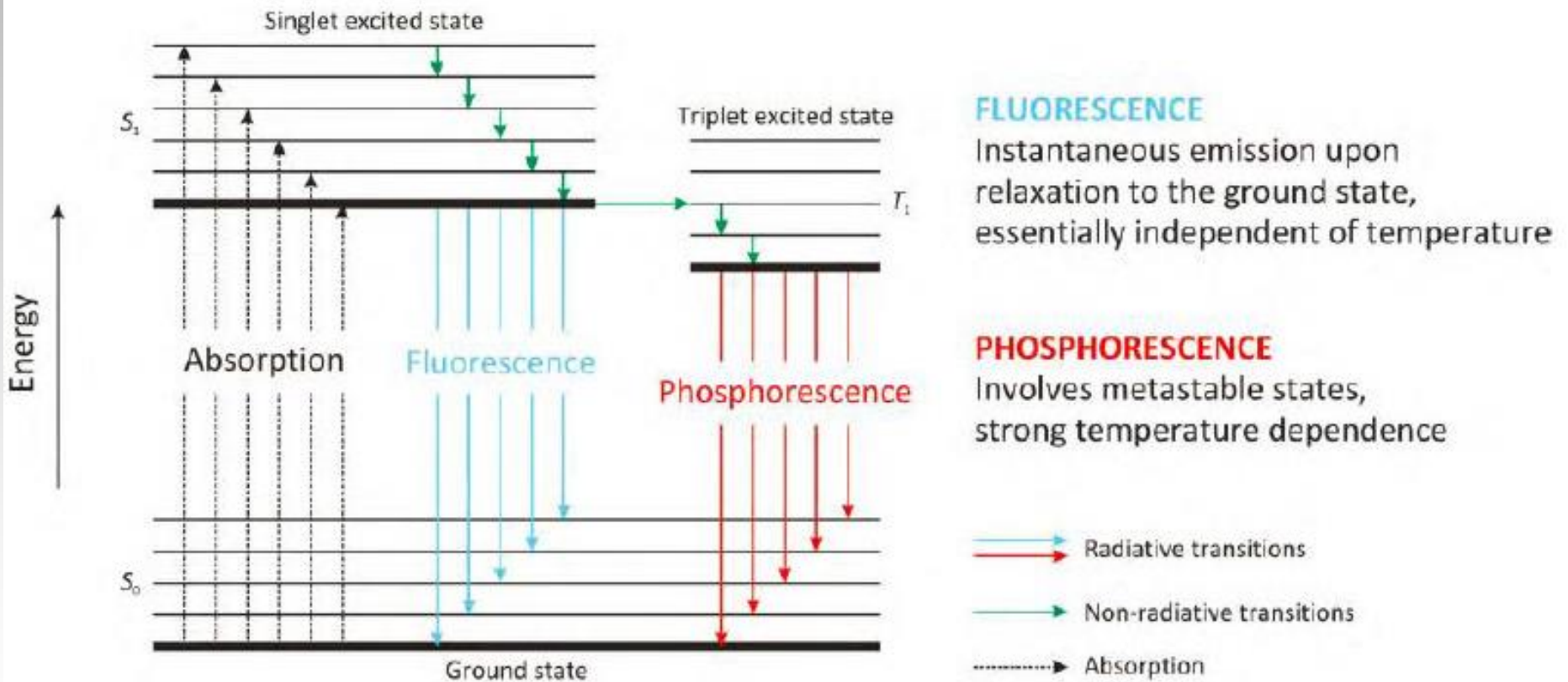


# Jablonski Diagram

## Classification of Luminescence Phenomena



### FLUORESCENCE

Instantaneous emission upon relaxation to the ground state, essentially independent of temperature

