[SANS collimation]
(Chapter 5.4.1 in *Elements*)

Collimation

Steady-source instruments usually use *pinhole* collimation, consisting of a pair of round apertures having radii R_1 and R_2 a distance L_c apart, as in Fig. SC3. (Square or rectangular pinholes can also define the pinholes, viz., with Cartesian geometry.) Section 4.1 describes simple two-aperture collimators. That analysis applies here, where the transverse dimension has rotational symmetry, to any longitudinal planar slice.

The entrance and exit areas are

$$A_1 = \frac{\pi}{2} R_1^2 \text{ and } A_2 = \frac{\pi}{2} R_2^2 \quad (5\text{-SC1})$$

and the two-dimensional acceptance is $A\Delta\Omega = \frac{A_1 A_2}{L_c^2}$. Figure 5-SC1 illustrates the two-pinhole collimation scheme common to many existing SANS instruments.

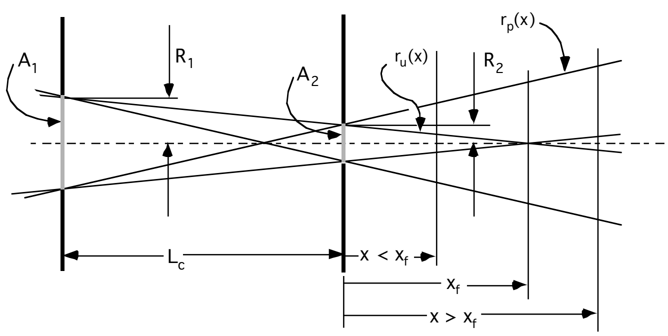

Figure5-SC1. Double-pinhole collimator. The lines $r_u(x)$ and $r_p(x)$ represent the limits of the umbra and penumbra, respectively, which are cones in three dimensions. In the figure, transverse dimensions are greatly exaggerated in relation to longitudinal dimensions.

The outer radius of the penumbra at distance x from the exit aperture, which defines the minimum accessible scattering angle, is

$$r_p(x) = R_2 + \frac{x}{L_c}\left(R_1 + R_2\right) \ , \quad (5\text{-SC2})$$

and the outer radius of the umbra is

$$r_u(x) = R_2 - \frac{x}{L_c}\left(R_1 - R_2\right) \ , \quad (5\text{-SC2})$$

which exists as a positive radius only when $R_1 > R_2$ and when

$$x < x_f = \frac{R_2 L_c}{\left(R_1 - R_2\right)} . \quad (5\text{-SC3})$$

The spatial distribution of intensity is trapezoidal except when $x = x_f$, at which distance the true umbra disappears and the distribution is triangular. Typically, the detector is located at the focal point, according to general optimization conditions.