II Spectroscopy of rare-earths: light matter interactions

An ensemble of N ions : our lasing medium

at least 2 energy levels such that their difference in energy is $\boxed{\Delta E = h\nu_{12} = h\frac{c}{\lambda_{12}}}$ (Planck's formula)

material

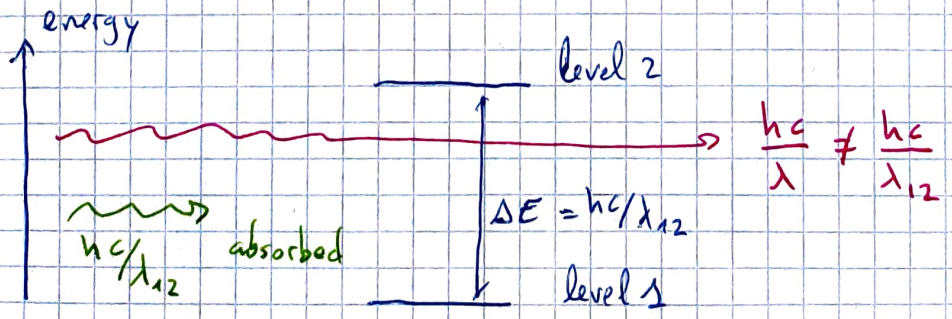
The population of the upper level is N_2

_____ lower _____ N_1

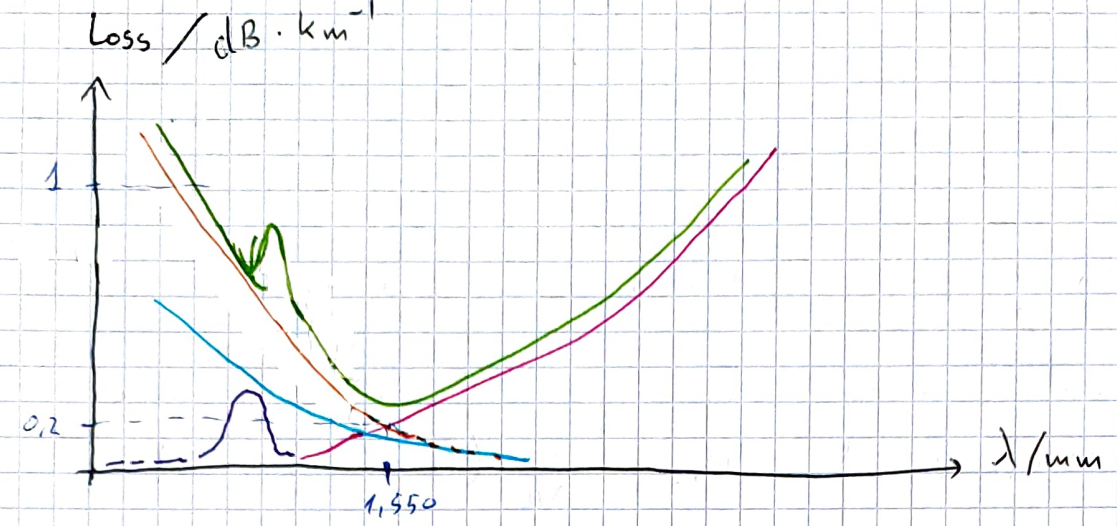
$\forall t \quad N_1 + N_2 = N$

- We consider photons travelling in this medium
- The 3 light-matter interactions
  - → absorption
  - → stimulated emission
  - → spontaneous emission

II.1 Absorption

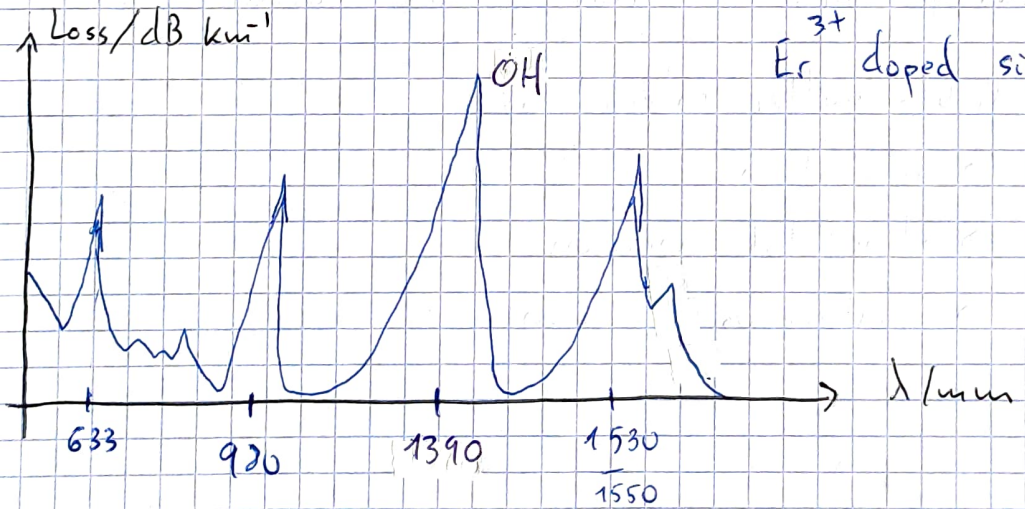


Rare-earth doped silica glass (made by MCVD)

