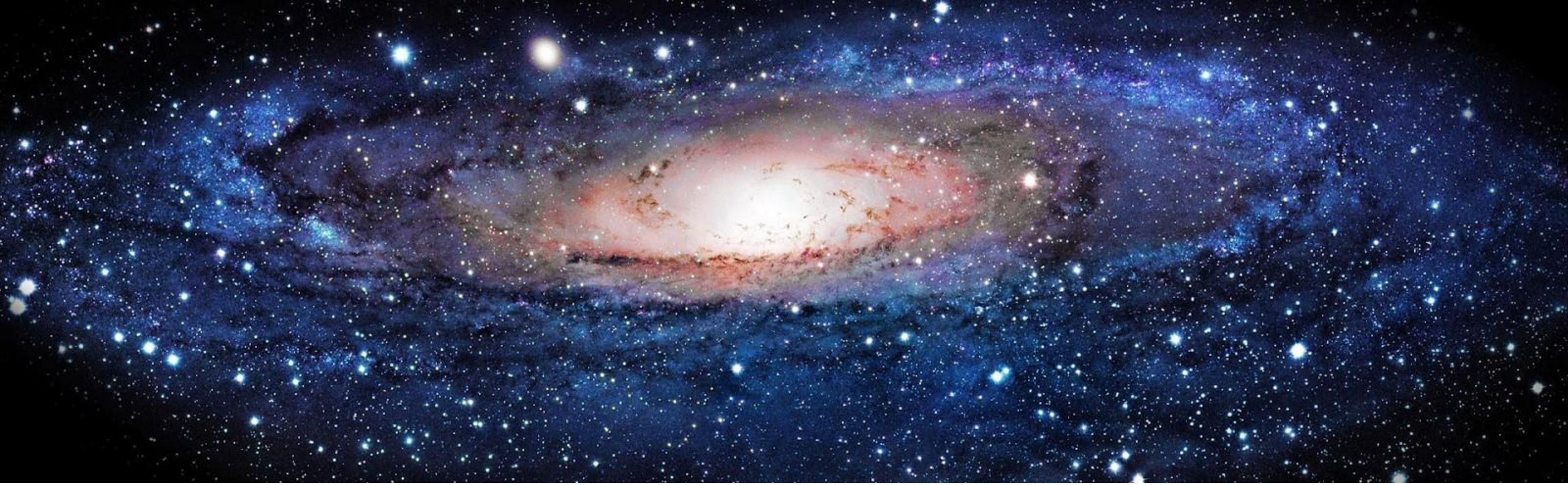


Майнор. Астрофизика.

Семинар 3. (16.09)

4 Разр 2/3

$\theta = 1{,}22 \frac{\lambda}{D} \cdot 206265''$

1) Разрешение

1 а.е. → 10 пк

$(206650)^2$

2) Качест.

1 $m_1 = m_2 = 2^m$

$f = f_1 + f_2 = 2f_0$

$-2{,}5\lg\frac{f_1}{f_0}$

$+2.5 = 7.3$

3 10^5 8 10 пк

4,8 10 пк

$f_c = f_{00} \cdot \frac{10^5}{\left(\frac{10\text{ пк}}{10\text{ пк}}\right)^2}$

(1)

$$P^2 = \frac{4\pi^2}{G(M_1+M_2)} a^3$$

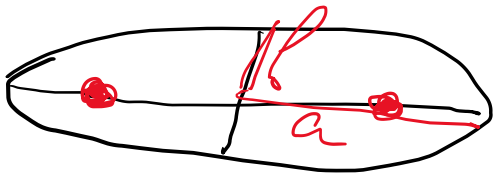
(сол. масс.)

