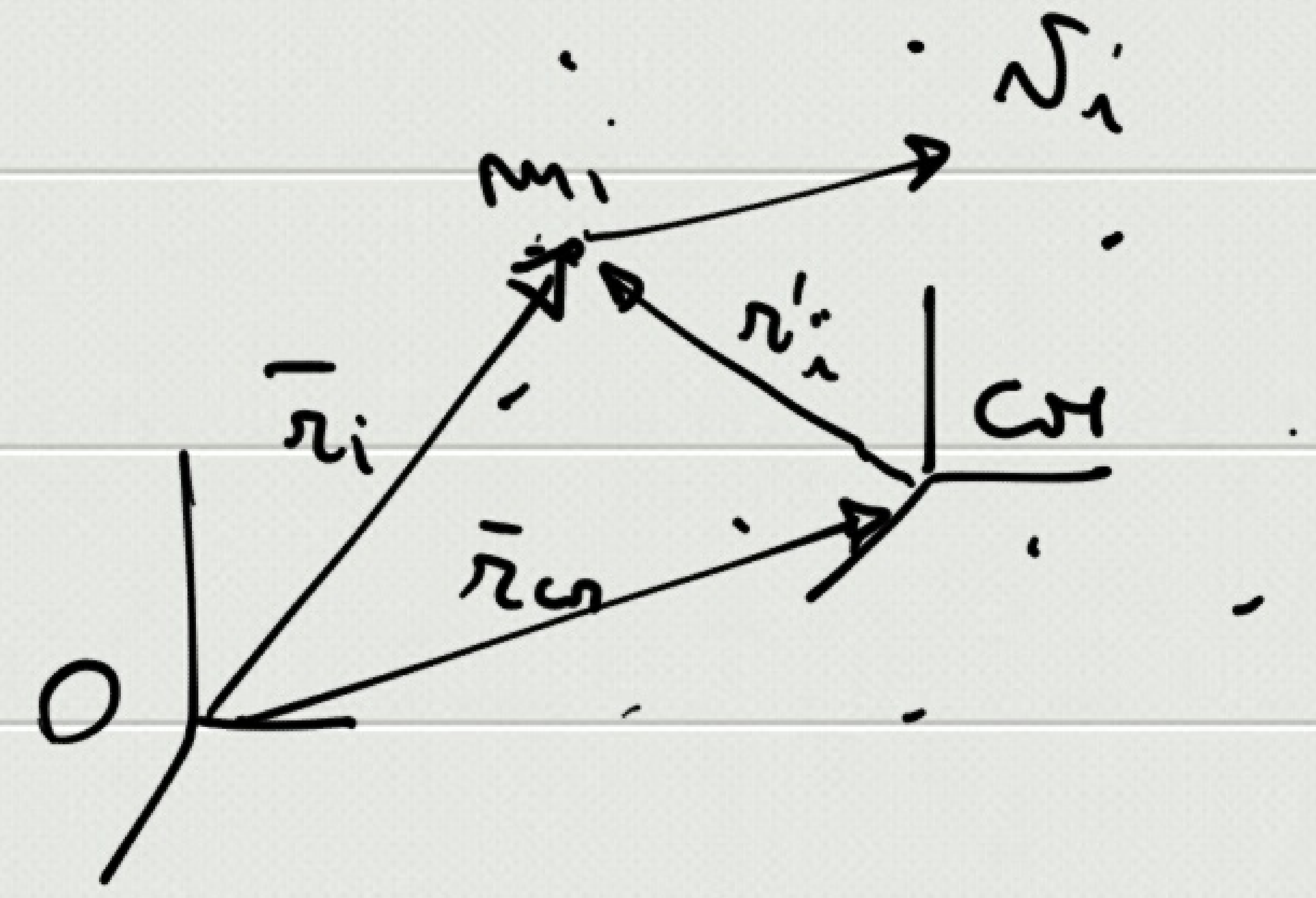
$$\bar{L}_O = \sum_i \bar{L}_{O,i} = \sum_i \bar{r}_i \times m_i \bar{v}_i$$



