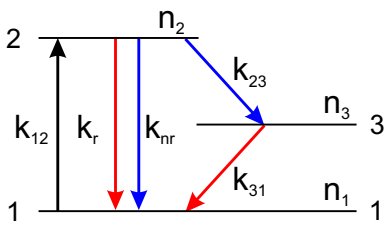
Priv.-Doz. Dr. A. Naber
Exercises to the lecture Nano-Optics, WS 2023/24

**Exercises (V)**
(Discussion is on Friday, 19.1.2024)

**Problem 1:**




In the lecture a simplified solution for the emission rate $R_{\mathrm{em}}$ of molecules was discussed which was based on three states of different energy (ground- singulet-, and triplet state). Establish the differential equations for the rates between these states and derive the steady state solution for the photon emission rate $R_{\mathrm{em}} = k_{\mathrm{r}} n_2$ for the 'allowed' transition from the singulet state (population number $n_2$) to the ground state (population number $n_1$) as a function of the excitation intensity $I$ and the rate constants $k_{23}$, $k_{31}$, $k_{\mathrm{r}}$, and $k_{\mathrm{nr}}$ (see figure and lecture notes).

*Note:* The excitation intensity $I$ of light can be expressed as $I = \frac{h\nu}{\sigma} k_{12}$ with photon energy $h\nu$, absorption cross section $\sigma$, and absorption rate constant $k_{12}$.