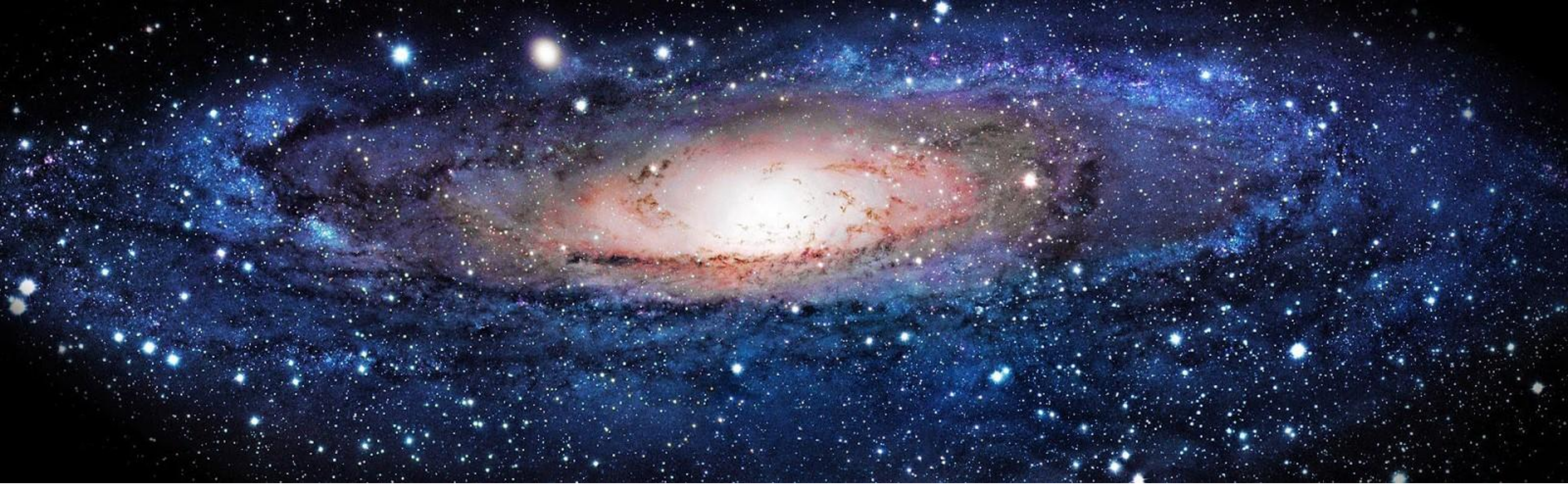
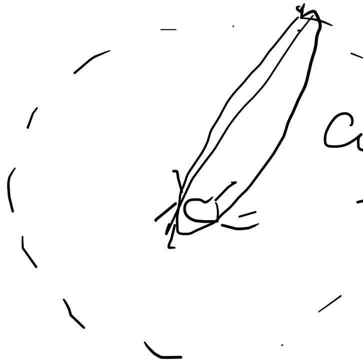


Майнор. Астрофизика.

Семинар 5. (30.09)

1



$a = \frac{1}{2} a_0$

$T = \frac{1}{2} P_{orb}$

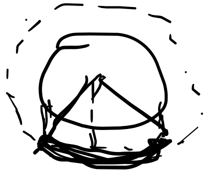
2

$T = \frac{1}{\pi} \frac{R_*}{a} P_{orb}$

$P_{orb}^2 = \frac{4\pi^2}{GM} a^3$

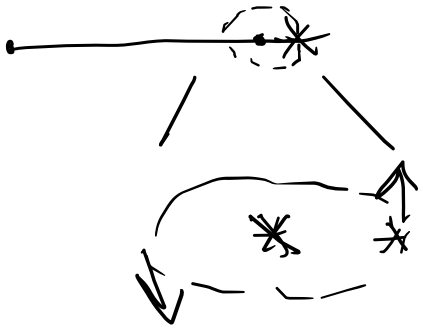
$v_{orb} = \frac{2 R_*}{T} = \sqrt{\frac{GM}{a}}$

