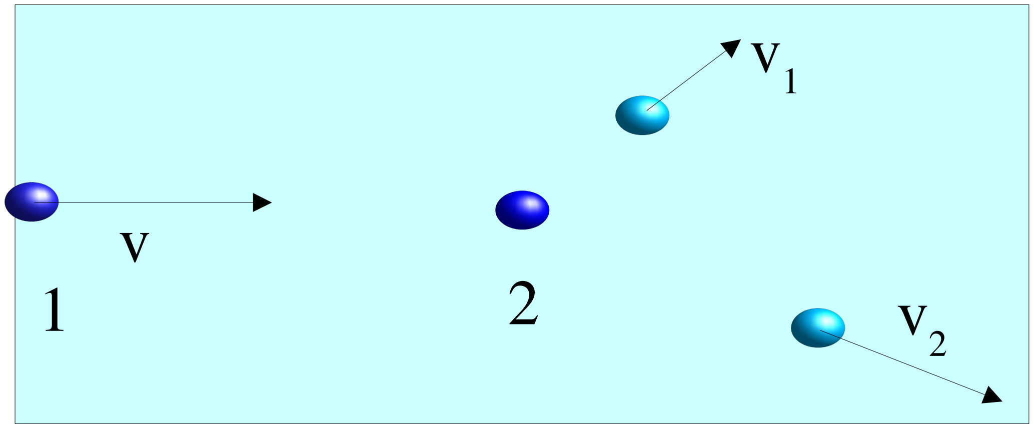
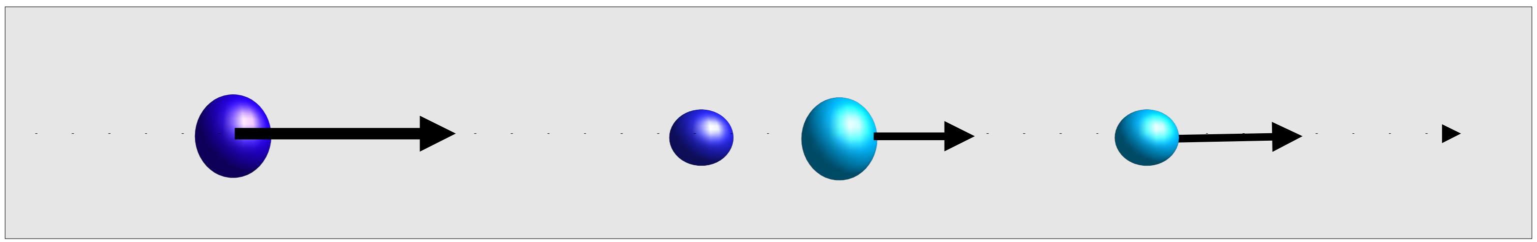
Sistema a due corpi

