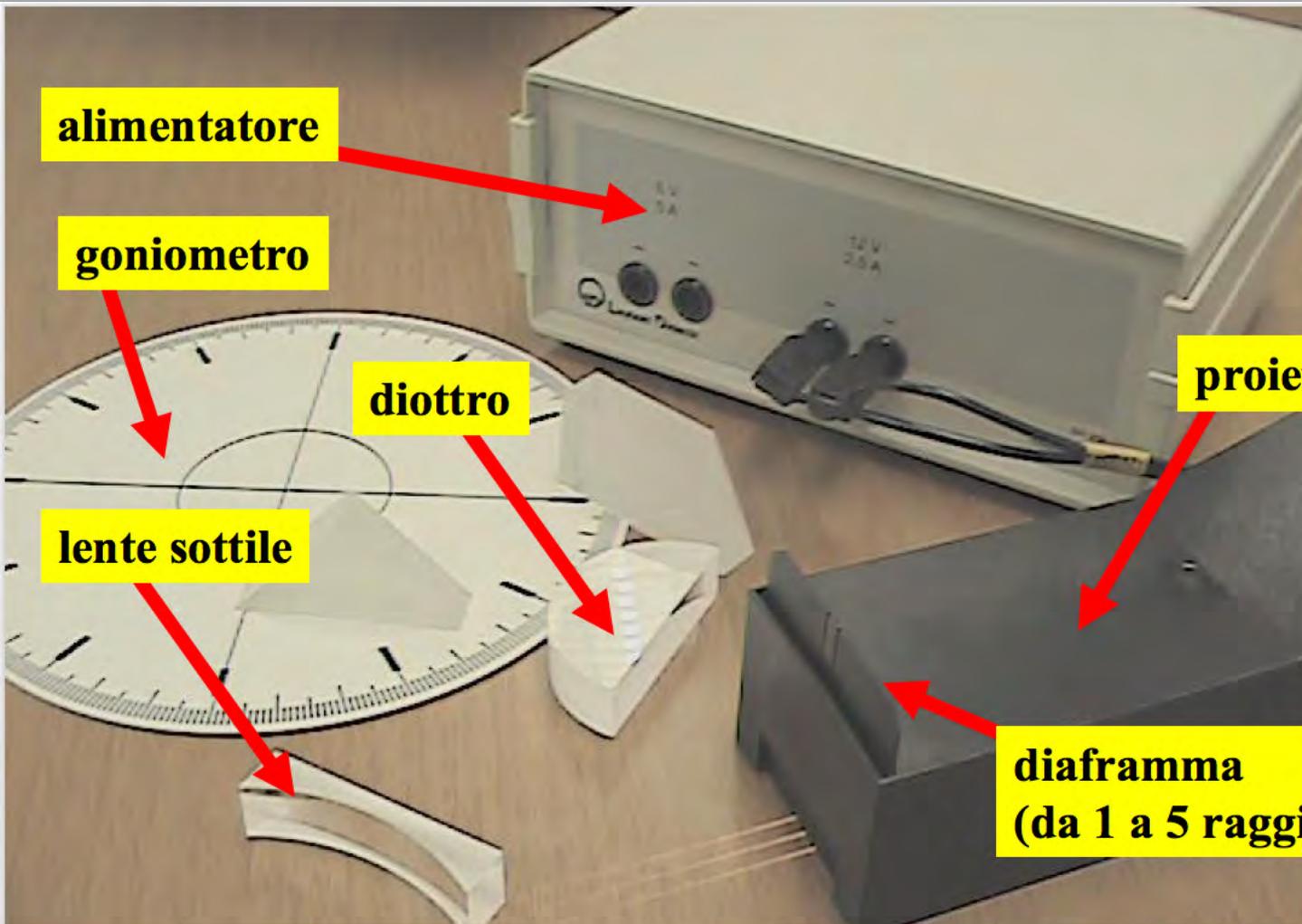
goniometro

diottro

lente sottile

proiettore

**diaframma
(da 1 a 5 raggi)**



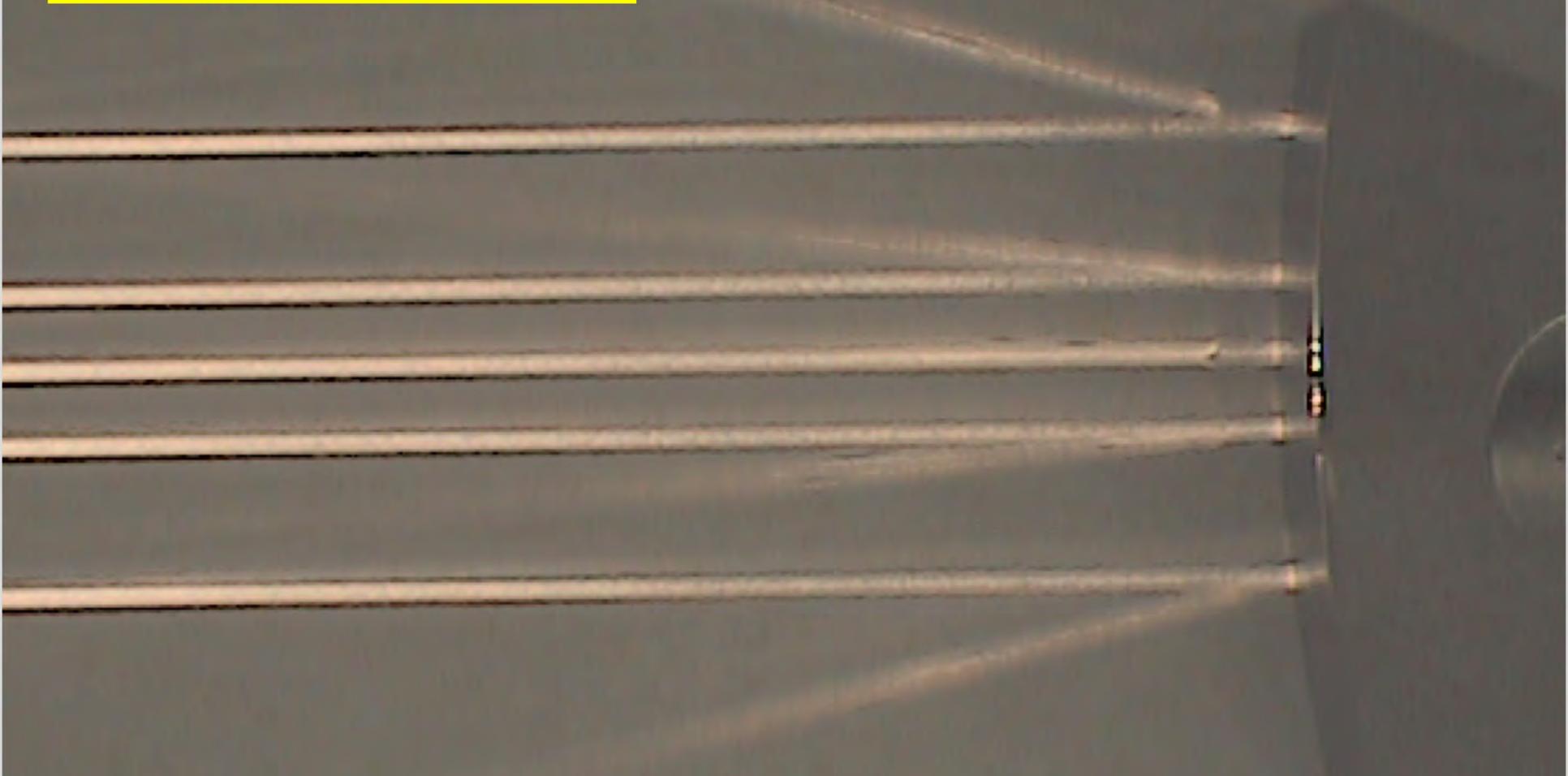
$$\frac{1}{p} - \frac{1}{q} = -\frac{2}{R} = -\frac{1}{f}$$

