La matematica delle maree

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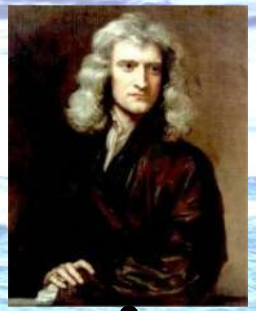
“THE UNREASONABLE EFFECTIVENESS OF MATHEMATICS IN THE NATURAL SCIENCES”

E.Wigner

Le Teorie del Passato

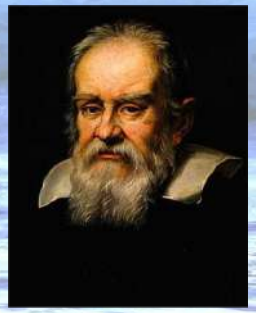


XV secolo

XVI secolo

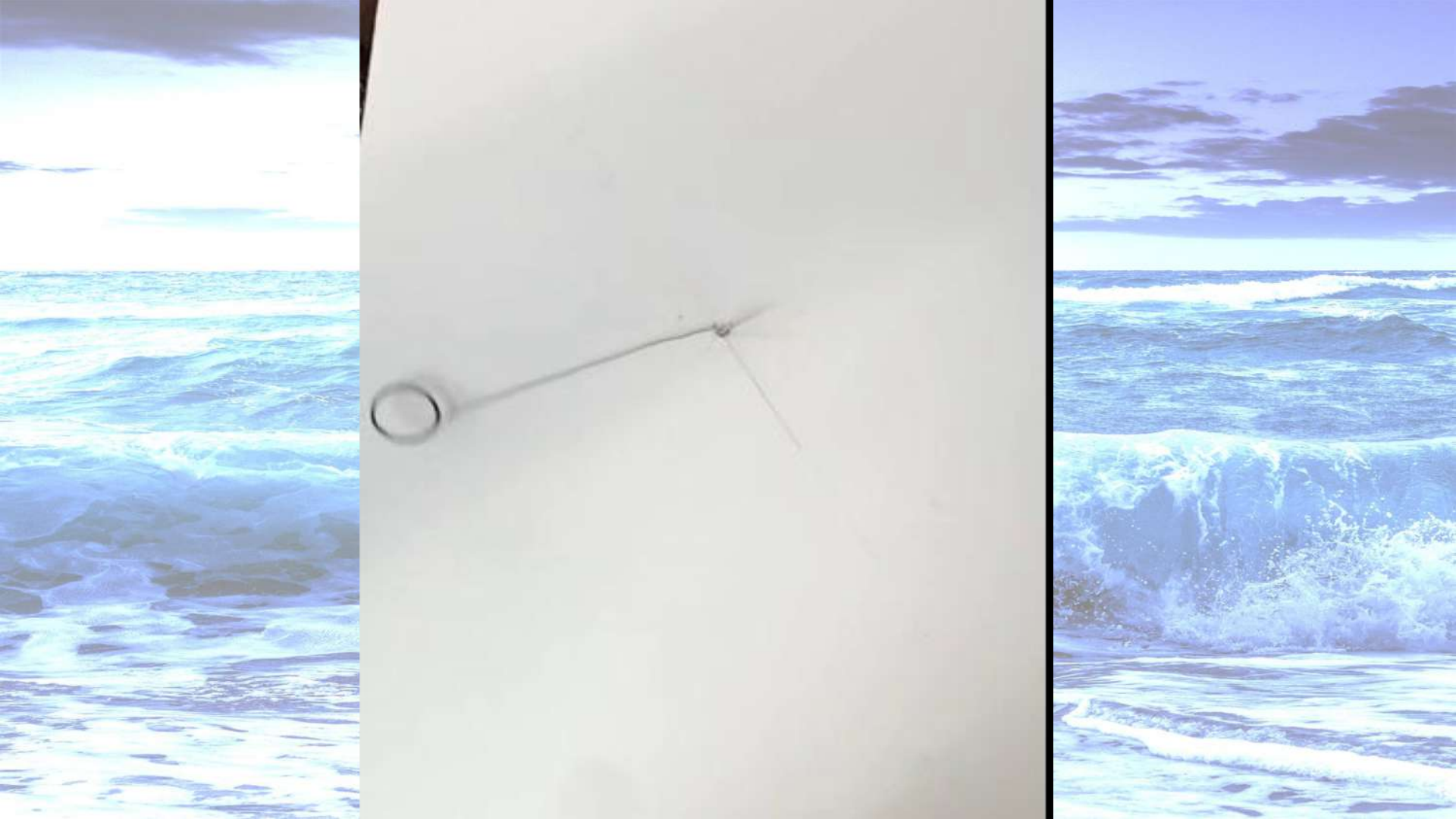
XVII secolo

XVIII secolo