$v_{orb} = \frac{2\pi a}{P_{orb}}$



$9 \frac{cm}{c}$

3



$a_* \approx a \frac{m}{M}$

$\Delta = 2 v_{orb} = 75\ cm/c$

$v_{orb} = \frac{2\pi a_*}{P}$

$P = \frac{2\pi}{\sqrt{G}\sqrt{M}} a^{3/2}$

$v_{orb} = \frac{2\pi}{P} a \frac{m}{M} = \frac{2\pi a m \sqrt{G}\sqrt{M}}{M\, 2\pi\, a^{3/2}} = \frac{\sqrt{G}\, m}{\sqrt{M}\sqrt{a}} = 38 \frac{cm}{c}$

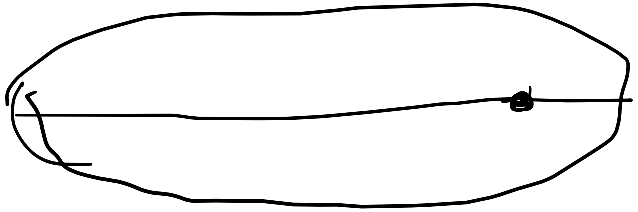
$$P^2 = \frac{4\pi^2}{G(M_1+M_2)}\,a^3$$

$a = a_1 + a_2$

$M_1 a_1 = M_2 a_2$

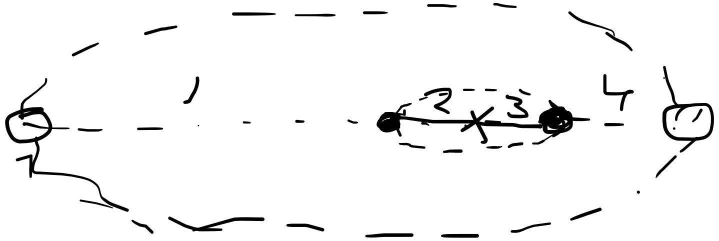
$r_{max} = 1+2+3$

$r_{min} = 4+2+3$



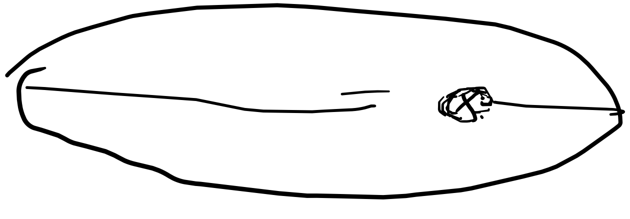
$2a = r_{max} + r_{min} =$

$= \underbrace{1+2+3+4}_{2a_1} + \underbrace{2+3}_{2a_2}$



$\underline{a} = a_1 + a_2$

D/3 $m \ll M_*$



$a = a_p + a_* \approx a_p$

$M_* a_* \approx M_p \cdot a$

1) $d = 50$ пк $M_* = 0,1 M_\odot$ $M_p = M_J = 0,001 M_\odot$

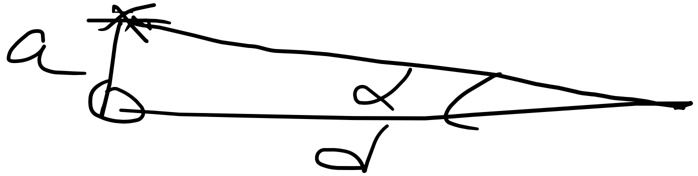
$P_{orb} = 100^d$

а) D - телескоп

$\theta = 1,22\, \lambda / D$ $\lambda = 0,5$ мкм $= 5\cdot 10^{-7}$ м $= 5 \cdot 10^{-5}$ см

$\alpha = \frac{a}{d}$ [рад]

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



$$a = \left[\frac{G(M_* + M_p)}{4\pi^2} P^2\right]^{1/3} = 3\cdot 10^{12}\text{ см} = 0,2\text{ а.е.}$$

$$\alpha'' = \frac{3\cdot 10^{12}\text{ см}}{50\cdot 3,1\cdot 10^{18}\text{ см}} \cdot 206265 = 0''004$$