$$p = \infty \Rightarrow q = f = R/2 < 0$$

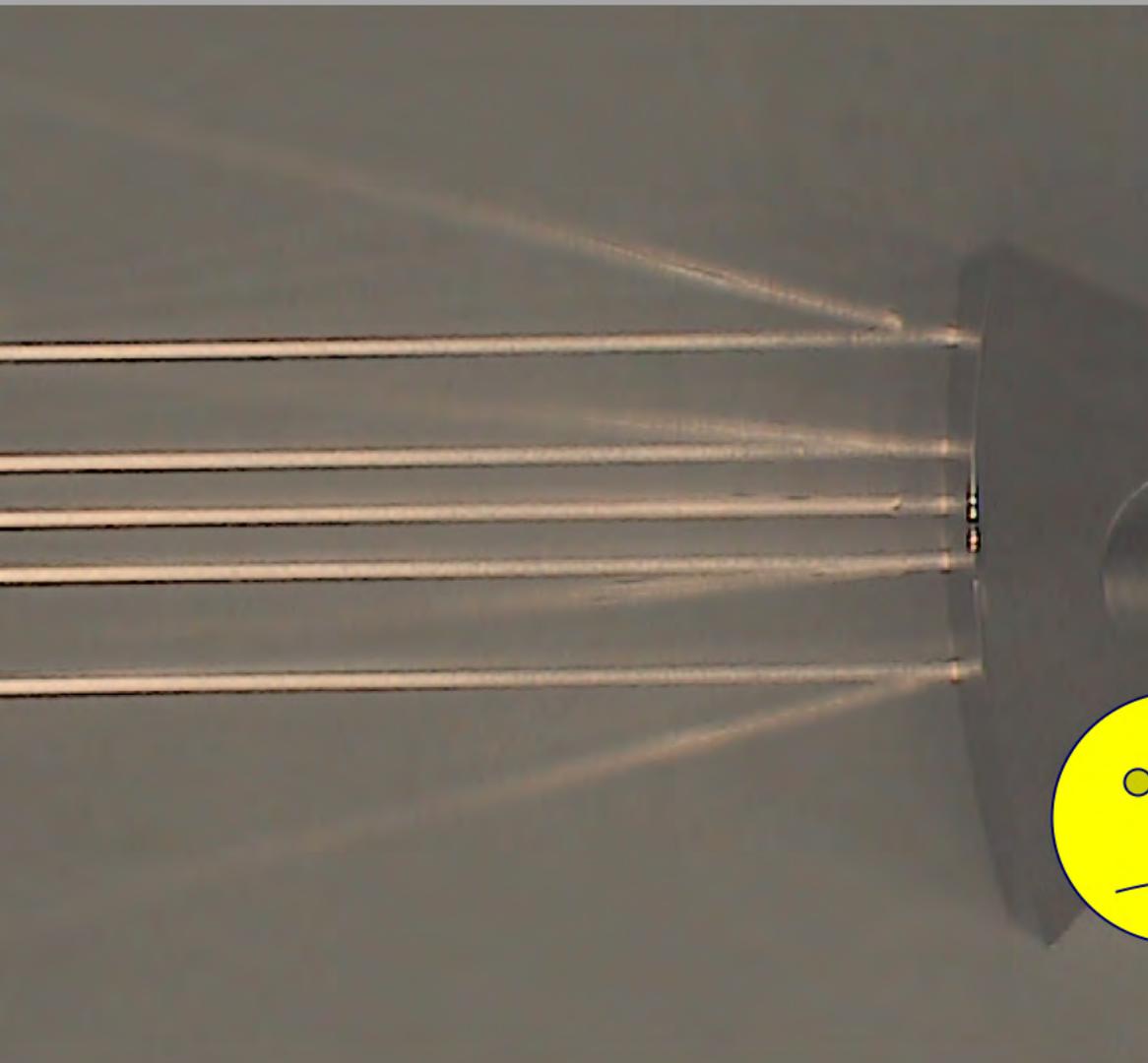
specchio concavo

$$\frac{1}{p} - \frac{1}{q} = -\frac{2}{R} = -\frac{1}{f}$$

$$p = \infty \Rightarrow q = f = R/2 > 0$$

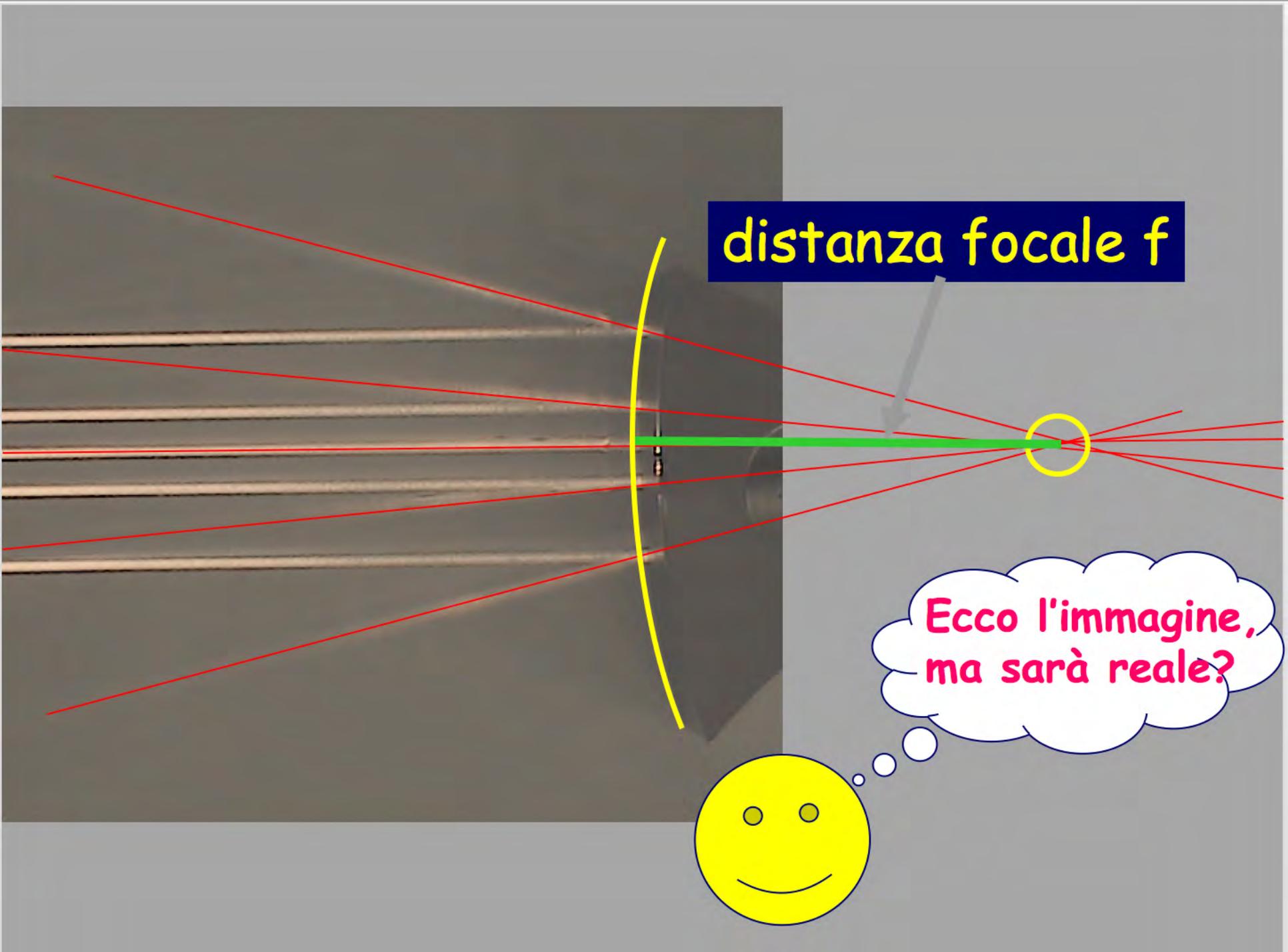


specchio convesso



**Chissà dov'è
finita
l'immagine ...**





The diagram shows a concave mirror on the left, represented by a curved yellow line. Parallel red lines representing light rays enter