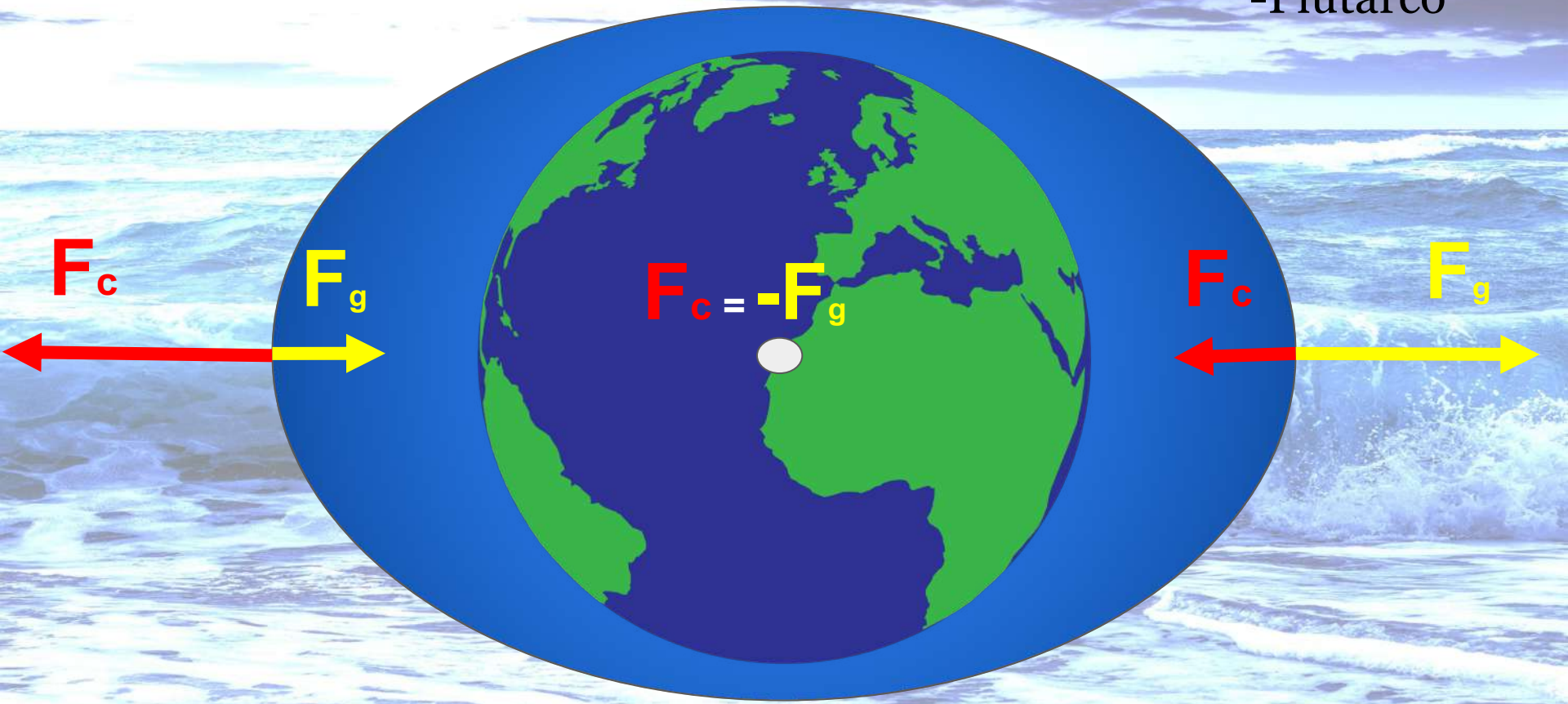
Fatti

- In un punto qualsiasi dell'oceano, due alte e due basse maree al giorno (lunare);
- Oltre al periodo giornaliero, esiste anche un periodo mensile (28 giorni), annuale e uno di 18 anni e mezzo;
- L'altezza delle maree dipende fortemente dalla costa;
- Si osserva l'alta marea in corrispondenza della luna.



