[focusing SANS]
Chapter 5.4.1 in *Elements*)

Focusing SANS

Recently developed focusing elements, material lenses, sextupole magnetic, and critically-reflecting ellipsoidal mirror lenses, can enhance the resolution (lower Q_{min}) in pinhole SANS instruments, as in Fig. 7, which illustrates a focusing pinhole SANS based on a biconcave lens. Neutrons from the source pass trough the pinhole, and from there diverge to illuminate the converging lens located at distance L_1. The lens focuses the pinhole at the distance L_2 from the lens. Neutrons that scatter in the sample travel to the detector at distance L_s from the sample.

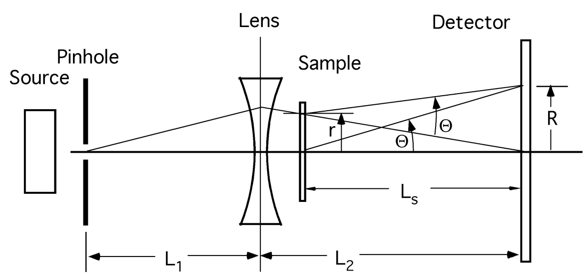

Figure 5-FS1. Arrangements of components in a focusing SANS diffractometer.

Focusing, in the thin-lens approximation, implies

$$\frac{1}{L_1}+\frac{1}{L_2}=\frac{1}{f}, \qquad (5\text{-FS1})$$

where f is the focal length of the lens. Neutrons that are incident on the sample traveling along the instrument centerline, strike the sample in the center and scatter to a point on the detector a distance R from the centerline, are deflected through angle

$$\theta=\frac{R}{L_s}. \qquad (5\text{-FS2})$$

Neutrons that travel off-axis, scatter from the sample at a general point r from the axis, and reach the detector at R scatter through the same angle independent of r. This focusing effect is identical to the effect of multiple converging aperture (MCA) (see Collimators, Chap 7.1 in *Elements*) because the lens introduces the same correlation between the angle of incidence and the incident position on the sample as the MCA. But the focal length f of material and magnetic lenses varies strongly with wavelength,

$$f \propto \frac{1}{\lambda^2}. \tag{5-FS3}$$