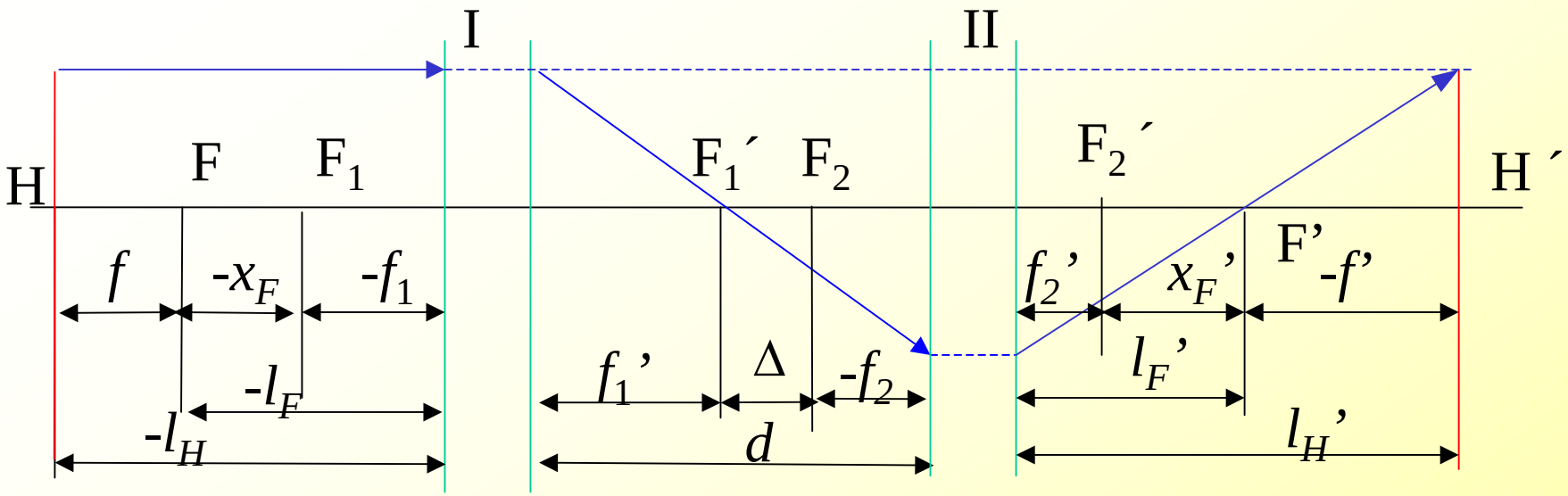
第四节

共轴球面系统的组合



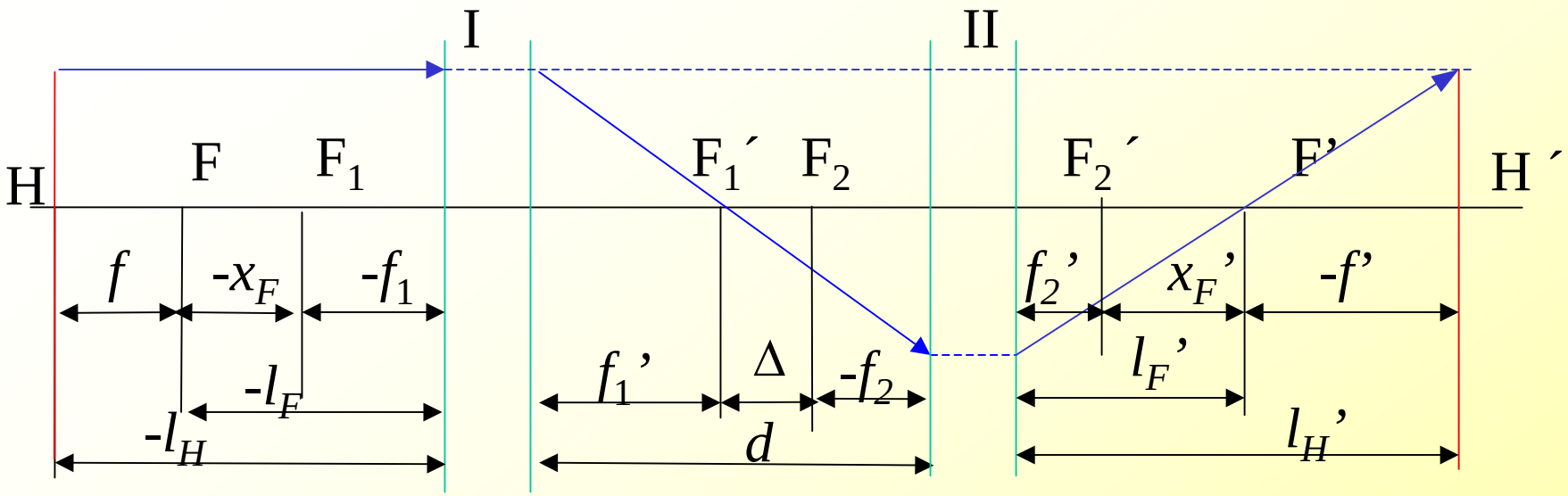
1．合成光组焦点F和F’位置的确定

$$\Delta = F_1' F_2 \qquad \text{光学间隔}$$

∵光线过 F_1' 和 F' ，∴ F_1'和 F'为此光线在系统II一对共轭点

由牛顿公式 $-\Delta \cdot x_F' = f_2 f_2'$ $\quad \therefore x_F' = -\dfrac{f_2 f_2'}{\Delta}$

类似，对系统I，F' 和 F_2 一对共轭点