from the left and reflect off the mirror. A green horizontal line represents the principal axis. A yellow circle marks the focal point where the rays converge. A grey arrow points from the text 'distanza focale f' to this focal point. A yellow smiley face is at the bottom, with a thought bubble containing the text 'Ecco l'immagine, ma sarà reale?'.

distanza focale f

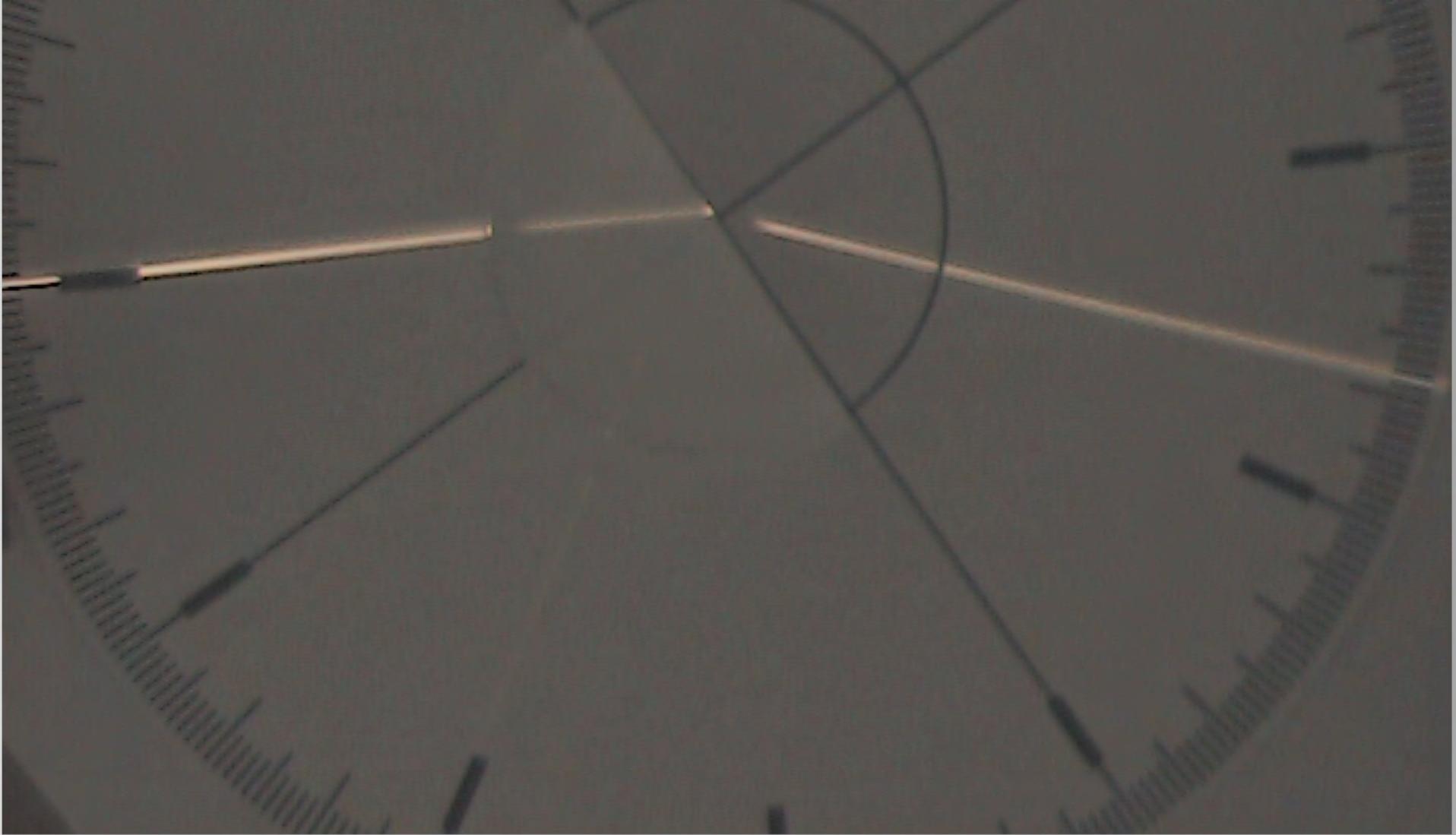
Ecco l'immagine,
ma sarà reale?

