

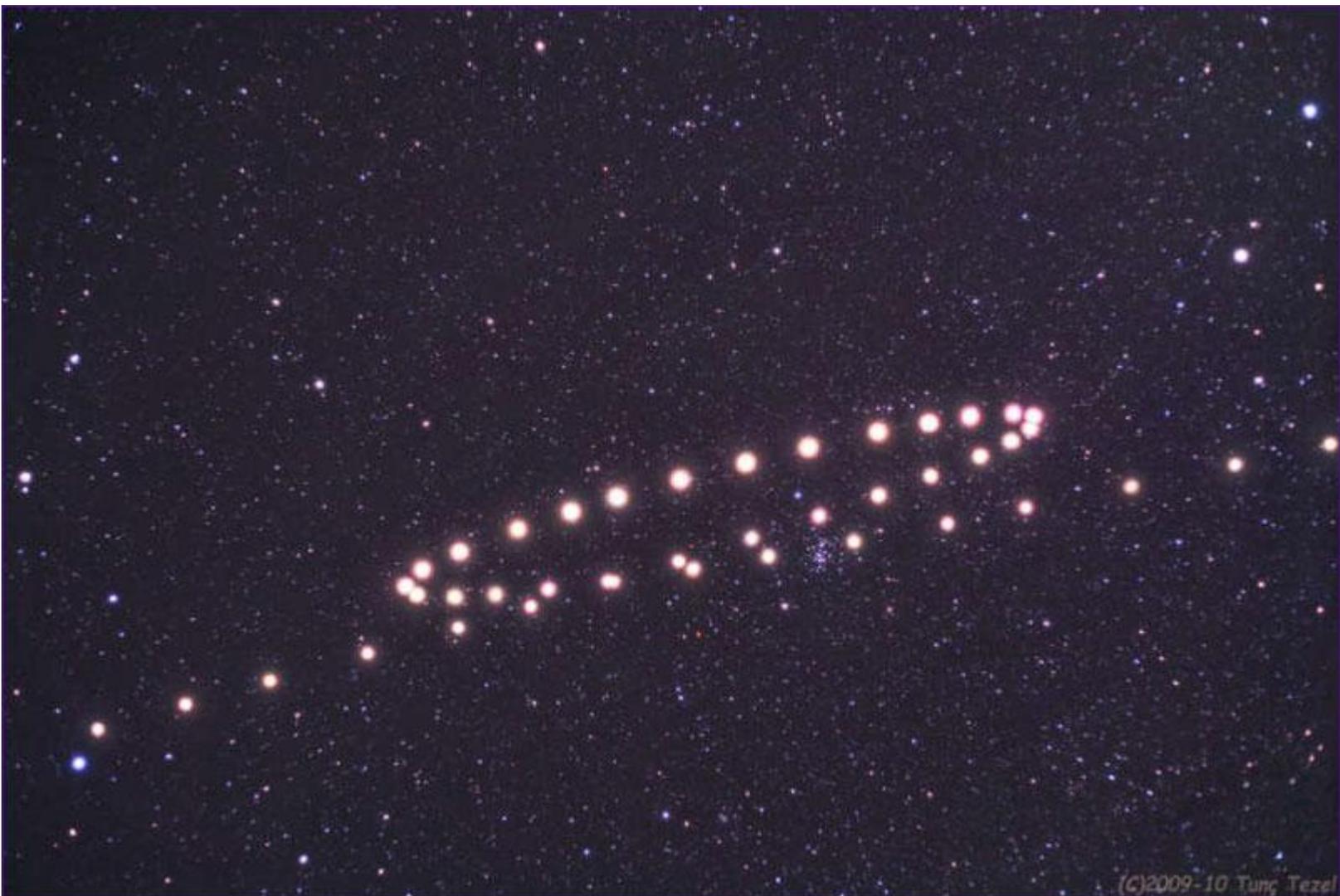
Небесная механика

12 октября 2017 г.

Вебинар

Б.Б.Эскин

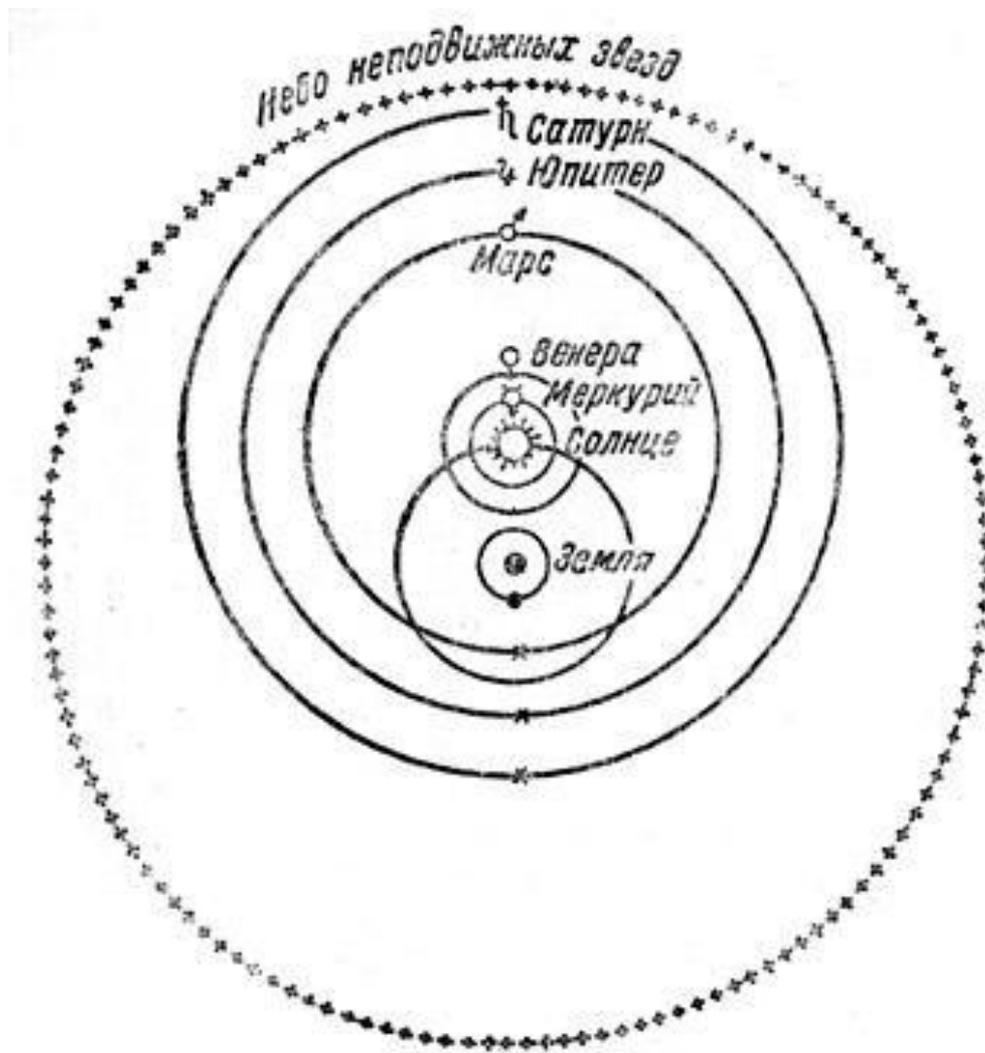
История



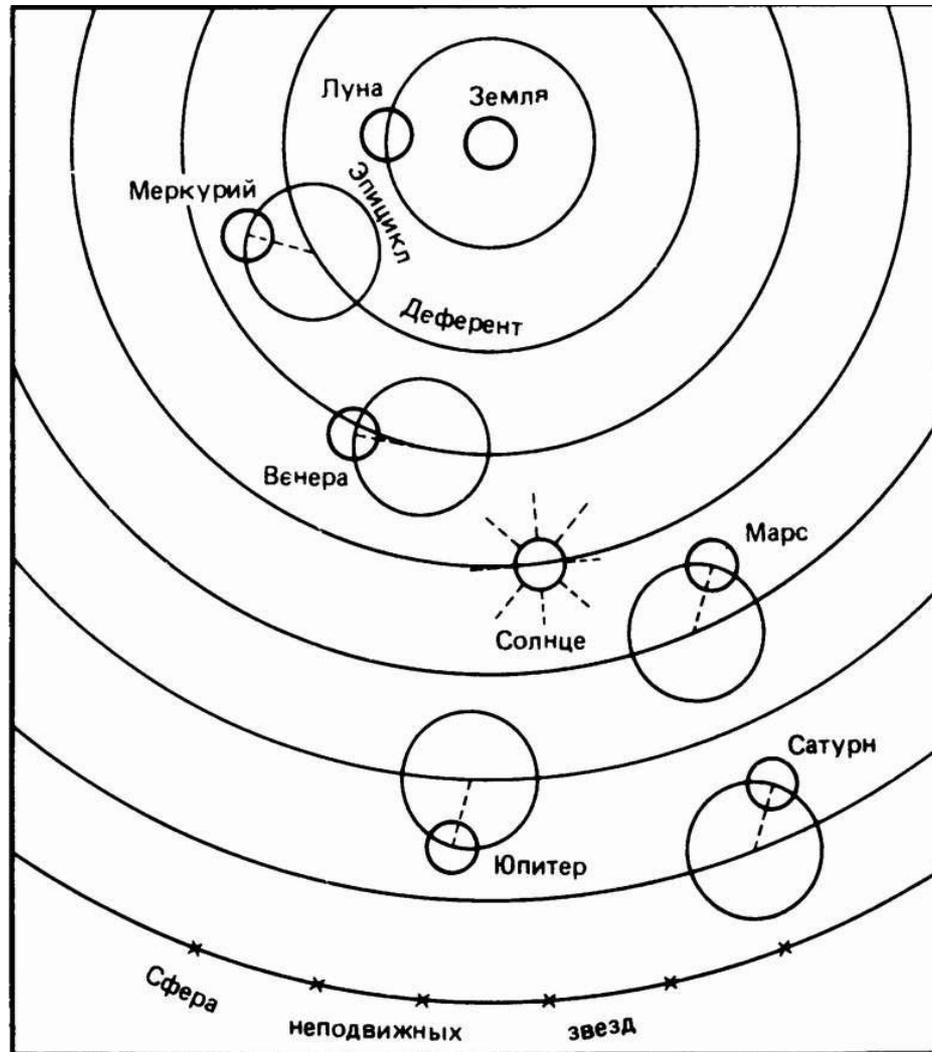
История



История



История



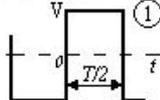
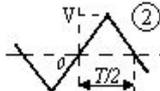
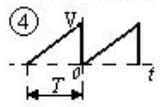
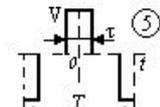
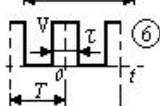
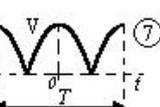
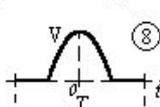
История

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \sin nx \, dx, \quad (n = 1, 2, \dots).$$

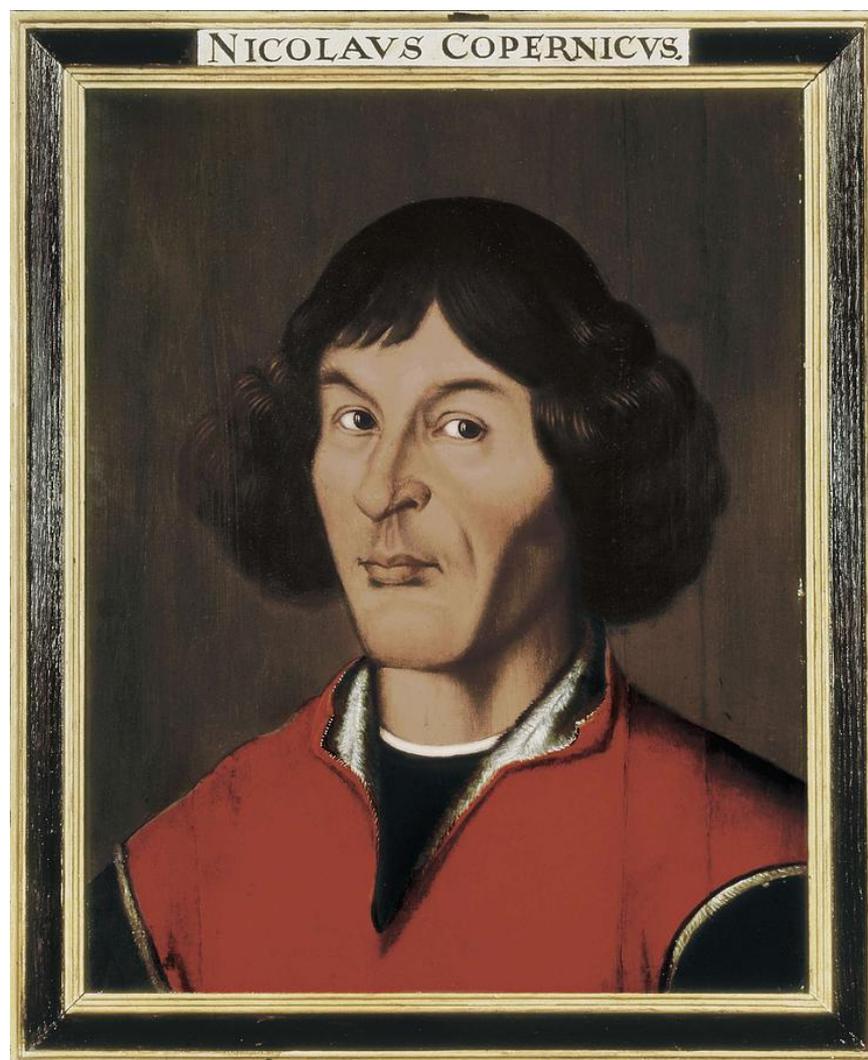
Рядом Фурье функции $f(x)$ называется ряд

$$\frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos nx + b_n \sin nx).$$