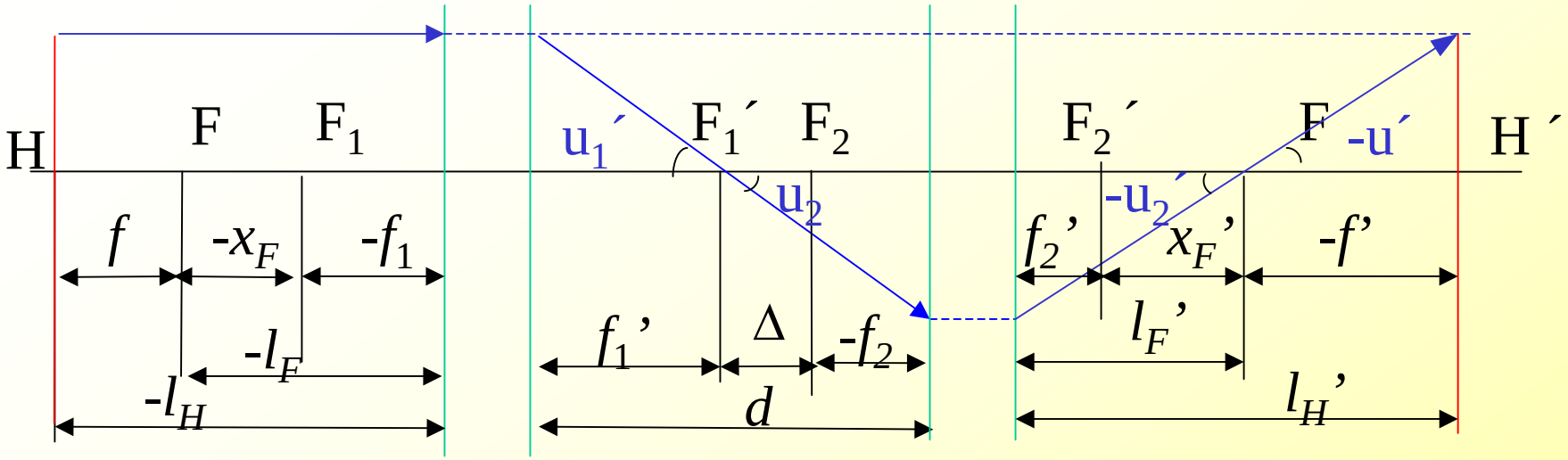
类似，对系统I，

$$x_F = \frac{f_1 f_1^{'}}{\Delta}$$

$$\therefore -l_F = -x_F - f_1$$

$$\therefore l_F = x_F + f_1 = \frac{f_1 f_1^{'}}{\Delta} + f_1 = f_1(1+\frac{f_1^{'}}{\Delta})$$

$$l_F^{'} = x_F^{'} + f_2^{'} = -\frac{f_2 f_2^{'}}{\Delta} + f_2^{'} = f_2^{'}(1-\frac{f_2}{\Delta})$$



2、合成光组的焦距 f 和 f'

