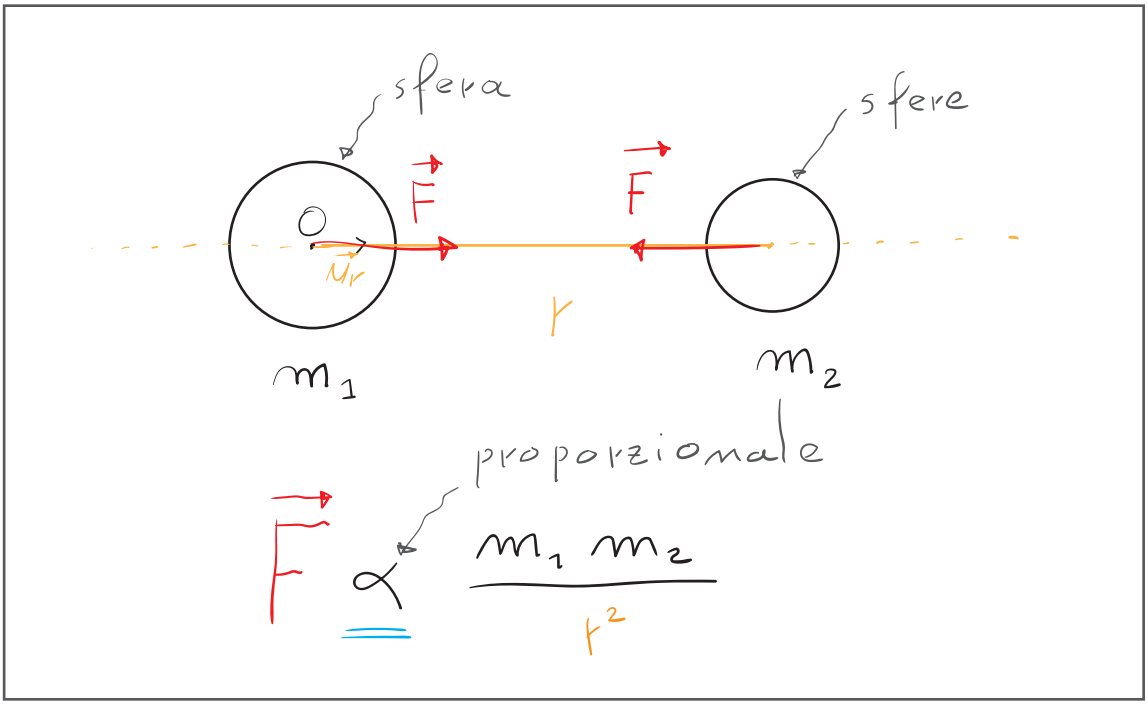
Università
degli Studi
di Padova

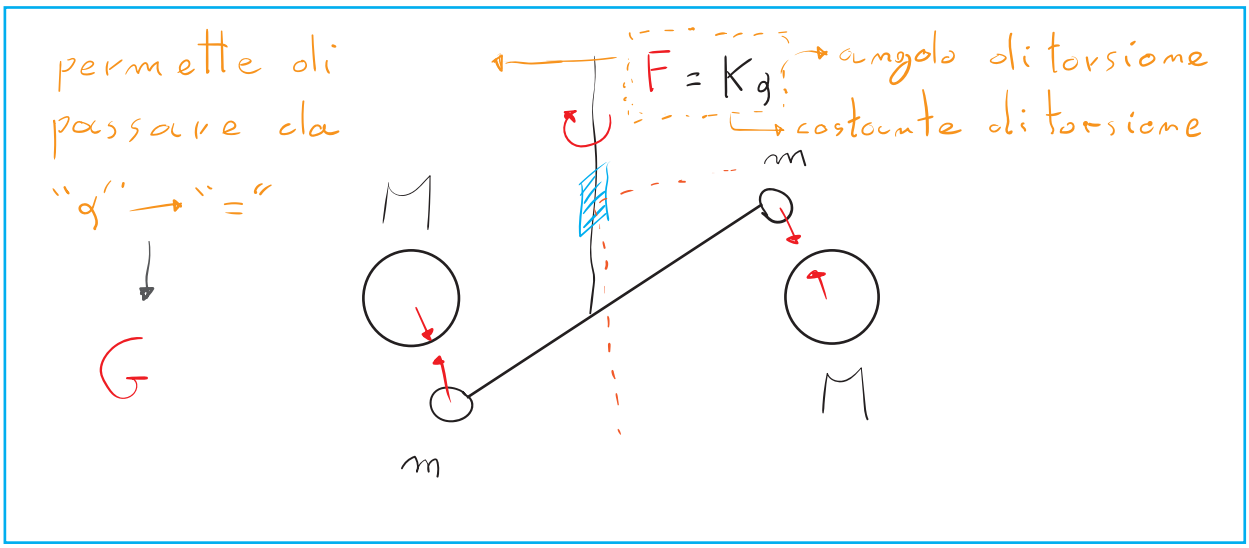
Fisica 1

Lezione 36: Gravitazione

Prof. Giubilato

Legge gravitazione Universale





Bilancia di torsione

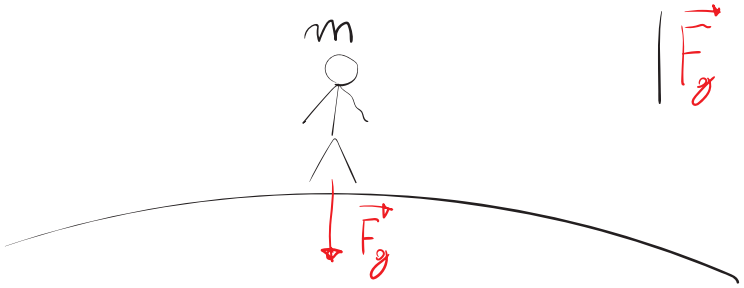
sempre attrattiva → non ci sono masse negative

$$\vec{F} = -G \frac{m_1 m_2}{r^2} \simeq G$$

1 Kg, 1 Kg, $r^2 = (1\,m)^2$

G: costante gravitazione universale $\} \simeq 6.67 \cdot 10^{-11} \left[\frac{N\,m^2}{Kg^2}\right]$

Calcolo di g_0



$$|\vec{F}_g| = G\frac{m M_\oplus}{R_\oplus^2}$$

$$g_0 = \frac{F_g}{m} = G\frac{M_\oplus}{R_\oplus^2}$$

$M_\oplus \simeq 6\cdot 10^{24}\ Kg$

$R_\oplus \simeq 6.4\cdot 10^{6}\ m$

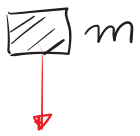
$$g_0 \simeq 6.67\cdot 10^{-11}\frac{6\cdot 10^{24}}{(6.4\cdot 10^{6})^2}$$