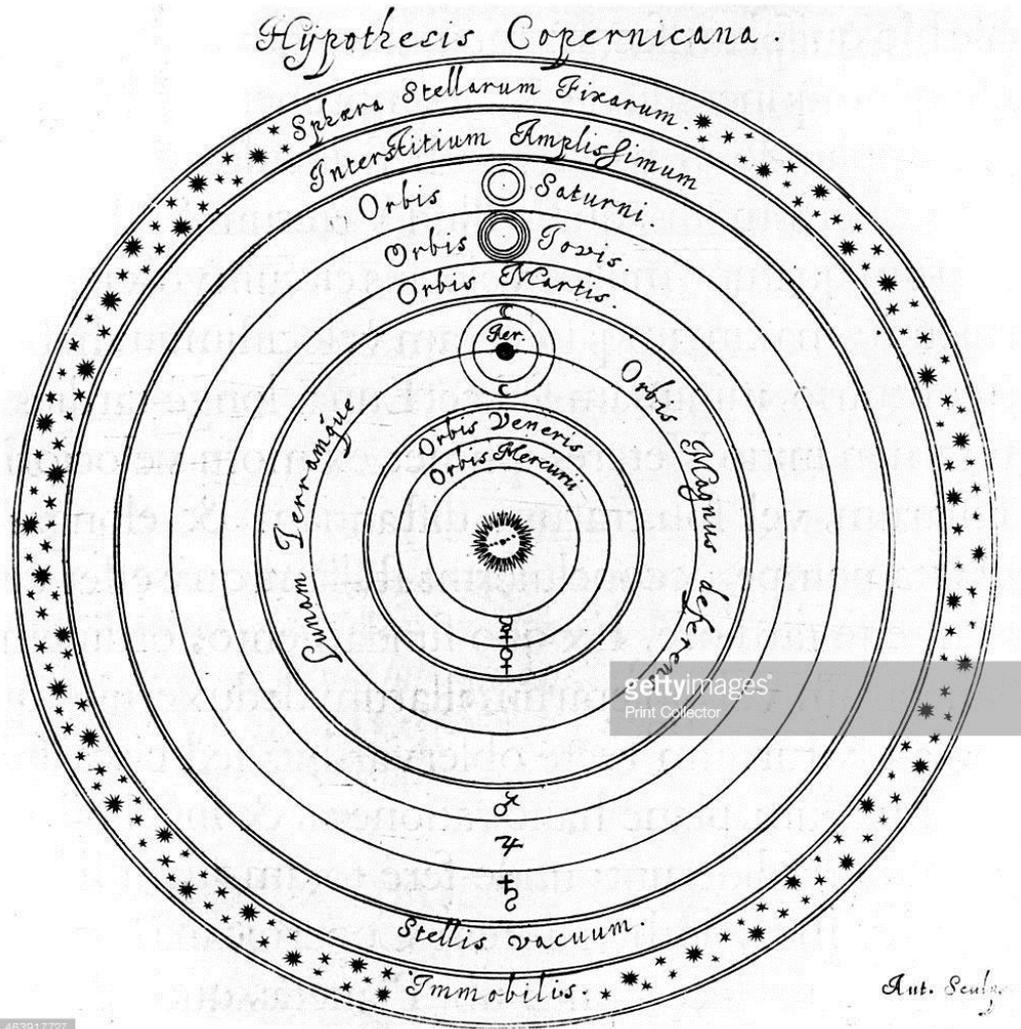
История

График $f(t)$	Таблица 2 Ряд Фурье функции $f(t)$	Примечание
	$f(t) = \frac{4V}{\pi} \sum_{k=1}^{\infty} \frac{\sin k\omega t}{k}$	$k=1,3,5,\dots$ $\omega = \frac{2\pi}{T}$
	$f(t) = \frac{8V}{\pi^2} \sum_{k=1}^{\infty} (-1)^{\frac{k-1}{2}} \frac{\sin k\omega t}{k^2}$	$k=1,3,5,\dots$ $\omega = \frac{2\pi}{T}$
	$f(t) = \frac{4V}{\omega T \pi} \sum_{k=1}^{\infty} \frac{\sin k\omega \tau}{k^2} \sin k\omega t$	$k=1,3,5,\dots$ $\omega = \frac{2\pi}{T}$
	$f(t) = \frac{V}{2} - \frac{V}{\pi} \sum_{k=1}^{\infty} \frac{1}{k} \sin k\omega t$	$k=1,2,3,4,5 \dots \omega = \frac{2\pi}{T}$
	$f(t) = \frac{4V}{\pi} \sum_{k=1}^{\infty} \frac{1}{k} \sin \frac{k\omega \tau}{2} \cos k\omega t$	$k=1,3,5,\dots$ $\omega = \frac{2\pi}{T}$
	$f(t) = V \left[\frac{\tau}{T} + \frac{2}{\pi} \sum_{k=1}^{\infty} \frac{1}{k} \sin \frac{k\omega \tau}{2} \cos k\omega t \right]$	$k=1,2,3,4,5 \dots \omega = \frac{2\pi}{T}$
	$f(t) = \frac{4V}{\pi} \left[\frac{1}{2} + \sum_{s=1}^{\infty} \frac{(-1)^{s+1}}{(2s)^2 - 1} \cos 2s\omega t \right]$	$S=1,2,3,4,\dots$ $\omega = \frac{2\pi}{T}$
	$f(t) = \frac{2V}{\pi} \left(\frac{1}{2} + \frac{\pi}{4} \cos \omega t + \frac{1}{1.3} \cos 2\omega t - \frac{1}{3.5} \cos 4\omega t + \frac{1}{5.7} \cos 6\omega t - \dots \right)$	$k=1,2,4,6,\dots$ $\omega = \frac{2\pi}{T}$

История



История



История



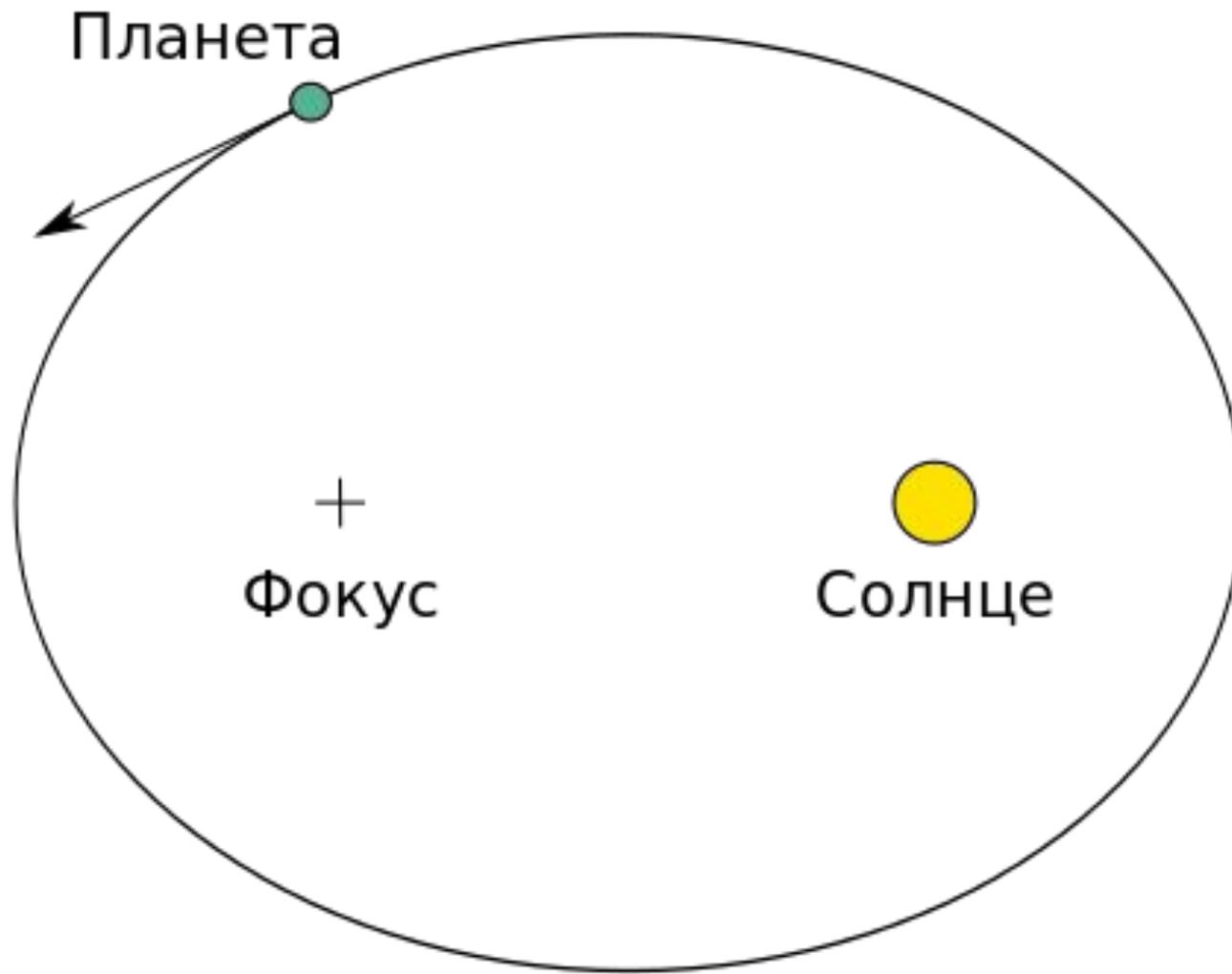
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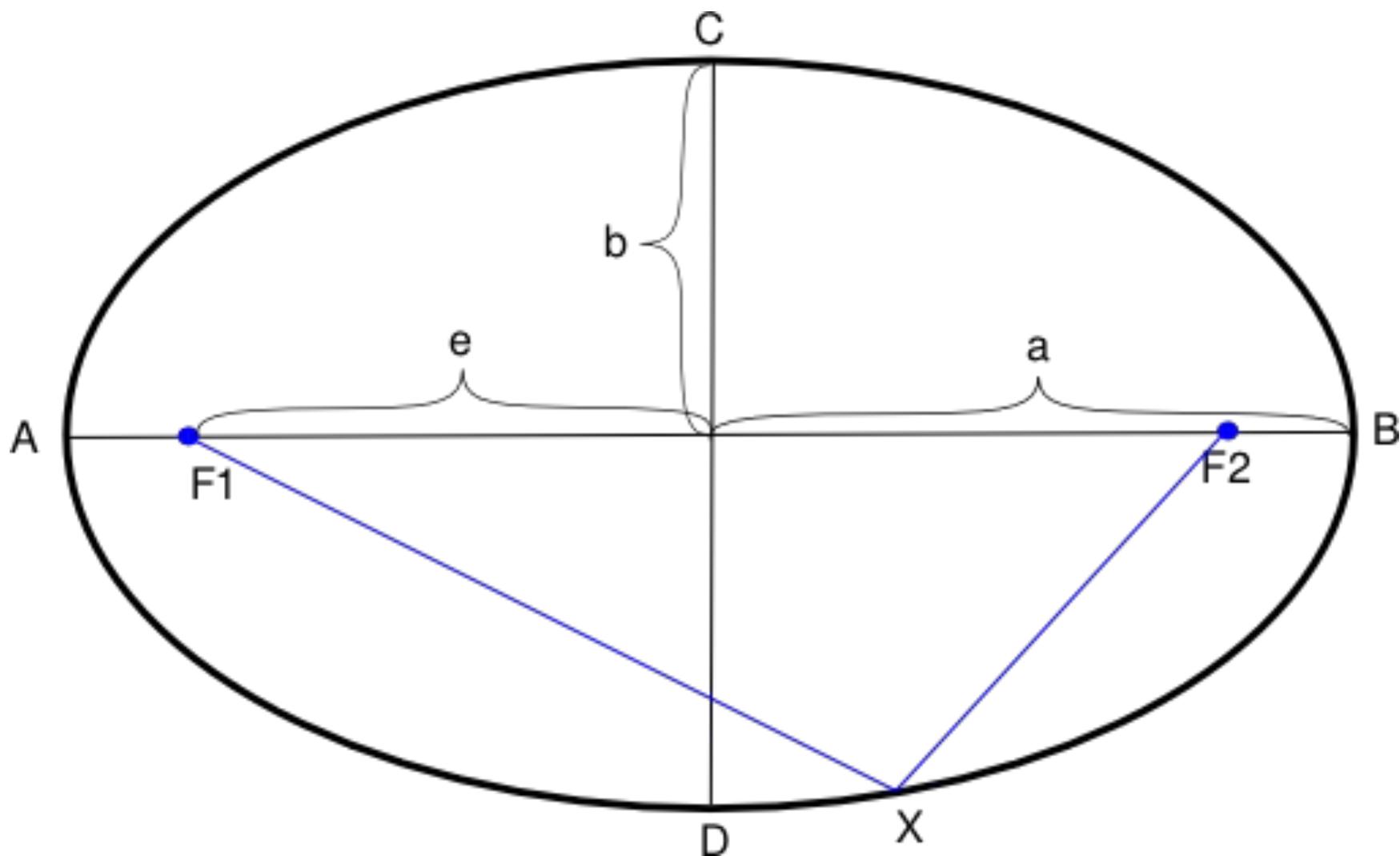
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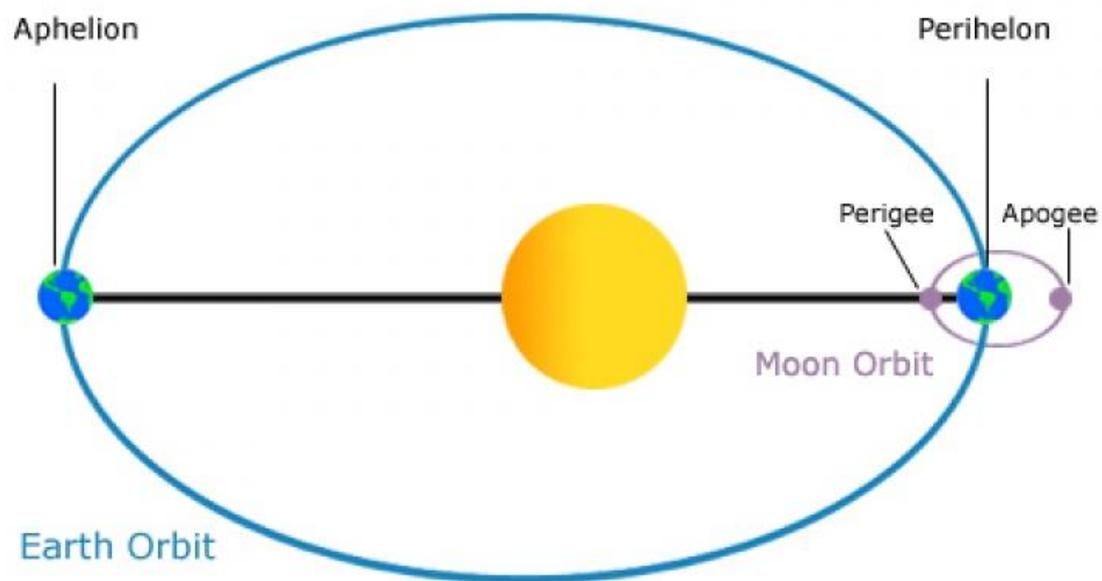
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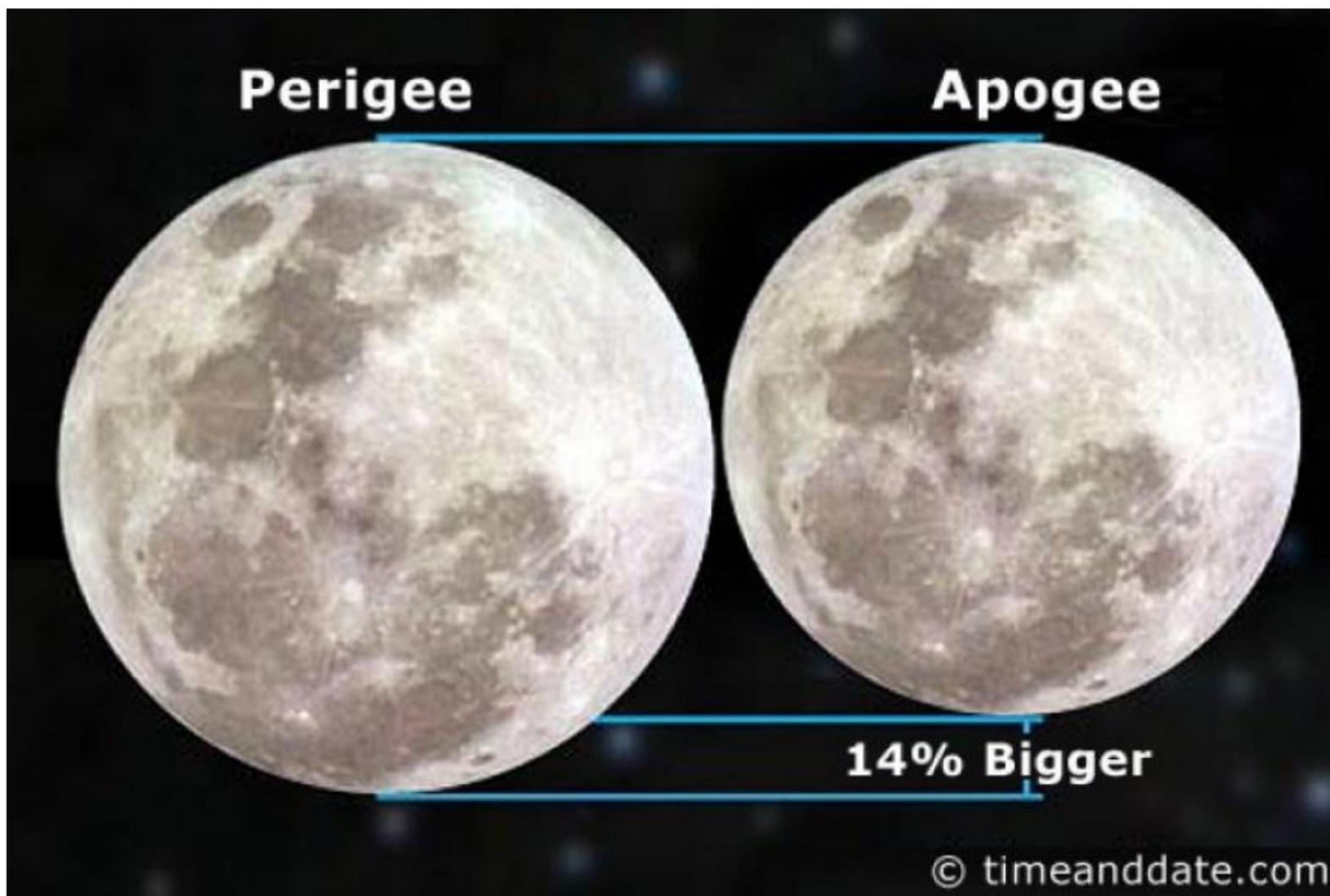
Законы Кеплера



