Degradation of vertex resolution as a function of scattering material location

The final vertex projection of a track is determined primarily by the two hits in the inner two layers of the vertex detector as illustrated in the figure below. Material at the first layer or anywhere in between the two layers generates multiple coulomb scattering which degrades the projection determination. As illustrated in the figure the degree to which material spoils the projection resolution is a linear function of r, the radial position of the material:

$$d_v = \frac{r_1(r_2 - r)}{r_2 - r_1}\theta_m$$

where r ranges between r_1 and r_2 and θ_m is the multiple coulomb scattering angle. The resolution is degraded most by material at the inner layer and drops linearly to 0 at the second layer. Material at the second layer has other issues, but it does not directly affect the accuracy of locating the vertex which is the primary requirement.

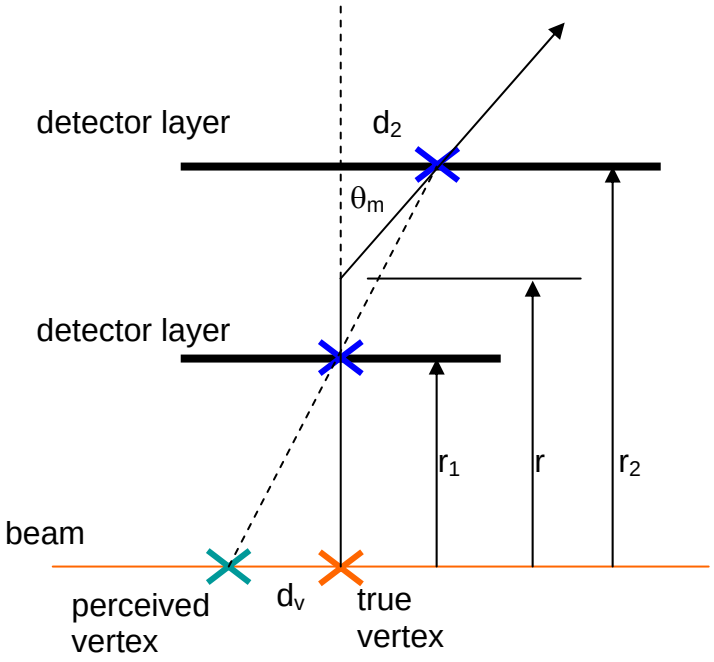

Diagram of vertex location using the inner two layers of a tracking vertex detector. A particle is emitted from the vertex or collision point and records a hit point on the first detector layer shown as a blue x. The particle continues to radius r where it scatters on intervening material to an angle θ_m from the original path and records a hit in the second detector layer as indicated again by a blue x. The error in determining the vertex using the two recorded hit points is d_v.