$$\bar{r}_i = \bar{r}'_i + \bar{r}_{CM} \qquad \bar{v}_i = \bar{v}'_i + \bar{v}_{CM}$$

$$\Rightarrow \bar{L}_O = \sum_i \left(\bar{r}'_i + \bar{r}_{CM}\right) \times m_i \left(\bar{v}'_i + \bar{v}_{CM}\right) =$$

$$= \sum_i \bar{r}'_i \times m_i \bar{v}'_i + \sum_i \bar{r}'_i \times m_i \bar{v}_{CM} +$$

$$+ \sum_i \bar{r}_{CM} \times m_i \bar{v}'_i + \sum_i \bar{r}_{CM} \times m_i \bar{v}_{CM} =$$

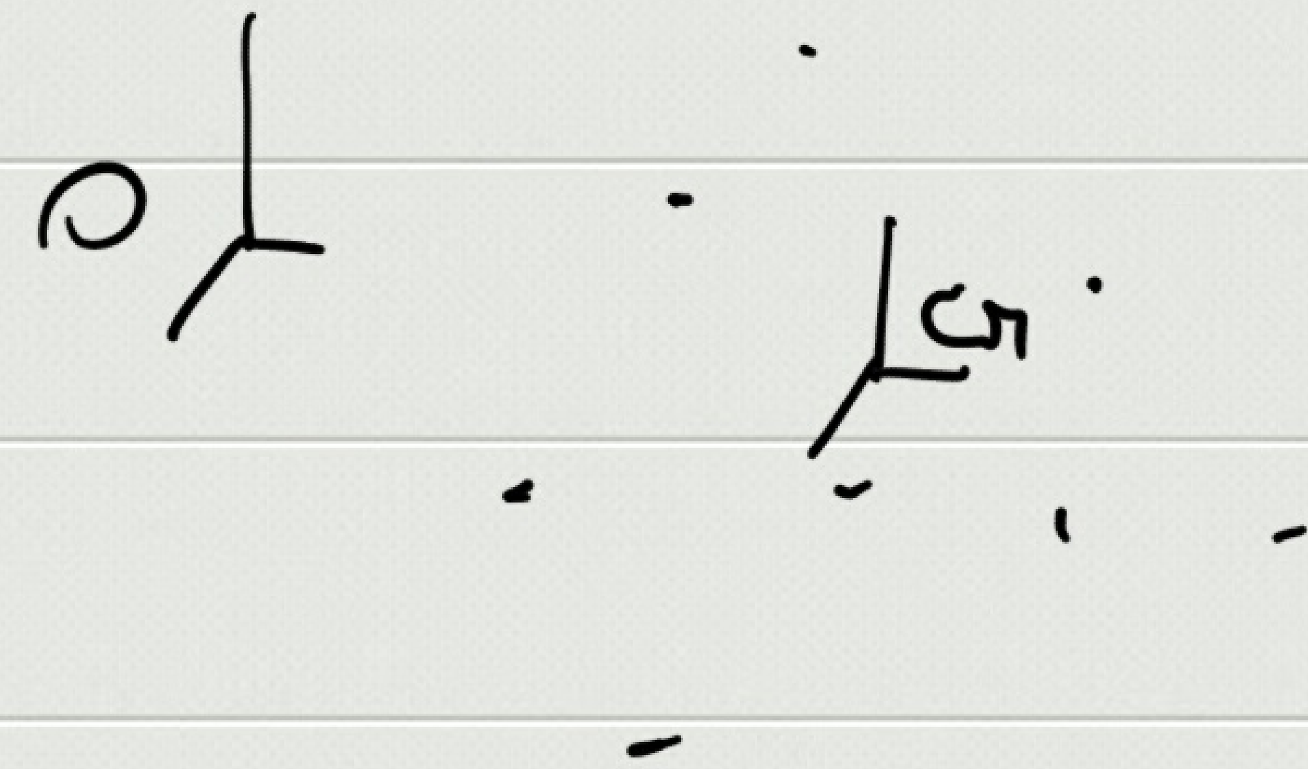
$$= \sum_i \bar{L}'_{CM,i} + \cancel{\underbrace{\left(\sum_i m_i \bar{r}'_i\right)}_{=0} \times \bar{v}_{CM}} + \cancel{\bar{r}_{CM} \times \underbrace{\left(\sum_i m_i \bar{v}'_i\right)}_{=0}} + \bar{r}_{CM} \times \sum_i m_i \bar{v}_{CM} =$$

