$$\frac{\mathrm{d}I_\nu}{\mathrm{d}s} = -\alpha_\nu I_\nu + j_\nu$$

$$\boxed{\alpha_\nu = \frac{h\nu}{4\pi} n_l B_{lu} \left(1 - \underbrace{\boxed{e^{-h\nu/kT}}}_{\text{“Correction for Stimulated Emission”}}\right) \phi(\nu)}$$

$$\boxed{j_\nu = \left(\frac{h\nu}{4\pi}\right) \phi(\nu)\, n_u A_{ul}}$$

$$j_\nu = \alpha_\nu \, B_\nu(T)$$

Arnold and Whiting Eqn (1)

$$\frac{dI_\lambda}{dx} = \alpha_\lambda[1 - \exp(-h\nu/kT)]B_\lambda(T) + \alpha_\lambda I_\lambda \exp(-h\nu/kT) - \alpha_\lambda I_\lambda$$

Spontaneous emission   Stimulated emission   Absorption

Note:

$$\alpha_\lambda = \frac{h\nu}{4\pi} n_l B_{lu} \phi(\nu)$$

$$\alpha'_\lambda = \frac{h\nu}{4\pi} n_l B_{lu}[1 - \exp(-h\nu/kT)]\phi(\nu)$$

When integrated over a path from 0 to L, we get simply:

$$I_\lambda = B_\lambda(T)[1 - \exp(-\alpha'_\lambda L)] + I_{\lambda,\circ} \exp(-\alpha'_\lambda L)$$