“La Terra è come una fionda”

-Plutarco



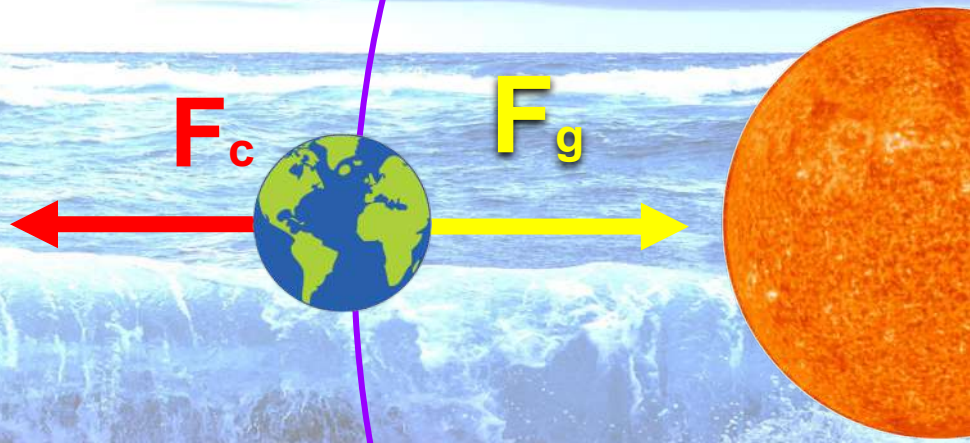
Maree Solari

$$F_g = k\frac{M_s\, m}{r^2}$$

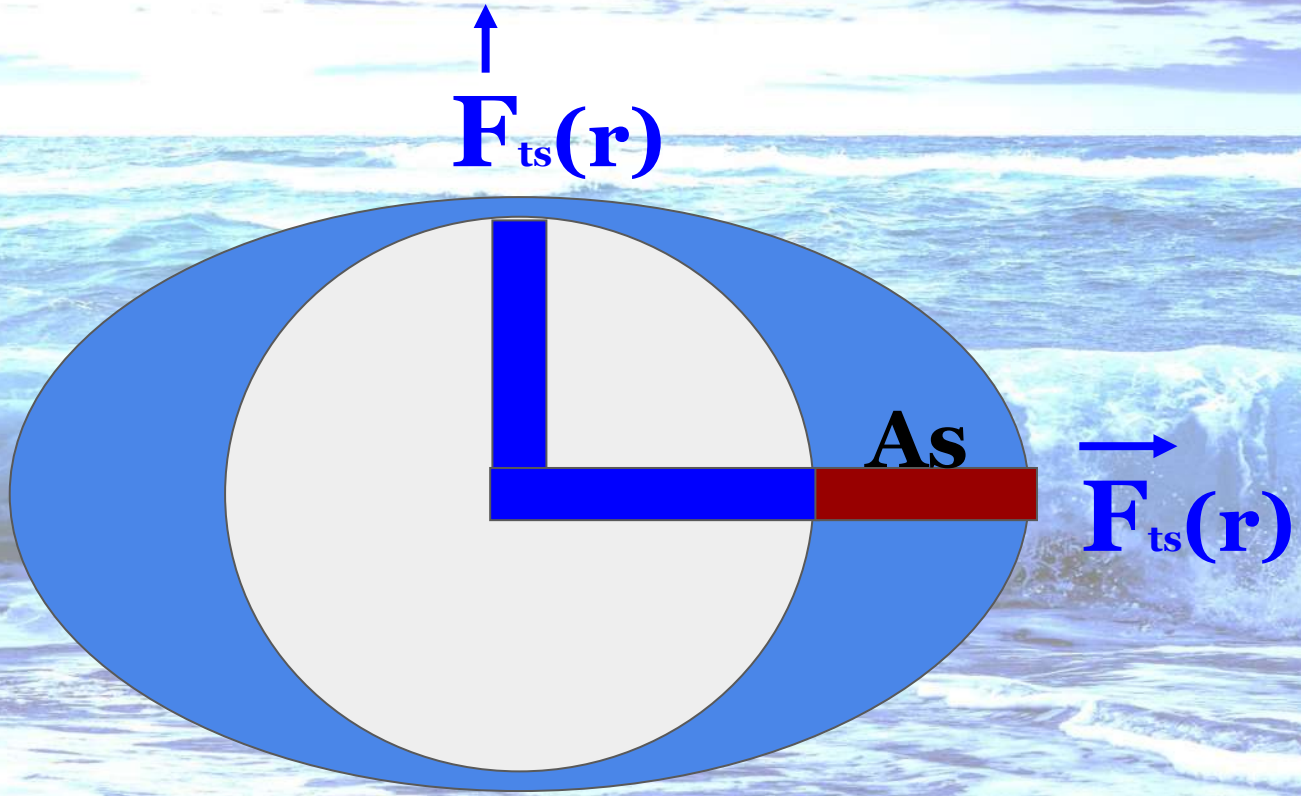
$$F_c = m\omega^2 r$$

$$\vec{F}_{ts}(0) = 0$$

