FROM "ION IMPLANT PROFILE CALCULATIONS" - - -

As derived in Appendix I.

$$f_N(u) = \frac{1}{\sqrt{2\pi}\,\sigma} \quad \text{(from Normal Dist. Theory)}.$$

and for a total charge Q the peak concentration is given by

$$C_{peak_0} = \frac{Q}{\sqrt{2\pi}\,\sigma} = .3989\,\frac{Q}{\sigma}.$$

It would seem that we should get the same result by substituting $Dt_0 = \sigma^2/2$ into the equation

$$C(x,t) = \frac{Q}{\sqrt{\pi D t}}\, e^{-x^2/4Dt}.$$

If we do this substitution,

$$C(0,t_0) = C_{peak_0} = \frac{Q}{\sqrt{\pi D t_0}} = \frac{Q}{\sqrt{\frac{\pi}{2}}\,\sigma} = .7978\,\frac{Q}{\sigma}$$

But this is twice the peak calculated earlier.

An incongruity would seem to exist.

Why?

Because Grove's equation applies only to a one sided distribution, as derived from diffusion theory. We, however, are looking at the whole distribution hence 2x charge and 2x dose.

If we examine the density function as given in the appendix

A.) $f_N(x) = \frac{1}{\sqrt{2\pi}\,\sigma} \exp\left[-\frac{(x-\mu)^2}{2\sigma^2}\right]$

and compare with the Drive In Diffusion equation;

B.) $C(x,t) = \frac{Q}{\sqrt{\pi D t}} \exp\left[-x^2/4Dt\right]$,

the following comments would seem to apply:

1.) Equation B) is merely centered about the mean, hence $\mu = 0$.

2.) To have eqn B.) satisfy the exponent of A);

$2\sigma^2 = 4Dt \quad Dt = \sigma^2/2$ so that

$C(0,t_0) = \frac{Q}{\sqrt{\frac{\pi}{2}}\,\sigma}$; thus instead of

$C_{peak} = \frac{Q}{\sqrt{2\pi}\,\sigma}$, in order to ~~satisfy~~ satisfy the Normal Equation, $C_{peak} = \dfrac{Q}{\sqrt{\frac{\pi}{2}}\,\sigma}$; .

The discrepancy appears to be that the factor $1/\sqrt{\pi D t}$ is not truly consistent with the $4Dt$ being the $2\sigma^2$ term in the standard normal density function equation.

If it were consistent, the equation's peak would be $C(x,t)\big|_{peak} = \dfrac{Q}{\sqrt{2\pi}\,\sigma} = \dfrac{Q}{\sqrt{2\pi}\sqrt{2Dt}} = \dfrac{Q}{2\sqrt{\pi D t}}$

and the Gaussian Drive-In Equation would be $C(x,t) = \dfrac{Q}{2\sqrt{\pi D t}} \exp\left[-x^2/4Dt\right]$.