### PHOSPHORESCENCE

Involves metastable states, strong temperature dependence

**ELECTRONIC TRANSITIONS IN INSULATORS**  
(Jablonski diagram)

# Basic Discrimination: emission after excitation

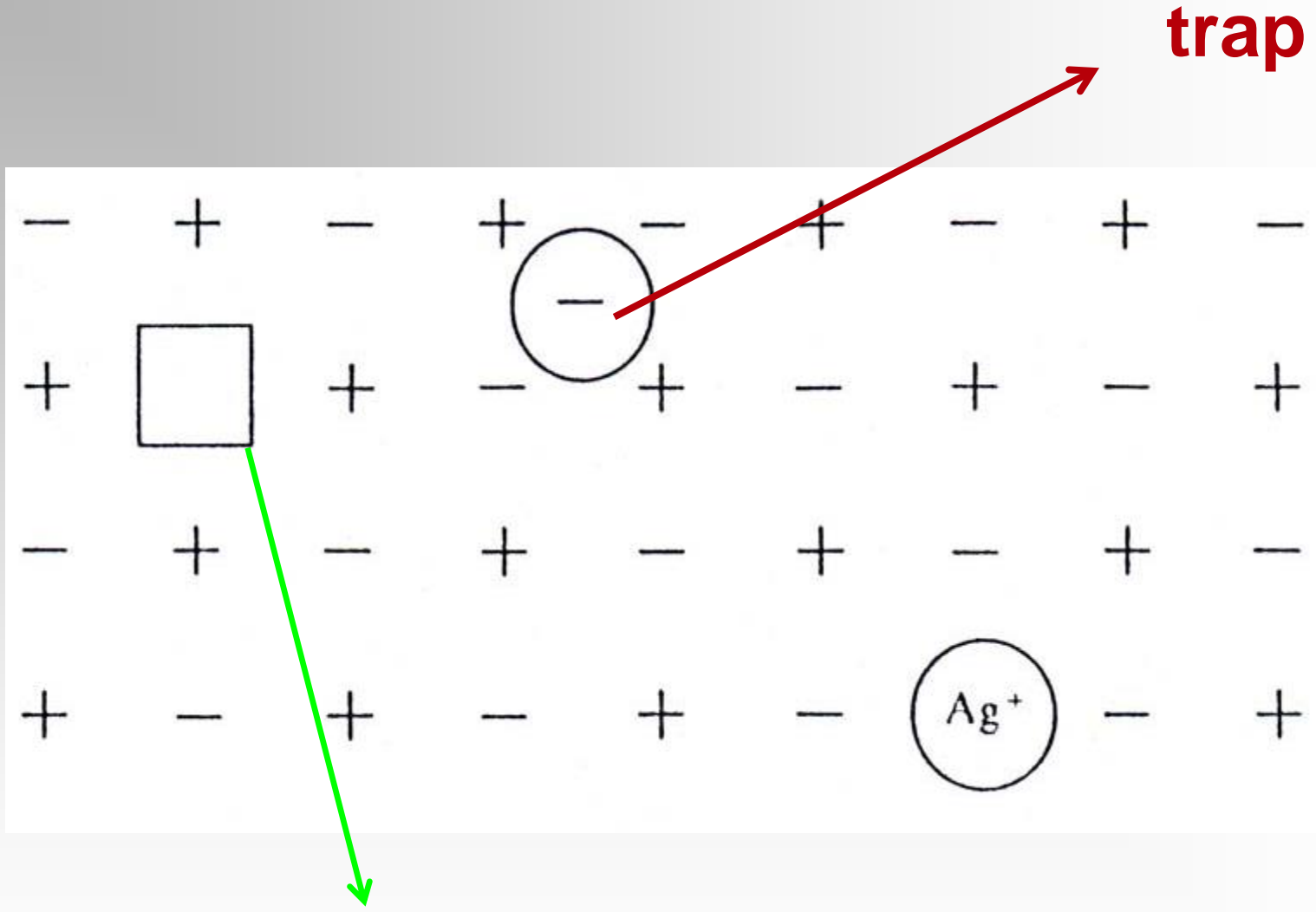
For  $\tau < 10^{-8}$  s  $\rightarrow$  fluorescence (spontaneous, T-independent)

For  $\tau > 10^{-8}$  s  $\rightarrow$  phosphorescence (requires stimulation, T-dependent)

Excitation = Irradiation

Stimulation = heating (TL), light (OSL)

