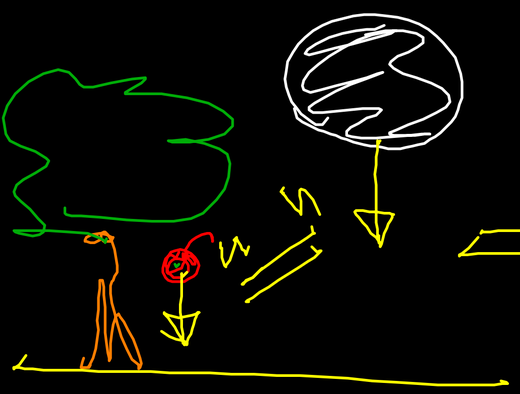
GRAVITAZIONE UNIVERSALE

TYCO BRAHE → ORBITE DEI PIANETI

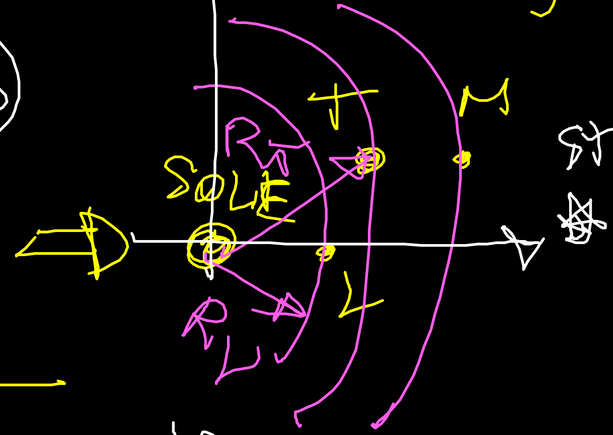
↳ KEPLER → i) ORBITE ELLITTICHE (SOLE NEL FUOCO)

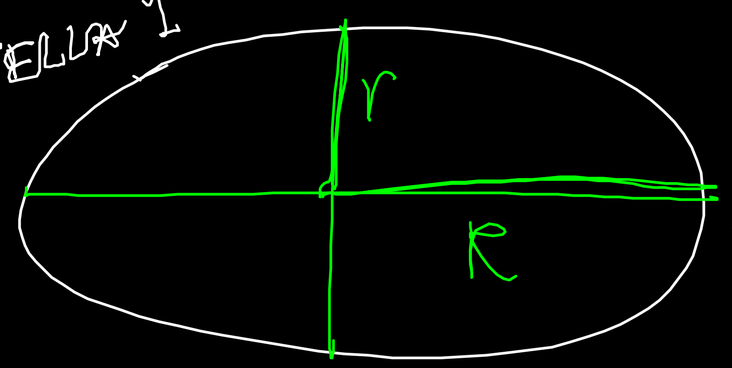
(COPERNICO) ii) LEGGE DELLE AREE

iii) $T^2 \propto R^3$



NEWTON





$\frac{r}{R} = \varepsilon$

$M_T = 6{,}4 \times 10^{24}\ kg$

$R_T = 1{,}5 \times 10^{11}\ m$

IPOTESI

- ORBITE CIRCOLARI
- PUNTI MATERIALI
- SIST. INERZ.
- FORZA SOLE

CORPO	T	R	$a_c = \frac{4\pi^2 R}{T^2}$
SOLE			—
MERCURIO	$0{,}760 \times 10^7\ s$	$0{,}579 \times 10^{11}\ m$	
⋮			
SATURNO	$93{,}5 \times 10^7\ s$	$14{,}3 \times 10^{11}\ m$	—

$$a_c R^2 = \frac{4\pi^2 R^3}{T^2}$$

$1{,}33 \times 10^{20}\ \frac{m^3}{s^2}$

$(1{,}33 \times 10^{20}\ m^3/s^2)$

$1{,}32 \times 10^{20}\ \frac{m^3}{s^2}$

FATTO SPERIM.