$$\simeq \frac{40\cdot 10^{13}}{41\cdot 10^{12}} \simeq 0.98\cdot 10$$

$$\simeq 9.8\left[\frac{m}{s^2}\right]$$

$$\vec{F} = \frac{d\vec{p}}{dt} = m\vec{a} + \vec{v}\frac{dm}{dt}$$

$$\vec{F}_g = -G\frac{m_1 m_2}{r^2}$$



massa dinamica

$$\vec{F} = m\vec{a}$$

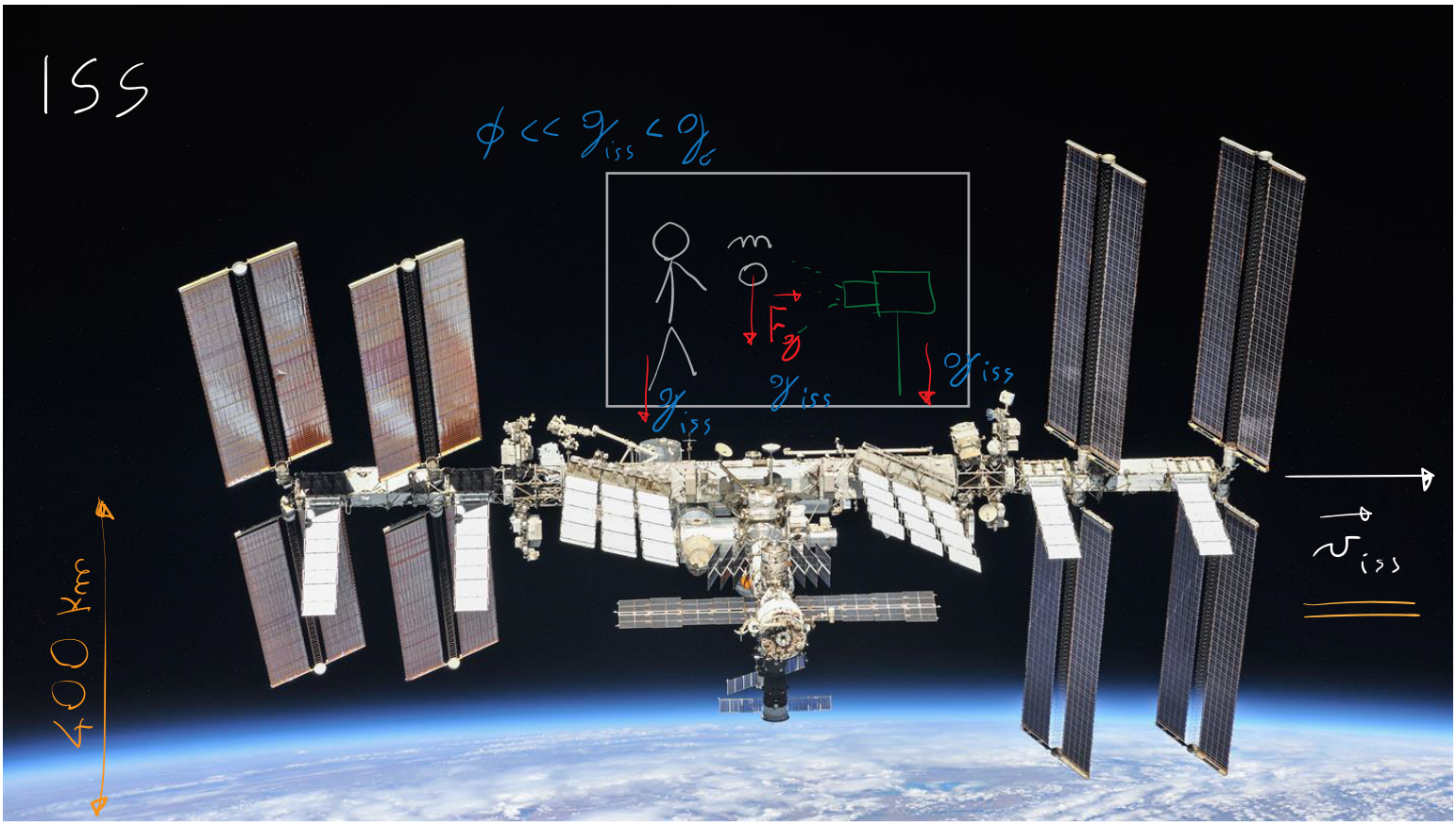
$$\omega = \sqrt{\frac{K}{m}}$$

$$\vec{F}_g = \frac{m M_\oplus}{r^2}$$

massa gravitazionale

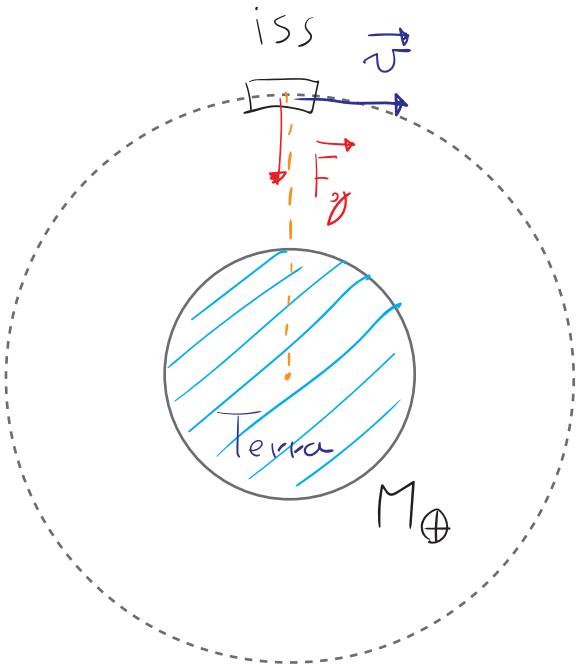
Principio di equivalenza (Einstein)