$$\frac{P_1^2}{P_2^2} = \frac{a_1^3}{a_2^3}$$

$$F = G\frac{M_1 M_2}{a^2}$$

Эллипс, парабола, гипербола

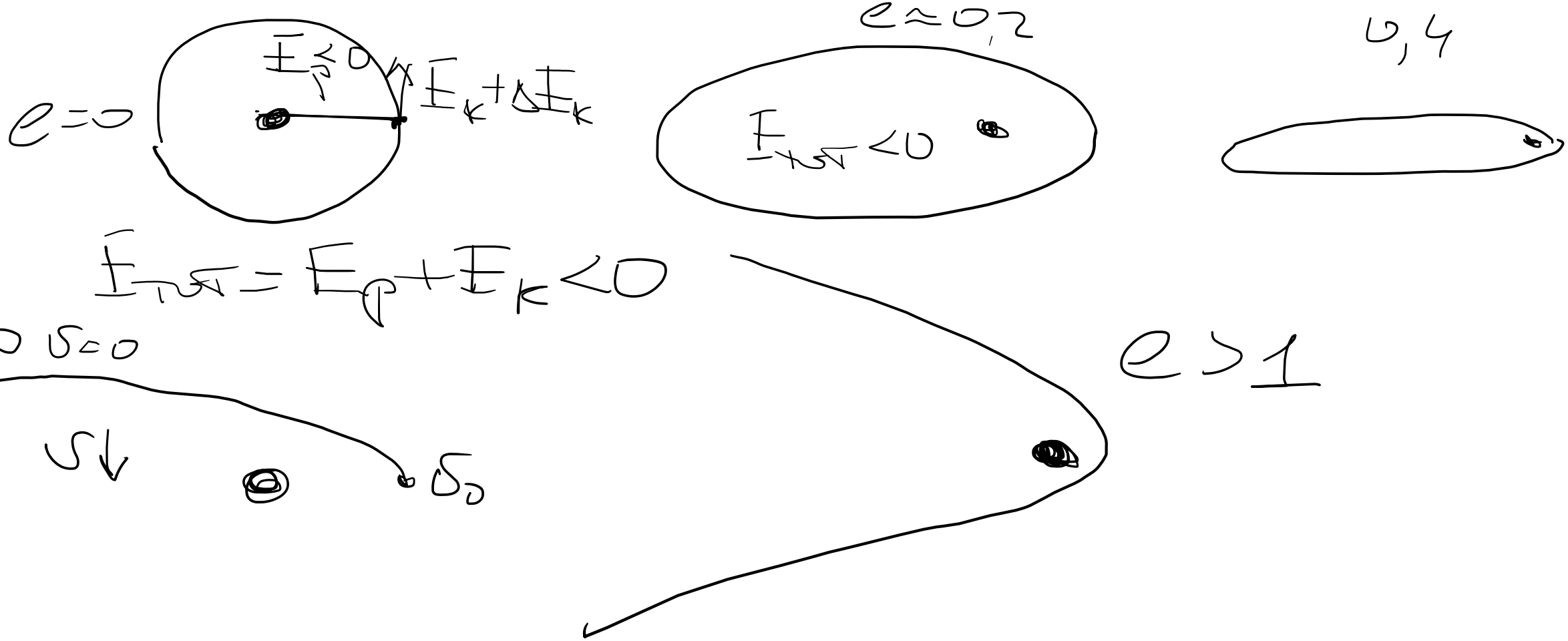
$e<1$, $e=1$, $e>1$



$$e = \sqrt{1 - b^2/a^2}$$ эллипс

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

Гипербола $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ $e = \sqrt{1 + b^2/a^2}$