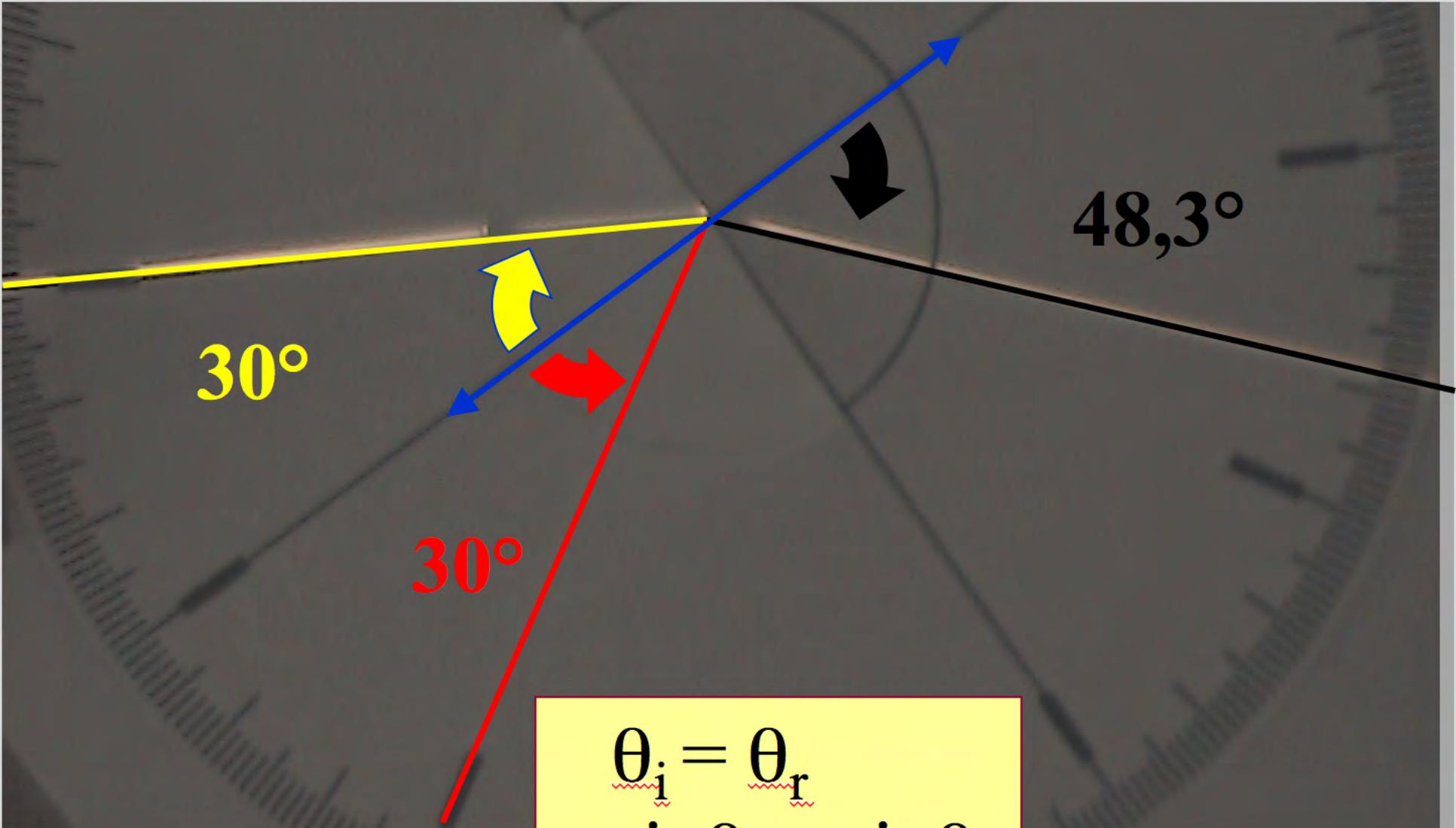
Riflessione totale e angolo limite

il raggio deve passare per il centro del goniometro

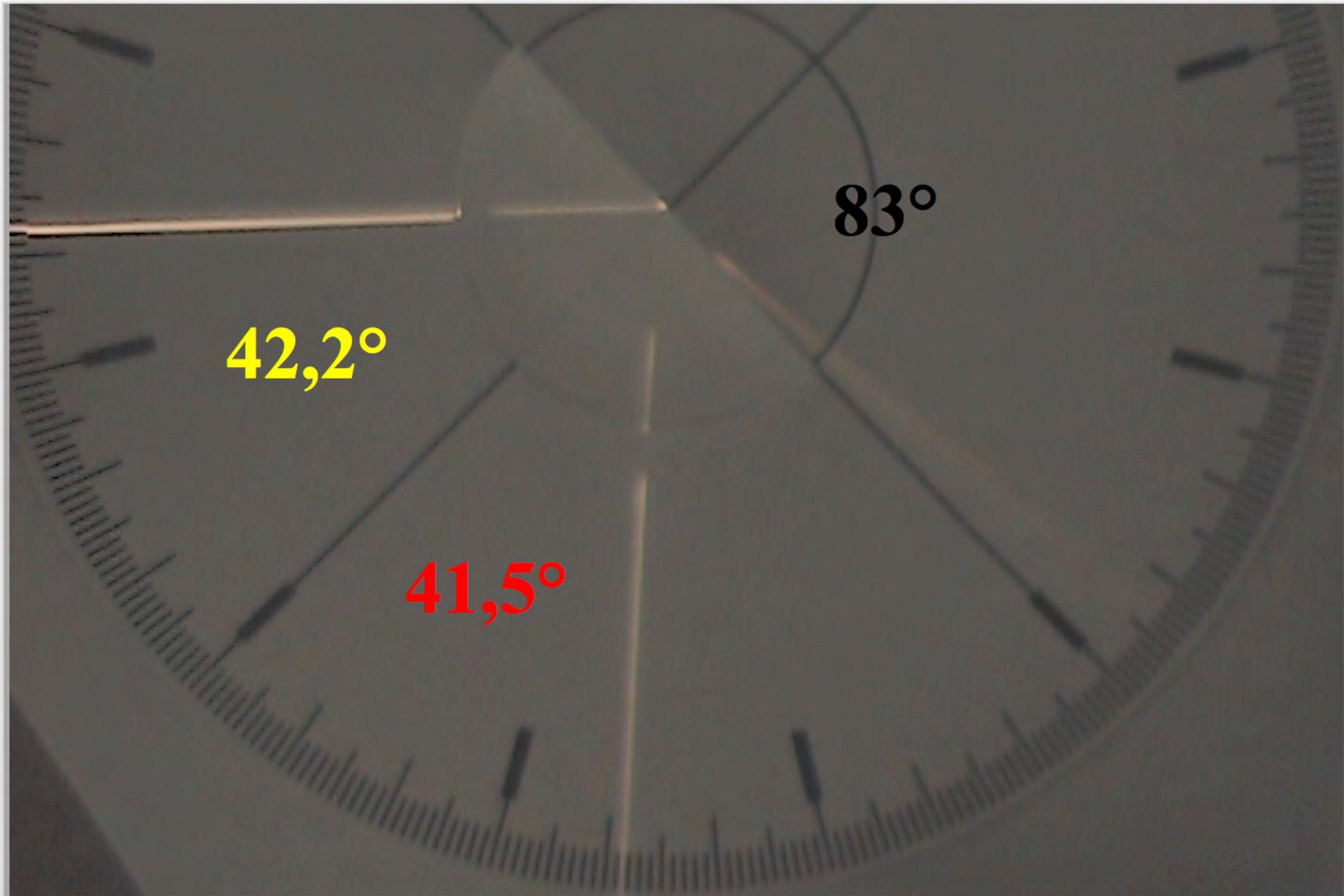
il diottro deve essere allineato con il centro del goniometro







$$\theta_i = \theta_r$$
$$n \sin \theta_i = \sin \theta_t$$



$42,2^\circ$

$41,5^\circ$

83°

$$1/n = \sin \theta_L$$

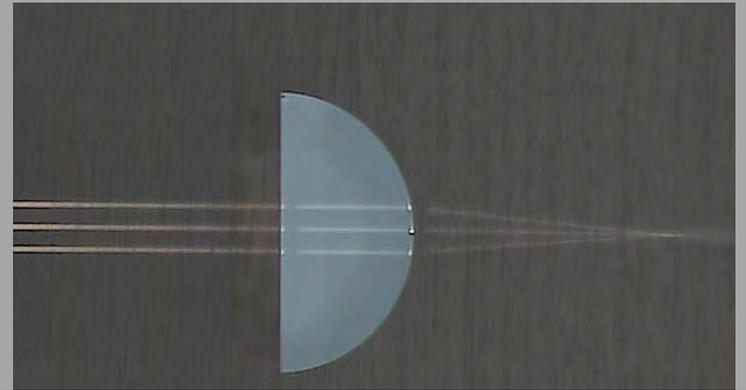
50°

50°

È sparito il raggio rifratto ... che fine ha fatto la sua energia ?