urti

URTO CLASSICO DI DUE PALLE DA BILIARDO



Urto classico

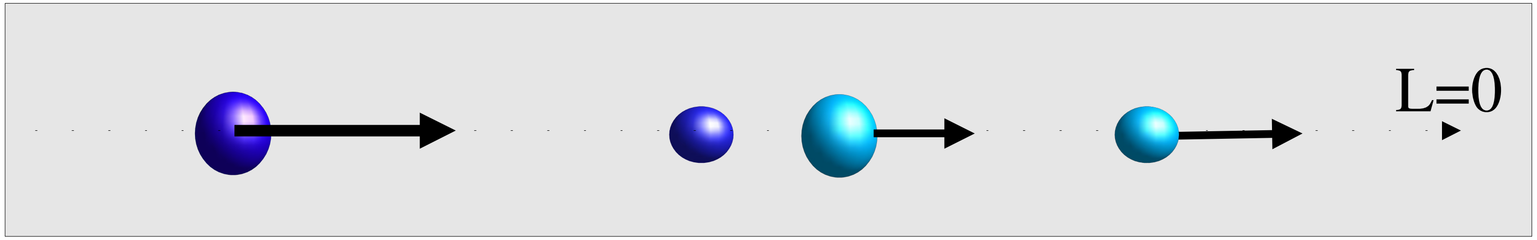


Urto centrale

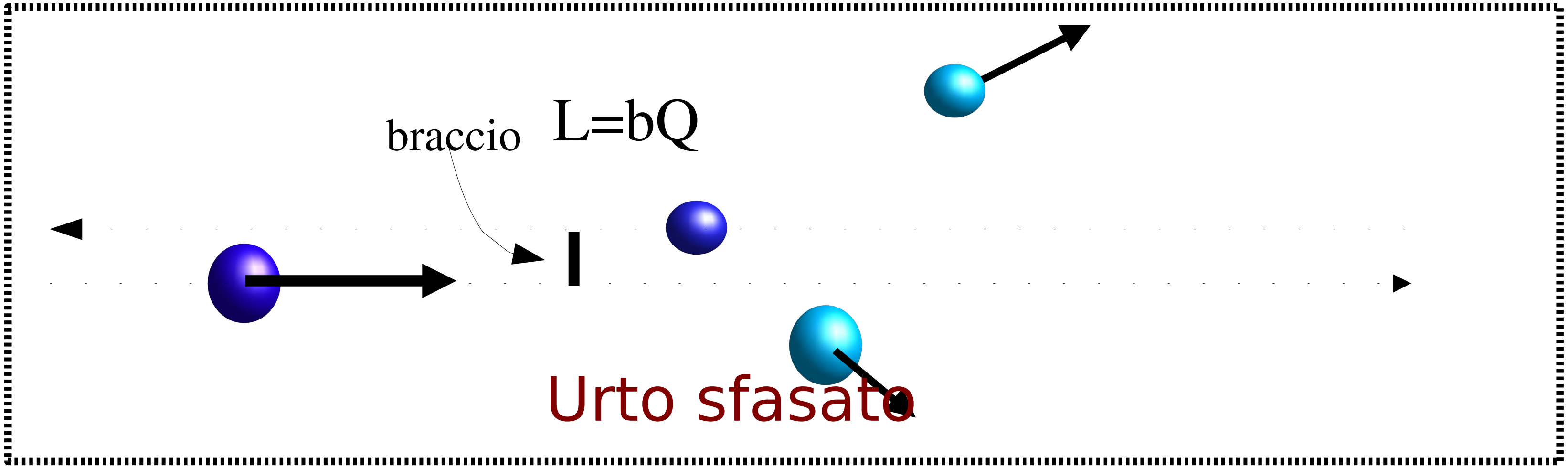
Sistema a due corpi

urti

URTO CLASSICO DI DUE PALLE DA BILIARDO

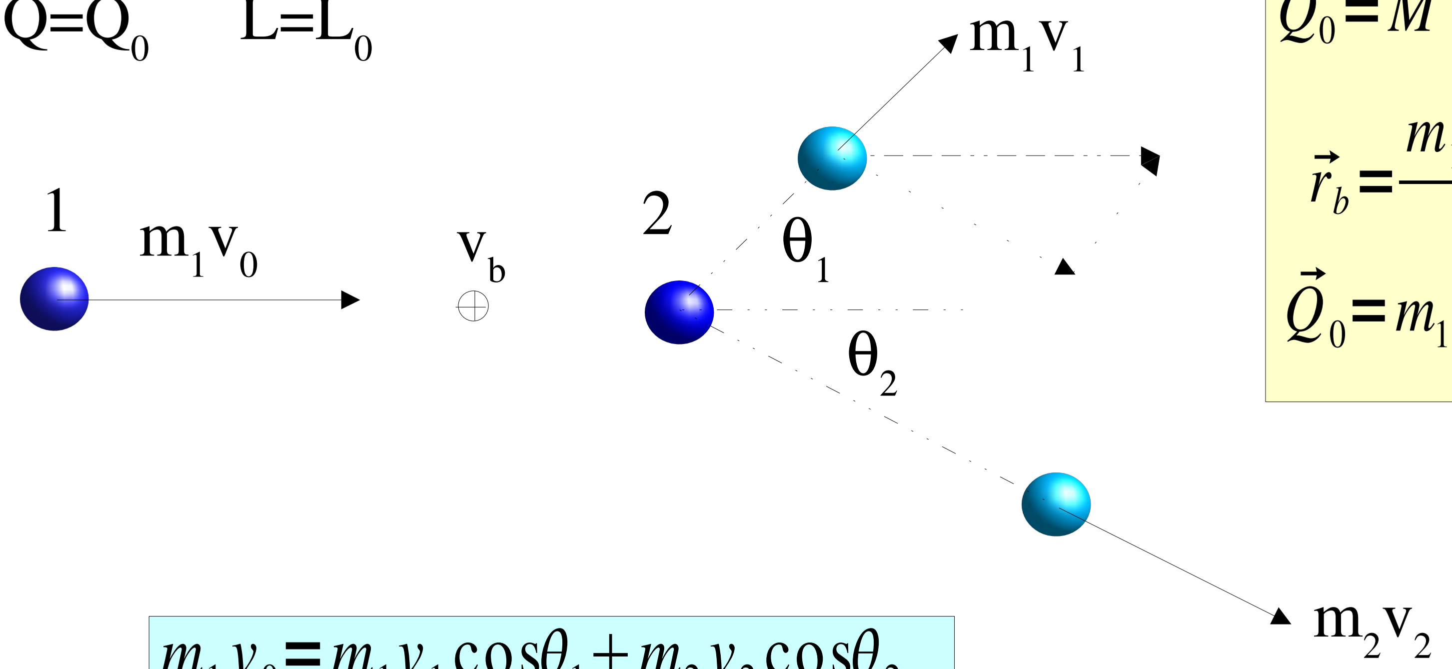


Urto centrale



Sistema a due corpi
Urto

$Q=Q_0$ $L=L_0$