e=0
E<0
E_k+ΔE_k
e≈0,7
E_całk<0
0,4
E_całk = E_p + E_k < 0
∞ v=0
e>1
v↓
v_0

② Teorema Lagrange

$$E_{TOT} = E_p + E_K$$

$$E_K = \frac{mv^2}{2}$$

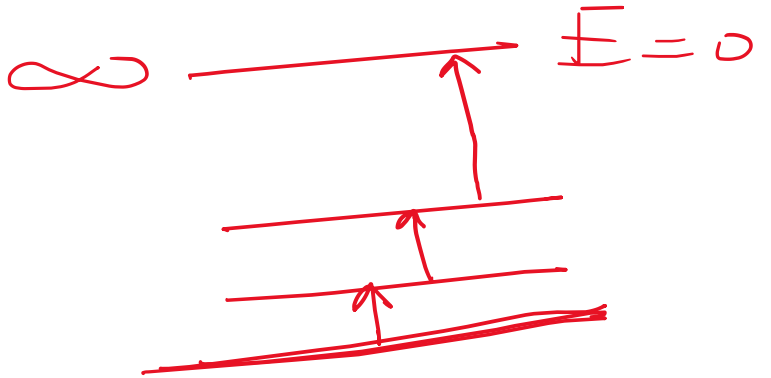
$$2E_K = -E_p$$

$$E_{TOT} = -E_K$$

$$E_p = -\frac{GMm}{a}$$

$$2\frac{mv^2}{2} = \frac{GMm}{a}$$

$$v = \sqrt{\frac{GM}{a}}$$



3) Марс vs. Венера

$B_{\odot}$ 0,72 ае М: 1,52 ае

1 - 0,72

1,52 - 1

- ☉
- В ♀
- З ⊕
- М ♂

$E_T = E_K + E_P = -E_K$

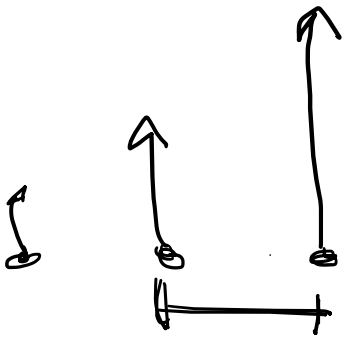
$v = \sqrt{\frac{GM}{a}}$

$E_K = \frac{mv^2}{2} = \frac{m}{2}\frac{GM}{a}$

$\frac{E_{TB}}{E_{T3}}$: $\frac{E_{T3}}{E_{TM}}$

$\Delta E_{3B} = \frac{1}{0,72} - \frac{1}{1} = 0,39$

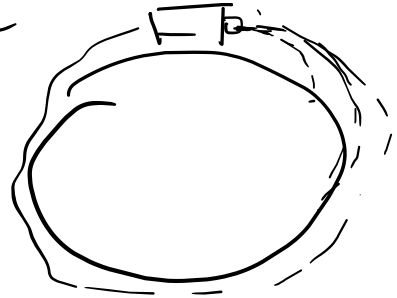
$\Delta E_{3M} = \frac{1}{1} - \frac{1}{1,52} = 0,34$



4

a) 1 kosm.

