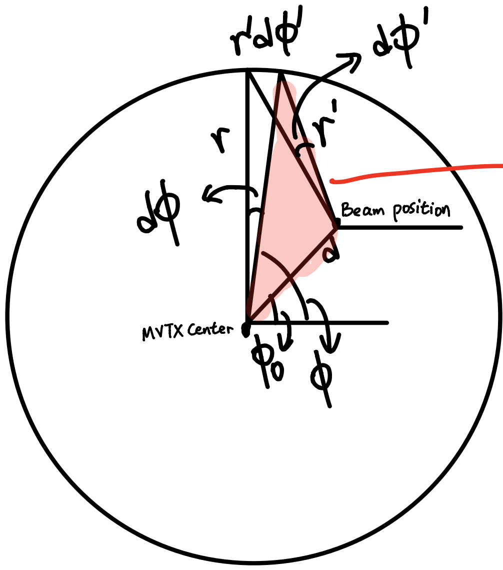
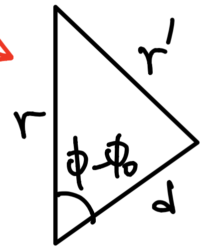




$$r' = \sqrt{[d\cdot\sin(\phi-\phi_0)]^2 + [r - d\cos(\phi-\phi_0)]^2}$$
$$= \sqrt{r^2 + d^2 - 2rd\cos(\phi-\phi_0)}$$

Cluster azimuth angle distribution is uniform w.r.t Beam position

$$f(\phi') = \frac{1}{2\pi}$$

cluster azimuth angle distribution w.r.t MVTX Center is not uniform

$$f(\phi) = f(\phi')\left|\frac{d\phi'}{d\phi}\right|$$

$$\frac{d\phi'}{d\phi} = \frac{r}{r'} \Longleftarrow \quad r'd\phi' = rd\phi$$

$$= \frac{r}{(r^2 - 2rd\cos(\phi-\phi_0) + d^2)^{1/2}}$$

$$= \frac{1}{\left(1 - 2\frac{d}{r}\cos(\phi-\phi_0) + \frac{d^2}{r^2}\right)^{1/2}}$$

Taylor expansion w.r.t. small d/r

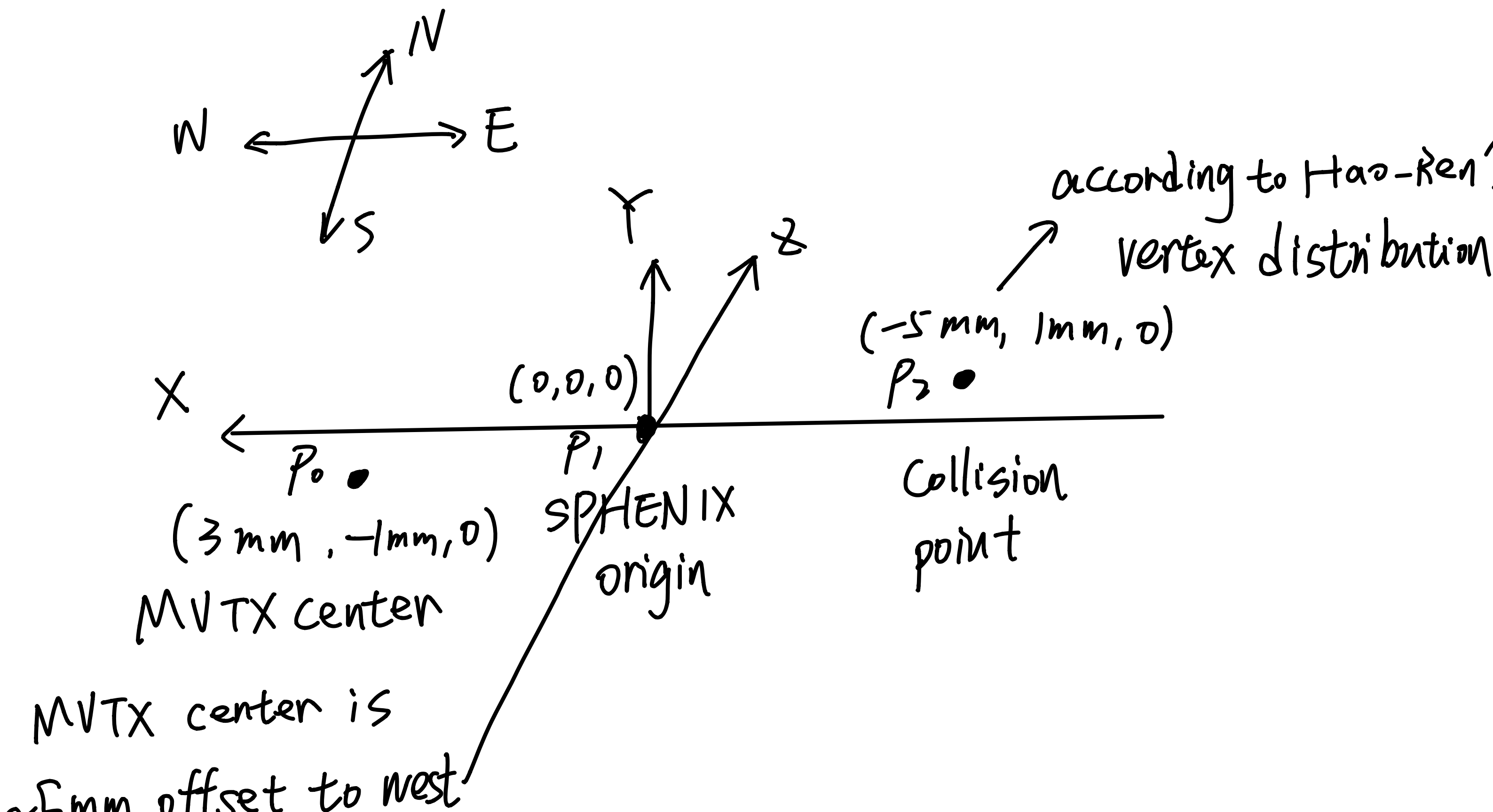
$$= 1 + \left(-\frac{1}{2}\right) \left.\frac{-2\cos(\phi-\phi_0) + 2\frac{d}{r}}{\left(1 - 2\frac{d}{r}\cos(\phi-\phi_0) + \frac{d^2}{r^2}\right)^{3/2}}\right|_{\frac{d}{r}=0} \cdot \left(\frac{d}{r}\right)^1 + O\left(\frac{d^2}{r^2}\right)$$

$$\approx 1 + \underline{\underline{\frac{d}{r}}} \cos(\phi - \phi_0)$$

Xin's formula $1 + \underline{\underline{2}} \frac{d}{r} \cos(\phi - \phi_0)$

After correction, Beam position w.r.t. MVTX center

$(X_0, Y_0) \sim (-8\,mm, 2\,mm)$



1. Beam position w.r.t. MVTX center

   P_2 is $(X_0, Y_0) = (-8\,mm, 2\,mm)$ w.r.t. P_0

2. MVTX center w.r.t. SPHENIX origin

   P_1 is $(3\,mm, -1\,mm)$ w.r.t P_1