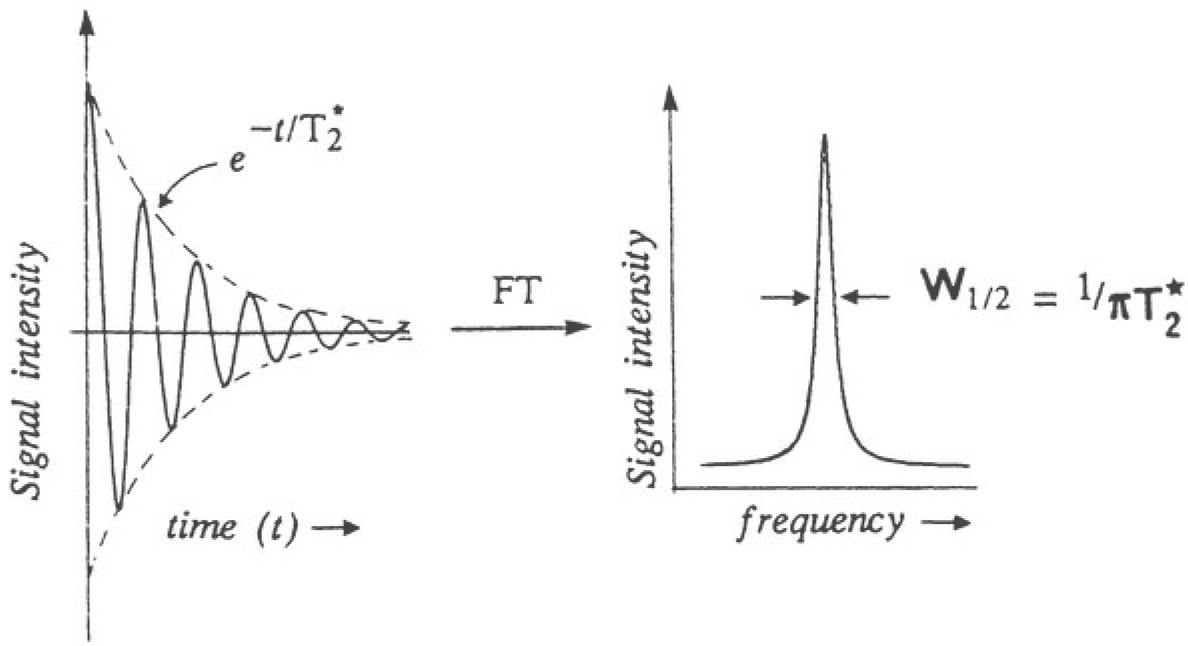
Some effects like T_2^* can be described in terms of an intra-voxel distribution off $\Delta\omega$'s :



The relationship between the "irreversible" T_2 and "reversible" T_2' components of this decay is

$$1/T_2^* = 1/T_2 + 1/T_2'.$$

Thus, we are interested in modelling a distribution of $\Delta\omega$'s that will result in an exponential decay of $e^{-t/T_2'}$, or

$$e^{-t/T_2'} = \int_{-\infty}^{\infty} p_{\Delta\omega}(w) e^{-iwt} \, \mathrm{d}t$$

The result of this is to have a Lorentzian distribution!

Inverse cumulative distribution

We can obtain random numbers distributed in this way by calculating the cumulative distribution

$$F(\Delta\omega) = \int_{-\infty}^{\Delta\omega} p_{\Delta\omega}(w) \, \mathrm{d}w, \quad \text{with} \quad p_{\Delta\omega}(w) = \frac{T_2'}{\pi(1 + T_2'^2 \Delta\omega^2)}.$$

Using this we obtained an expression to generate $\Delta\omega \sim p_{\Delta\omega}$

$$\Delta\omega = \frac{1}{T_2'} \tan\left[\pi\left(x - \frac{1}{2}\right)\right],$$

with $x \sim \mathcal{U}(0, 1)$.

Problem

This is very inefficient, and requires a high number of x's to converge to an exponential decay.