$$\vec{F}_{ts}(r) = F_g - Fc = 3k\,\frac{M_s\, m}{R^3_{TS}}\, r$$

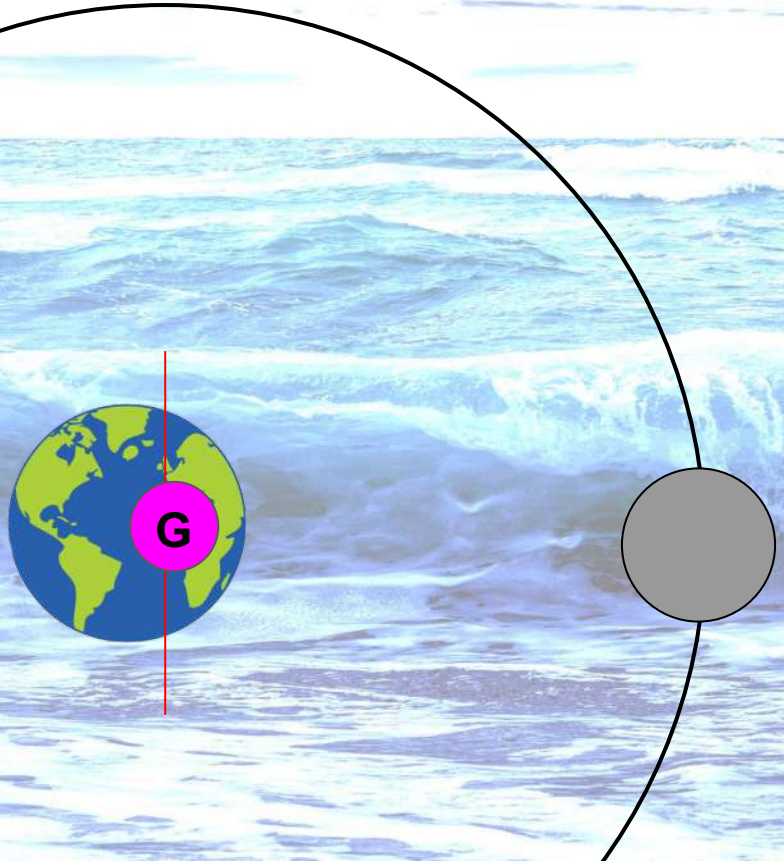


Formula di Newton: **As** = $\frac{3}{2}\left(\frac{M_S}{M_T}\right)\left(\frac{R_T}{R_{TS}}\right)^3 R_T$