il diottro



raggi parassiali:
sistema stigmatico

raggi non parassiali



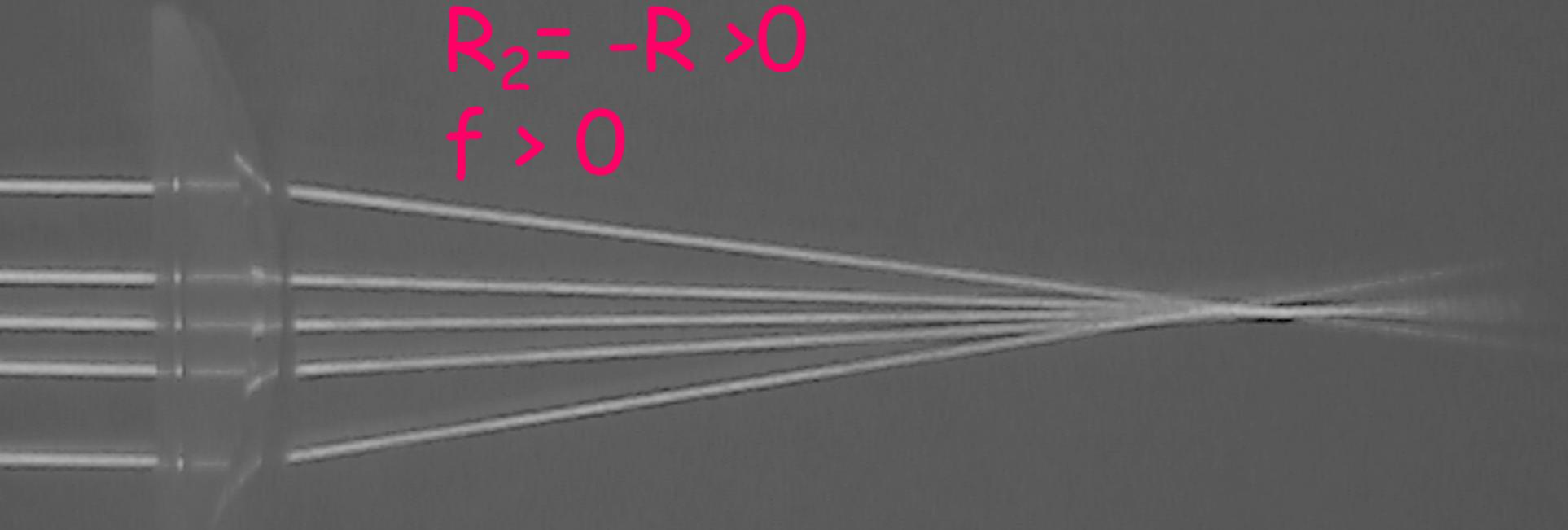
aberrazione ottica:
sistema non stigmatico

lente sottile convergente

$$R_1 = \infty$$

$$R_2 = -R > 0$$

$$f > 0$$



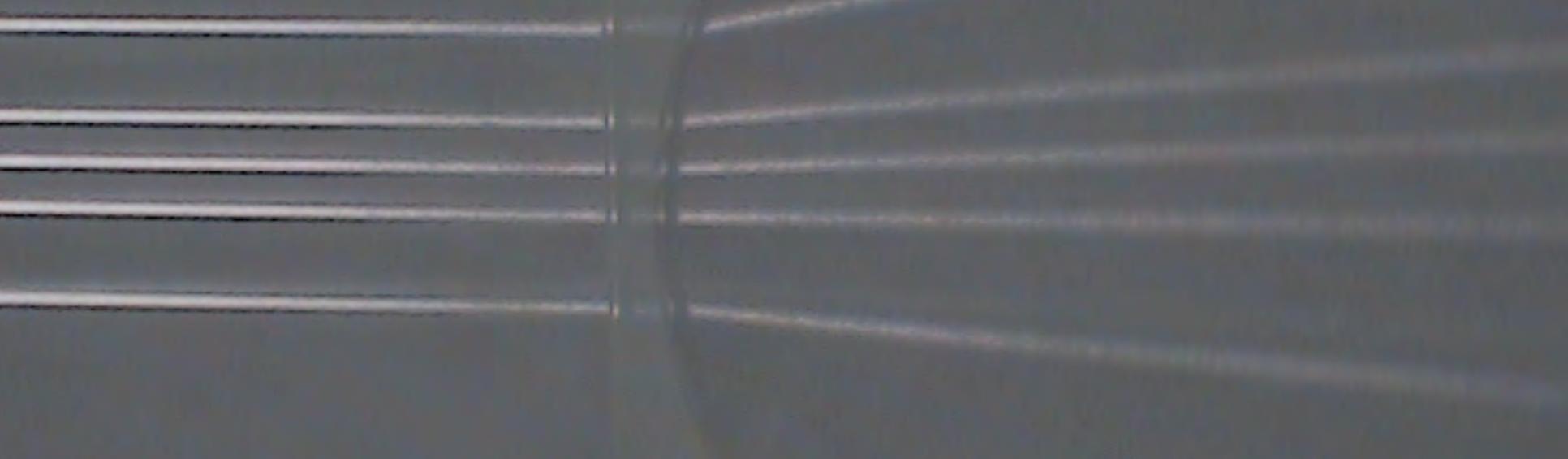
$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f} = (n - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

lente sottile divergente

$$R_1 = \infty$$

$$R_2 = R > 0$$

$$f < 0$$



$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f} = (n - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

