[gravity droop]
(Chapter 5.4.1 in *Elements*)

Correction of Gravitational Droop Using a Prism

Neutron trajectories droop under gravitational acceleration g, as can be significant in long-path instruments such as SANS. The change in vertical height at the detector, measured from the collimator entrance, is

$$\Delta y_g = -L_D\left(L_s + L_D\right)\left(g/2\right)\left(m/h\right)^2 \lambda^2 , \qquad \text{(5-GD1)}$$

where, in units of common practice, $\left(h/m\right) = 3956.0 \mathring{A} - m/s$.

Refractive optics (prisms) can correct the *gravitational droop* at the detector position, that is, at only one distance, independent of the wavelength.

If neutrons start from the sample position at an angle δ, they travel a distance x on a parabolic arc from the sample at speed v on the arc

$$\Delta y = x\delta - \frac{1}{2} g \frac{x^2}{v^2} . \qquad \text{(5-GD2)}$$

Refractive optics can correct the gravitational droop at the detector position independent of the wavelength. Hammouda and Mildner (2007) have demonstrated this application.

A prism near the sample position can induce such a deflection, $\delta(\lambda)$, which depends on the wavelength. The deflected trajectories cross the beam axis where $\Delta z = 0$, that is, where

$$x = x^* = 2v^2 \frac{\delta(\lambda)}{g} = 2\left(\frac{h}{m}\right)^2 \frac{\delta(\lambda)}{g\lambda^2} . \qquad \text{(5-GD3)}$$

The deflection angle is proportional to $(n-1)$,

$$\delta(\lambda) = (n-1)\alpha , \qquad \text{(5- GD4)}$$

where α is the apex angle of the prism. Thus the crossing point, which is to be at the position of the detector (beam stop), is independent of the wavelength because $(n-1)$ is proportional to λ^2 see Eq. 7.17 in *Elements,*

$$x^* = -\left(\frac{h}{m}\right)^2 \frac{1}{g}\left(\rho b - \frac{2\pi m}{h^2} \vec{\mu} \cdot \vec{B}\right)\alpha . \qquad \text{(5-GD5)}$$

The crossing point must be downstream from the location of the prism, therefore the apex angle, in the usual case in which $n < 1$, must be negative that is, the apex angle must open downward.