Laser assisted isotopic separation

Enrichment of isotope can be done using laser schemes if:

- Isotopic shift in absorption frequency is well resolved.
- Laser linewidth is smaller than isotopic frequency shift.
- There is an efficient extraction stage.

To quantify the enrichment, we introduce enrichment factor:

$$\beta = \frac{N(P_1)/N(P_2)}{N(R_1)/N(R_1)} = \frac{X(P_1)/[1-X(P_2)]}{X(R_1)/[1-X(R_2)]}$$

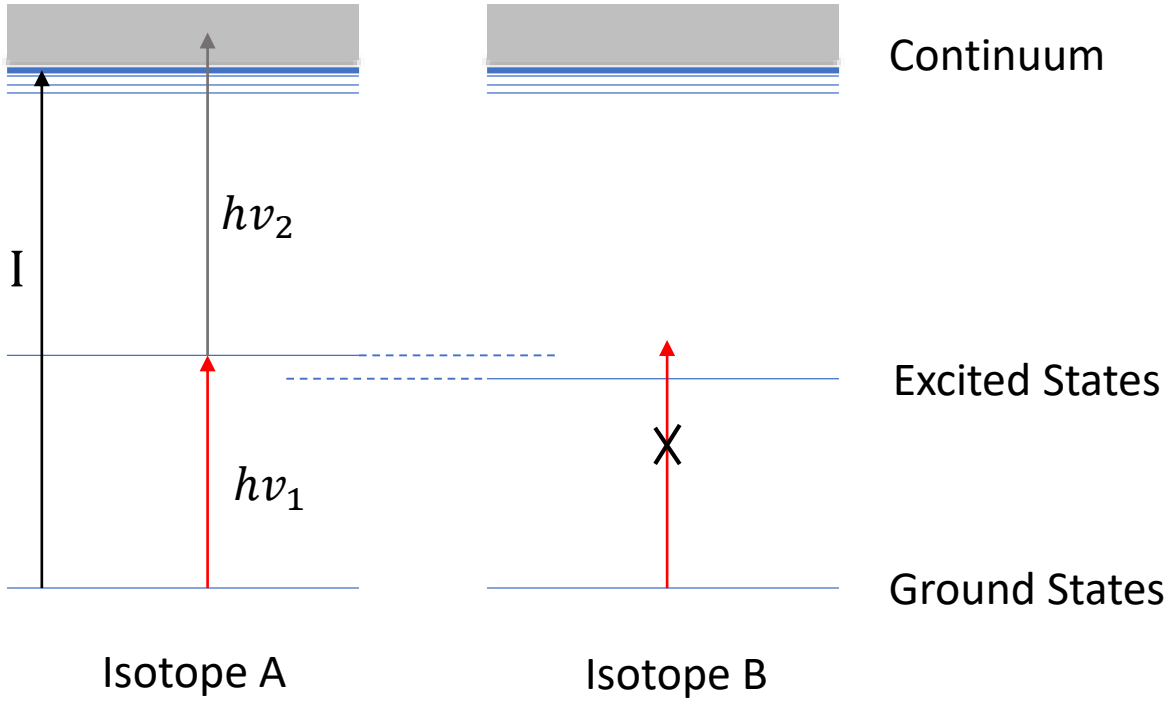
$N(i) =$ indicates no. of mole of isotopes to be separated (R_1, R_2) and products after laser action (P_1, P_2).

$X(i) =$ indicates respective mole fractions.

Selective photoionization

This laser scheme is based upon fact that excited state of isotopes differs in energy. By using proper combination of incident frequencies the isotope can be selectively ionized. The condition is: $hv_1, hv_2 < I < hv_1 + hv_2$