$F = G\frac{Mm}{R^2}$ $\quad F = m \cdot a$



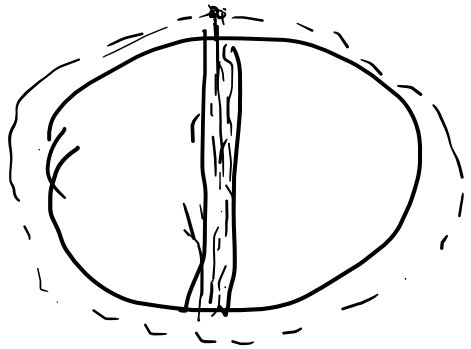
$a = \frac{v^2}{R} = \frac{GM}{R^2}$

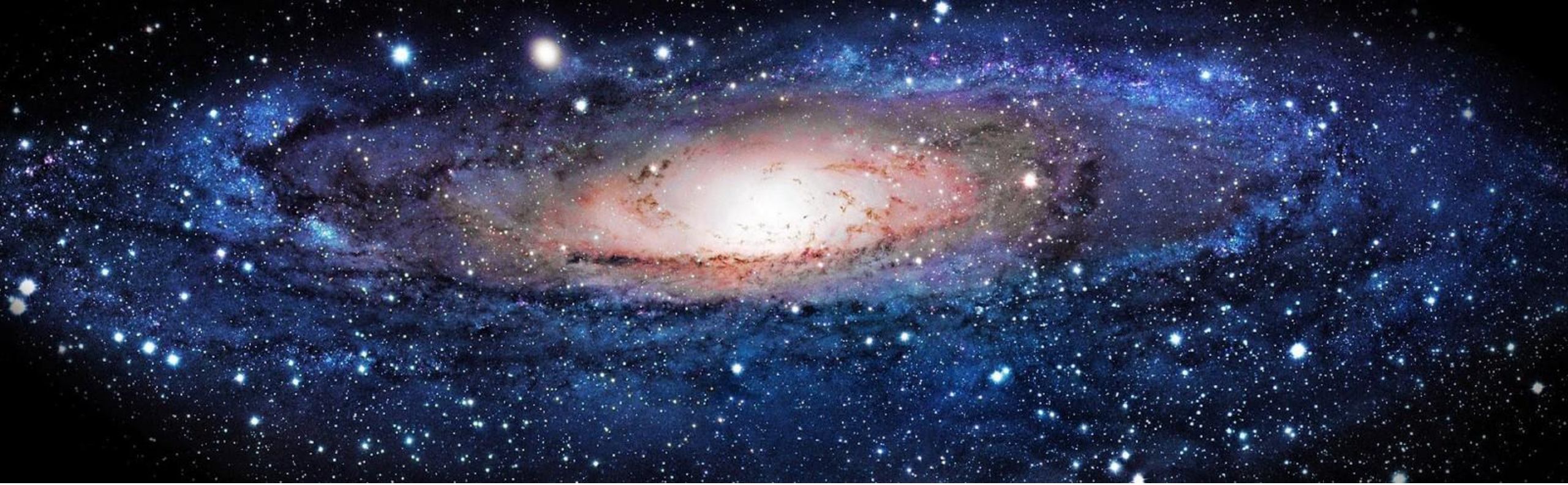
$v = \sqrt{\frac{GM}{R}}$

$v = \frac{2\pi R}{T_{orb}}$

$\rho = \frac{M}{\frac{4}{3}\pi R^3}$

$T_{orb} = \frac{2\pi R^3 h}{\sqrt{GM}} = \frac{2\pi}{\sqrt{G}}\sqrt{\frac{R^3}{M}} \sim \frac{1}{\sqrt{G\rho}}$



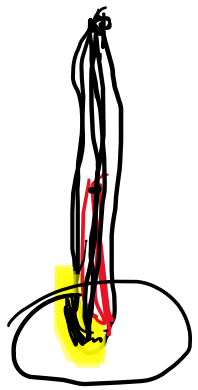


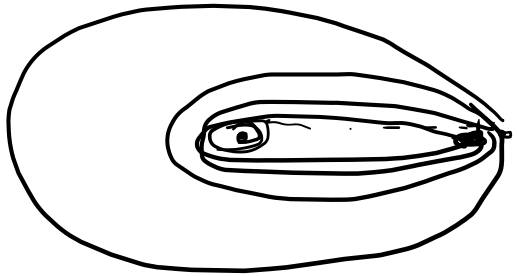
Майнор. Астрофизика.