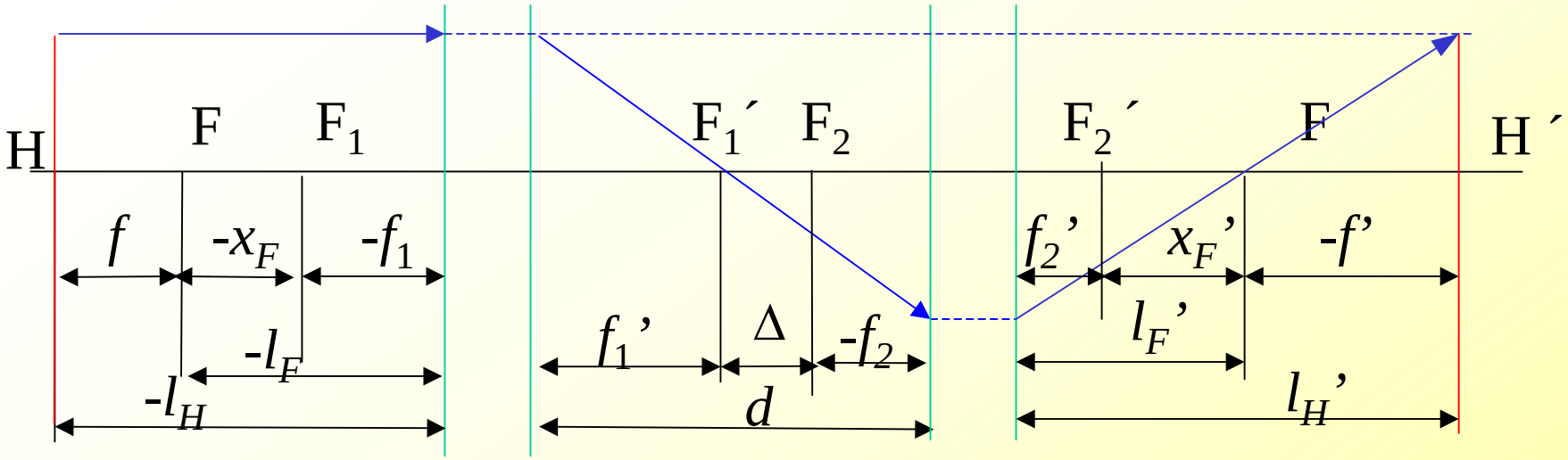
f ‘ 的证明如下：

$$h_1 = f_1'u_1' = (-f')(-u')$$

$$-h_1' = (\Delta - f_2)u_2 = (f_2' + x_F')(-u_2')$$

$$\therefore \begin{cases} \dfrac{u_1'}{-u'} = -\dfrac{f'}{f_1'} \\ \dfrac{u_2}{-u_2'} = \dfrac{f_2' + x_F'}{\Delta - f_2} \end{cases} \qquad u_1' = u_2 \qquad -u' = -u_2'$$

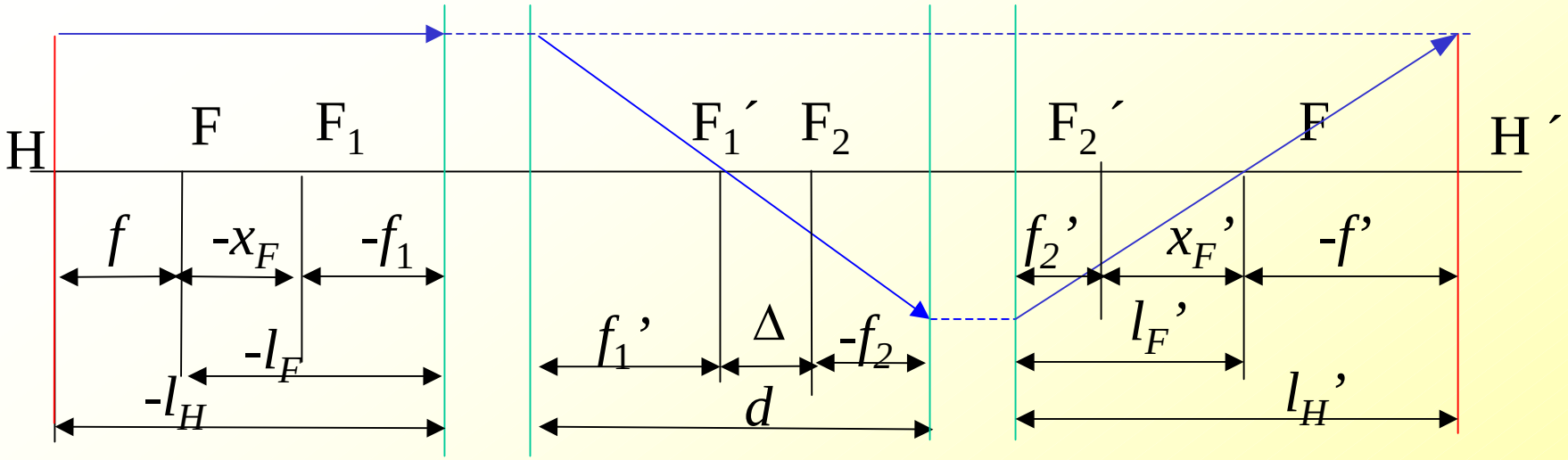
$$\therefore \frac{u_1'}{-u'} = \frac{u_2}{-u_2'} \qquad \therefore -\frac{f'}{f_1'} = \frac{f_2' + x_F'}{\Delta - f_2}$$