Законы Кеплера



Законы Кеплера



Законы Кеплера

$$v_q = v_c \sqrt{\frac{1+e}{1-e}}$$

Законы Кеплера

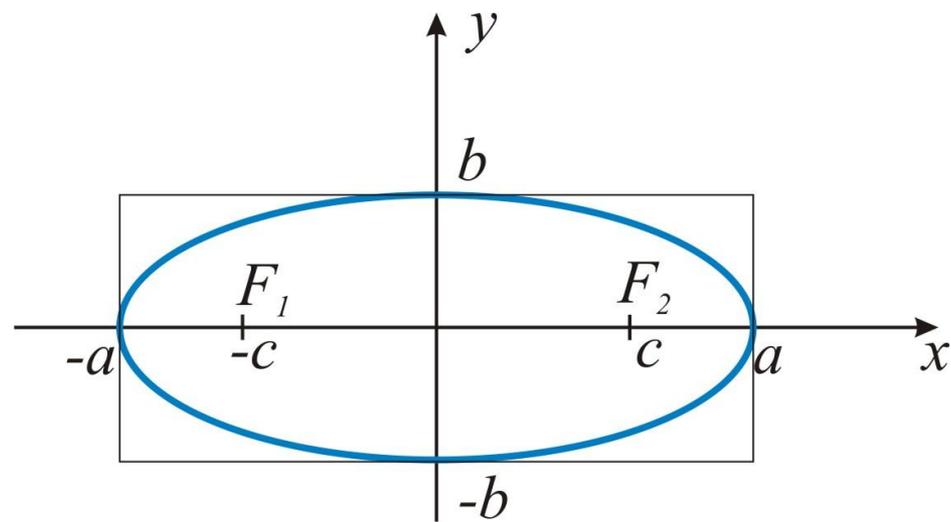
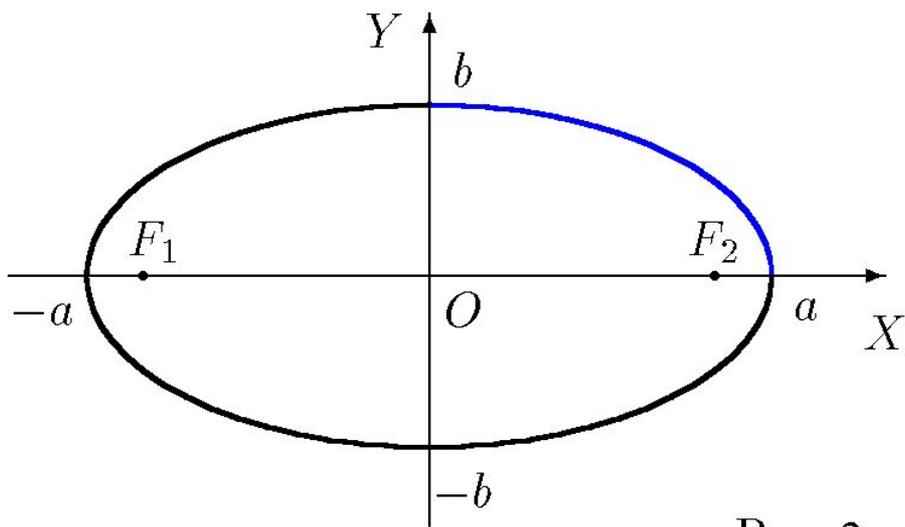