$\alpha[\text{рад}] = \theta[\text{рад}]$

$$D = \frac{1,22\lambda}{\alpha[\text{рад}]} = 3460\text{ см} = 34,6\text{ м}$$

б) $a = a_* + a_p$

$a_* M_* = a_p M_p$

$M_* \gg M_p \Rightarrow a \approx a_p$

$\beta = 2 \frac{a_*}{d}$

$\beta = 2 \frac{M_p}{M_p + M_*} a d^{-1} \approx 4 \cdot 10^{-10}$ рад $\to 0{,}00008''$

(2) $A = 2 v^{*}_{orb} = 50$ см/с

$M_p \ll M_*$ $\qquad M_* = 0.5 M_\odot$

$P_{orb} = 0.5$ года $\simeq 1,6 \cdot 10^7$ сек

$a_* = a \dfrac{M_p}{M_*}$ $\qquad v^{*}_{orb} = \dfrac{2\pi a_*}{P_{orb}}$

$A = 2 \dfrac{2\pi}{P_{orb}} a \dfrac{M_p}{M_*}$ $\qquad M_p = \dfrac{A \cdot M_* P_{orb}}{4\pi a} =$

~~$M_p = M_* \dfrac{4\pi A}{P_{orb} \cdot A a}$~~

$= M_* \dfrac{A \cdot P_{orb}}{4\pi} \left[\dfrac{G M_* P_{orb}^2}{4\pi^2}\right]^{-1/3} =$

$= 4,2 \cdot 10^{-6} M_\odot = 1,4 M_\oplus$

③ $d = 10$ пк $\quad L = L_{\odot} \rightarrow M_{\odot} = 4{,}8^m$

$D_T = 6{,}5$ м $\quad \frac{D_T}{D_{гл}} = \frac{6{,}5 м}{6{,}5 мм} = 10^3 \Rightarrow \frac{S_T}{S_{гл}} = 10^6$

$f_1/f_2 = 10^6 = (10^2)^3$

$\Delta m = 5^m$ $\quad \Delta m = 15^m$ $\quad m \rightarrow \lg \frac{f_1}{f_2}$

1) $\theta = 1{,}22 \frac{\lambda}{D} = 1{,}22 \cdot \frac{0{,}55 \cdot 10^{-6} м}{6{,}5 м} = 1{,}1 \cdot 10^{-7}$ рад

~~$a = \frac{d}{\theta}$~~ $\quad a = d \cdot \theta = 3{,}4 \cdot 10^{12}$ см $\simeq 0{,}23$ ае.

2) $M^{пред}_{гл} = 6^m$ $\quad M^{пред}_{тел} = M^{пред}_{гл} + \Delta m = 21^m$

$m_* = 4{,}8^m$ $\quad \Delta m = 21 - 4{,}8 \simeq 16{,}2^m = (15 + 1{,}2)$

f_* $\quad f_3 \simeq \frac{f_*}{3 \cdot 10^6}$ $\quad 1 \rightarrow 2{,}512$ $\quad 10^6$

$$f = \frac{L}{4\pi d^2}$$

$$\frac{f_*}{f_3} = \frac{L_*}{L_3}$$

$$m = 16{,}2 - (-15 + 1{,}2)$$

$$\Delta m = 1{,}2 \Rightarrow \frac{f_1}{f_2} = 3$$

$$L_3 = \frac{L_*}{3 \cdot 10^6}$$

$$f = \frac{L_*}{4\pi a^2}$$

$$L_3 = f \cdot \pi R_3^2 = \frac{L_*}{4\pi a^2} \pi R_3^2$$

$$R_3 = \left[\frac{4\pi a^2 L_3}{\pi L_*}\right]^{1/2} = \left(\frac{4a^2}{3 \cdot 10^6}\right)^{1/2} = 1{,}15 \cdot 10^{-3} a$$

$$\approx 4 \cdot 10^9 \text{ cm} \approx 41000 \text{ km}$$