General Physics Notes (07092026):

Let's try a little biophysics. This is a slight departure from fusion, EM, and quantum, but it is relevant to our bioengineering division. Here we'll set our sights on fluorescence and photon intensity.

The observed fluorescence life τ_F is given by the relation $I(t) = I_0 e^{\frac{-t}{\tau}}$ thus we use the relation $\ln I(t) - \ln I_0 = \frac{-t}{\tau_F}$.

The observed lifetime is given by this equation.

$$\tau_F = \left[\frac{-1}{t} \ln \frac{I(t)}{I_0} \right]^{-1} \tag{1}$$

A quantum yield is as follows.

$$\phi_F = \frac{\tau_F}{\tau_R} \tag{2}$$

Here the rate constant of decay is inverse to the lifetime. $A_{rate} = \frac{1}{\tau_R}$
Using Förster theory we continue.

$$E = \frac{k_T}{k_T + (k_F^D + k_{ic}^D + k_{is}^D)} \tag{3}$$

We know

$$k_T = \frac{1}{\tau_D} \left(\frac{R_0}{R} \right)^6 \rightarrow E = \frac{R_0^6}{R^6 + R_0^6} = \frac{k_T}{k_T + \frac{1}{\tau_D}} \tag{4}$$

Now we can really start substitution in the equations to find values.

$$\frac{\tau_{D+A}}{\tau_b} = 1 - E_2 = \frac{R_0^6}{R^6 + R_0^6} \tag{5}$$

This is a little fluorescence theory and it is sufficient for the yields and lifetimes. The quantum nature of the particles is what generates the phenomenon.

Let's switch gears in a somewhat neurodivergent topic but a little related to fluorescence (binding of markers to molecules etc.) to binding.

DNS to BSA binding

$$A = \frac{I_\parallel - I_\perp}{I_\parallel + 2I_\perp}, P = \frac{I_\parallel - I_\perp}{I_\parallel + I_\perp} \rightarrow A = \frac{2P}{3 - P} \tag{6}$$

Binding constant is given but this ratio. We assume linear binding and the non-linear effects are ignored. I mean, in reality there is a lot of higher order geometric turbulent motion going on here.

$$K_d = \frac{[DNS - BSA]}{[DNS][BSA]} \tag{7}$$

Coefficients of mass are related to the association.

$$A = \left(\frac{\alpha}{\beta}\right)\left(\frac{[BSA]_{free}}{[BSA]_{bound}}\right) \tag{8}$$

Let's stop here and continue later.