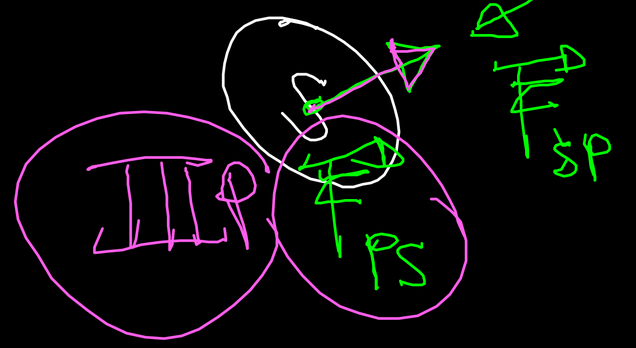
$$a_c = \frac{V^2}{R} = \omega^2 R = \frac{4\pi^2 R}{T^2}$$

$$\omega = \frac{2\pi}{T}$$

$$a_c R^2 = K_S \quad (\forall \text{ pianeta})$$

$$a_c = \frac{K_S}{R^2} \; ; \; F_{SP} = m_P a_c$$

II P



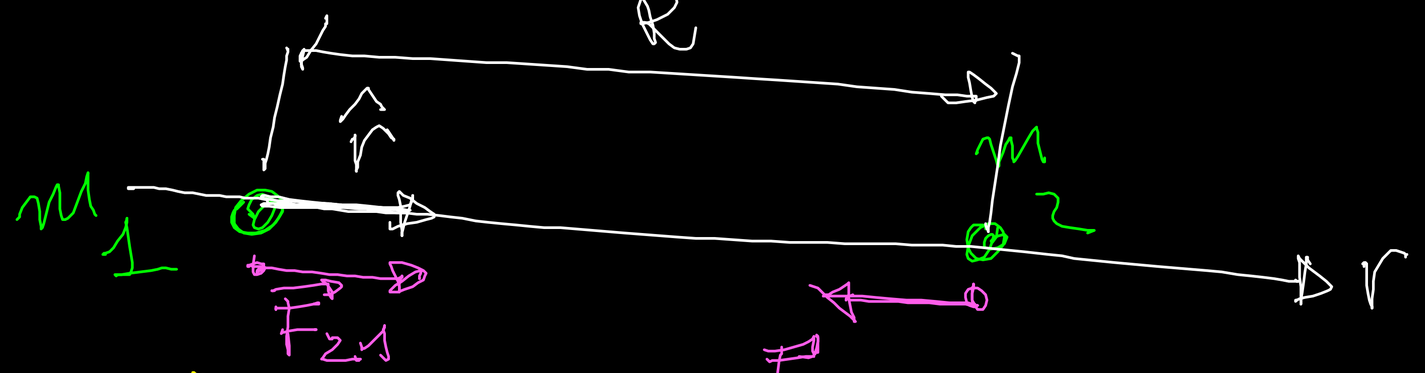
$$F_{SP} = m_P \frac{K_S}{R^2} = F_{PS} =$$

$$K_S = G m_S$$

$$= \frac{G m_S m_P}{R^2} = F_G$$

$$F_G = G\frac{M_S M_P}{R^2}$$

G → "gi grande"



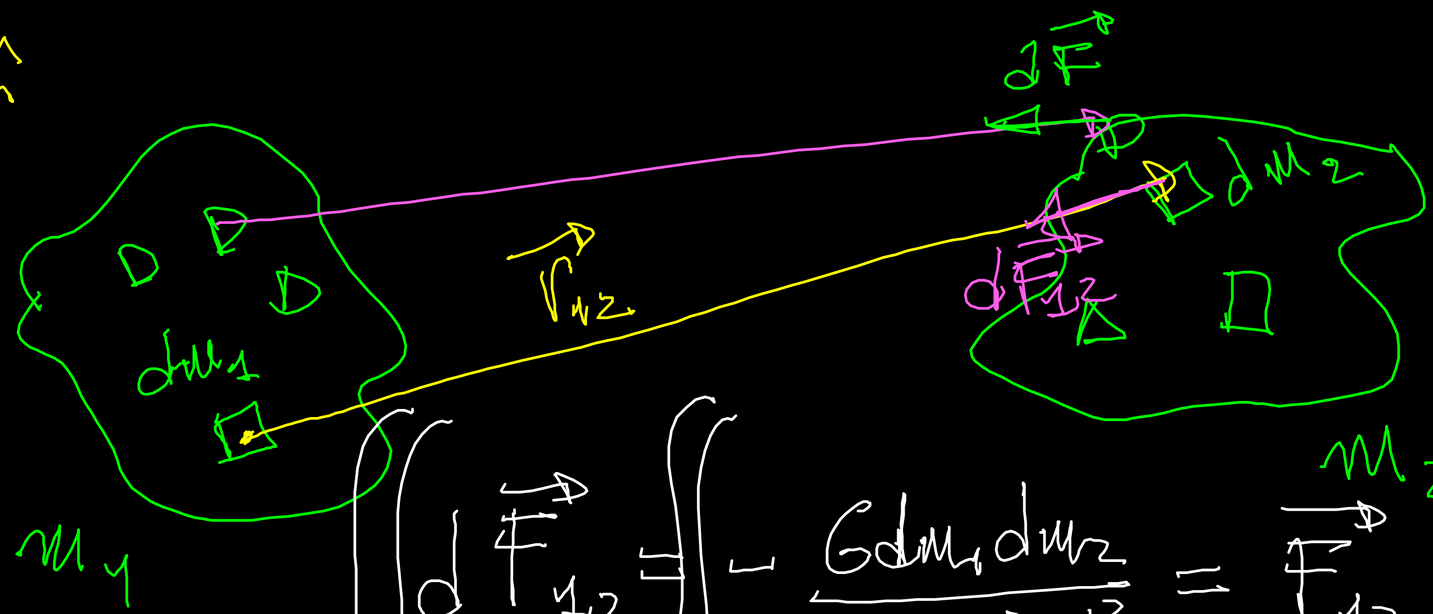
$$\vec{F}_{12} = -\frac{G m_1 m_2}{R^2}\hat{r} = -\vec{F}_{21}$$