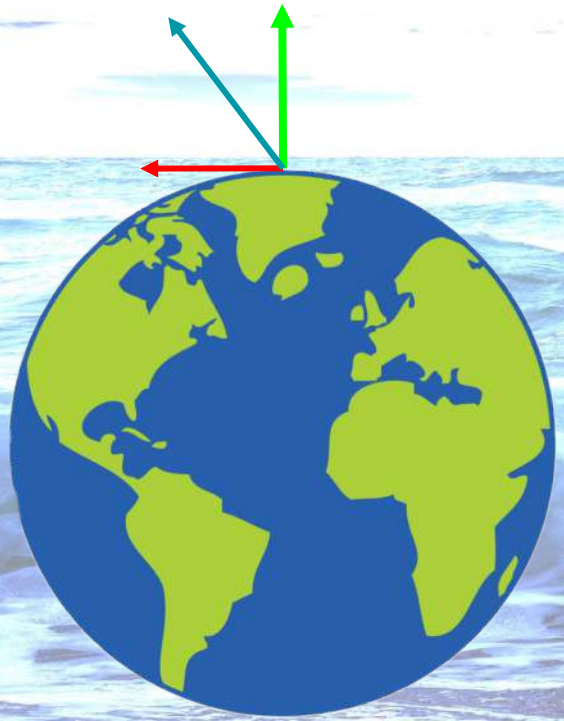
Baricentro

Baricentro Terra-Luna



$$X_g = \frac{M_t X_t + M_l X_l}{M_t + M_l} \cong 4700 \text{ km}$$

Maree lunari



$$\vec{F}_T = \vec{F}_c + \vec{F}_g = \frac{kmM_L}{R_{TL}^3} r \frac{M_T}{M_L}$$

$$\vec{F}_T = \vec{F}_c + \vec{F}_g = \frac{kmM_L}{R_{TL}^3} r \left(3 + \frac{M_T}{M_L}\right)$$

$$F_T = \frac{3kmM_L}{R_{TL}^3} r$$

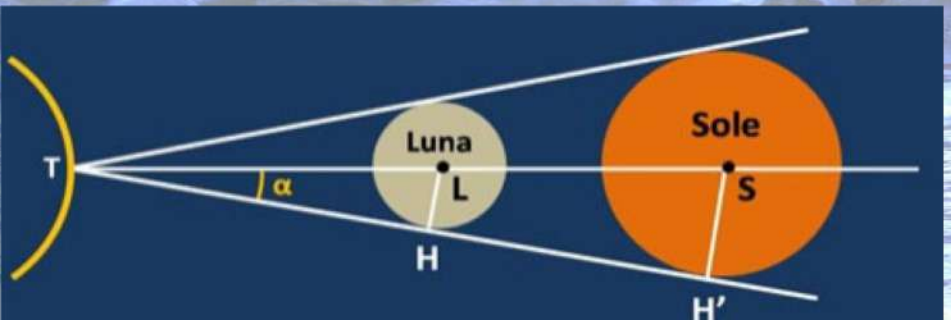
Maree Luni-Solari

ESCURSIONE MAREALE SOLARE

$$As = \frac{3}{2}\left(\frac{M_S}{M_T}\right)\left(\frac{R_T}{R_{TS}}\right)^3 R_T \simeq 24\ cm$$

ESCURSIONE MAREALE LUNARE

$$Al = \frac{3}{2}\left(\frac{M_L}{M_T}\right)\left(\frac{R_T}{R_{TL}}\right)^3 R_T \simeq 54\ cm$$



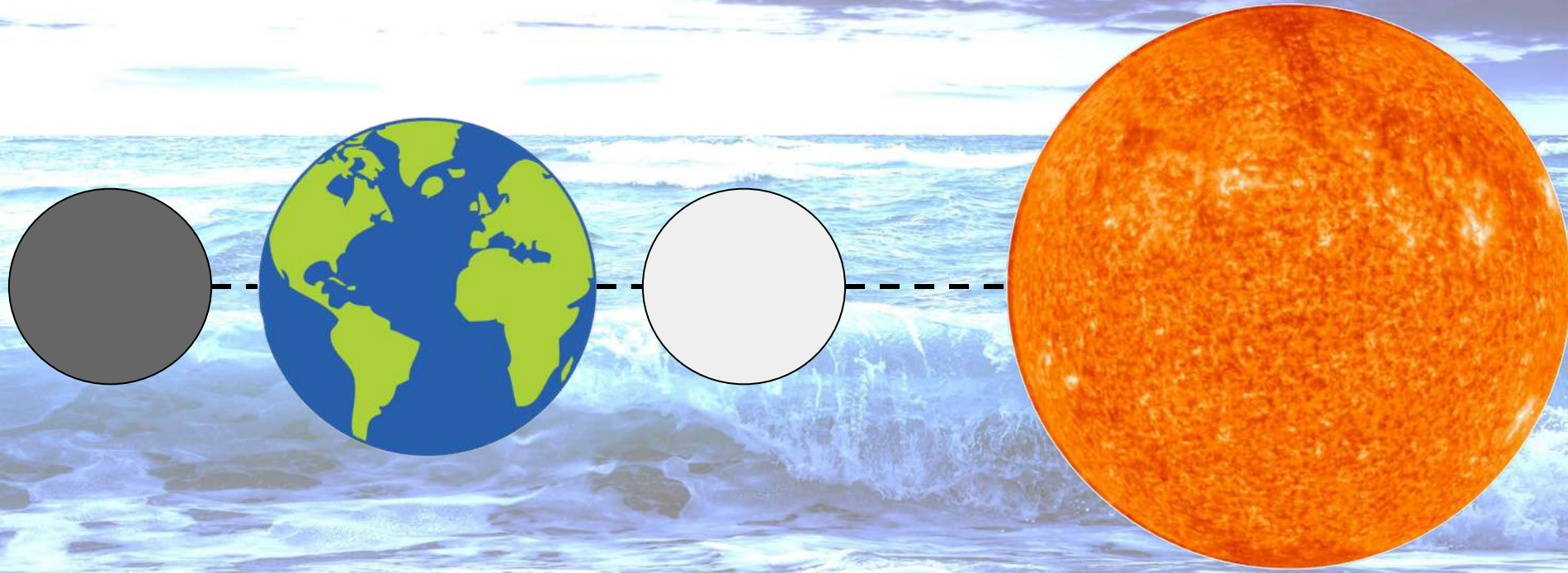
$$A_{\cdot} = \frac{3}{2}\,\frac{R_T^{\,4}}{M_T}\,\frac{4\pi}{3}\,\delta_{\cdot}\left(\frac{R_{\cdot}}{R_T}\right)^3_{\cdot 3}$$