$$\therefore -\frac{f'}{f_1'} = \frac{f_2'+x_F'}{\Delta - f_2}$$

将 $x_F' = -\frac{f_2 f_2'}{\Delta}$ 代入整理得 $f' = -\frac{f_1' f_2'}{\Delta}$ $\therefore \frac{f_1'}{\Delta} = -\frac{f'}{f_2}$

同理： $f = \frac{f_1 f_2}{\Delta}$

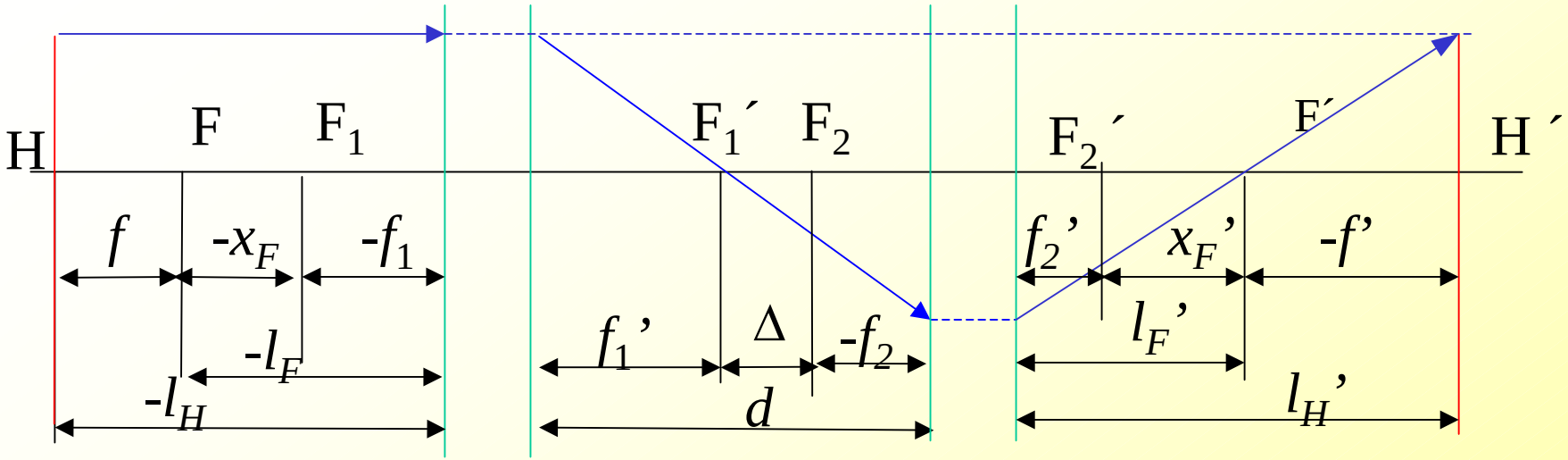


又 $\because\ d = f_1' + \Delta - f_2$ $\therefore \Delta = d - f_1' + f_2$

由 $f' = -\dfrac{f_1' f_2'}{\Delta}$ $\Rightarrow \therefore f' = \dfrac{-f_1' f_2'}{d - f_1' + f_2}$