lente sottile divergente

$$R_1 = \infty$$

$$R_2 = R > 0$$

$$f < 0$$



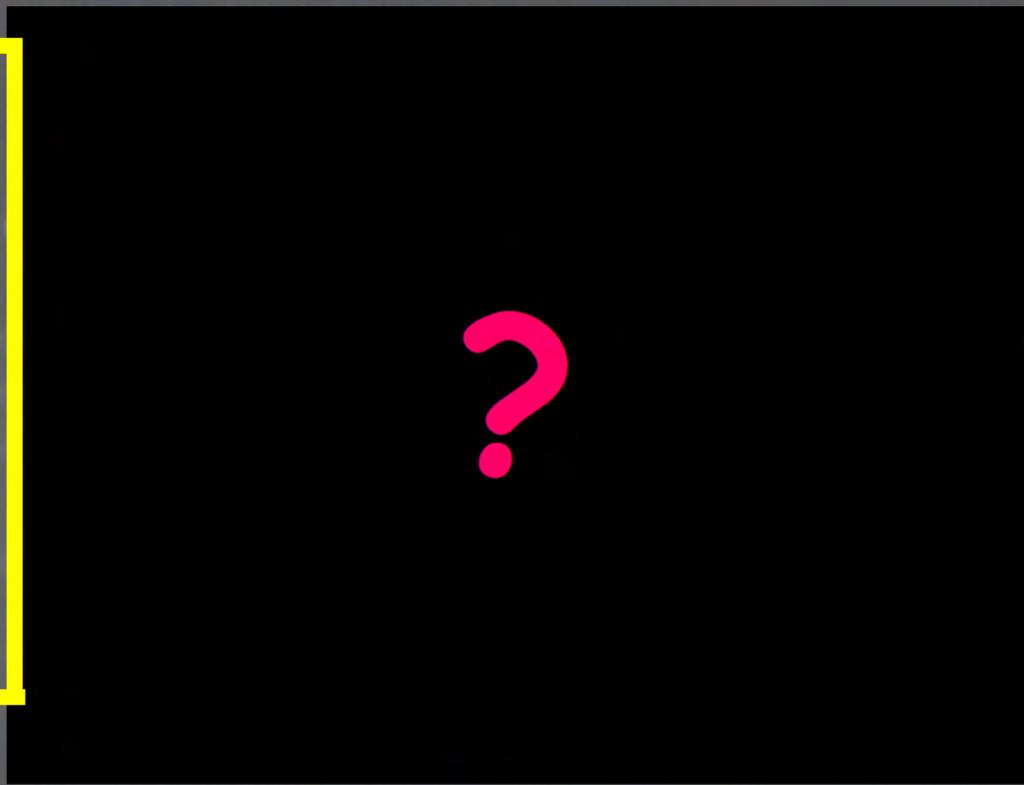
$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f} = (n - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$



