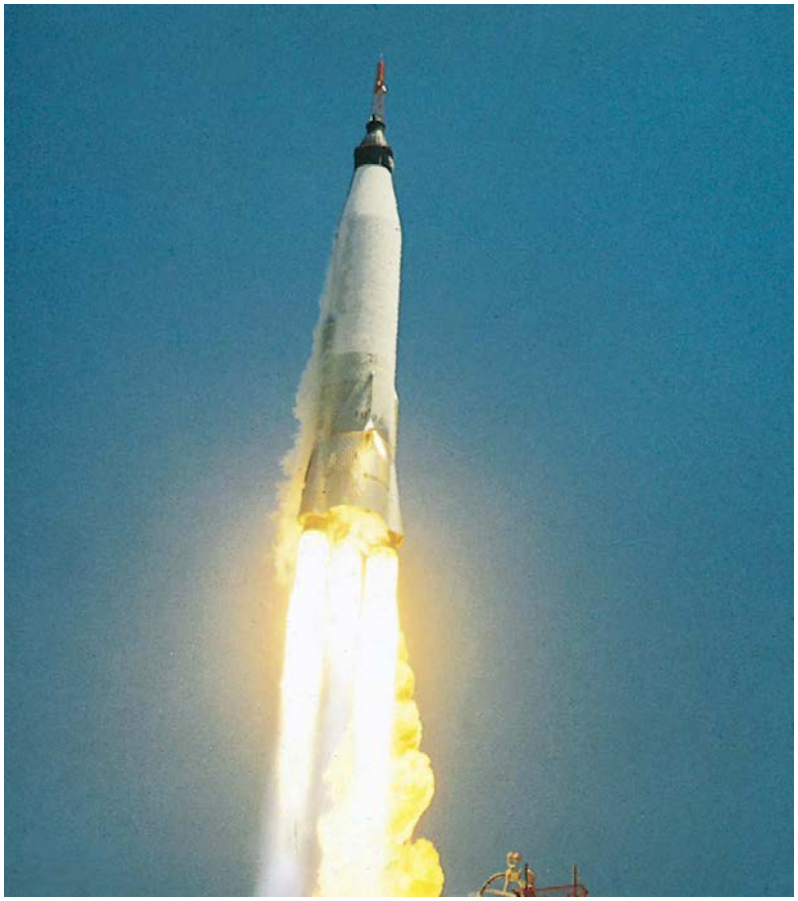
Systems of particles



Internal and external forces

$$\vec{F}_i = m_i \vec{a}_i = \vec{F}_{i\,\text{ext}} + \vec{F}_{i\,\text{int}}$$

$$\vec{F}_{ik\,\text{int}} = -\vec{F}_{ki\,\text{int}} \quad \rightarrow \quad \sum_i F_{i\,\text{int}} = 0$$

$$\sum_i m_i \vec{a}_i = \frac{d}{dt} \sum_i \left(m_i \vec{v}_i \right) = \frac{d\vec{p}}{dt} = \sum_i \vec{F}_{i\,\text{ext}} = \vec{F}$$

isolated systems $\vec{F} = 0$

Centre of mass

$$m\vec{r}_s = \sum_i m_i \vec{r}_i \quad \rightarrow \quad \vec{r}_s = \frac{1}{m} \sum_i m_i \vec{r}_i$$

Mass centre motion

$$\vec{v}_s = \frac{1}{m}\sum_i m_i \vec{v}_i$$

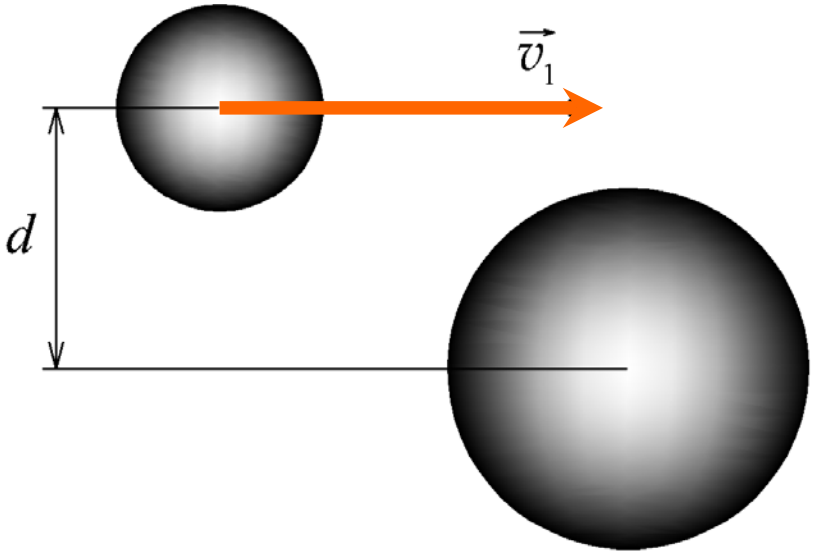
$$\vec{p} = \sum m_i \vec{v}_i = m\vec{v}_s$$