Рис. 2

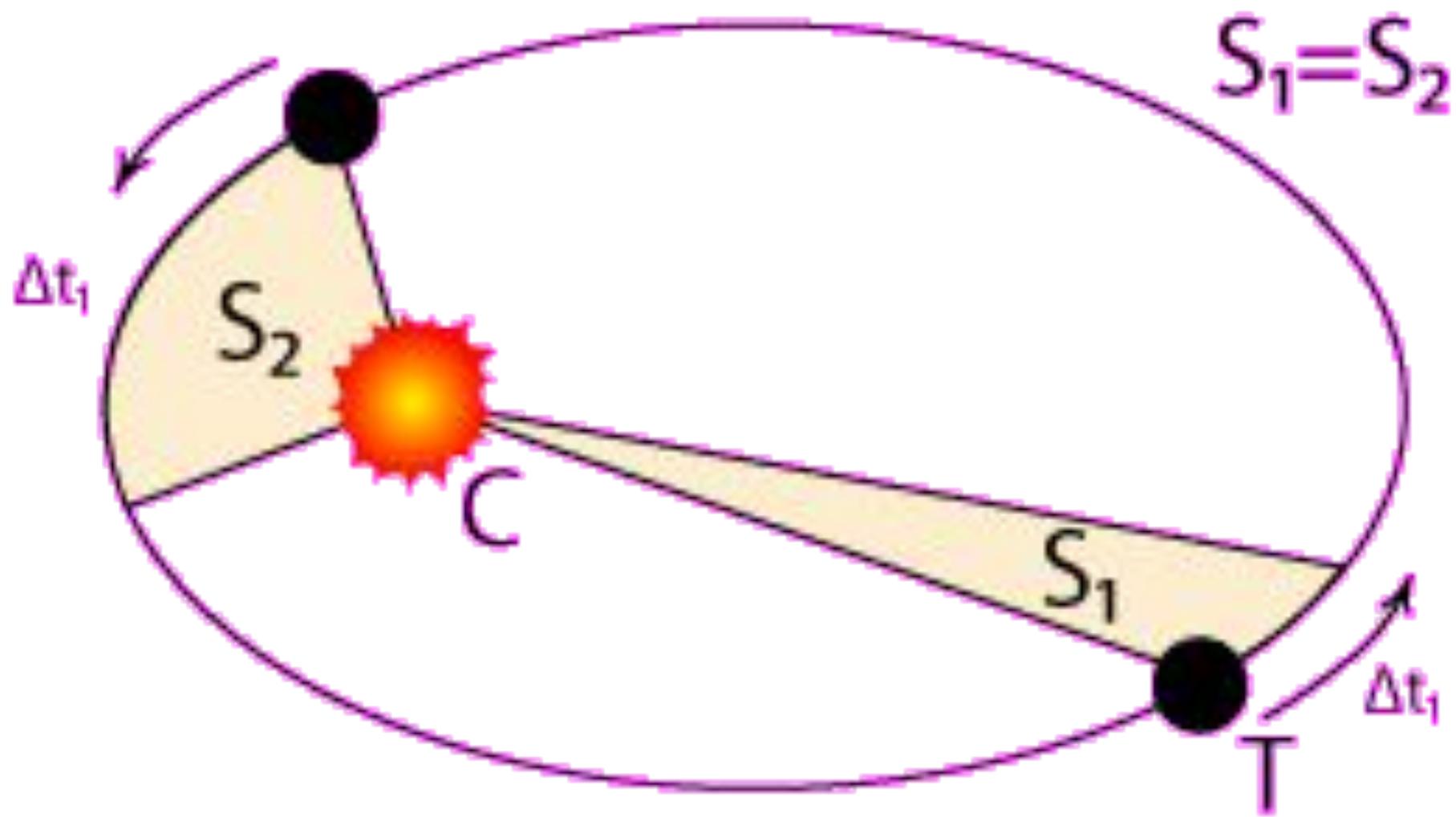
Законы Кеплера

$$e = \frac{c}{a}$$

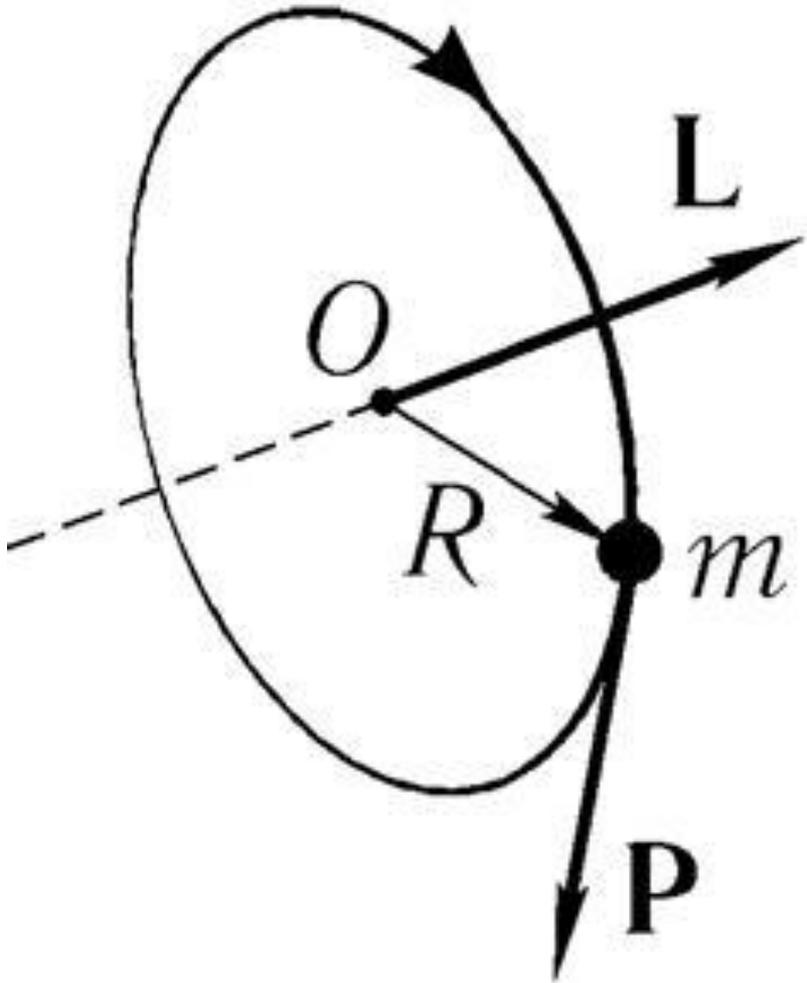
Законы Кеплера

$$e = \frac{c}{a} = \sqrt{1 - \frac{b^2}{a^2}} \quad (0 \leq e < 1).$$

Законы Кеплера



Законы Кеплера



$$\sum_{i=1}^n L_i = \text{const},$$

Законы Кеплера

$$\frac{T_1^2}{T_2^2} = \frac{a_1^3}{a_2^3}$$

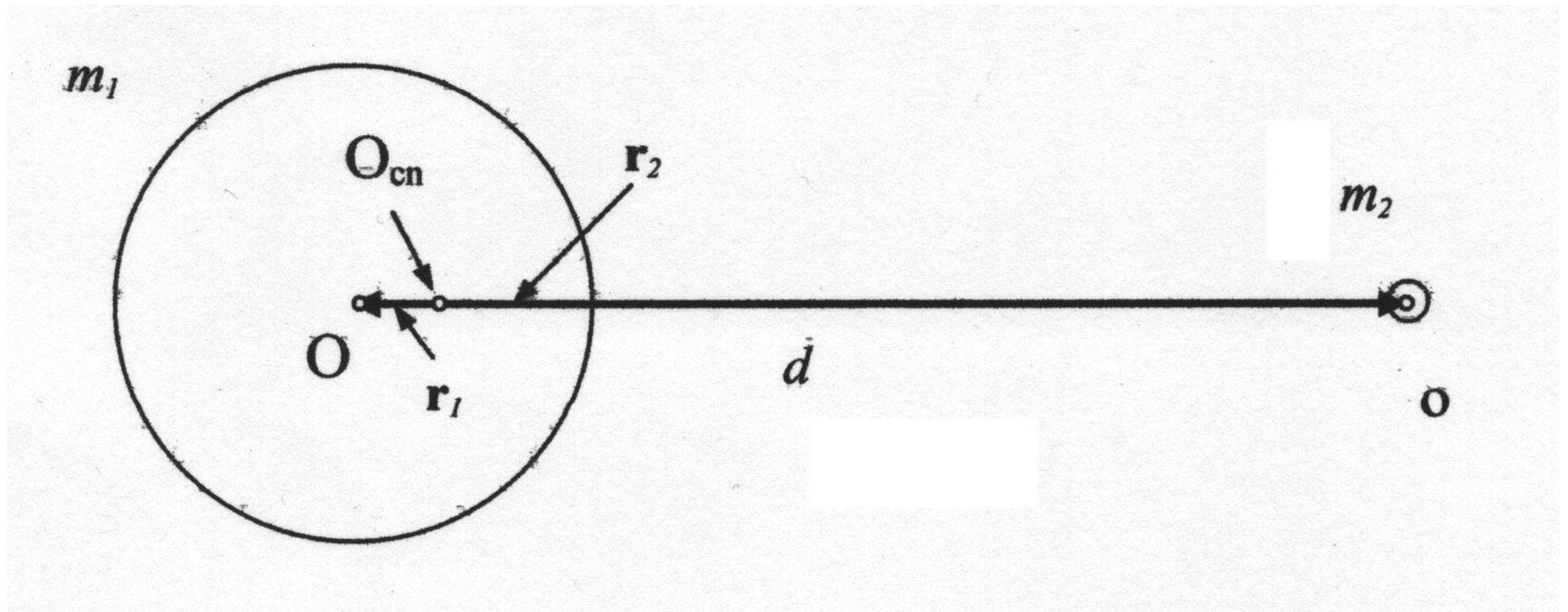
Законы Кеплера

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

Законы Кеплера

$$a_{\text{цс}} = \frac{v^2}{R} = \frac{4\pi^2 R}{T^2}$$

Законы Кеплера

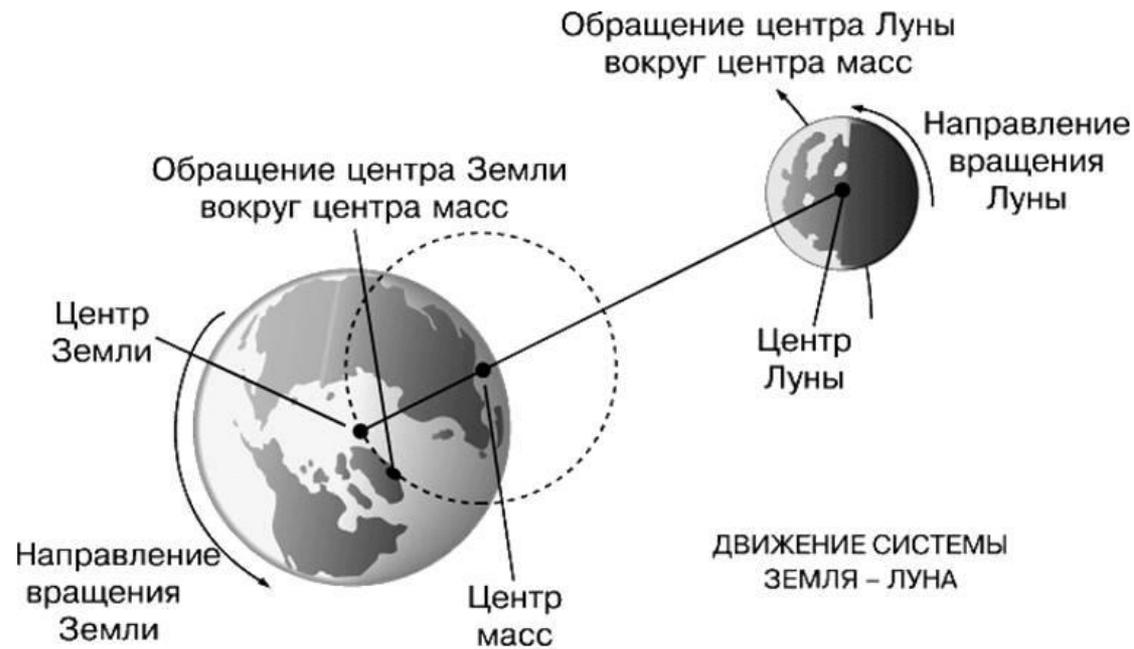


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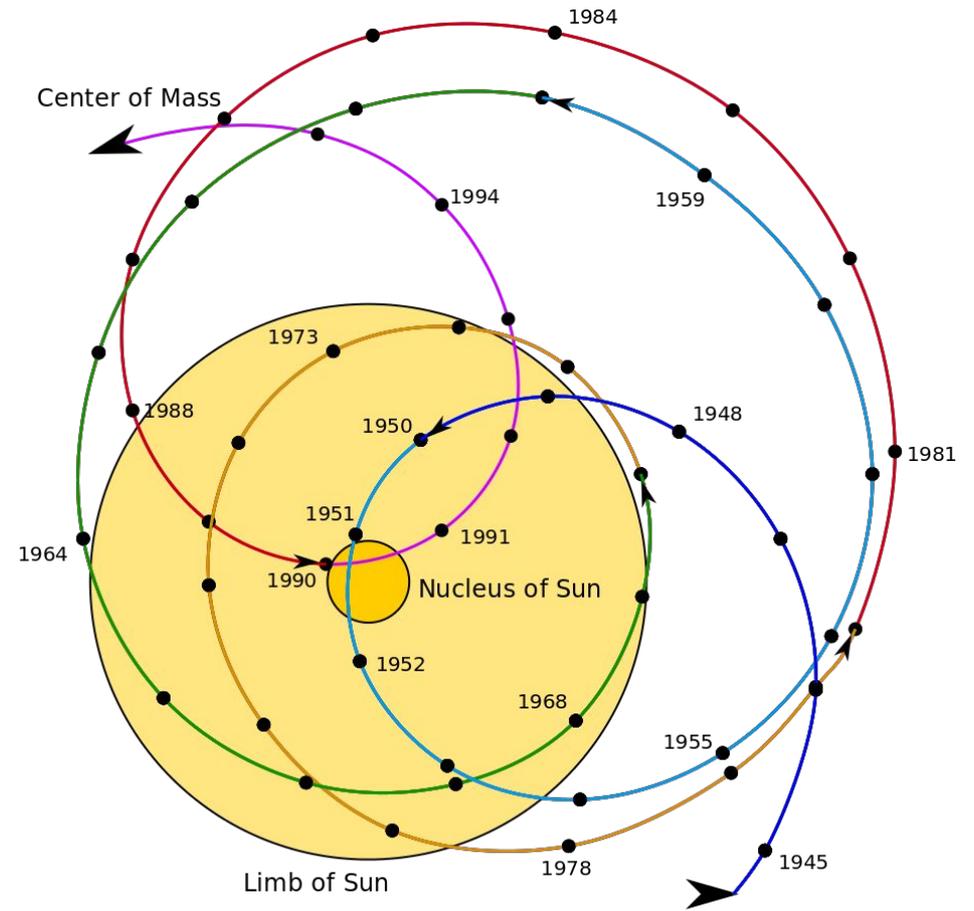
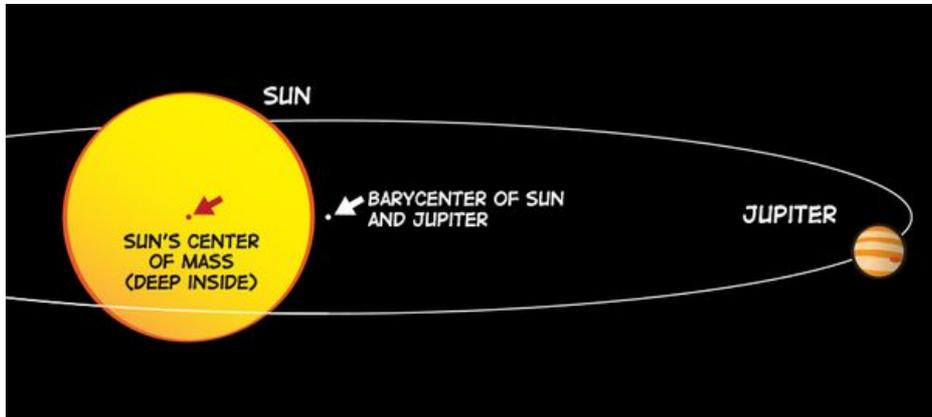
$$\frac{T_1^2 (M_1 + m_1)}{T_2^2 (M_2 + m_2)} = \frac{a_1^3}{a_2^3}$$

Законы Кеплера

Система Земля - Луна



Законы Кеплера



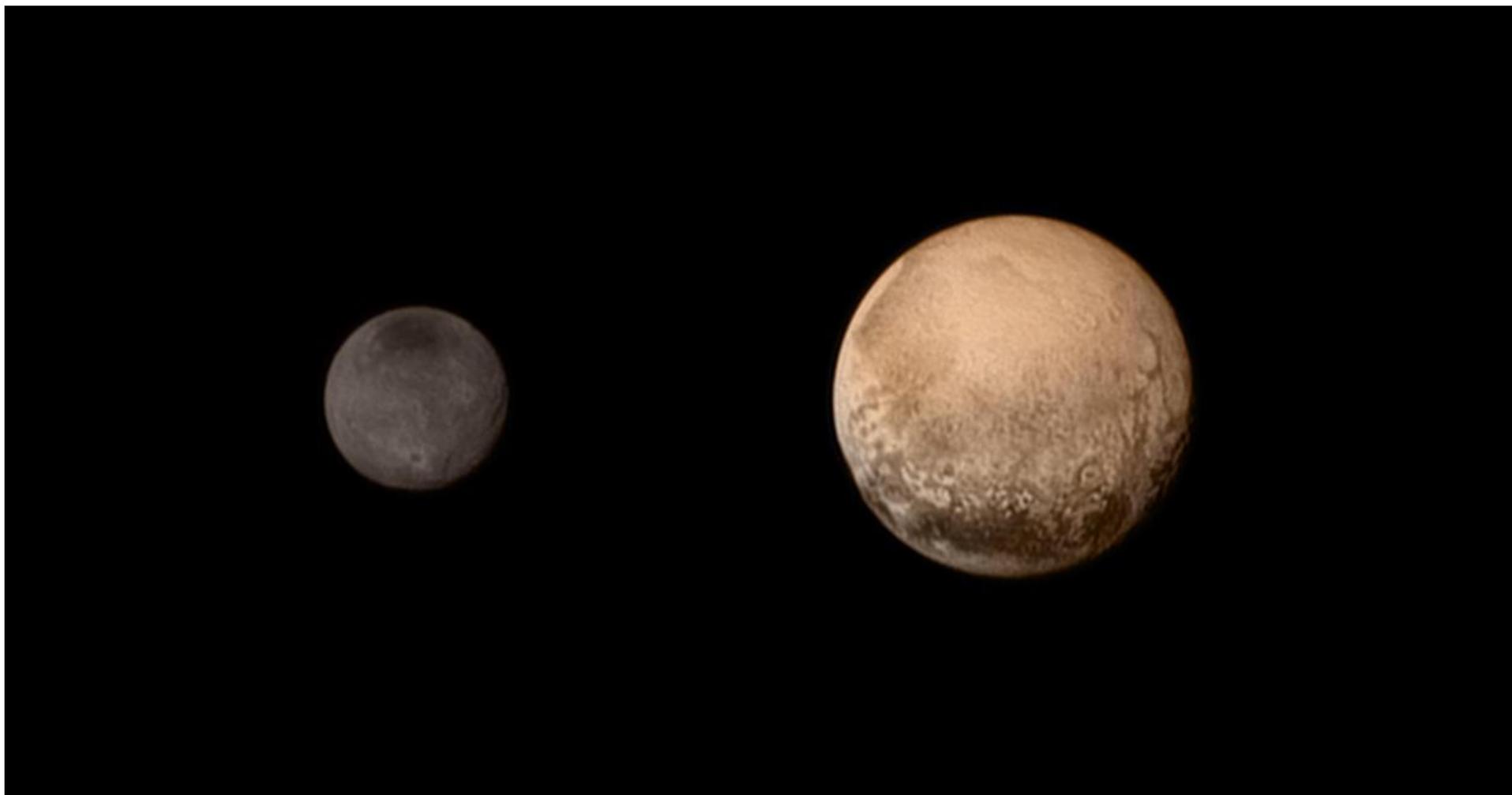
Законьы Кеплера



Законы Кеплера

$$\frac{M_{\odot}}{M_{\oplus}} = \left(\frac{a_{\oplus}}{a_{\opl�}} \right)^3 \div \left(\frac{T_{\oplus}}{T_{\opl�}} \right)^2.$$