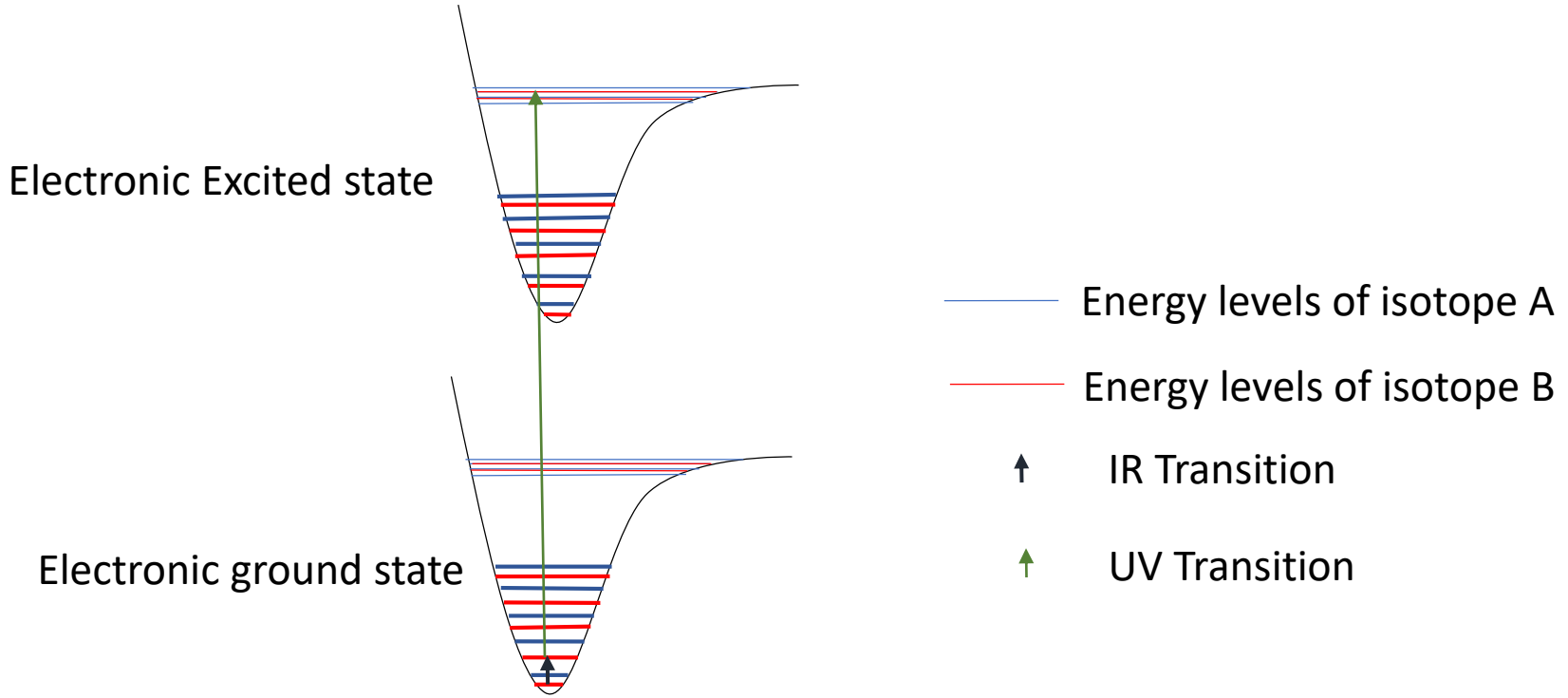
where, I = ionization energy.



Selective Photoionization of isotope A

Selective dissociation

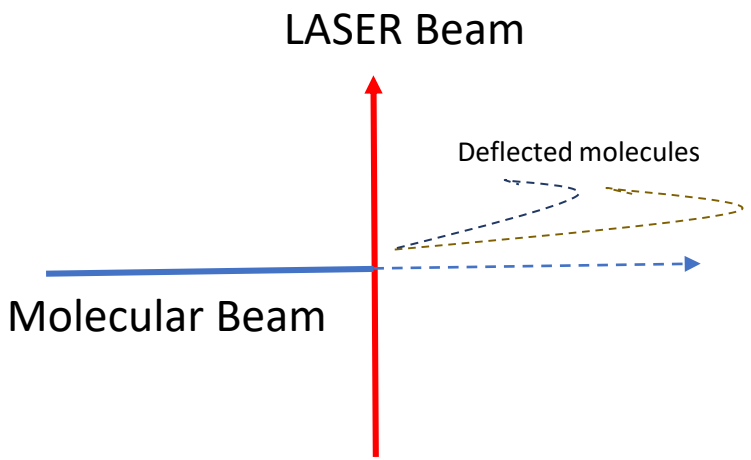
By bringing a suitable IR frequency we can selectively populate vibration levels of one of the isotopes and than using a suitable UV radiation the isotope can be dissociated selectively.



Selective Photo-dissociation of isotope B

Photo-deflection

- When laser beam strikes a molecular beam than deflection of molecules occurs depending upon molecular masses. As isotopes differs in mass so they can be separated using this selective deflection phenomena.



Selective Deflection