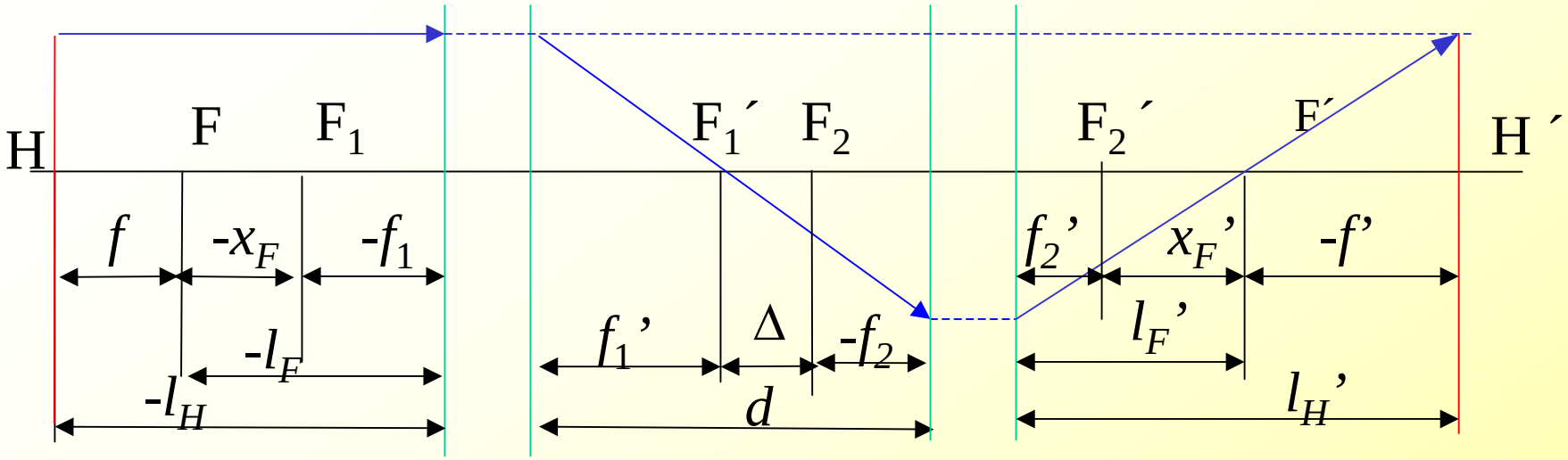
若光组位于同一介质 $n' = n$ $\therefore f_2' = -f_2$

$$\therefore f' = \frac{f_1' f_2'}{f_1' + f_2' - d}$$



$$\phi = \frac{n'}{f'} = \frac{n'(f_1' + f_2' - d)}{f_1' f_2'} = \frac{n'}{f_2'} + \frac{n'}{f_1} - \frac{n' d}{f_1' f_2'} = \phi_1 + \phi_2 - \frac{d}{n}\phi_1\phi_2$$

