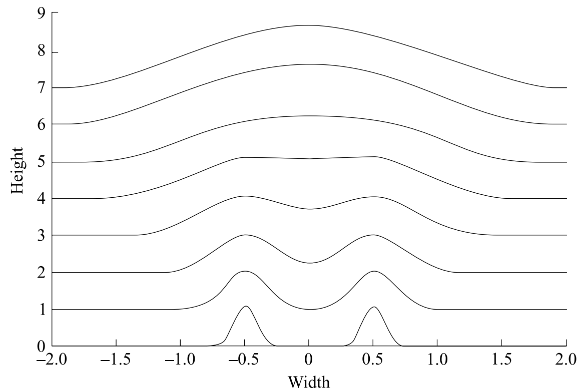

Figure 2: Merging Gaussian functions for a unit sources separation. (Kaye and Linden, 2004)

where z is the height above the plume sources (vertial origins), ξ_0 the separation of the plume sources, ξ the separation of the plume axes at any given height, and b the plume radius.

Consider the two equal plumes with origins at the same height. The average buoyancy profile of a single turbulent plume can be taken as Gaussian, with a radius given by

$$b = \frac{6}{5}\alpha z, \tag{27}$$

where α is the entrainment constant. Assuming that the plumes do not interact, buoyancy profile function is given by

$$g'(r, z) \sim f(z)E(r), \tag{28}$$

$$E(r) = \exp\left[-\frac{(r - \frac{1}{2}\xi_0)^2}{b^2}\right] + \exp\left[-\frac{(r + \frac{1}{2}\xi_0)^2}{b^2}\right]. \tag{29}$$

Here r is the radial distance from the plume axis and g' is the reduced gravity.

This function (28) is plotted in figure 2 for $1 < \lambda < 8$ and $x_0 = 1$. Clearly the two Gaussians coalesce when λ is large enough. We define the merging height to be the height at when the trough in the combined profile disappears, that is,

$$\frac{d^2E}{dr^2} = 0 \quad \text{at} \quad r = 0. \tag{30}$$

For non-interacting plumes (i.e. $\xi(z) = x_0$), (30) is easily solved to give

$$\xi_0 = \sqrt{2}b_m. \tag{31}$$

Here the subscript m denotes the value at the point where plunes merge. Dividing (31) by ξ, we obtain

$$\gamma_m = \frac{1}{\sqrt{2}}, \tag{32}$$