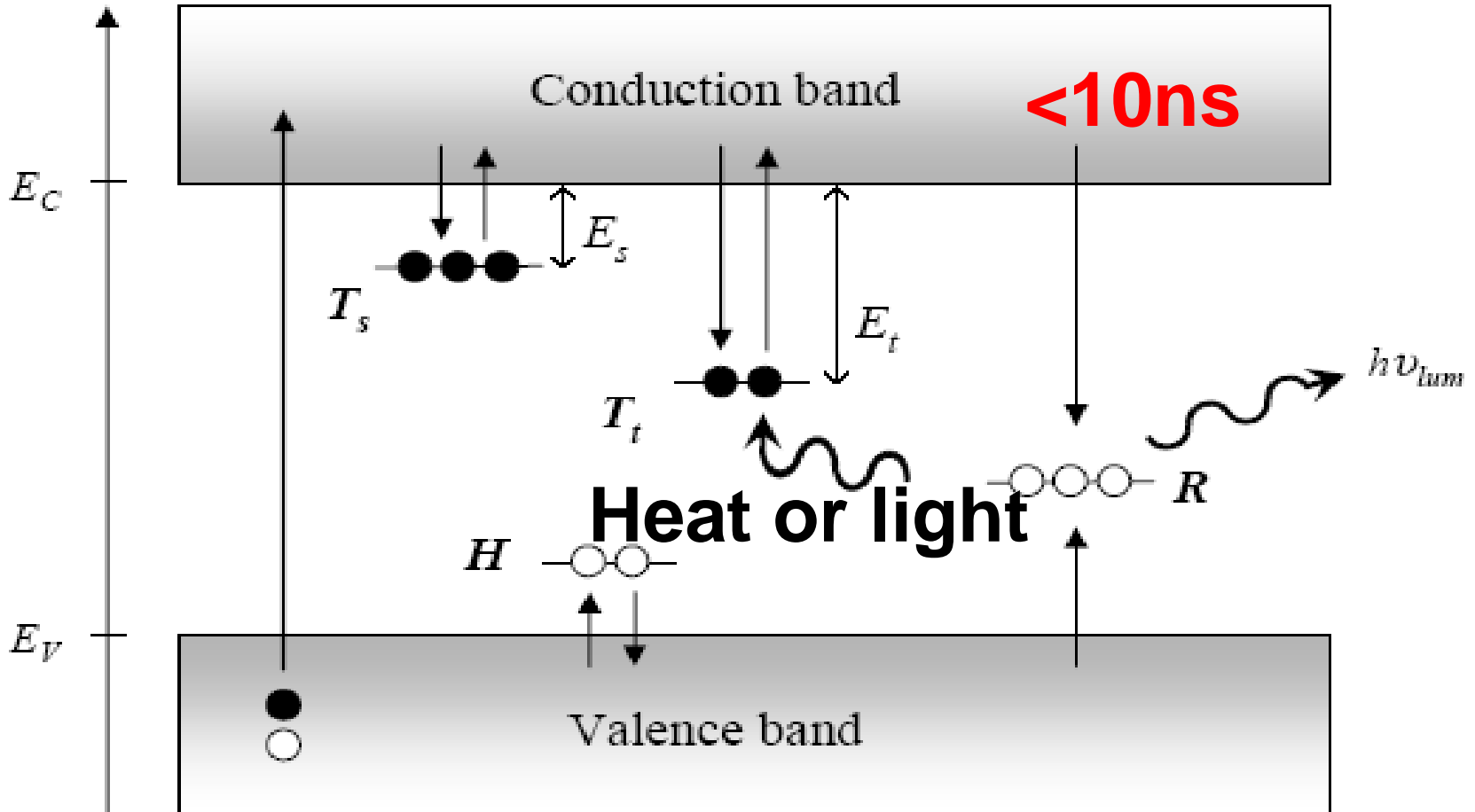
■  $\tau$  = lifetime =  $p^{-1}$



**trap**

**Trap – recombination center**

# Energy band diagram

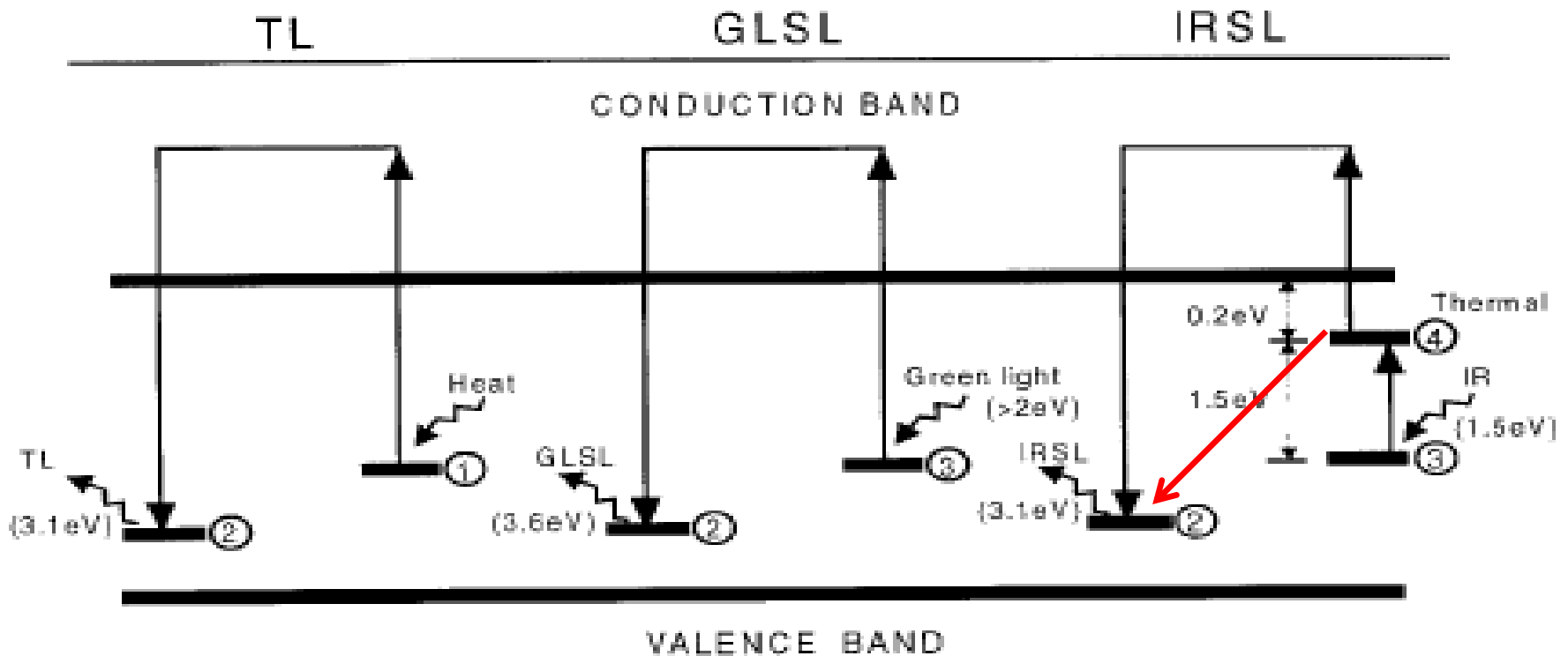


**Ionisation**

**Stimulation**

**Recombination**

# TL, Blue-GreenSL & IRSL



- ① TL trap
- ② Radiative recombination center
- ③ GLSL / IRSL trap
- ④ Excited state

$$I_{LUM}(t) = -\frac{dn}{dt} = pn$$

$$p = s \cdot \exp\left(-\frac{E}{kT}\right)$$

$$I_{TL}(T) = n_0 \cdot s \cdot \exp\left(-\frac{E}{kT}\right) \exp\left[-\frac{s}{\beta} \cdot \int_{T_0}^T \exp\left(-\frac{E}{kT'}\right) dT'\right]$$