(2) (1)

LEGGE DI GRAV. UNIV. DI NEWTON (CORPI PUNTIFORMI)

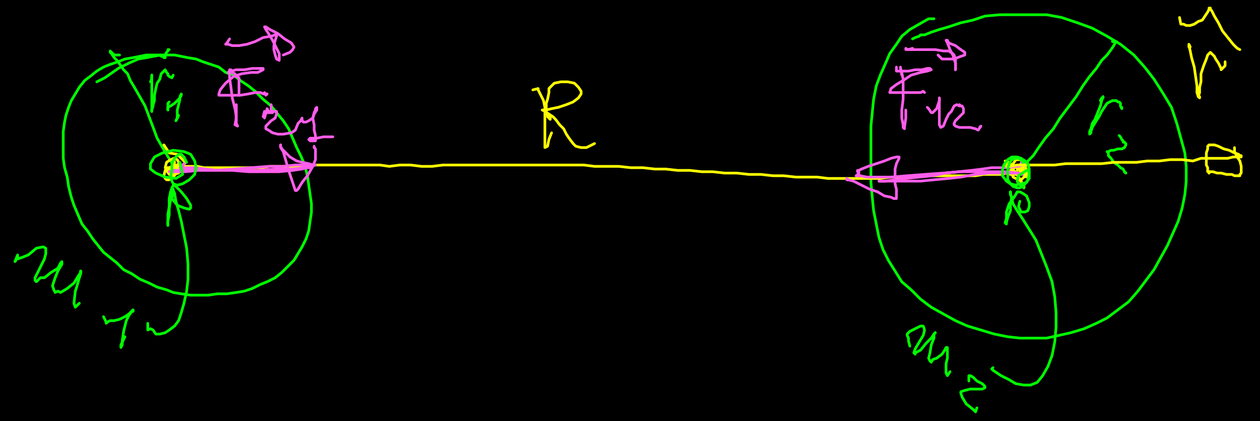
FORZA DI GRAVITA' TRA CORPI ESTESI

$$\vec{F}_G = -\frac{G m_1 m_2}{R^2}\hat{r}$$



$$\iint d\vec{F}_{12} = \iint -\frac{G\,dm_1\,dm_2}{|\vec{r}_{12}|^2}\hat{r} = \vec{F}_{12}$$

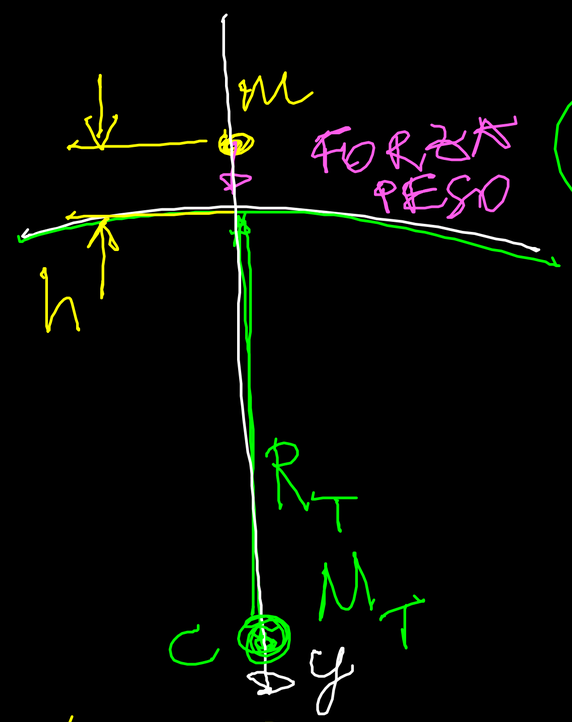
m_1 m_2



$$\vec{F}_{12} = -\frac{G m_1 m_2}{R^2}\hat{r}$$

G "GRANDE" — COST. DI GRAV. UNIV.