$$= \bar{L}'_{CM} + \bar{r}_{CM} \times M_{TOT} \bar{v}_{CM}$$

$$\boxed{\bar{L}_O = \bar{L}'_{CM} + \bar{L}_{O,CM}}$$

T. König per il momento angolare

$$\bar v_i = \bar v_i' + \bar v_{CM}$$



$$E_k = \sum_i E_{k,i} = \sum_i \frac{1}{2} m_i v_i^2 = \qquad\qquad v_i^2 = \bar v_i \cdot \bar v_i$$

$$= \sum_i \frac{1}{2} m_i \left(\bar v_i' + \bar v_{CM}\right)^2 =$$

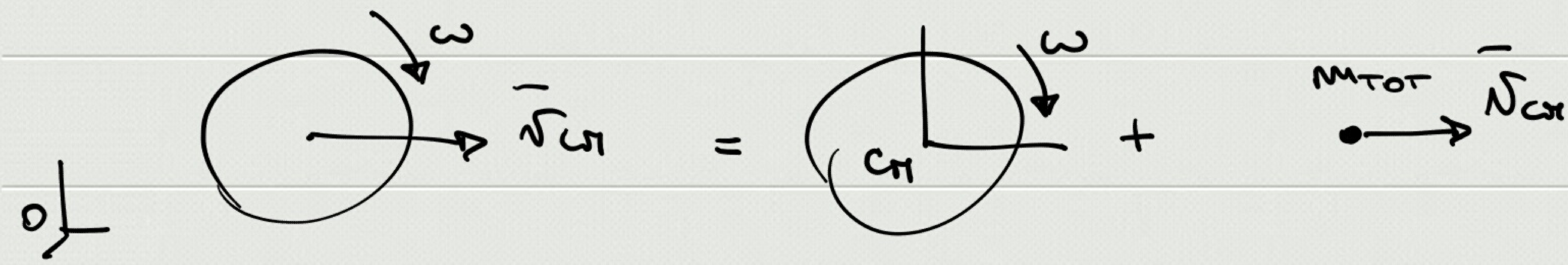
$$= \sum_i \frac{1}{2} m_i v_i'^2 + \sum_i \frac{1}{2} m_i v_{CM}^2 + \sum_i \cancel{\frac{1}{2}} m_i \cdot \cancel{2} \bar v_i' \cdot \bar v_{CM} =$$

$$= \sum_i E_{k,i}' + \frac{1}{2} m_{TOT} v_{CM}^2 + \underbrace{\left(\sum_i m_i \bar v_i'\right)}_{=0} \cdot \bar v_{CM}$$

$$= E_k' + \frac{1}{2} m_{TOT} v_{CM}^2$$

$$\boxed{E_k = E_k' + E_{k,CM}}$$

T. König per l'energia cinetica



$$E_k = E_k' + E_{k,CM}$$

SdR del CM

$$\bar{p} = m_{TOT}\, \bar{v}_{CM} \qquad (\bar{p}' = 0)$$

$$\bar{R}^{E} = m_{TOT}\, \bar{a}_{CM} \qquad (\bar{R}^{E} = 0)$$

moto di traslazione

$$\bar{L}_O = \bar{L}'_{CM} + \bar{L}_{O,CM}$$

$$\bar{M}^{E}_{O} = \bar{M}'^{E}_{CM} + \bar{M}_{O,CM}$$

$$E_K = E'_K + E_{K,CM}$$

$\Rightarrow$ moto di rotazione