$$I_{LUM}(t) = -\frac{dn}{dt} = p \frac{p_r}{p_t} \frac{n^2}{N}$$

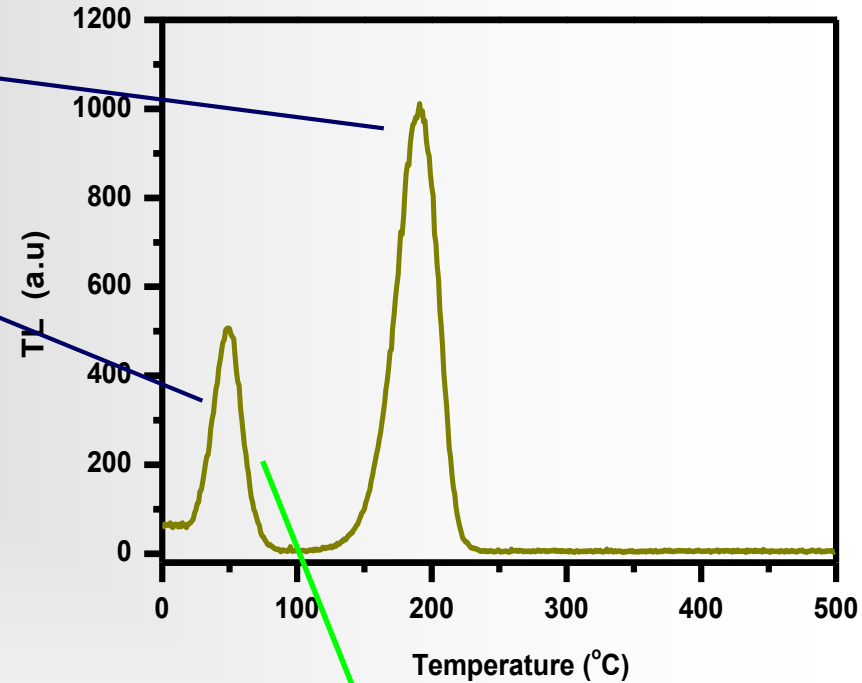
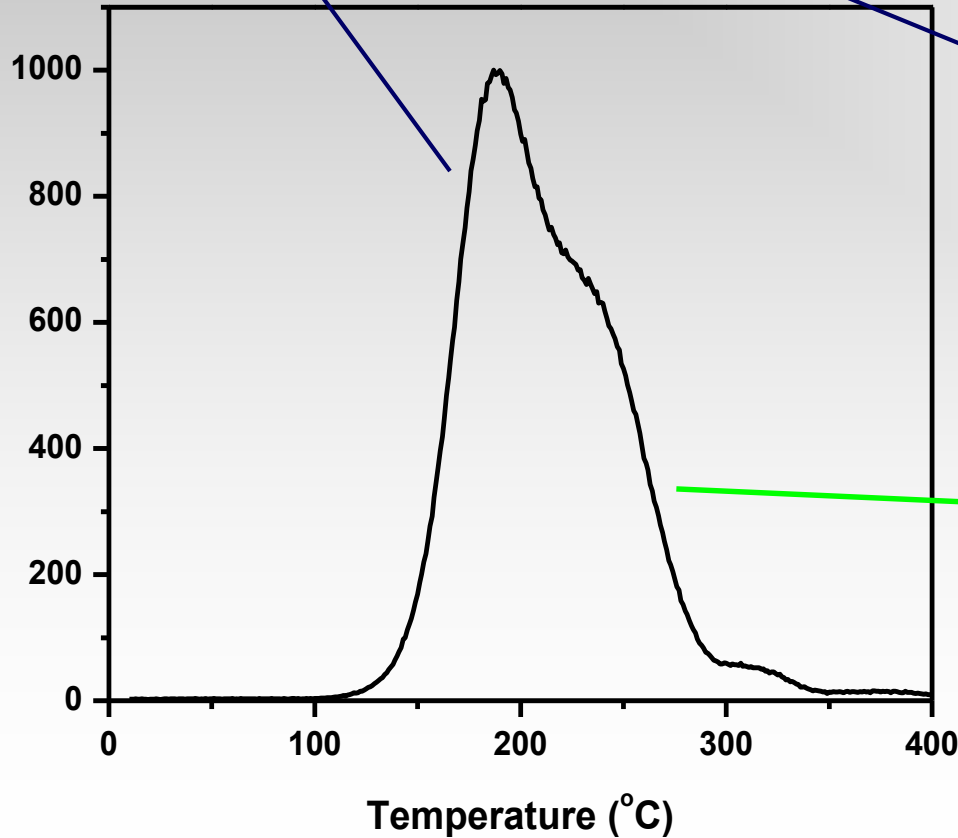
$$I_{TL}(T) = \frac{p_r}{p_t} \frac{s}{\beta} \exp\left(-\frac{E}{kT}\right) \frac{n_0^2}{N} \left(1 + \frac{n_0}{N} \int_{T_0}^T \frac{p_r}{p_t} \frac{s}{\beta} \exp\left(-\frac{E}{kT'}\right) dT'\right)^{-2}$$

$$I_{LUM}(t) = -\frac{dn}{dt} = p \frac{p_r}{p_t} \frac{n^b}{N}$$

$$I_{TL}(T) = s \cdot \frac{n_0^b}{N} \frac{p_r}{p_t} \cdot \exp\left(-\frac{E}{kT}\right) \cdot \left(1 + \frac{p_r}{p_t} \frac{s}{N} \cdot \frac{n_0^{b-1}}{\beta} \cdot (b-1) \cdot \int_{T_0}^T \exp\left(-\frac{E}{kT'}\right) dT'\right)^{\frac{b}{1-b}}$$