$$\frac{\delta S}{\delta L} = \frac{As}{AL}$$

$\delta S = 1{,}41\ g/cm^3$

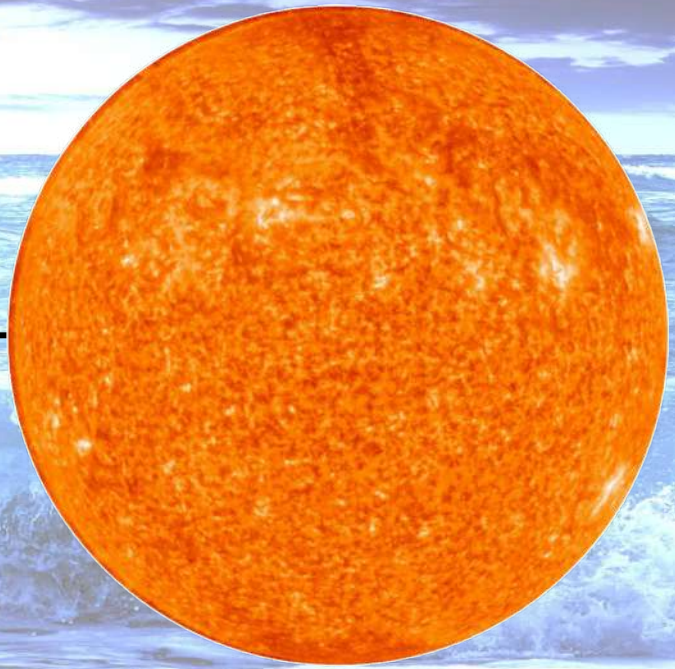
$\delta L = 3{,}34\ g/cm^3$

LUNA NUOVA e LUNA PIENA



A = AL + AS ≃ 80 cm

LUNA IN QUADRATURA

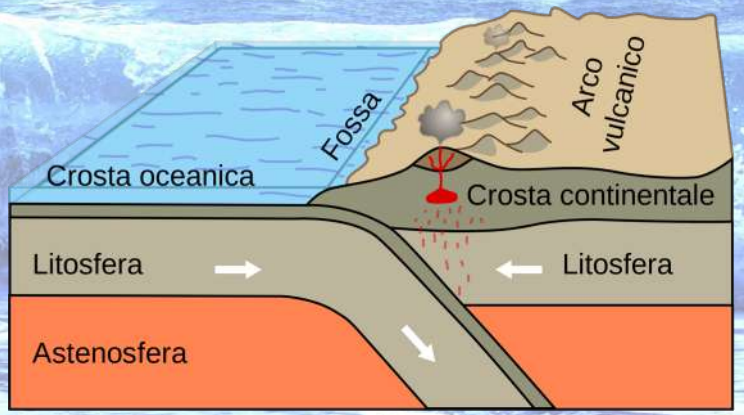


A = AL - AS ≃ 30 cm

TERREMOTI

- Studi recenti sulla correlazione maree e terremoti
- Maree terrestri di massimo 30 cm
- Maree ogni 6 ore
- Terremoti nell'ordine di secoli
- Maree come vibrazioni

Terremoti più deboli ma più frequenti imprevedibili



La scienza va avanti solo se c'è qualcuno disposto ad imparare e qualcuno disposto ad insegnare.


GRAZIE PER
L'ATTENZIONE