Законьы Кеплера



Законы Кеплера



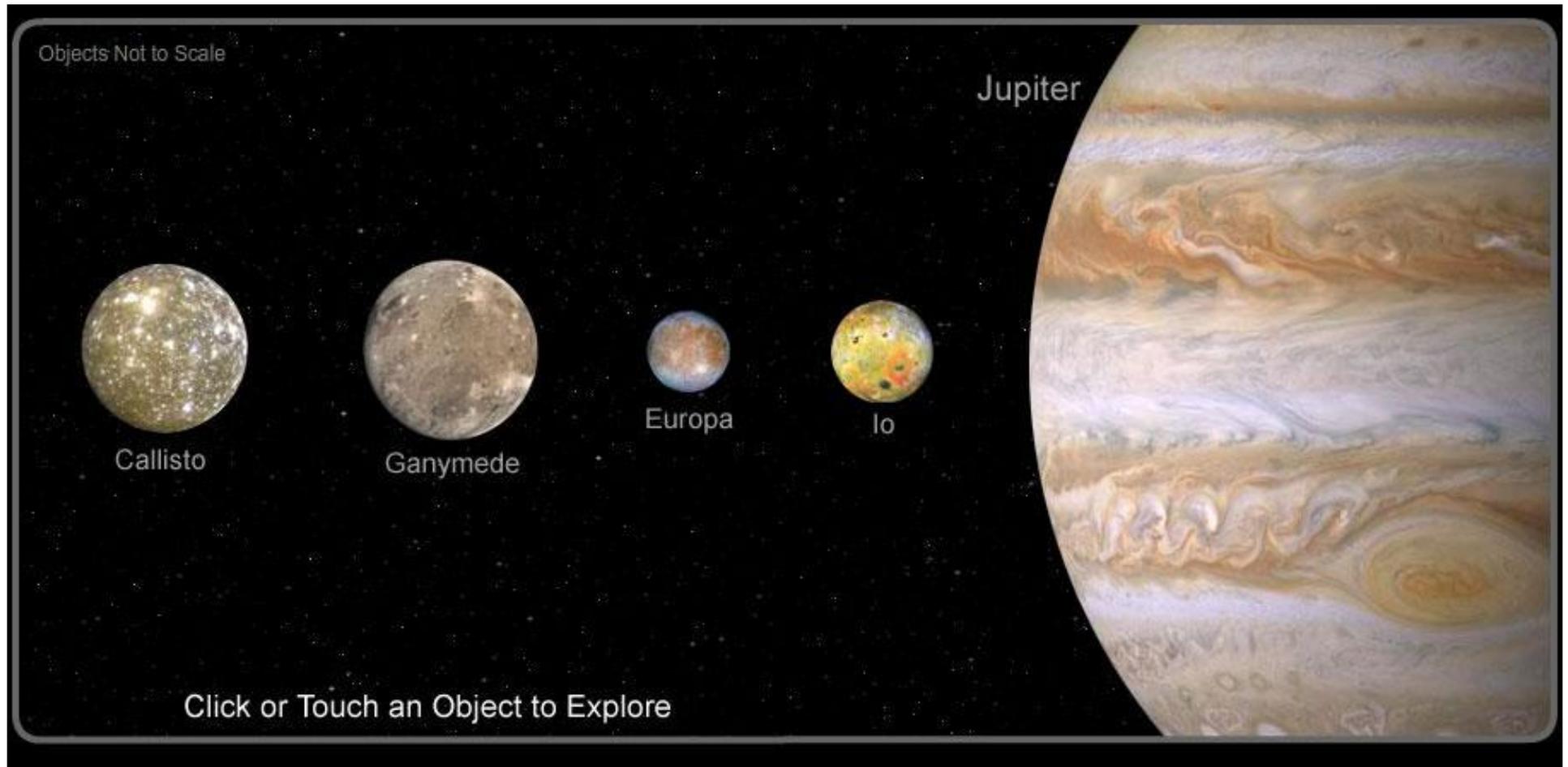
Законы Кеплера



Законы Кеплера



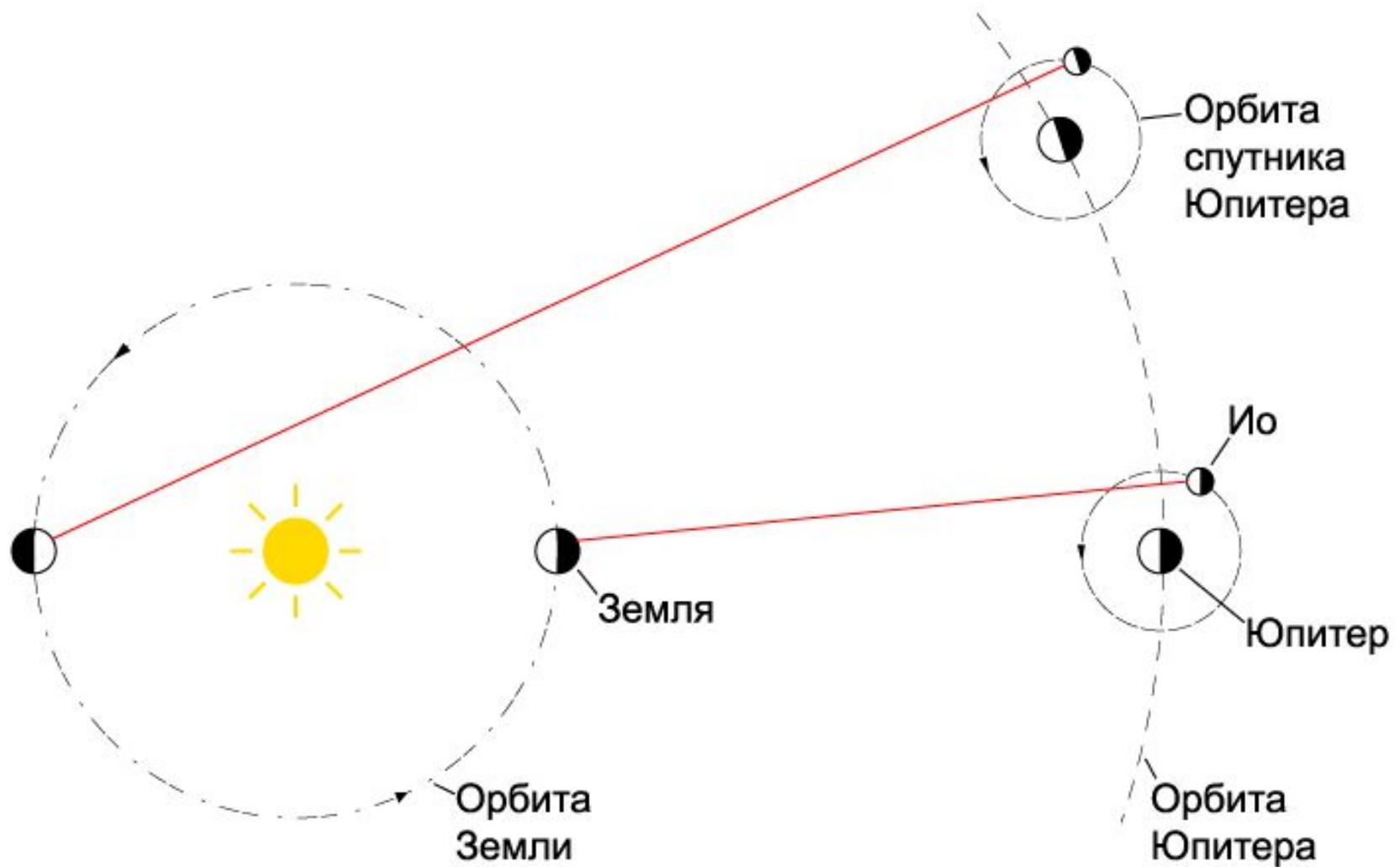
Законы Кеплера



Скорость света



Скорость света



Скорость света

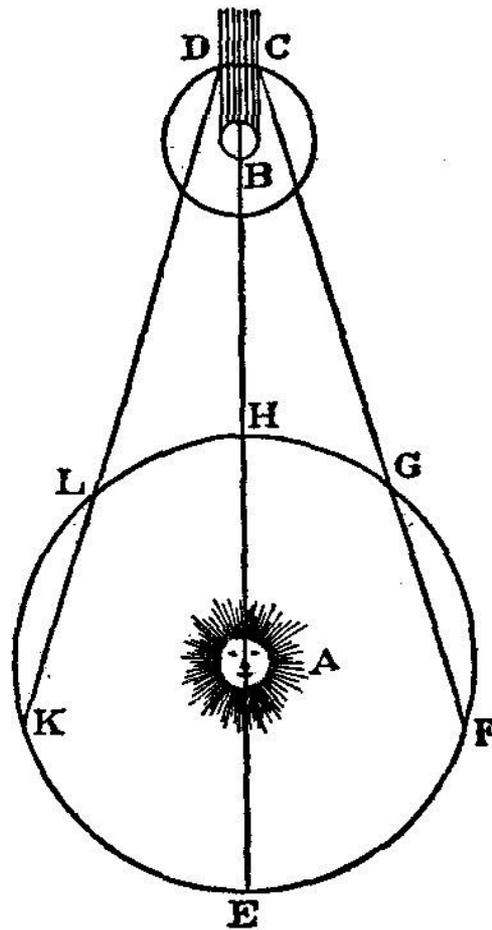
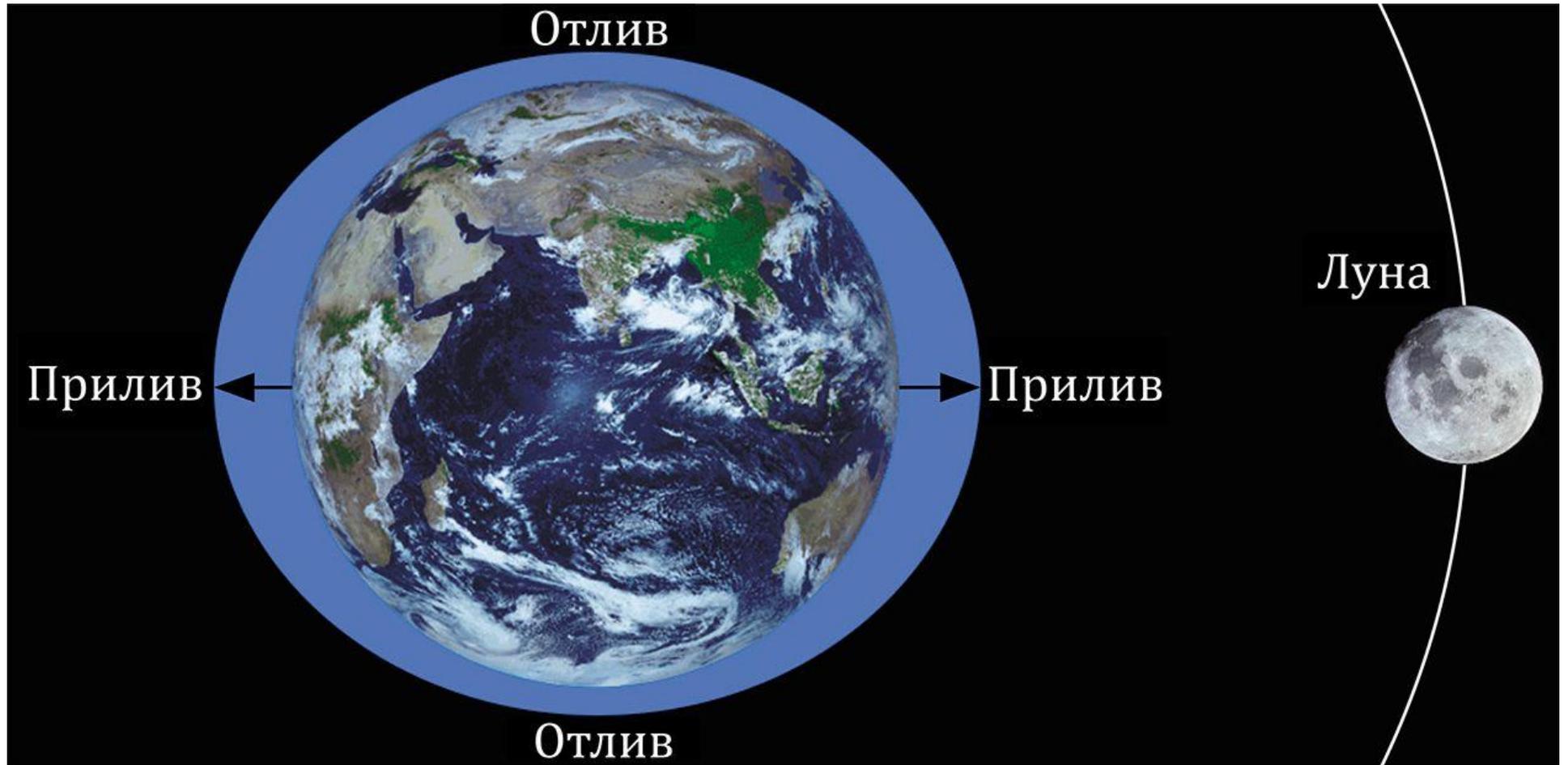
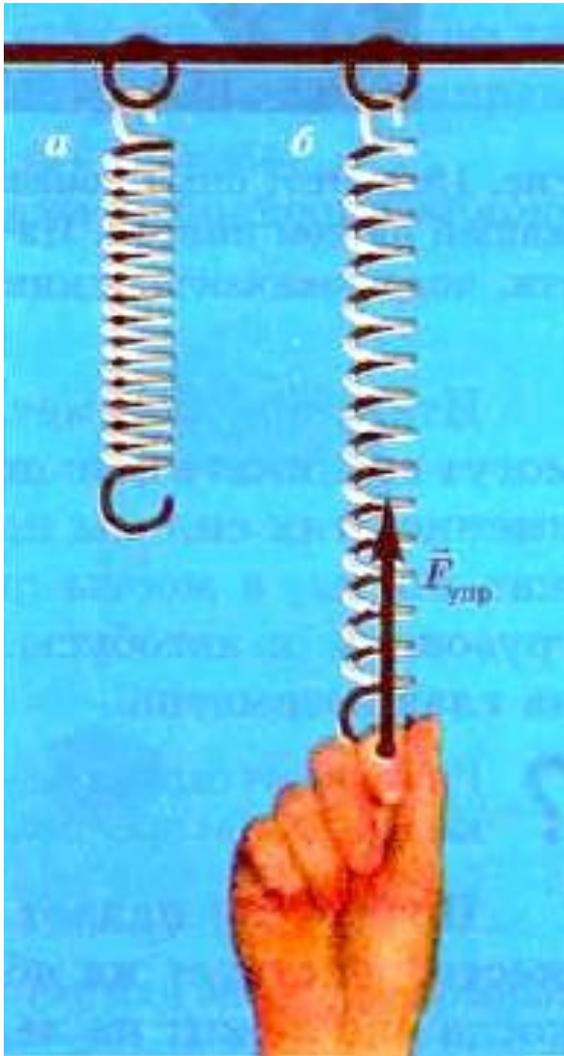


FIG. 70.