$$R_1 = -R < 0$$

$$R_2 = \infty$$

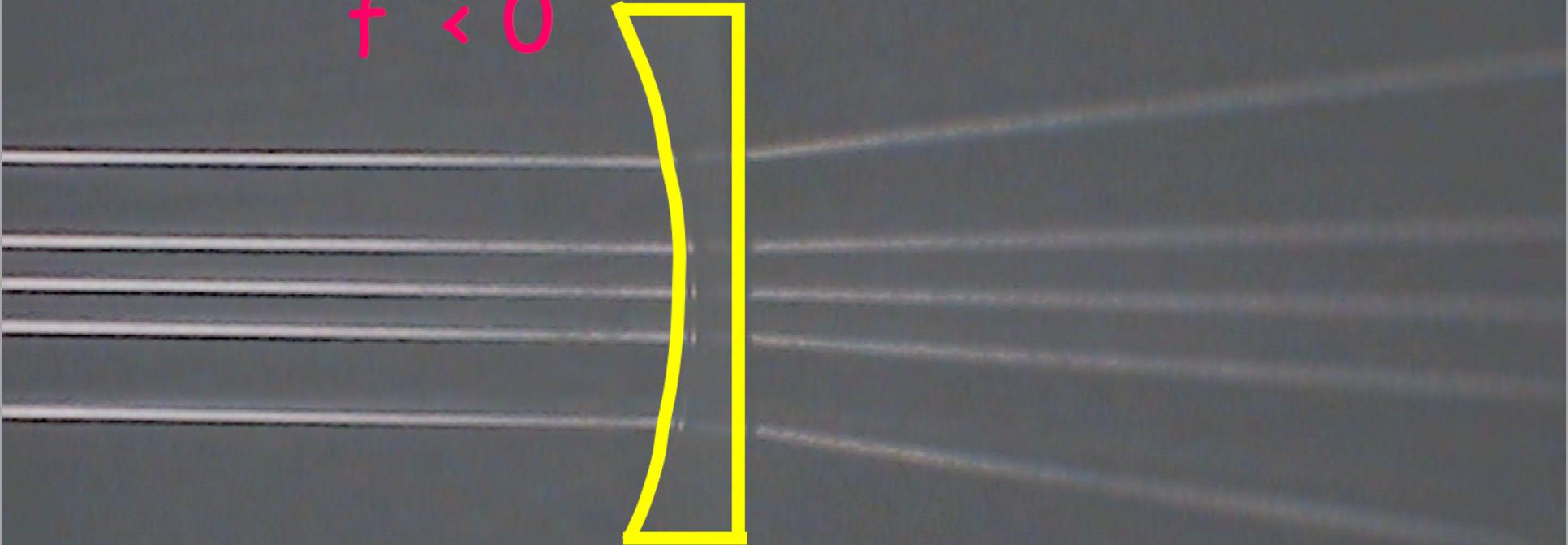
$$f < 0$$

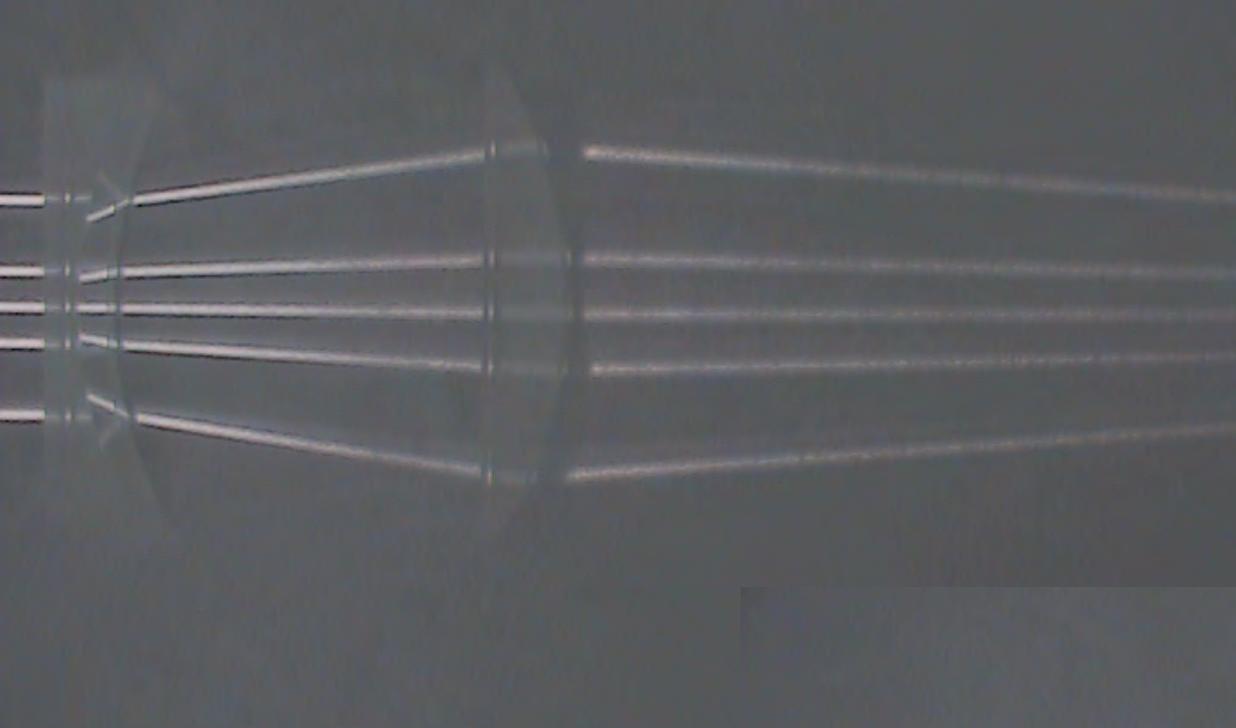


$$R_1 < 0$$

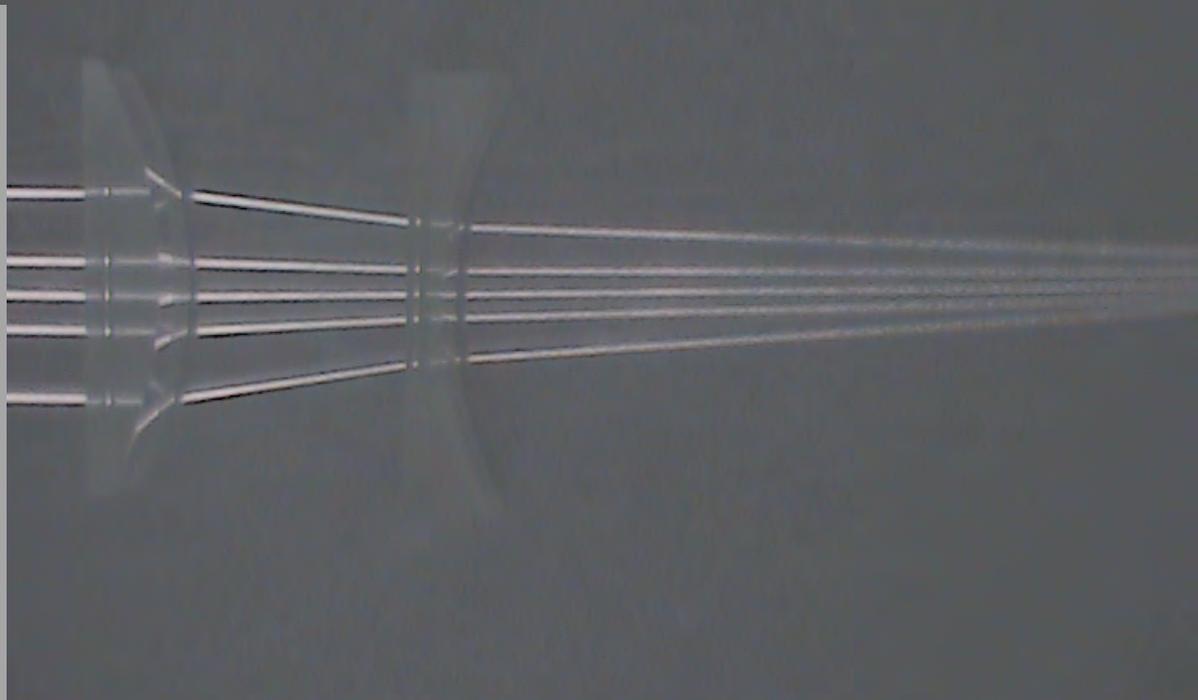
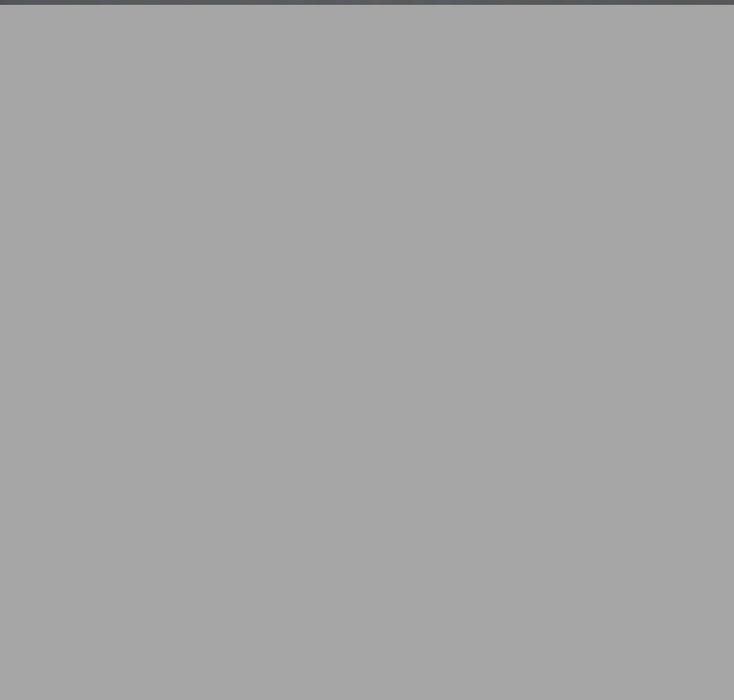
$$R_2 = \infty$$