ISS



$$\frac{\vec{F}_g}{m} = g_{iss} = \frac{6.67 \cdot 10^{-11} \cdot 6 \cdot 10^{24}}{(6.4 \cdot 10^6 + \underbrace{400 \cdot 10^3}_{400\ Km})^2} \simeq \frac{40 \cdot 10^{13}}{(6.4 \cdot 10^6 + 0.4 \cdot 10^6)^2}$$

$$\simeq \frac{40 \cdot 10^{13}}{46 \cdot 10^{12}} \simeq 8.7 \left[\frac{m}{s^2}\right]$$



$r_{iss} \simeq 6.8 \cdot 10^6\ m$ rispetto centro Terra

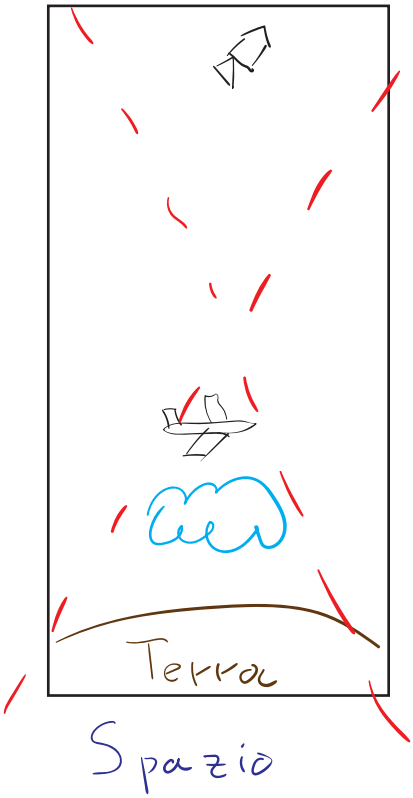
$$\begin{cases} a_c = \dfrac{v^2}{r} & \text{moto circolare uniforme} \\ a_{c,iss} = g_{iss} = G\dfrac{M_\oplus}{r_{iss}^2} \end{cases}$$

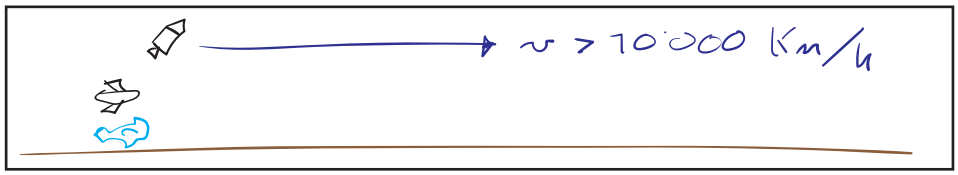
$$\frac{v^2}{r_{iss}} = G\frac{M_\oplus}{r_{iss}^2} \qquad v = \sqrt{\frac{G M_\oplus}{r_{iss}}}$$

$$v_{iss} \simeq \sqrt{\frac{40 \cdot 10^{13}}{6.8 \cdot 10^6}} \simeq \sqrt{6 \cdot 10^7} \simeq 7670 \left[\frac{m}{s}\right]$$

$$\simeq 27612 \left[\frac{Km}{h}\right]$$

Proporzioni dello spazio





Spazio

Mandare 1 Kg sulla ISS

$$U_g < \underbrace{mgh}_{1'} \; g_0 \; 4 \cdot 10^5 \simeq 4 \cdot 10^6 \text{ J}$$

$$E_K = \frac{1}{2} m v^2 = \frac{(7670)^2}{2} \simeq 30 \cdot 10^6 \text{ J}$$

Basi di lancio