

$$V_{eR} = \sqrt{\frac{2 E_R}{M}}$$

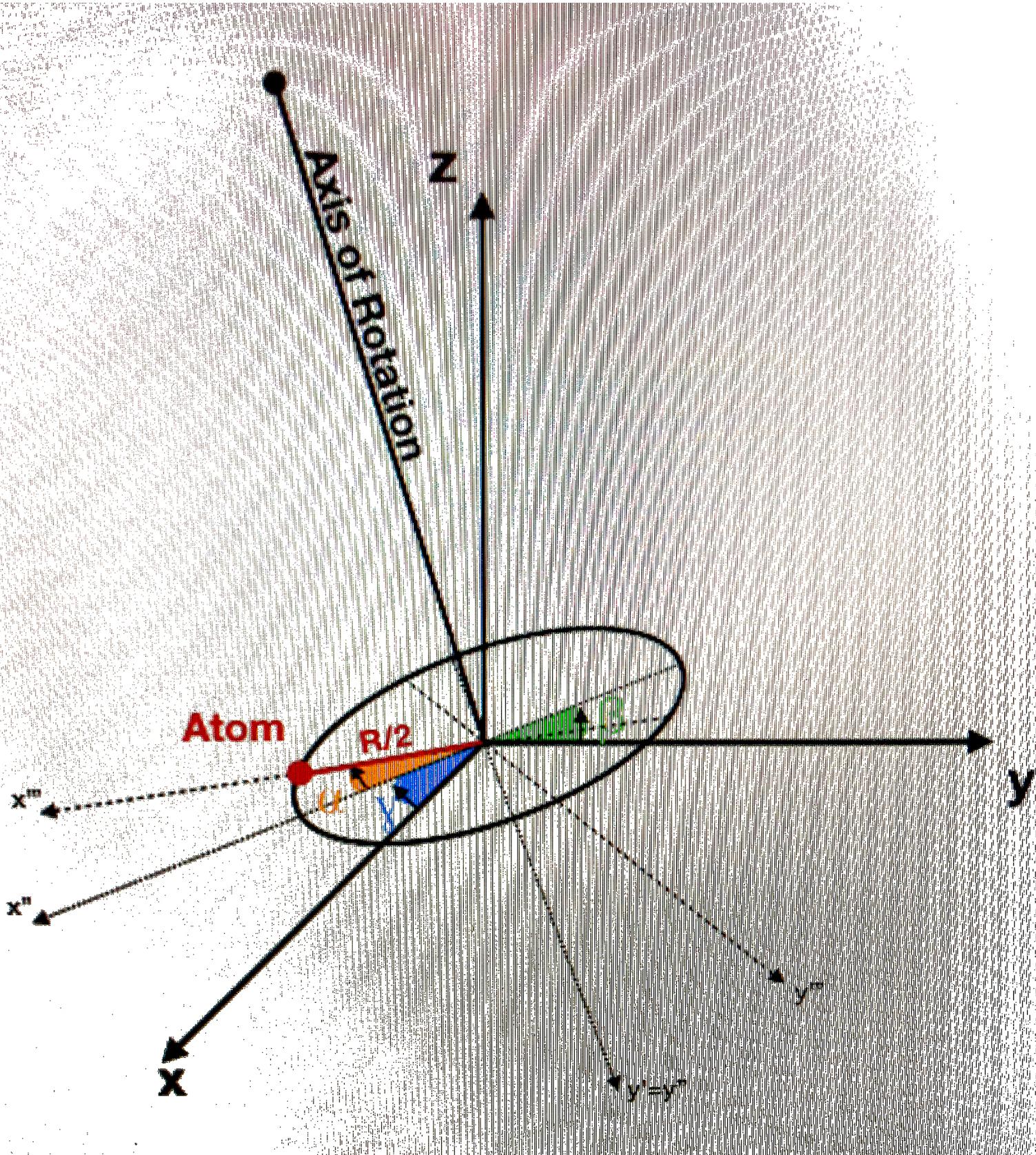
$$b : D_{NIR} = V_{ez} : V_{eR} \rightarrow V_{ez} = -V_{eR} \frac{b}{D_{NIR}}$$

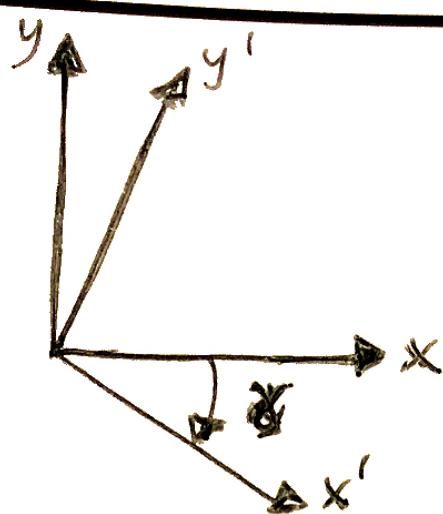
$$V_{ex} = -\sqrt{V_{eR}^2 - V_{ez}^2} = -V_{eR} \sqrt{1 - \frac{b^2}{D_{NIR}^2}}$$

