Fudge factor vs Density

$$\frac{dI}{dz} = -I \frac{\sigma_0}{1+\langle 4\frac{\Delta^2}{\Gamma^2}\rangle + \frac{I}{I_{sat}}} n(\vec{r})$$; assuming $1+\langle 4\frac{\Delta^2}{\Gamma^2}\rangle \rightarrow \alpha$

Solution : $\alpha \ln\left(\frac{I_i}{I_f}\right) + \frac{I_i - I_f}{I_{sat}} = \sigma_0 \int dz\, n(\vec{r}) dz = \sigma_0 \mathcal{N}(x,y)$

there is another fudge factor for I_{sat} from lost light which could be measured.

$$\alpha \ln\left(\frac{I_i}{I_f}\right) + \beta \Delta I = \sigma_0 \mathcal{N}$$

in principle β is independent of density and only depends on the camera specification and optical setup! But, α might depend on density in a complicated way.

Experiment : Goal is to measure $\alpha(n)$ given β is known.

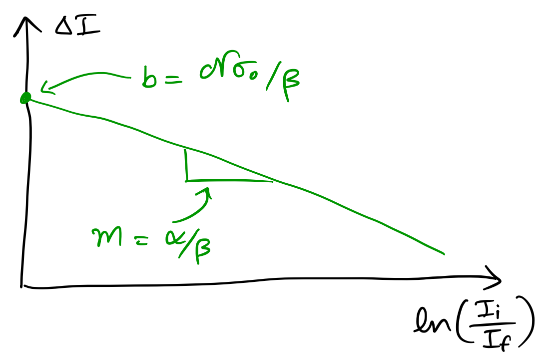
Hybrid Box with fixed atom nums. $\sigma_0 \mathcal{N} = \text{const}$ $\Rightarrow$ Vary I_i and measure I_f $\Rightarrow$ Extract $\ln\left(\frac{I_i}{I_f}\right)$ and $\Delta I = I_i - I_f$

Extract the fudge factor : suppose β is known!

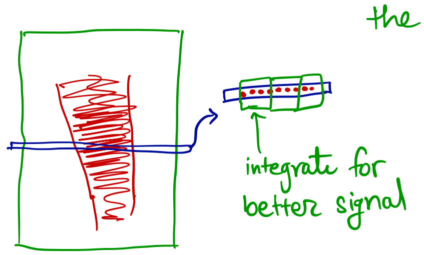
$$\alpha \ln\left(\frac{I_i}{I_f}\right) + \beta \Delta I = \sigma_0 \mathcal{N} = \text{Const}$$

$$\Delta I = \frac{\sigma_0 \mathcal{N}}{\beta} - \frac{\alpha}{\beta} \ln\left(\frac{I_i}{I_f}\right)$$

$$y = b - mx$$



Procedure :



in principle, for each pixel location in the series of data with varying I_i make the curve ΔI vs $\ln(I_i/I_f)$ and fit a line! Get the n for this pixel and make a plot of α vs n!

For better S2N average 10 pixels & same procedure!