$$\vec{Q}_0 = M\,\vec{v}_b = M\,\frac{d\,\vec{r}_b}{dt}$$

$$\vec{r}_b = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{M}$$

$$\vec{Q}_0 = m_1\vec{v}_{01} + m_2\vec{v}_{02}$$

$$m_1 v_0 = m_1 v_1 \cos\theta_1 + m_2 v_2 \cos\theta_2$$

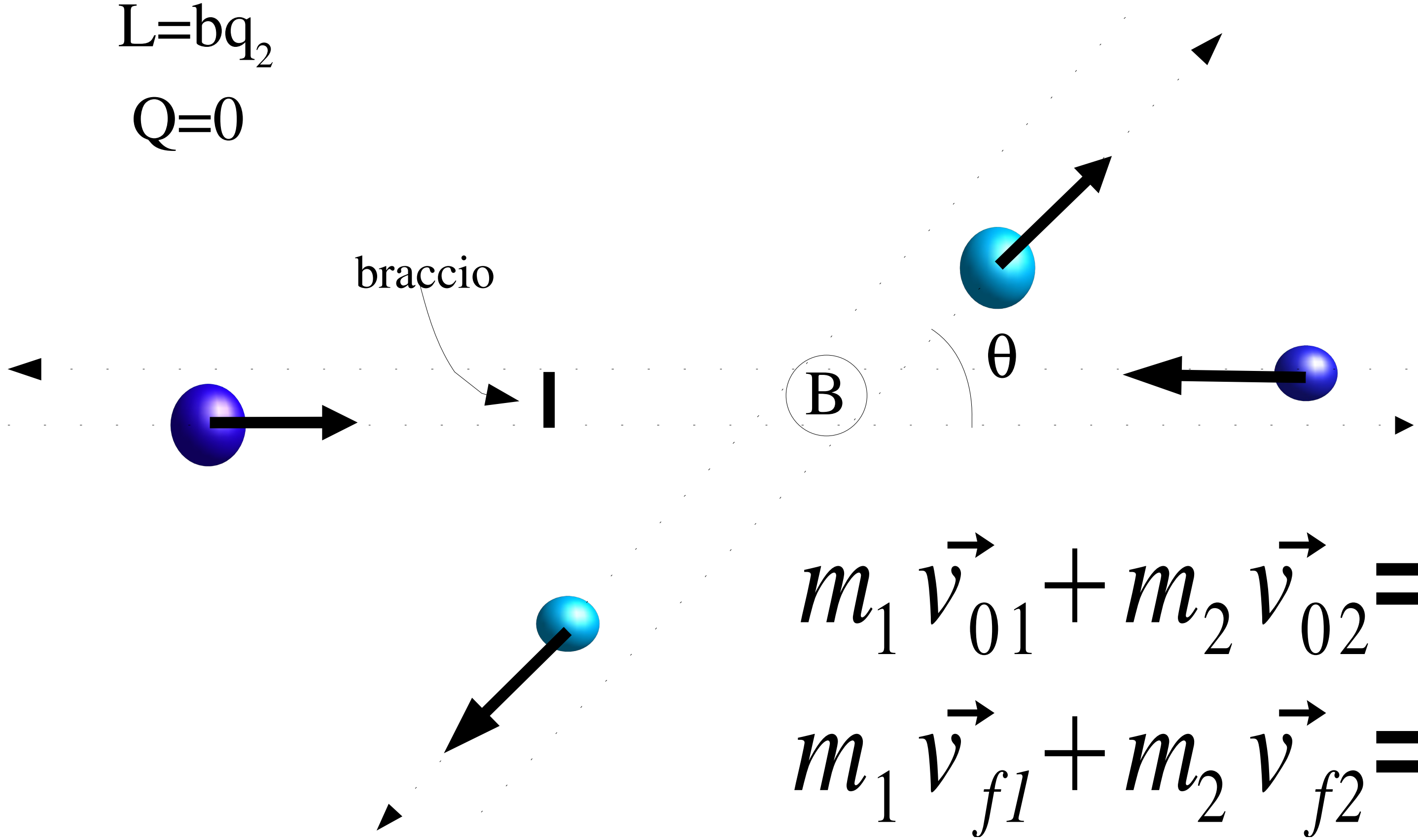
$$0 = m_1 v_1\, sen\theta_1 + m_2 v_2\, sen\theta_2$$