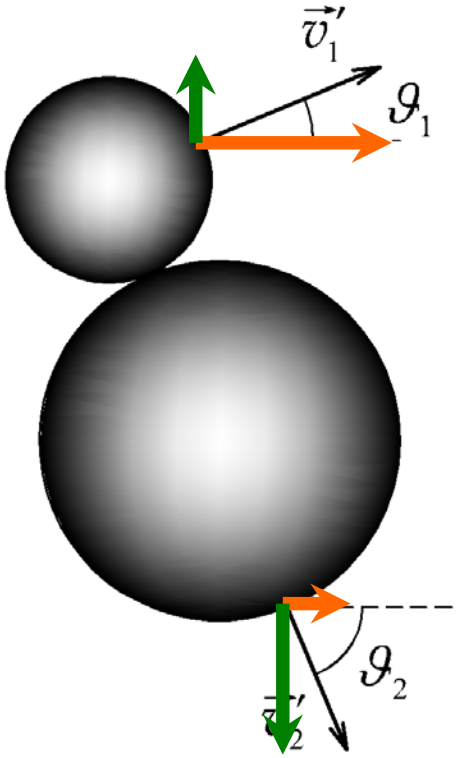
$$m\vec{a}_s = \vec{F} \quad \longrightarrow \quad \vec{F} = \frac{d\vec{p}}{dt}$$

isolated system $\quad \vec{F} = \sum_i \vec{F}_i = 0 \Rightarrow \vec{p} = \overrightarrow{const}$ $\quad$ **CLM**

Collision

isolated system of two particles → CLM $m_1\vec{v}_1 + m_2\vec{v}_2 = m_1\vec{v}'_1 + m_2\vec{v}'_2$

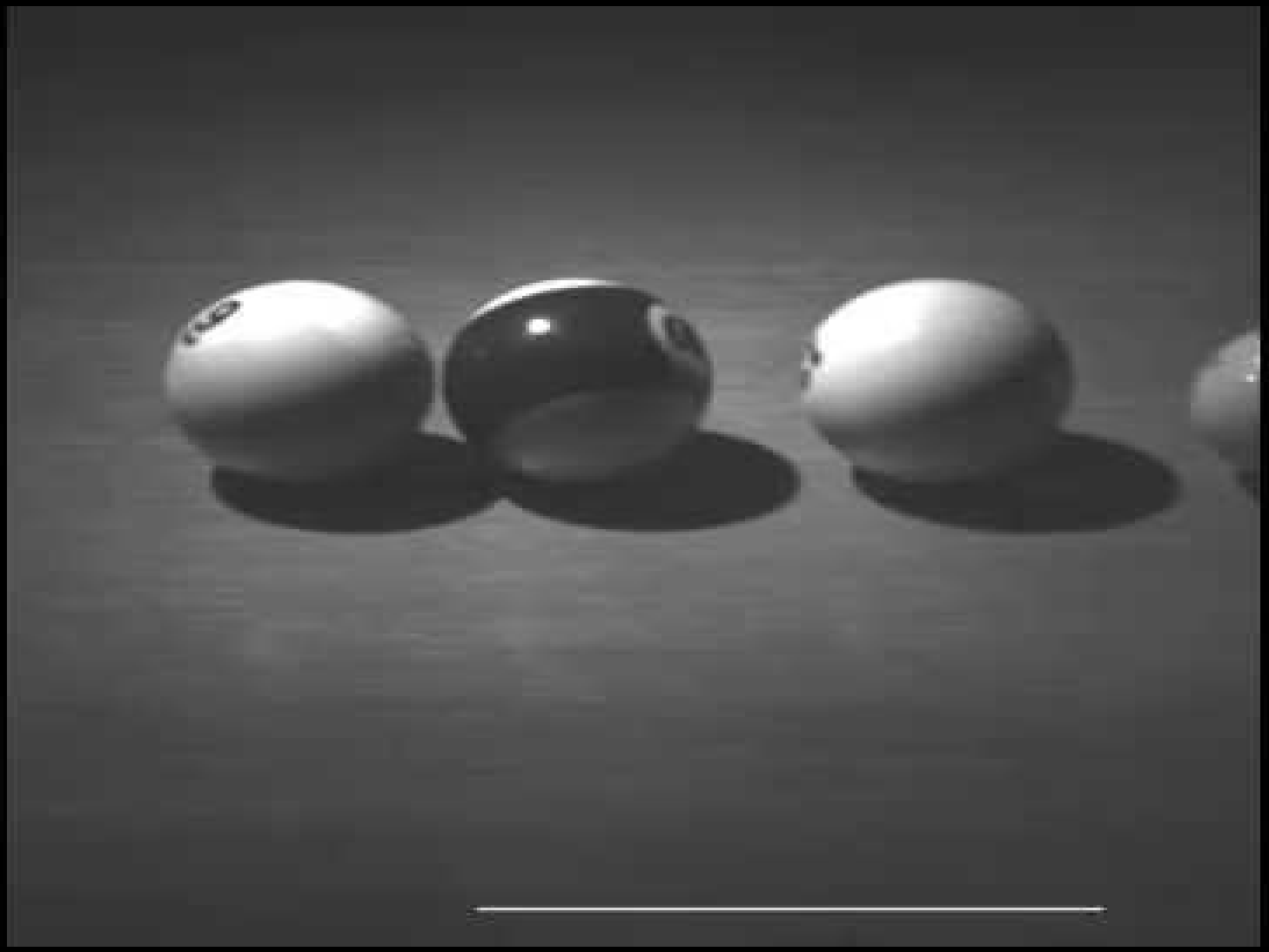




CME $\frac{1}{2}m_1v_1^2 = \frac{1}{2}m_1v_1'^2 + \frac{1}{2}m_2v_2'^2 + \boldsymbol{W_D}$

collision - elastic

- inelastic



Mass centre of a collision

analysis of the system mass centre velocity

solution of collision in a reference system fixed to the mass centre

if the mass centre stays at rest, linear momentum equals zero

Stationary target collision

projectile and target - solid state physics

- physics of particles

- nuclear physics