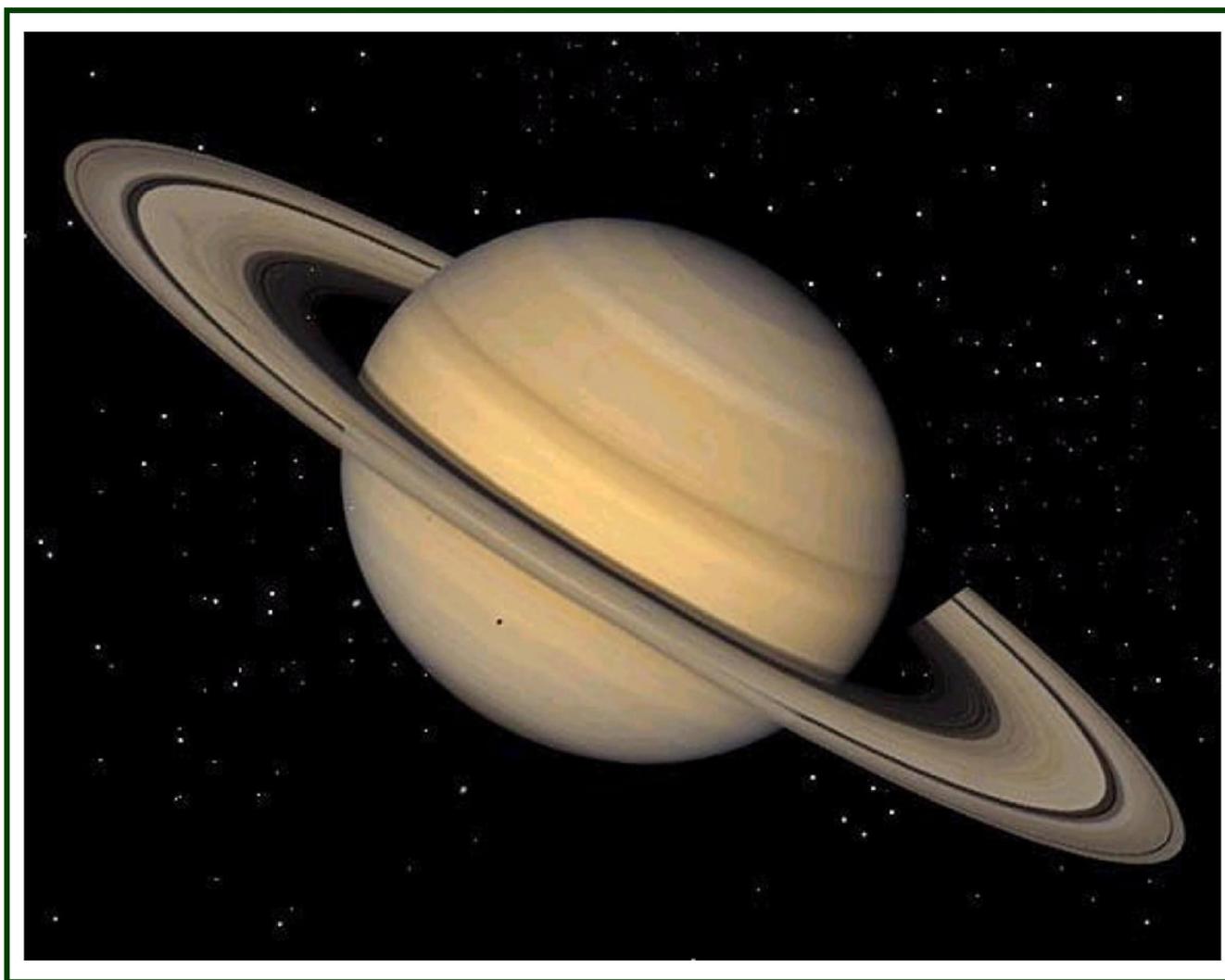
Приливы



Приливы



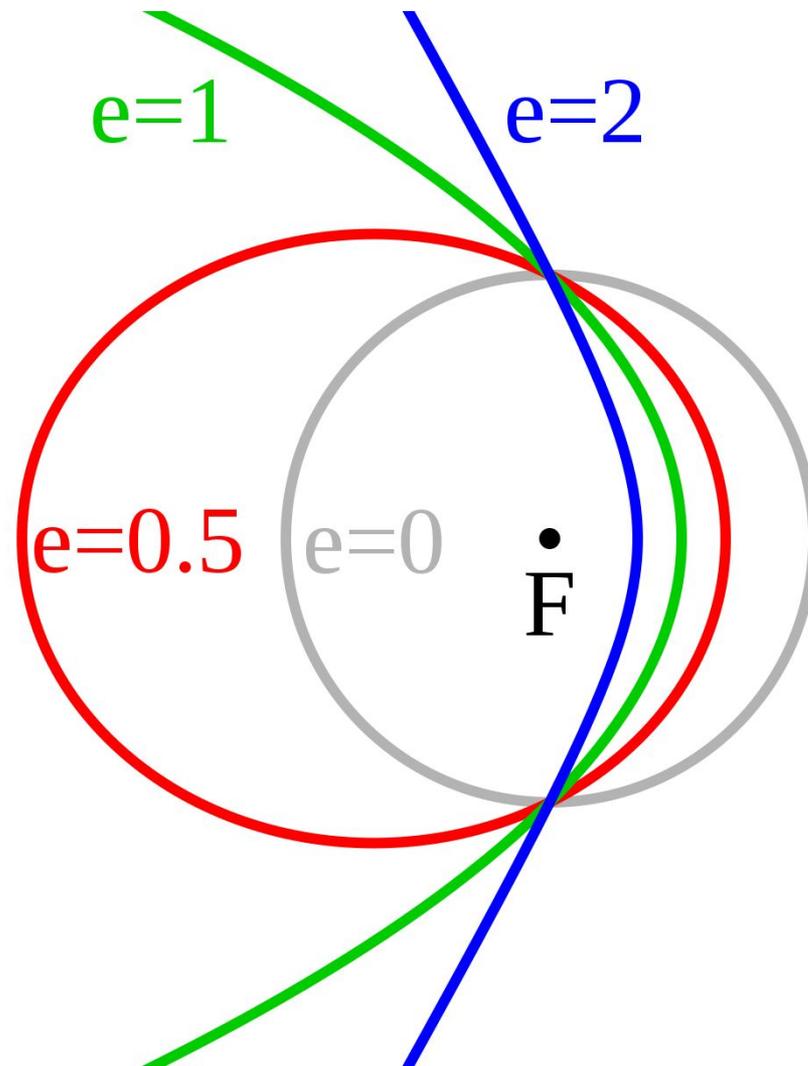
Приливы



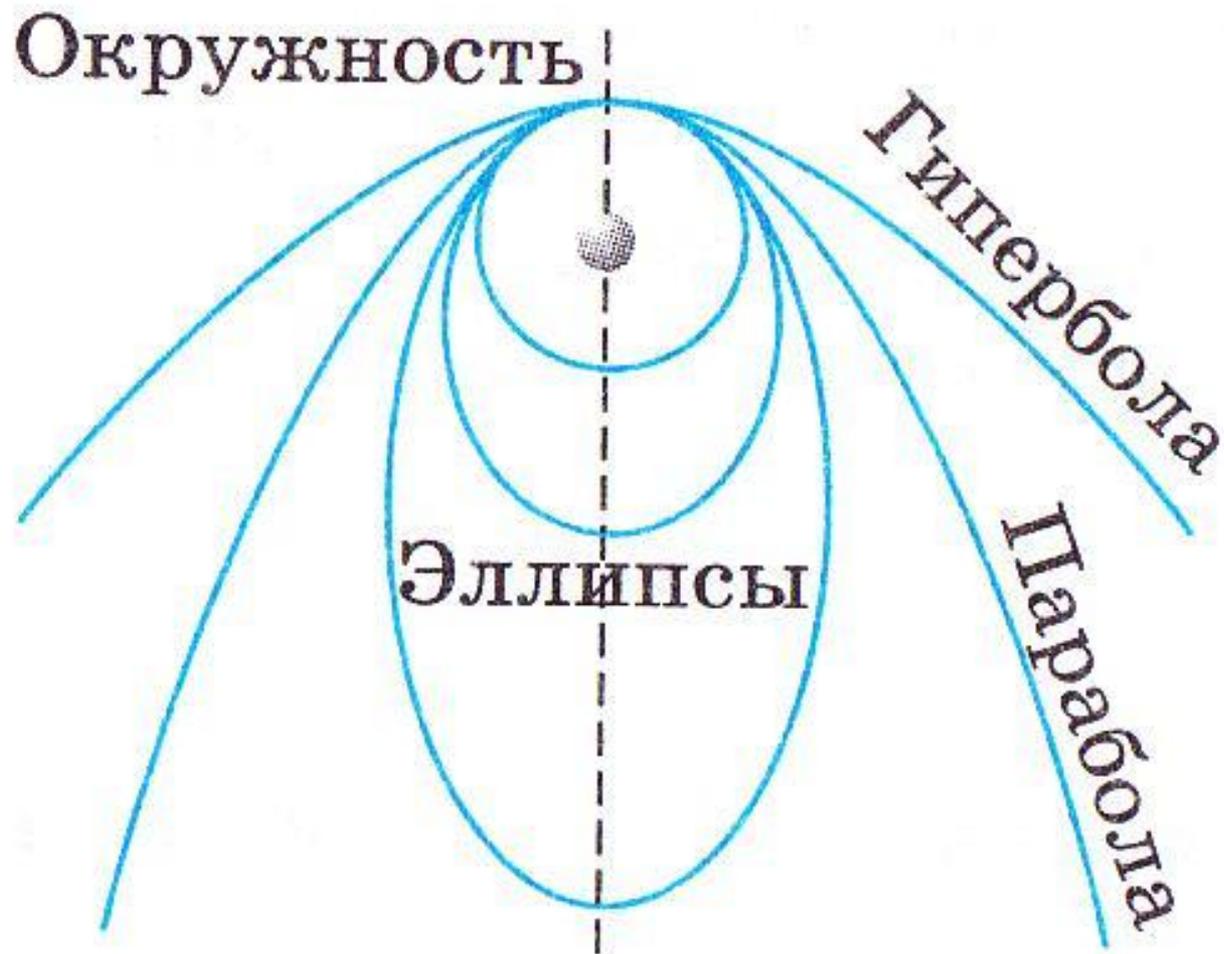
Эксцентриситет

$$\varepsilon = \frac{c}{a}$$

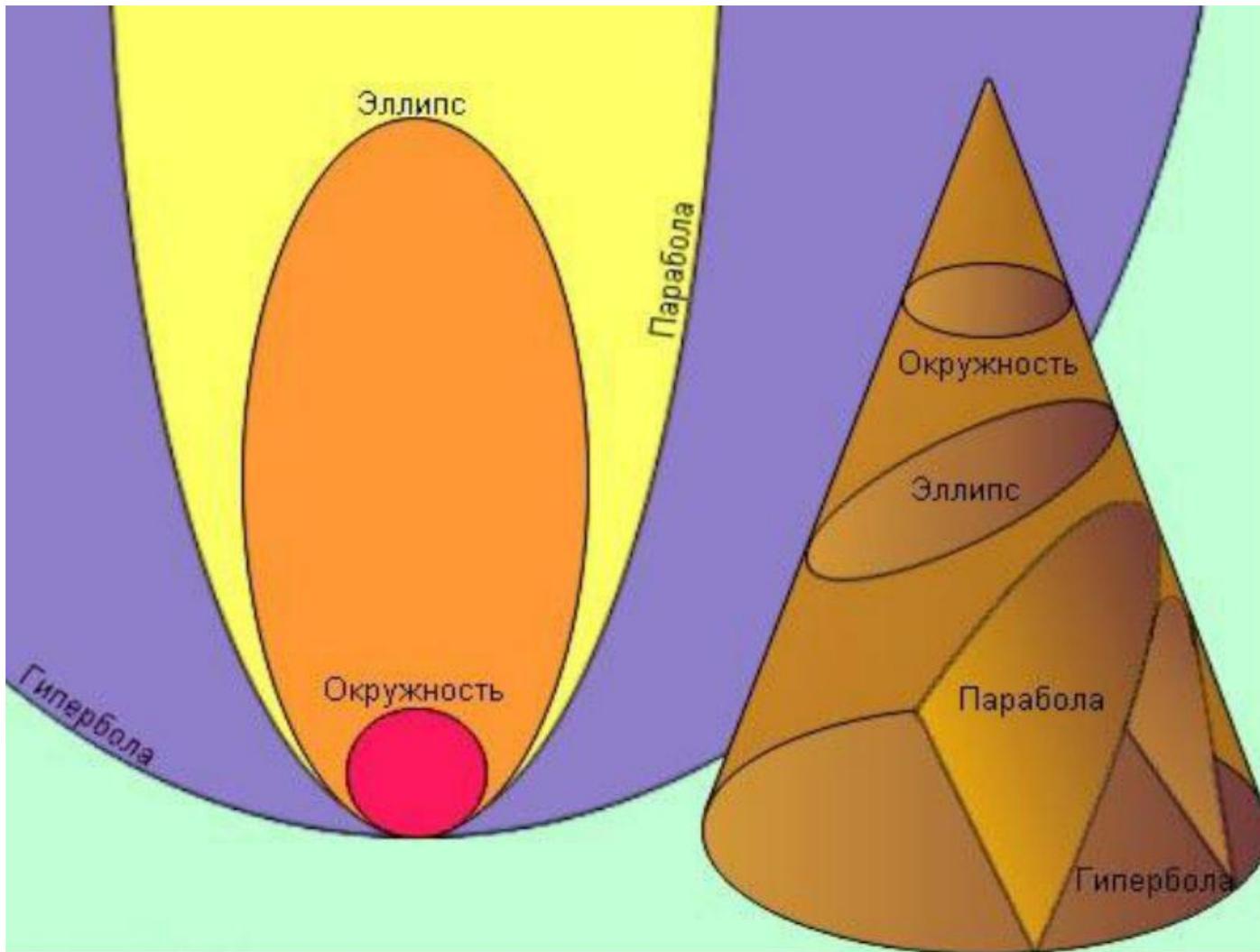
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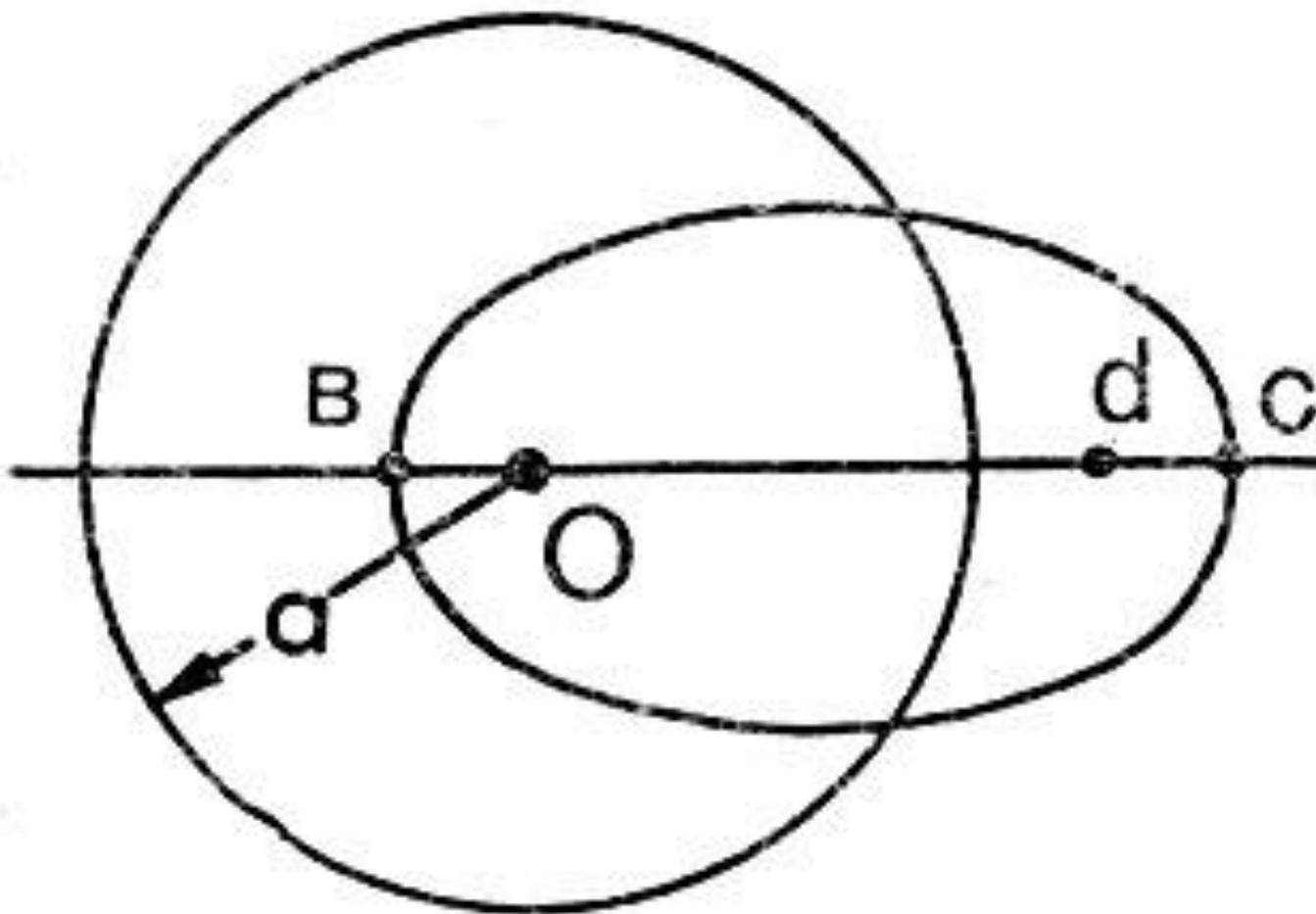
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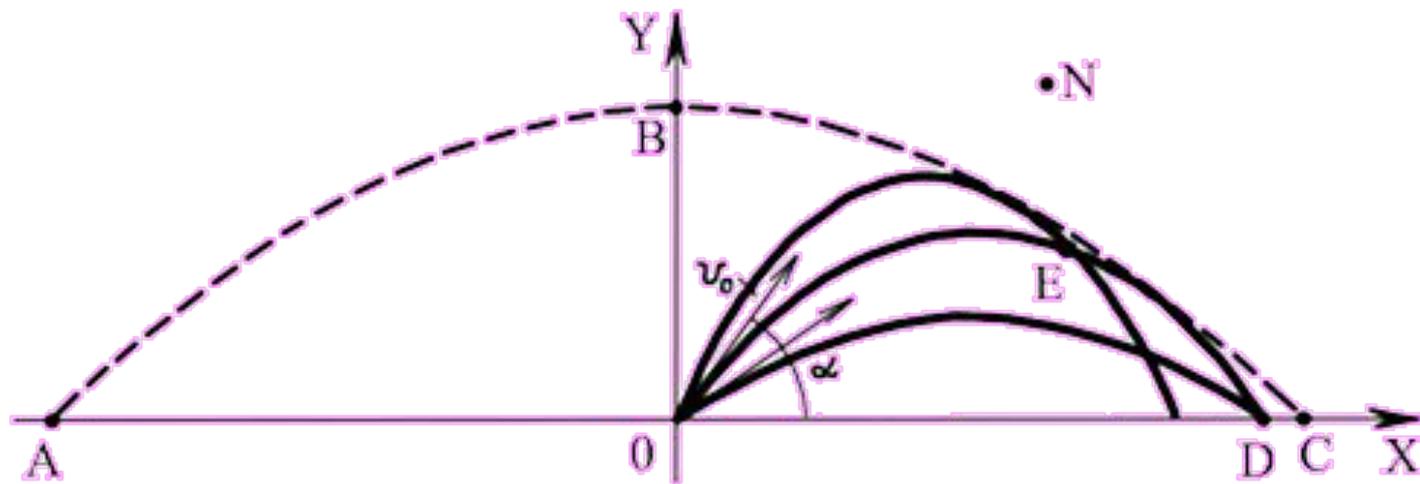
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Эксцентриситет



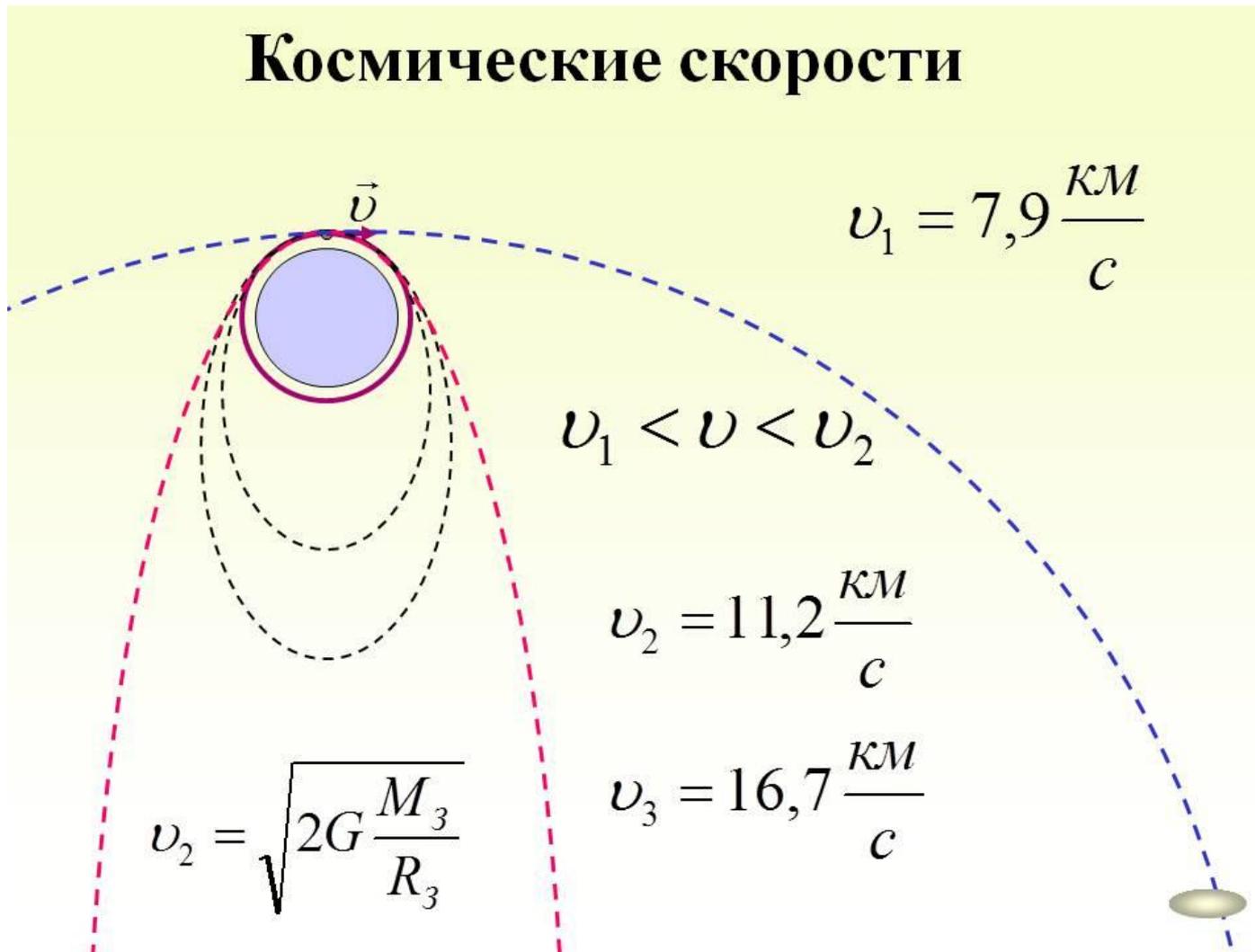
Эксцентриситет



Эксцентриситет

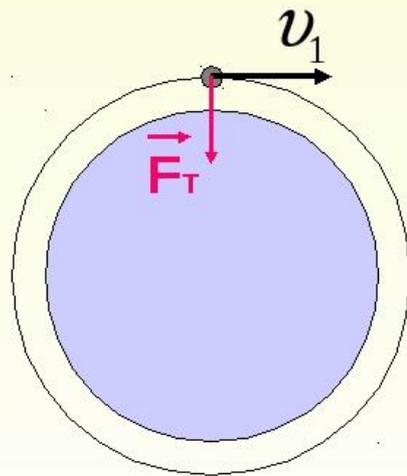
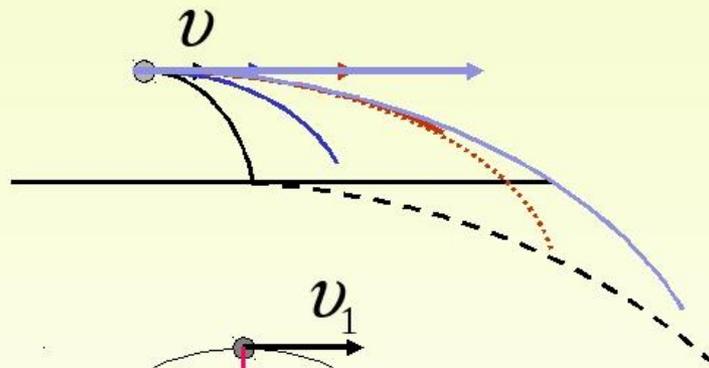