COORDVELOC - FREE TOTANG MOM

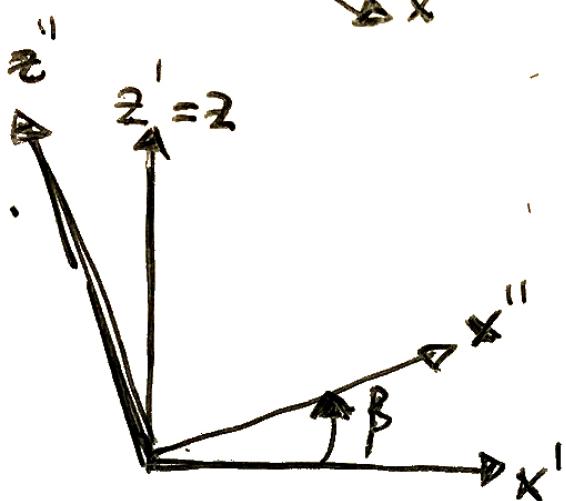
The diagram illustrates two rectangular blocks representing a target and a projectile. The target block on the left has a height of  $D_{INIT} \frac{M_P}{M_T + M_P}$  and contains three circles. The projectile block on the right has a height of  $D_{INIT} \frac{M_T}{M_T + M_P}$  and contains one circle.

$$Q = \begin{bmatrix} -V_{ex} & D_{int} \frac{M_p}{M_T + M_p} & V_{ex} & D_{int} \frac{M_T}{M_T + M_p} \\ 0 & & & \\ V_{ez} & D_{int} \frac{M_p}{M_T + M_p} & V_{ez} & D_{int} \frac{M_T}{M_T + M_p} \end{bmatrix}$$

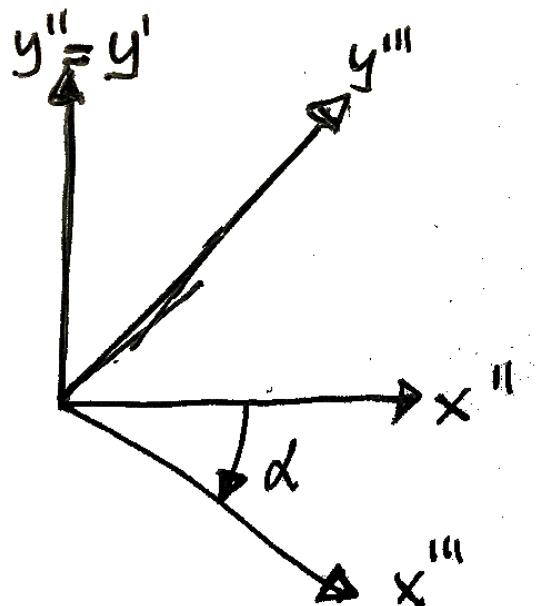




$$\begin{cases} x = x' \cos \gamma + y' \sin \gamma \\ y = -x' \sin \gamma + y' \cos \gamma \\ z = z' \end{cases}$$



$$\begin{cases} x' = \cos \beta x'' + \sin \beta z'' \\ z'' = \sin \beta x'' + \cos \beta z'' \\ y' = y'' \end{cases}$$



$$\begin{cases} x'' = x''' \cos \alpha + y''' \sin \alpha \\ y'' = -x''' \sin \alpha + y''' \cos \alpha \\ z'' = z''' \end{cases}$$

$$\left. \begin{array}{l} R x''' \\ 0 y''' \\ 0 z''' \end{array} \right\} = \left. \begin{array}{l} R \cos \alpha x''' \\ -R \sin \alpha y''' \\ 0 z''' \end{array} \right\} = \left. \begin{array}{l} (R \cos \alpha \cos \beta - 0) x' \\ -R \sin \alpha y' \\ (R \cos \alpha \sin \beta - 0) z' \end{array} \right\} =$$

$$\begin{aligned} & (R \cos \alpha \cos \beta \cos \gamma - R \sin \alpha \sin \gamma) x \\ = & (-R \cos \alpha \cos \beta \sin \gamma - R \sin \alpha \cos \gamma) y \\ & R \cos \alpha \sin \beta z \end{aligned} \quad \left. \begin{array}{l} x \\ y \\ z \end{array} \right\}$$

- RELATIVE TRANSLATIONAL ENERGY
- IMPACT PARAMETER

$\Rightarrow \underline{\underline{Q}} \text{ and } \dot{\underline{\underline{Q}}}$ , TARGET AND PROJECTILE REFERRED TO CM<sub>target</sub>

### INTERNAL STATES

- (• MOLECULE KIN ENERGY)
- ANGLES  $\alpha, \beta, \gamma$
- BOND LENGTH R and  $\dot{R}$

$\Rightarrow \underline{\underline{Q}}_{i,m} \text{ and } \dot{\underline{\underline{Q}}}_{i,m}$ , MOLECULE'S ATOMS REFERRED TO CM<sub>molecule</sub>



### SHIFT COORDINATES

$$\underline{\underline{Q}}_{\text{FINAL}} = \underline{\underline{Q}} + \underline{\underline{Q}}_{i,m}$$

$$\dot{\underline{\underline{Q}}}_{\text{FINAL}} = \dot{\underline{\underline{Q}}} + \dot{\underline{\underline{Q}}}_{i,m}$$