$$f < 0$$





$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

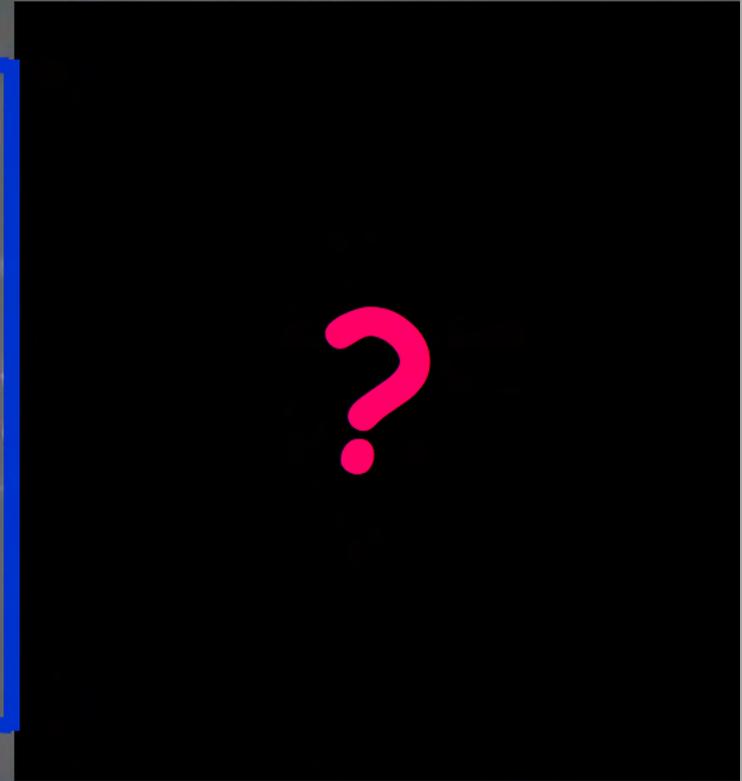




$$R_1 = \infty$$

$$R_2 = \infty$$

$$f = \infty$$



$$R_1 = \infty$$

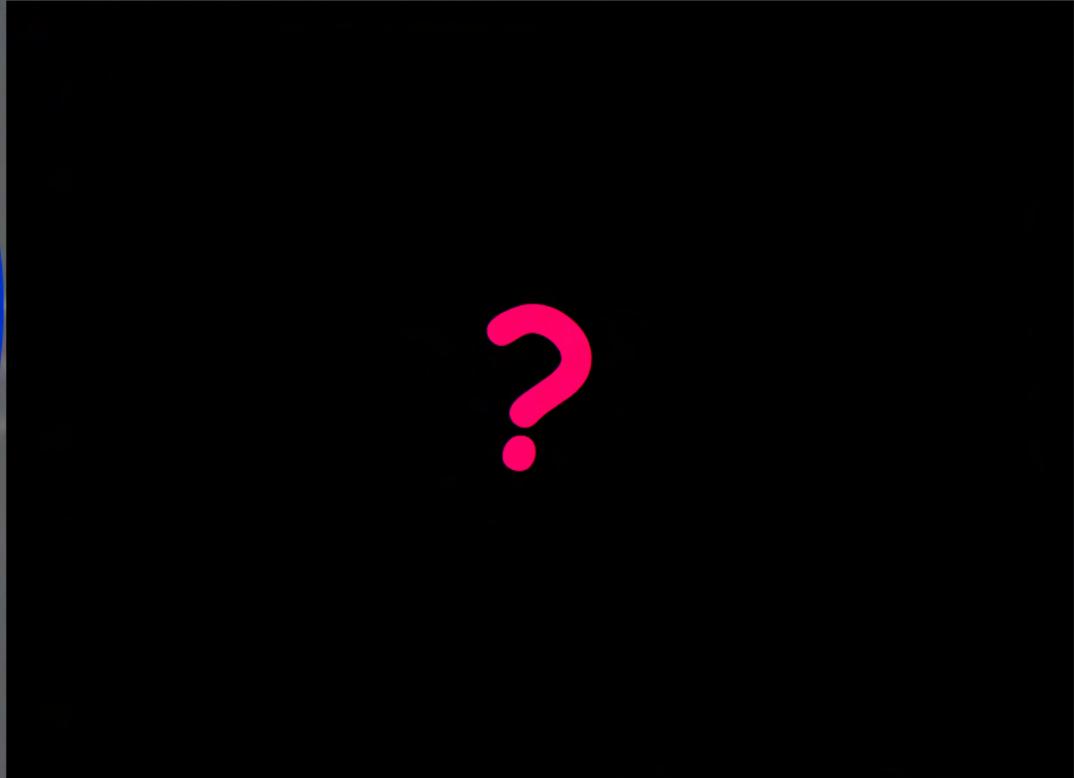
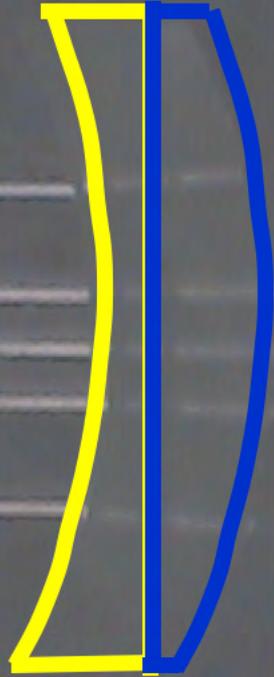
$$R_2 = \infty$$

$$f = \infty$$



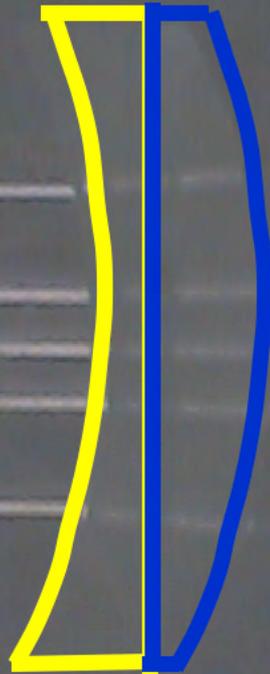


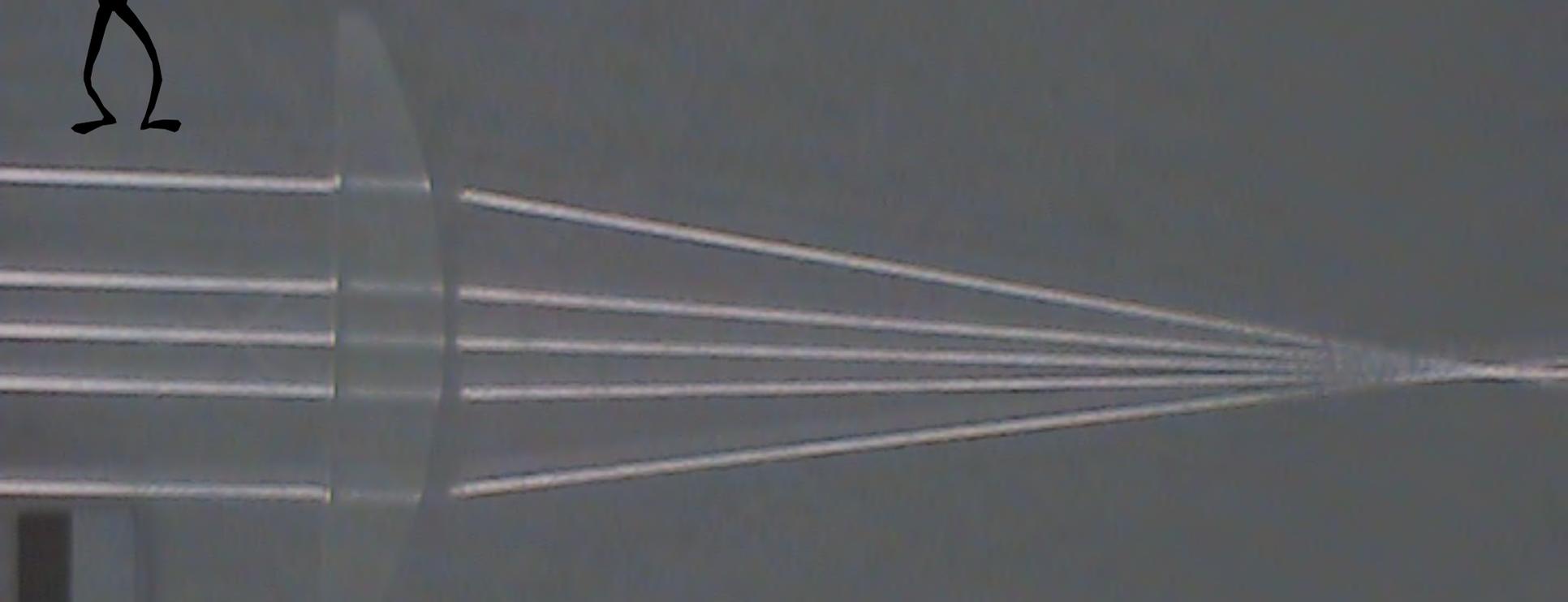
$$R_1 = R_2$$
$$f = \infty$$



$$R_1 = R_2$$

$$f = \infty$$





Cosa succede all'immagine reale se si copre parte di una lente (o di uno specchio)?