Космические скорости



Космические скорости

Первая космическая скорость



$$v_1 = 7,9 \frac{\text{KM}}{\text{c}}$$

$$F_T = G \frac{M_3 m}{R_3^2}$$

$$F_T = ma_u = m \frac{v_1^2}{R_3}$$

$$m \frac{v_1^2}{R_3} = G \frac{M_3 m}{R_3^2}$$

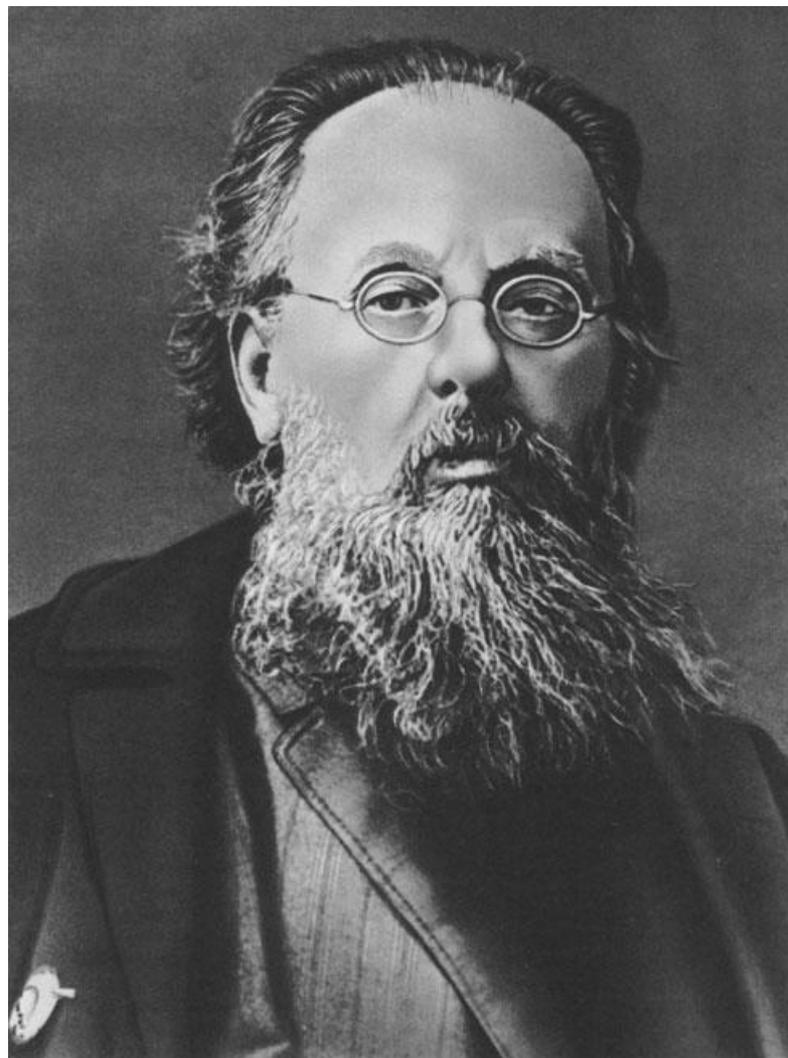
$$v_1 = \sqrt{G \frac{M_3}{R_3}}$$



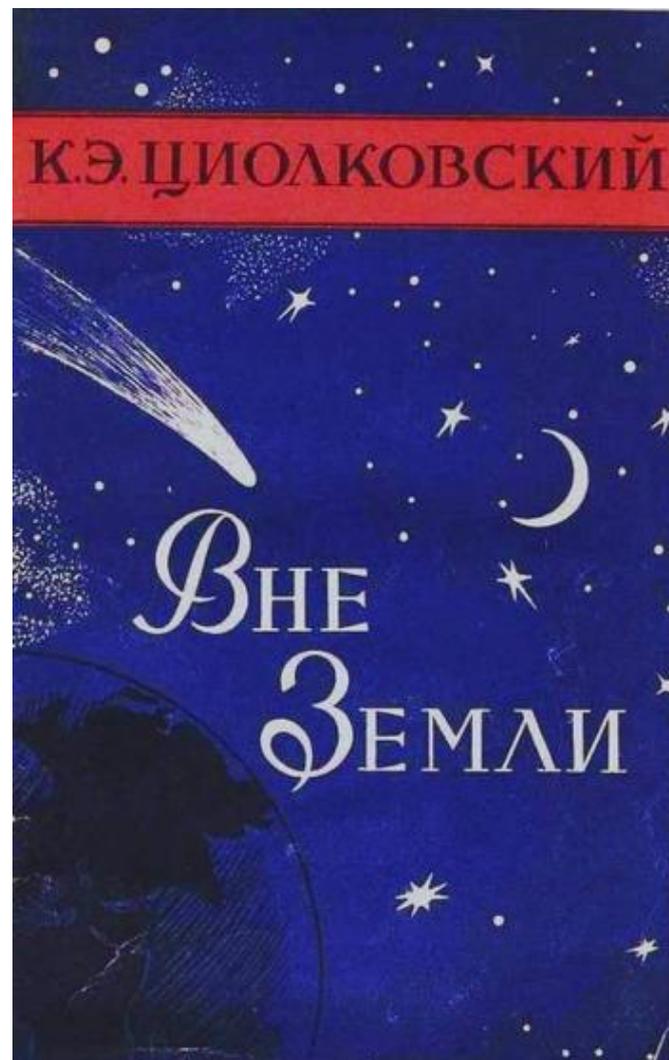
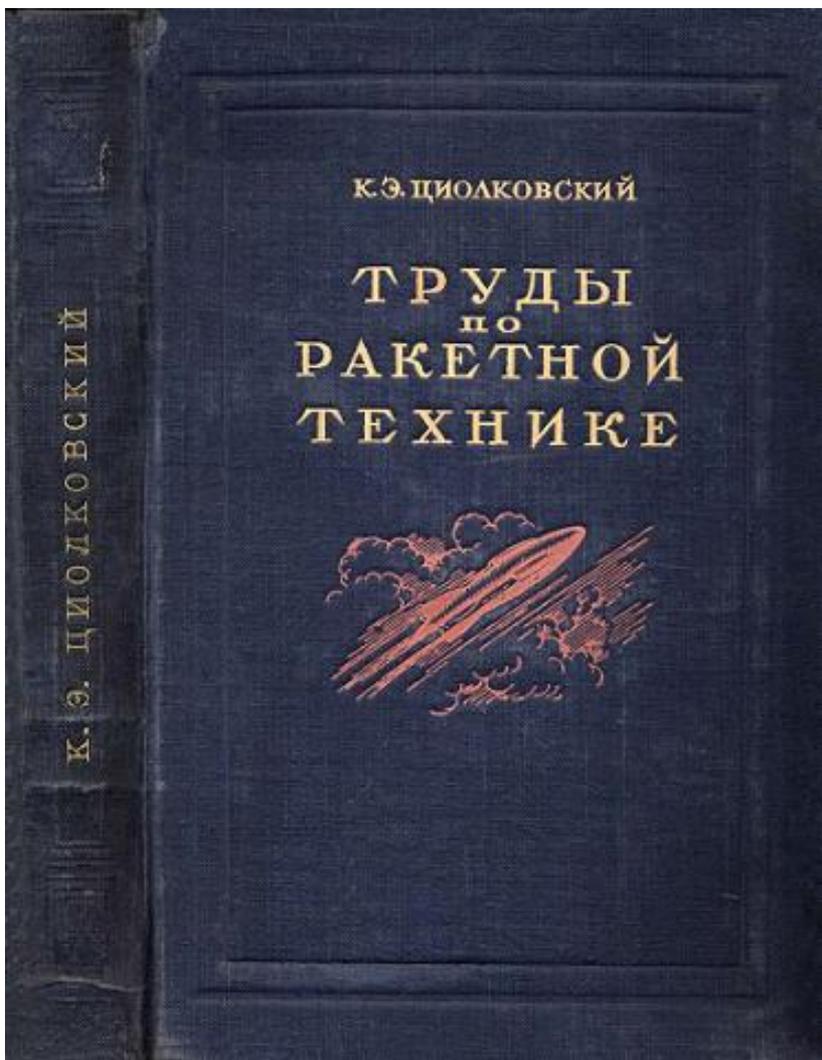
Космические скорости

$$\frac{mv_2^2}{2} - G \frac{mM}{R} = 0,$$

Космонавтика



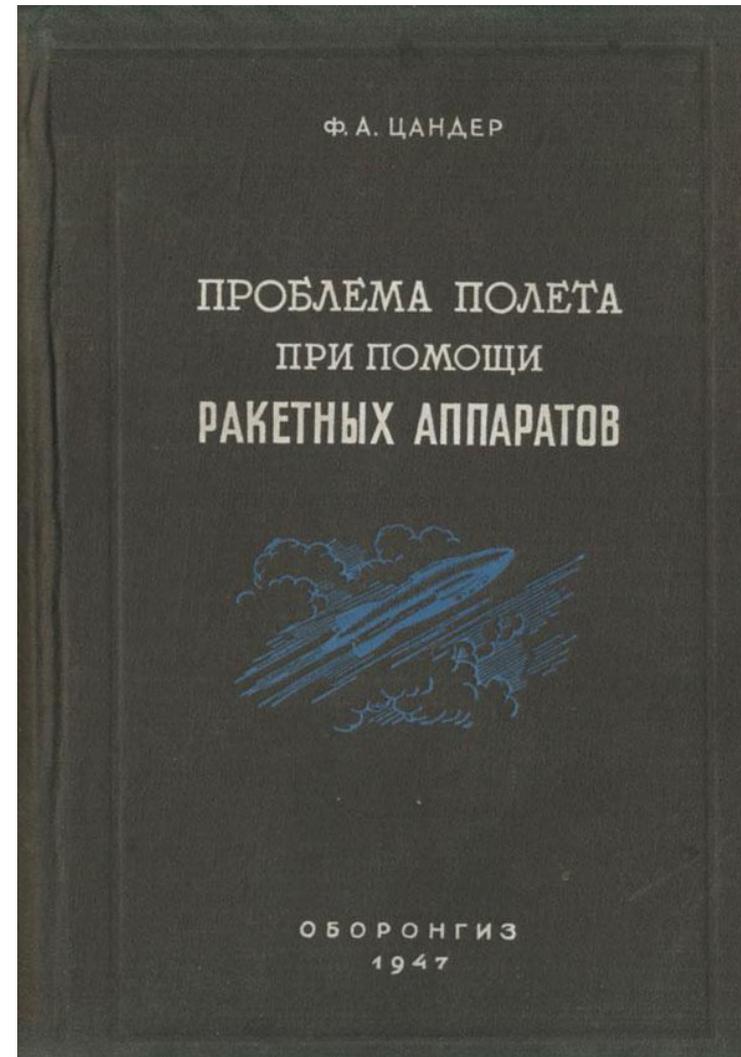
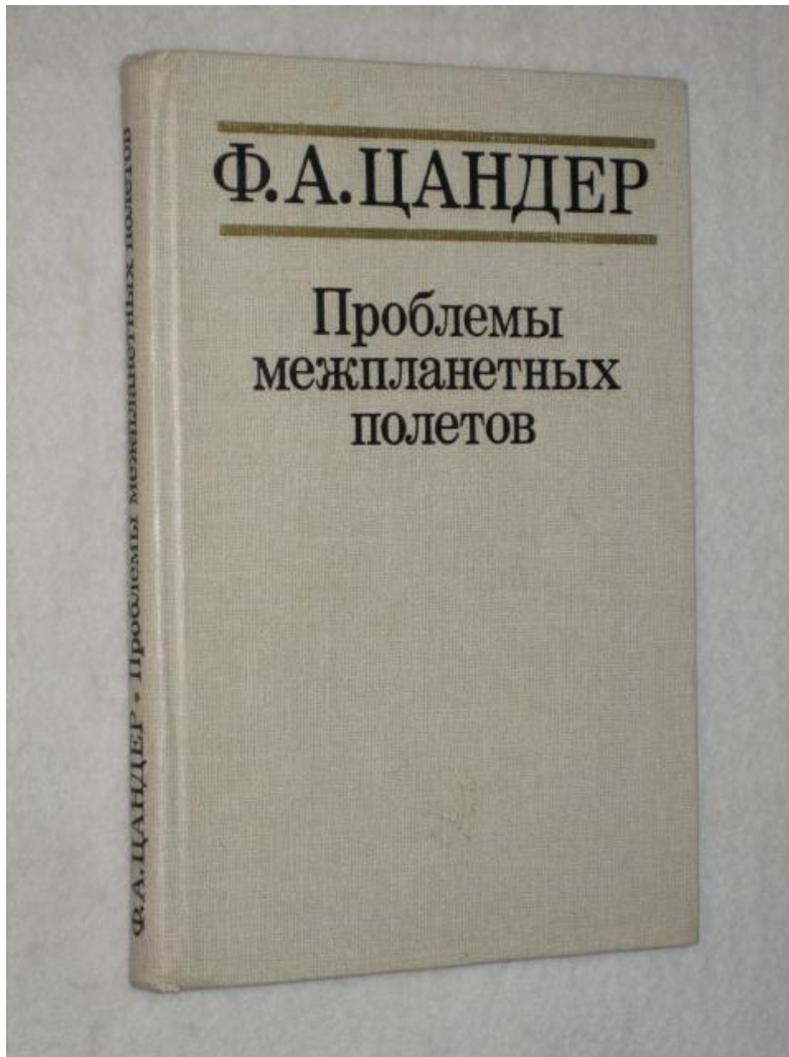
Космонавтика



Космонавтика



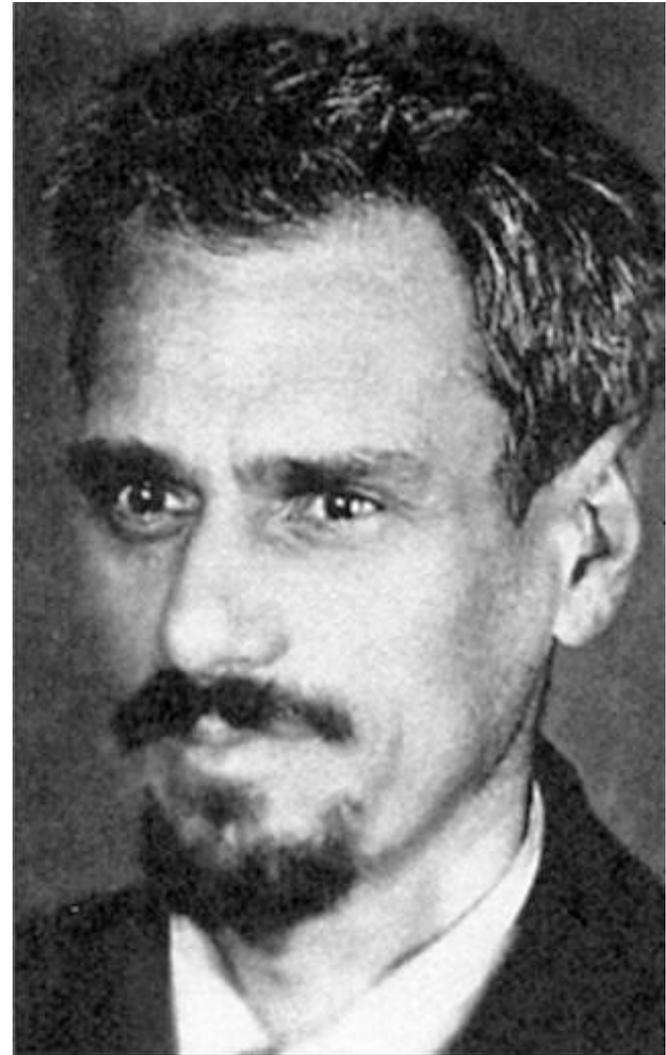
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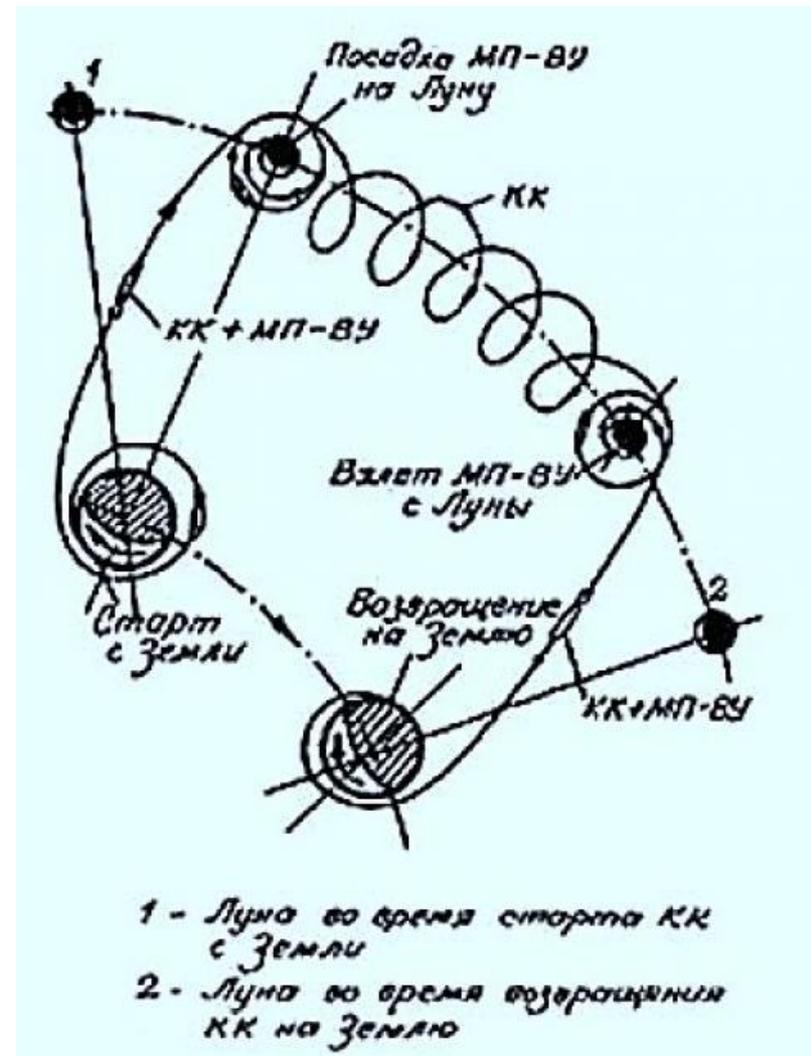
Космонавтика