Sistema a due corpi

Urto visto nel baricentro

$L = b q_2$

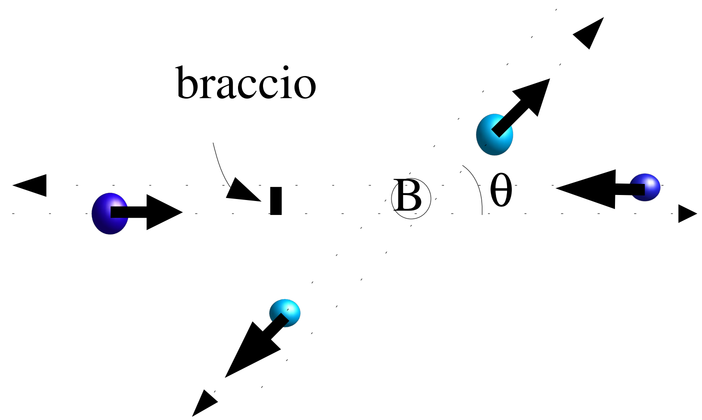
$Q = 0$

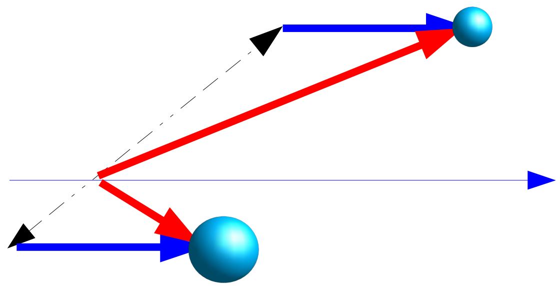


$$m_1 \vec{v}_{01} + m_2 \vec{v}_{02} = 0$$

$$m_1 \vec{v}_{f1} + m_2 \vec{v}_{f2} = 0$$

Sistema a due corpi
Conservazione energia





$$m_1 \vec{v}_{f1} + m_2 \vec{v}_{f2} = 0$$

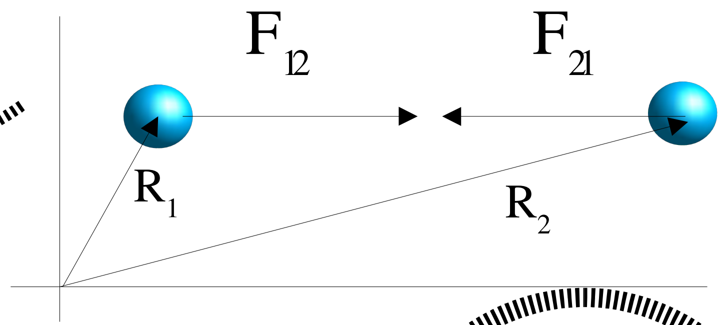
$$\vec{q}_1 + \vec{q}_2 = 0 \qquad \vec{q}_1 = -\vec{q}_2 = \vec{q}$$

$$E = \frac{1}{2}\frac{q_1^2}{m_1} + \frac{1}{2}\frac{q_2^2}{m_2} = \frac{1}{2}\frac{q^2}{\mu} \qquad con \qquad \mu = \frac{m_1 m_2}{m_T}$$