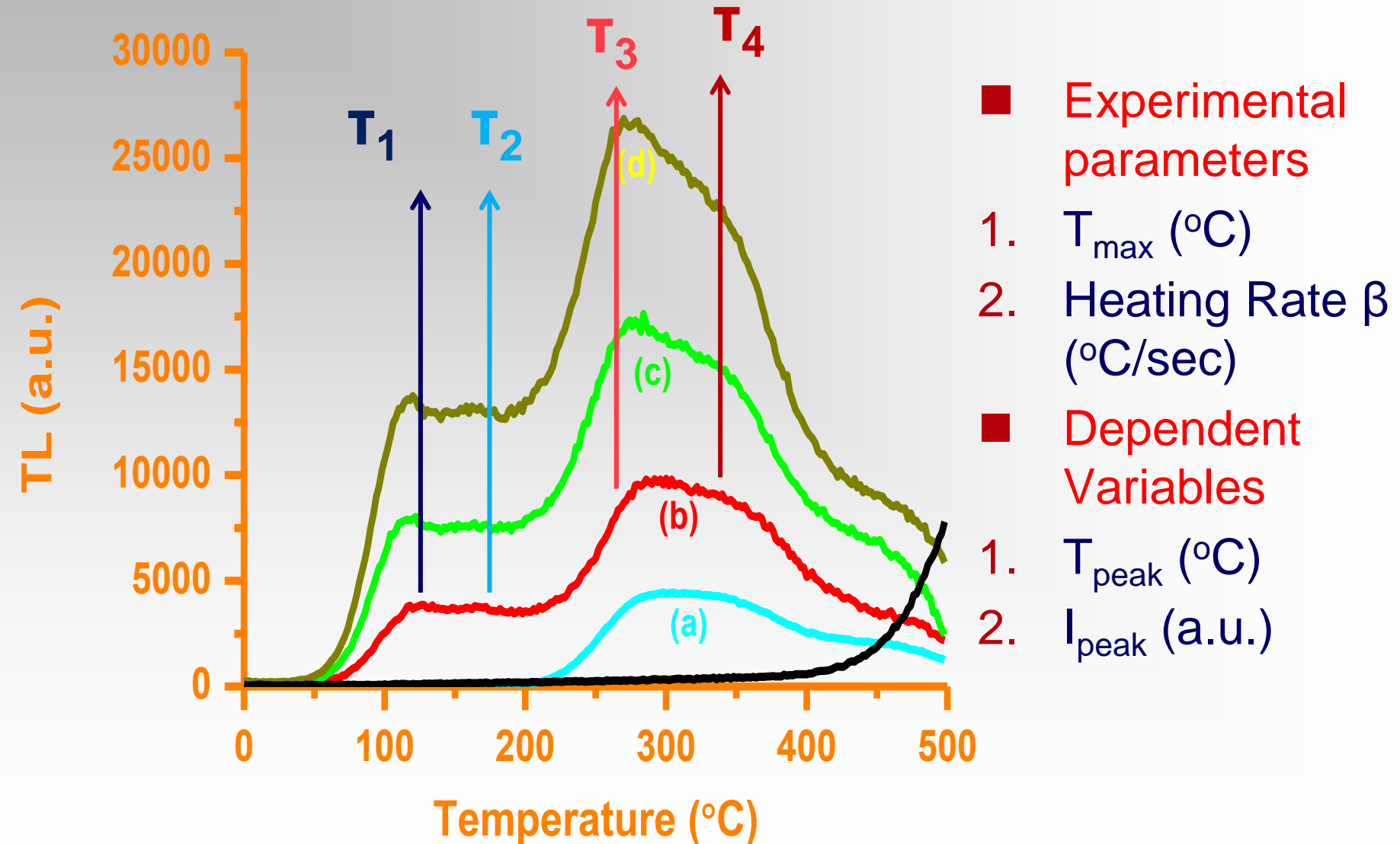
# Examples of TL glow curves

Initial part: Boltzmann factor  $\rightarrow$  Initial Rise Technique



Final part: Integral

# Experimental TL glow curves





# Examples of TL glow curves