$$\phi = \phi_1 + \phi_2 - \frac{d}{n}\phi_1\phi_2$$



由前面推导知：

$$l_F = f_1(1+\frac{f_1'}{\Delta})$$

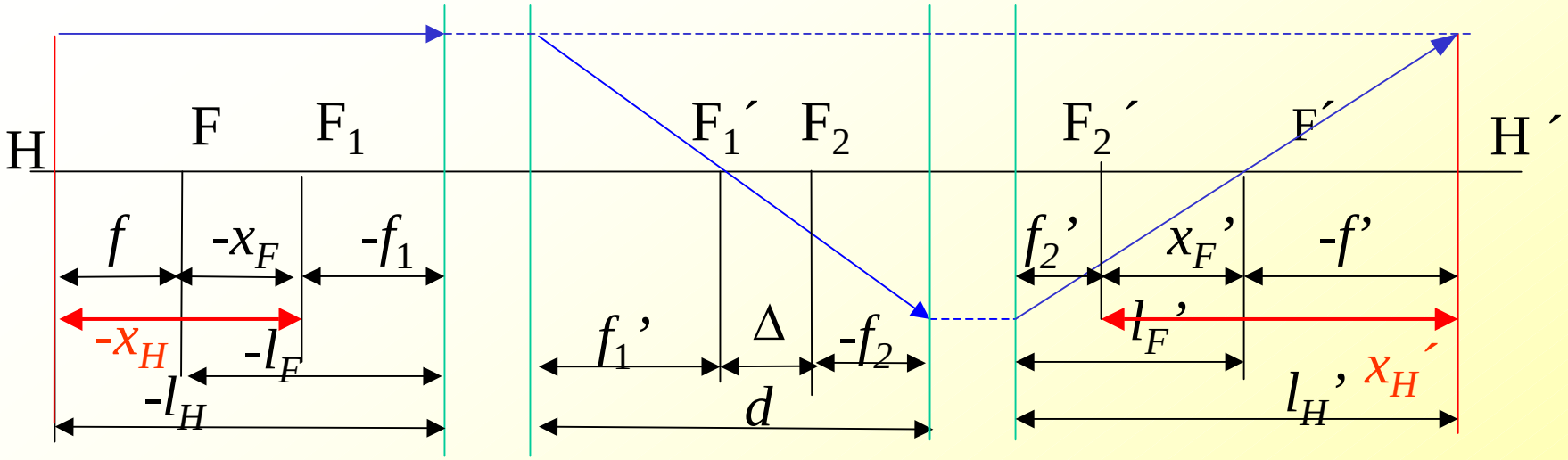
$$l_F' = f_2'(1-\frac{f_2}{\Delta})$$

及

$$f' = -\frac{f_1' f_2'}{\Delta}$$

$$f = \frac{f_1 f_2}{\Delta}$$

l_F l_F' 还可写为 $l_F' = f'(1-\frac{d}{f_1'})$ $l_F = f(1+\frac{d}{f_2})$



3、合成光组的主点：

$$-x_H = f - x_F$$

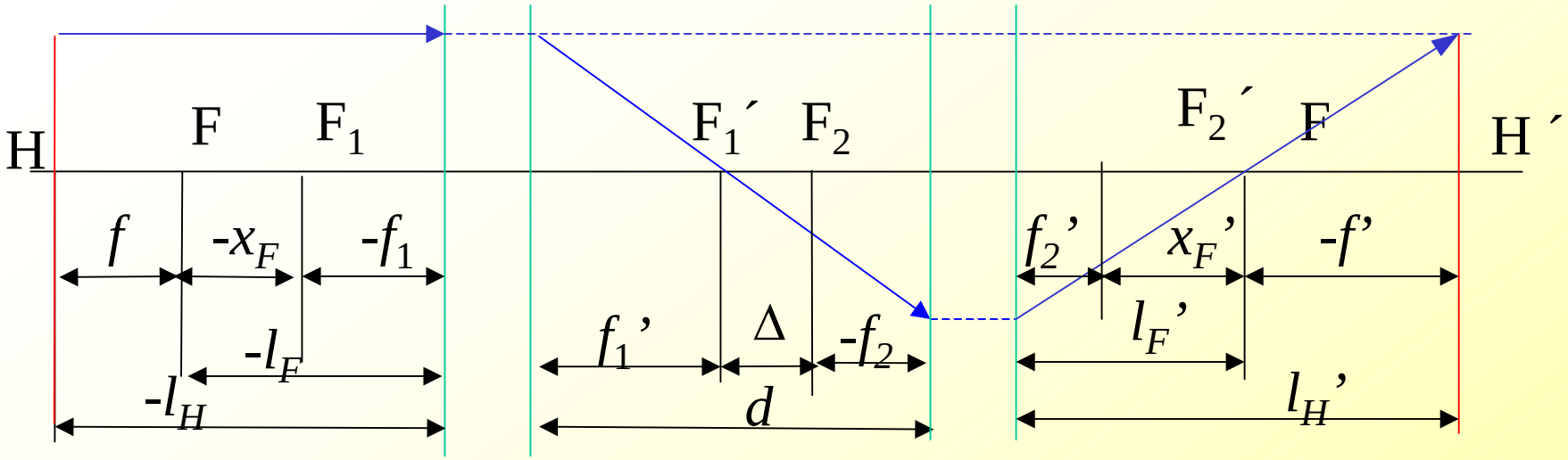
$$x_H = x_F - f$$

$$x_H' = x_F' - f'$$

$$\therefore \begin{cases} l_H = l_F - f = x_H + f_1 \\ l_H' = l_F' - f' = x_H' + f_2' \end{cases}$$

$$l_H = f \cdot \frac{d}{f_2} = \frac{f_1(f_1' - f_2 + \Delta)}{\Delta}$$

$$l_H^1 = -f' \frac{d}{f_1'} = \frac{f_2'(f_1' - f_2 + \Delta)}{\Delta}$$



4、合成光组的垂轴放大率

$$\beta = \frac{y'}{y}$$

$$\beta = -\frac{f}{x} = \frac{x'}{f'}$$

一般理想光具组的作图求象法