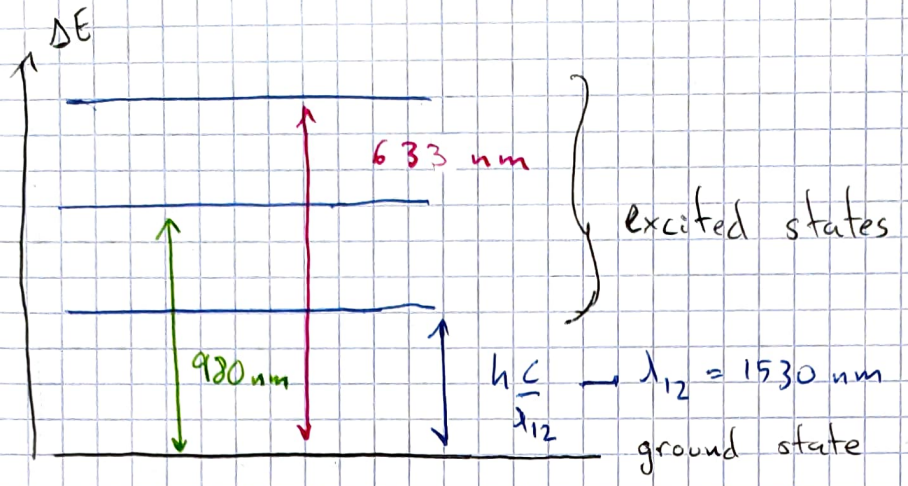


The higher the probability of absorption the higher the loss

- Rayleigth scattering (λ^{-4})
- UV absorption
- impurities OH^-
- IR absorption
- pure Silica

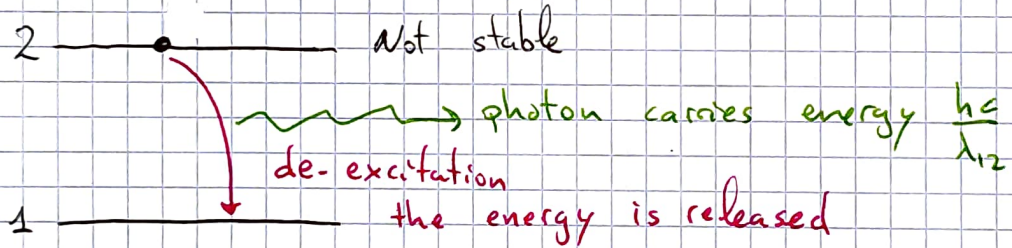


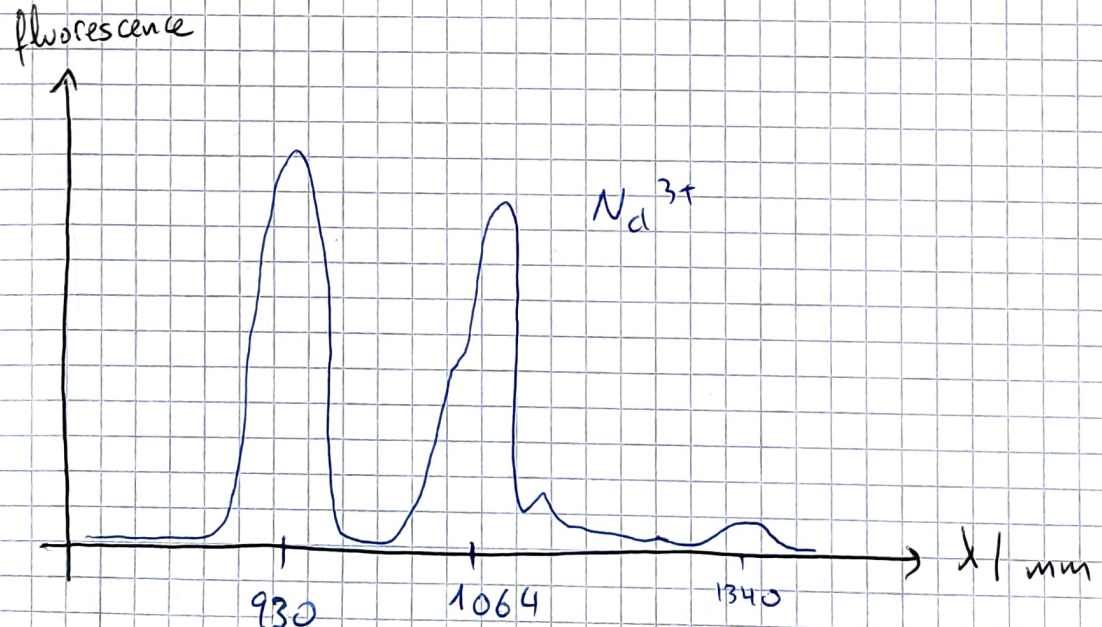
Er^{3+} doped silica fiber



We will use these absorption transition to transfer energy from the outside to the fiber.

II.2 Spontaneous Emission





Nd : YAG