$$F_G = -\frac{G m_1 m_2}{R^2}$$



misurabile

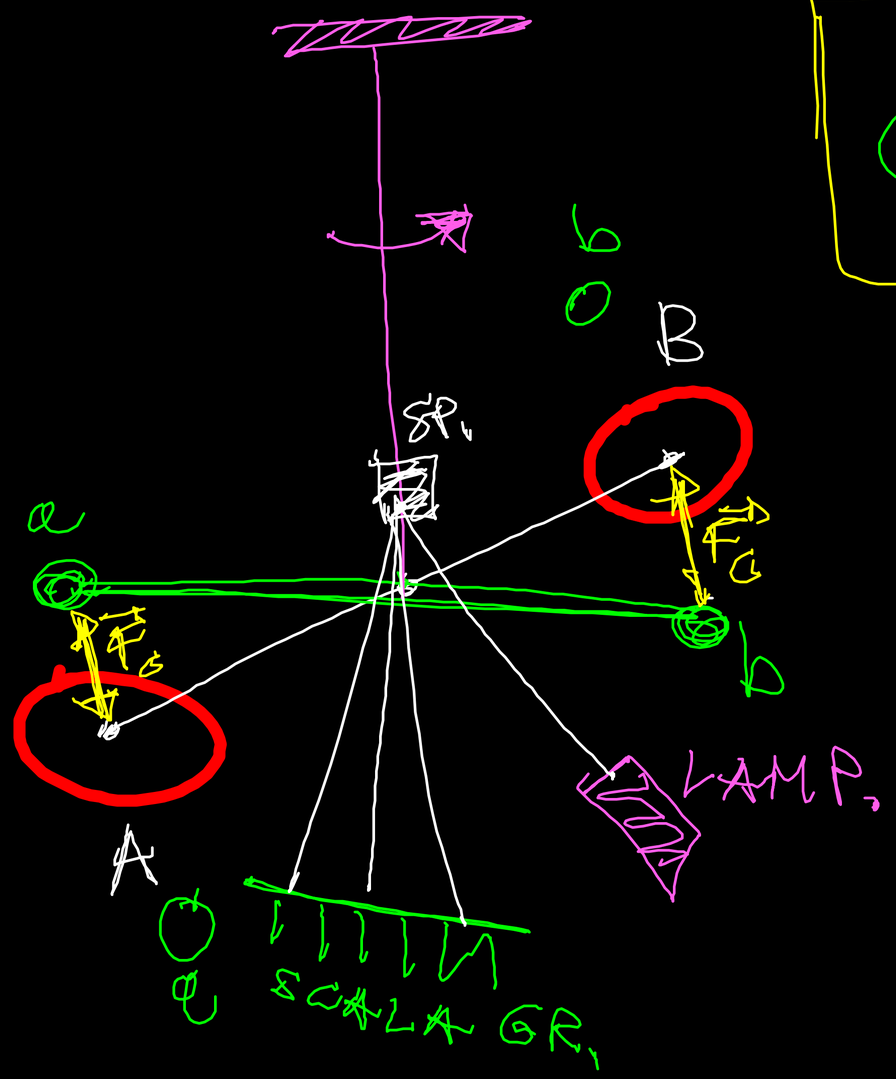
(9) $mg = \frac{G M_T m}{(R_T + h)^2} = \frac{G M_T m}{R_T^2} \frac{1}{\left(1 + \frac{h}{R_T}\right)^2}$

TAYLOR 1° ORD INT $\simeq 1$ $\frac{h}{R_T} \ll 1$

$m g = \frac{G M_T m}{R_T^2}$ ⇒ $G = \frac{g R_T^2}{M_T}$

$h \ll R_T = 6.4 \times 10^6$ m

MISURA DI G → CAVENDISH (1798)



$$G = 6{,}67 \times 10^{-11} \frac{N\,m^2}{Kg^2}$$

$$F = \frac{G\,m_1\,m_2}{R^2}$$

$$G = \frac{F R^2}{m_1 m_2}$$

$$G = \frac{g R_T^2}{M_T} \Rightarrow M_T = \frac{g R_T^2}{G}$$

"PESARE" LA TERRA

5×10^{24} Kg