Семинар 3. (16.09)

(5) $h = g t^2/2$ $g = \text{const}$ $h \ll R$

$$P^2 \simeq \frac{4\pi^2}{G M} a^3$$





$a \gg R$

$T = \frac{1}{2} P$

$h = 2a$

$T(h)\ h \gg R$

$$P = \left\{ \frac{4\pi^2}{G M} \left(\frac{h}{2}\right)^3 \right\}^{1/2}$$

$$T = \frac{1}{2} P = \frac{1}{2} \left[\frac{\pi^2 h^3}{2 G M} \right]^{1/2} \sim h^{3/2}$$

6 Эффект Доплера

$S = 10^{10}\ см^2$

$1\ км^2$

$P = mv$

$M \sim R^3$

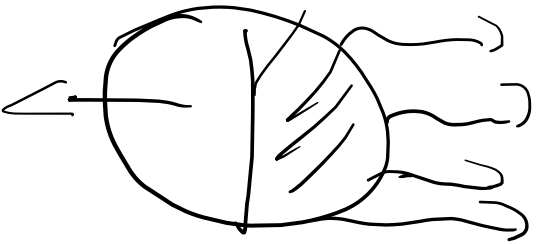
$I \sim R^2$

$L = S \cdot \sigma T^4$

$\sigma = 5{,}67 \cdot 10^{-5}$

Iae. $\sqrt{\frac{\epsilon M}{R}} = 30\ \frac{км}{с}$

$T = 300\ K$



$L = S\sigma T^4 = 10^{10} \cdot 5.67 \cdot 10^{-5} (300)^4 \approx$

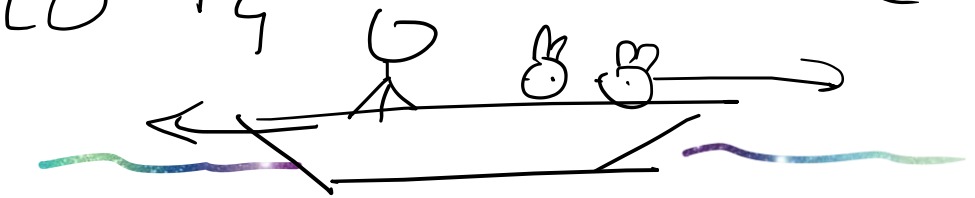
$\approx 4 \cdot 10^{15}$ эрг/с

$E_p = h\nu \qquad \lambda = c/\nu$

$E = N \cdot h\nu \qquad L = \dot{E} = \dot{N} \cdot h\nu$

$\lambda \simeq 10\ \mu m = 10^{-3}$ см $\qquad \nu = 3 \cdot 10^{13}$ Гц

$c = 3 \cdot 10^{10}$ см/с



$\dot{N} = L / h\nu = 2 \cdot 10^{28}$ фот/сек

$p = \frac{h\nu}{c}$ $\qquad \frac{\Delta p}{\Delta t} = 10^5$ г·см/с²

h – постоянная Планка $h \simeq 6.6 \cdot 10^{-27}$

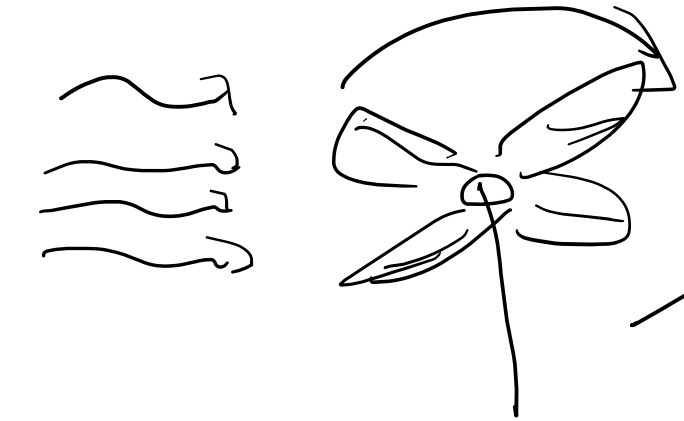
$p_a = mv = V \rho \cdot v = \frac{4}{3} \cdot 10^{15} \cdot 4 \cdot 30 \cdot 10^5 \sim 5 \cdot 10^{22}$ г·см/с