Кондратюк Юрий
Васильевич

Шаргей Александр
Игнатьевич



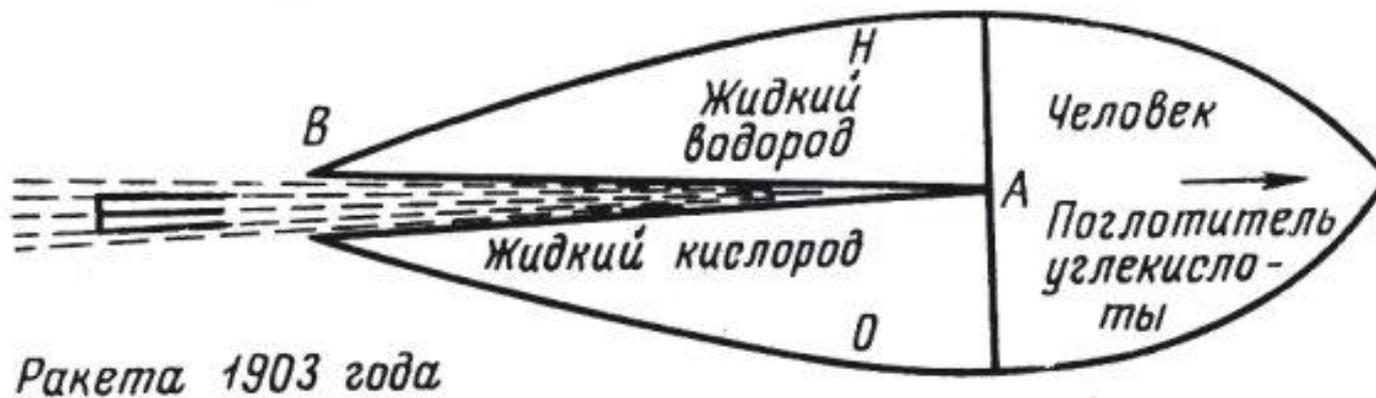
Космонавтика



Космонавтика



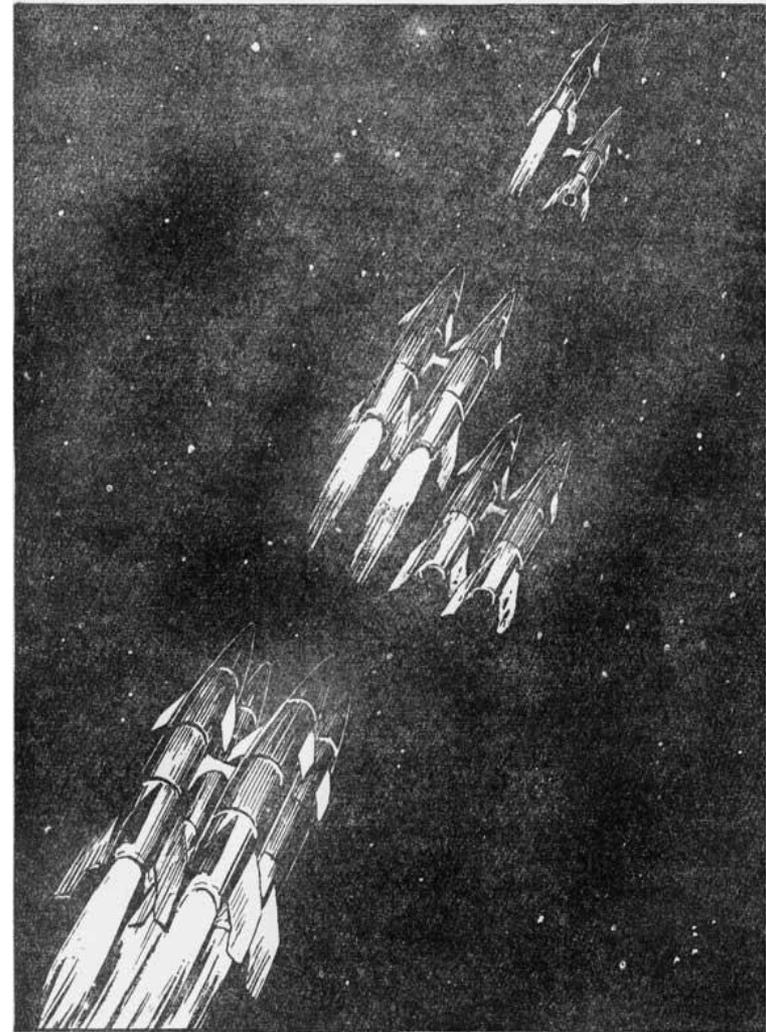
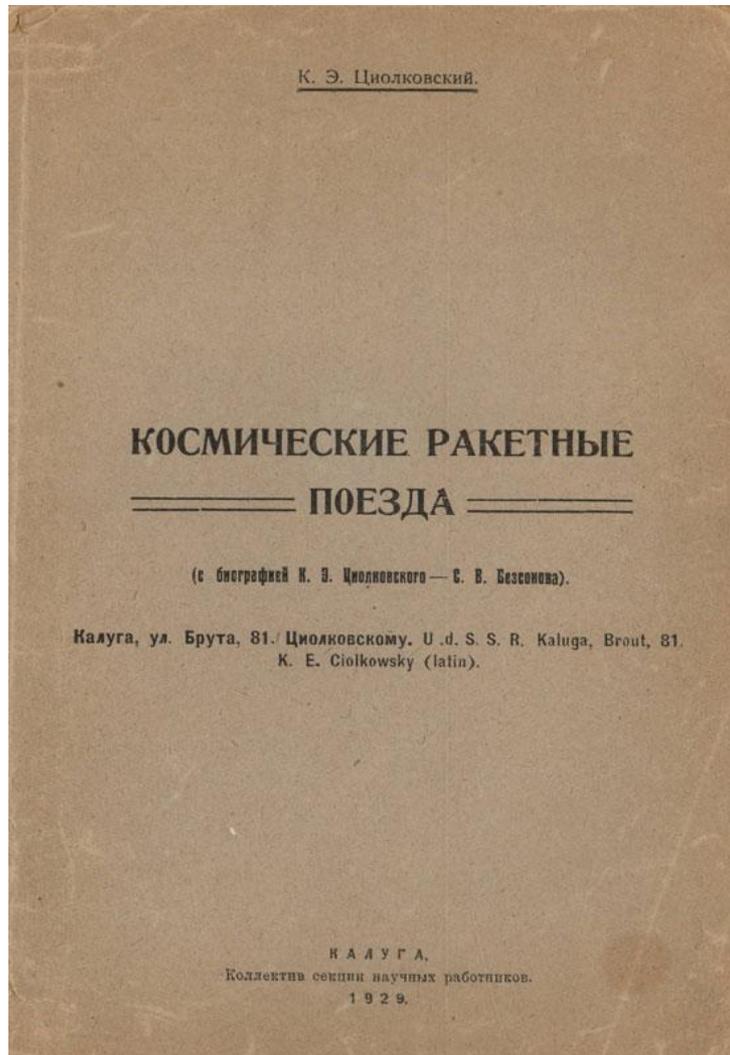
Космонавтика



Космонавтика

$$v_1 = v_2 \ln\left(1 + \frac{m_2}{m_1}\right)$$

Космонавтика



Космонавтика

Пилотируемые космические корабли



Космонавтика



Космонавтика

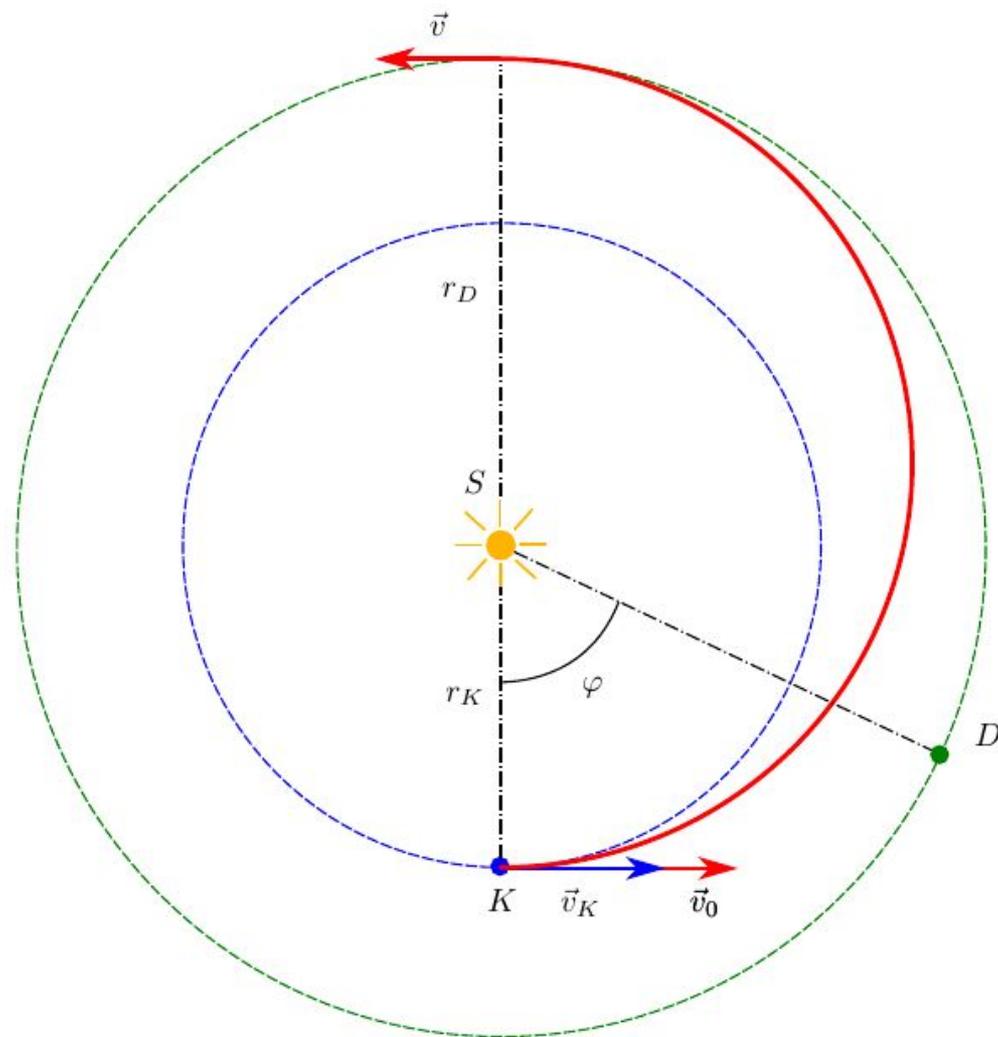
Космический корабль "Союз-ТМА"
Россия, 2002 г.



Лунный орбитальный корабль (ЛОК)
СССР, 1960-1965 гг.



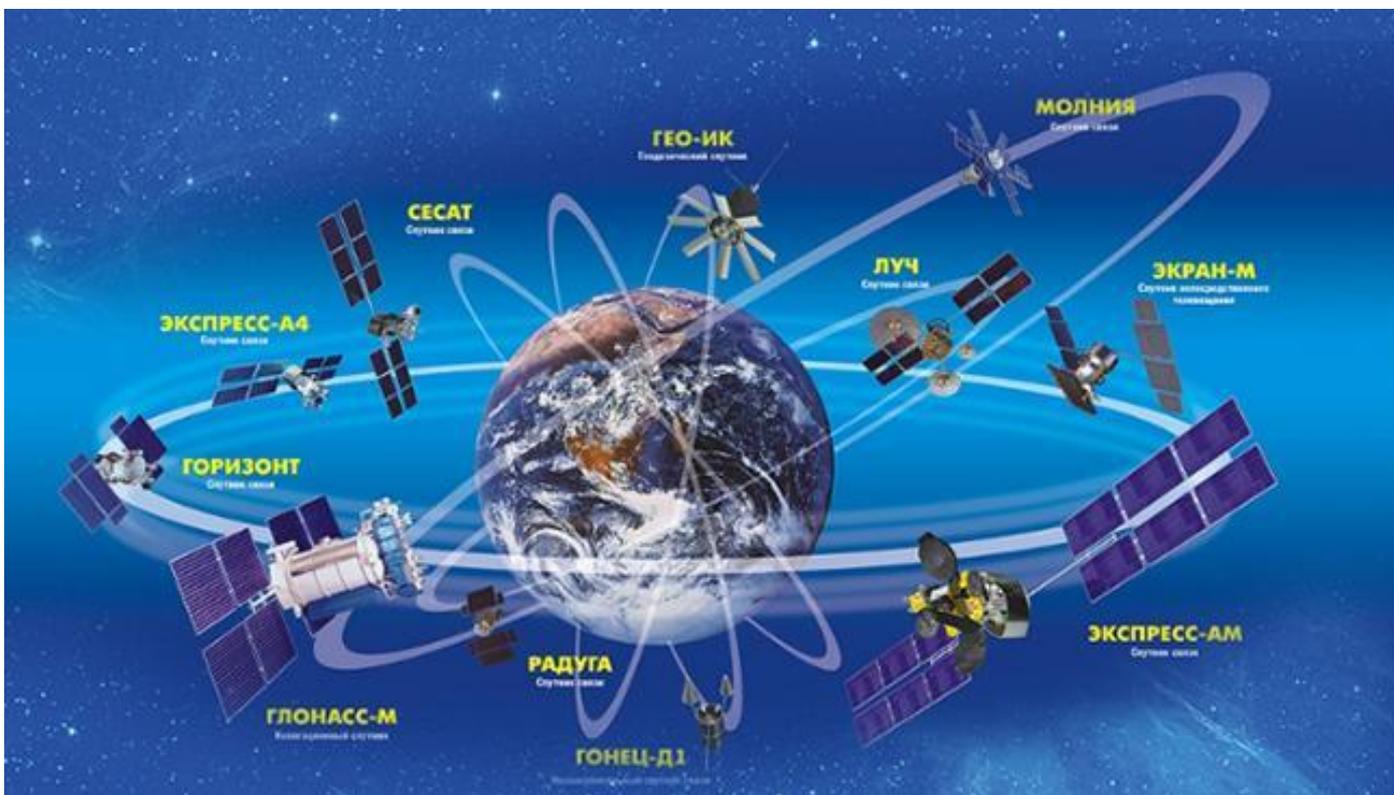
Космонавтика



Космонавтика



Космонавтика



Космонавтика



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