Sistema a due corpi

Particelle in interazione

$$m_1 \ddot{\vec{r}}_1 = \vec{F}_{12}$$
$$m_2 \ddot{\vec{r}}_2 = \vec{F}_{21}$$



somma

$$m_1 \ddot{\vec{r}}_1 + m_2 \ddot{\vec{r}}_2 = M \ddot{\vec{r}}_b = 0$$

poi moltiplicando la prima per m2
e la seconda per m1

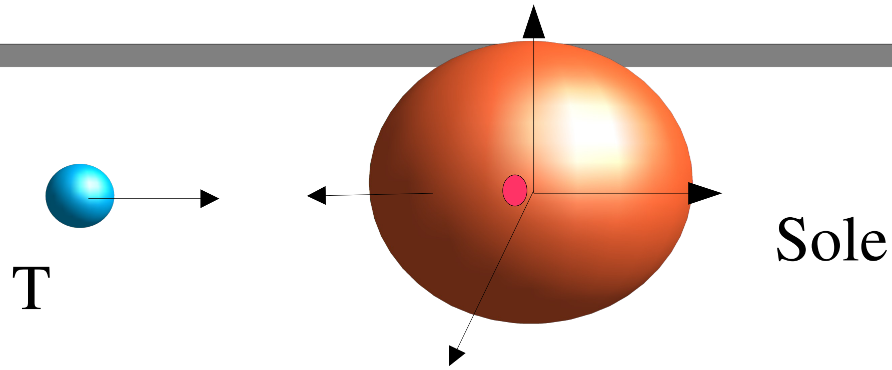
$$m_1 m_2 (\ddot{\vec{r}}_1 - \ddot{\vec{r}}_2) = (m_2 + m_1) \vec{F}_{21}$$

ponendo $\vec{r} = \vec{r}_1 - \vec{r}_2 \qquad \mu = \frac{m_1 m_2}{m_1 + m_2}$

$$\mu \ddot{\vec{r}} = F_{21}$$

$$\vec{r}_1 = \vec{r}_b + \frac{m_2}{M} \vec{r}$$
$$\vec{r}_2 = \vec{r}_b + \frac{m_1}{M} \vec{r}$$

Sistema a due corpi
terra – sole



$$\text{il baricentro corrispsonde con il centro del sole}\ \vec{r}_s \simeq \vec{r}_b$$

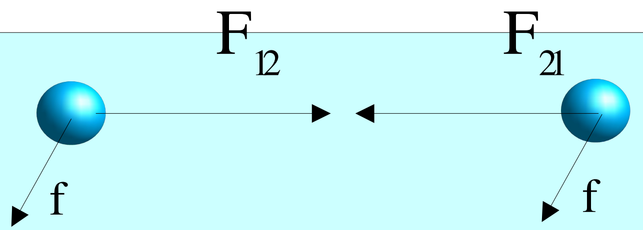
$$\vec{r}_s = \vec{r}_b \simeq 0 \qquad \vec{r}_t = \vec{r}_b + \vec{r}$$

$$\mu \equiv M_s \qquad m_t \ddot{\vec{r}}_t = -\frac{G M_s m_t}{r_t^2} \hat{r}_t$$

Sistema a due corpi
in campo di forze

$$m_1 \ddot{\vec{r}}_1 = \vec{F}_{12} + \vec{f}$$
$$m_2 \ddot{\vec{r}}_2 = \vec{F}_{21} + \vec{f}$$

Forza costante



$$M\,\ddot{\vec{r}}_b = 2\,\vec{f} \qquad \mu = \frac{m_1 m_2}{m_1 + m_2} \qquad \mu\,\ddot{\vec{r}} = \vec{F}_{21} + \frac{m_2 - m_1}{M}\,\vec{f}$$

Forza proporzionale alla massa

$$M\,\ddot{\vec{r}}_b = \vec{f}_1 + \vec{f}_2 = M\,\vec{g} \qquad \mu = \frac{m_1 m_2}{m_1 + m_2} \qquad \mu\,\ddot{\vec{r}} = \vec{F}_{21} + \cancel{\frac{m_2\,\vec{f}_1 - m_1\,\vec{f}_2}{M}} = \vec{F}_{21}$$

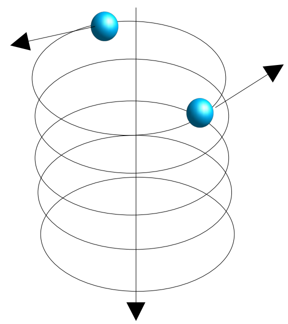
Sistema a due corpi
forza elastica

$$M\ddot{\vec{r}}_b = M\vec{g} \qquad \mu = \frac{m_1 m_2}{m_1 + m_2} \qquad \mu\ddot{\vec{r}} = -k\vec{r}$$

$$\vec{r} = (A_x \sin(\omega t + \phi_x), A_y \sin(\omega t + \phi_y), A_z \sin(\omega t + \phi_z))$$

$$\vec{r}_1 = \frac{1}{2}\vec{g}\,t^2 + \frac{m_2}{M}\vec{r}(t)$$

$$\vec{r}_2 = \frac{1}{2}\vec{g}\,t^2 + \frac{m_1}{M}\vec{r}(t)$$



E' una spirale a passo crescente...