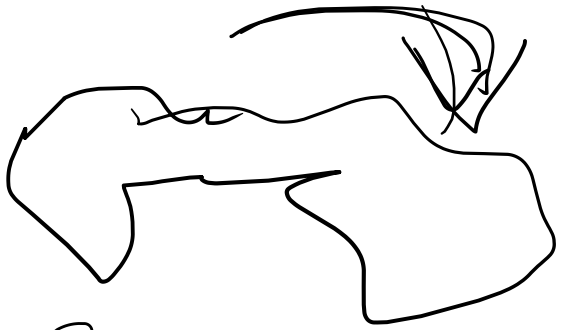
$120\ \text{дн} = 3{,}15 \cdot 10^7$ с

$\tau = \frac{p_a}{(\Delta p / \Delta t)} = 5 \cdot 10^{17}$ с $\approx 1{,}5 \cdot 10^{10}$ лет

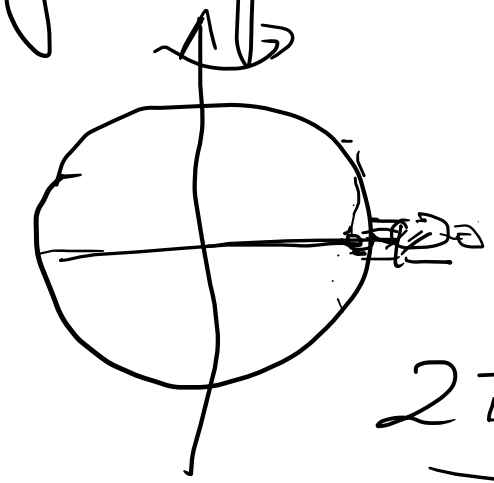
$\Delta p = \dot{N} P$

7) YORP





Neg. Plan.



$$v_l = \omega R$$

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

$$v_l = \frac{2\pi R}{P}$$

$$\sqrt{\frac{GM}{R^2}}$$

$$\frac{2\pi \cdot 6400 \cdot 10^5}{24 \cdot 3600} = 4{,}65 \cdot 10^4 \frac{cm}{s} = 0{,}465 \frac{m}{s}$$

$$\sqrt{\frac{GM}{R}} = \frac{2\pi R}{P_{lin}}$$

$$P_{rot} = 2\pi \frac{R\sqrt{R}}{\sqrt{GM}} \sim \frac{1}{\sqrt{\rho}}$$

$$P_{orb} = \frac{2\pi}{\sqrt{G}} \sqrt{\frac{R^3}{M}} = \frac{2\pi}{\sqrt{G}} \sqrt{\frac{1}{\rho} \frac{3}{4\pi}} =$$

$$= \frac{2\pi\sqrt{1.5}}{\sqrt{10^{-7}}} \frac{\sqrt{3}}{2\sqrt{\pi}\sqrt{\rho}} =$$

$$G = 6.674 \cdot 10^{-8} \approx \frac{10^{-7}}{1.5}$$

$$= \frac{\sqrt{\pi \cdot 4.5}}{\sqrt{10}} 10^4 \frac{1}{\sqrt{\rho}} \text{ cgs} \approx 3^h \rho^{-1/2}$$

8) Высота горы

$p = \frac{F}{S}$ $F = G\frac{M_1 M_2}{R^2}$

$M_1 = \frac{4}{3}\pi R^3 \rho$

$M_2 = V \cdot \rho = \frac{1}{2} h \cdot S \cdot \rho$

$\frac{G M_1 M_2}{S_1 R_1^2} = \frac{G M_3 M_4}{S_2 R_2^2}$

$M_1 \sim R_1^3$

$M_3 \sim R_2^3$

$\rho_1 = \rho_2 = \rho$

$R_2 \approx h_2$

$R_1 R_1 = R_2 h_2$

$R_1 = 6400$ км

$h_1 = 10$ км

$R_2 = \sqrt{R_1 h_1} \approx 253$ км

$D \approx 500$ км