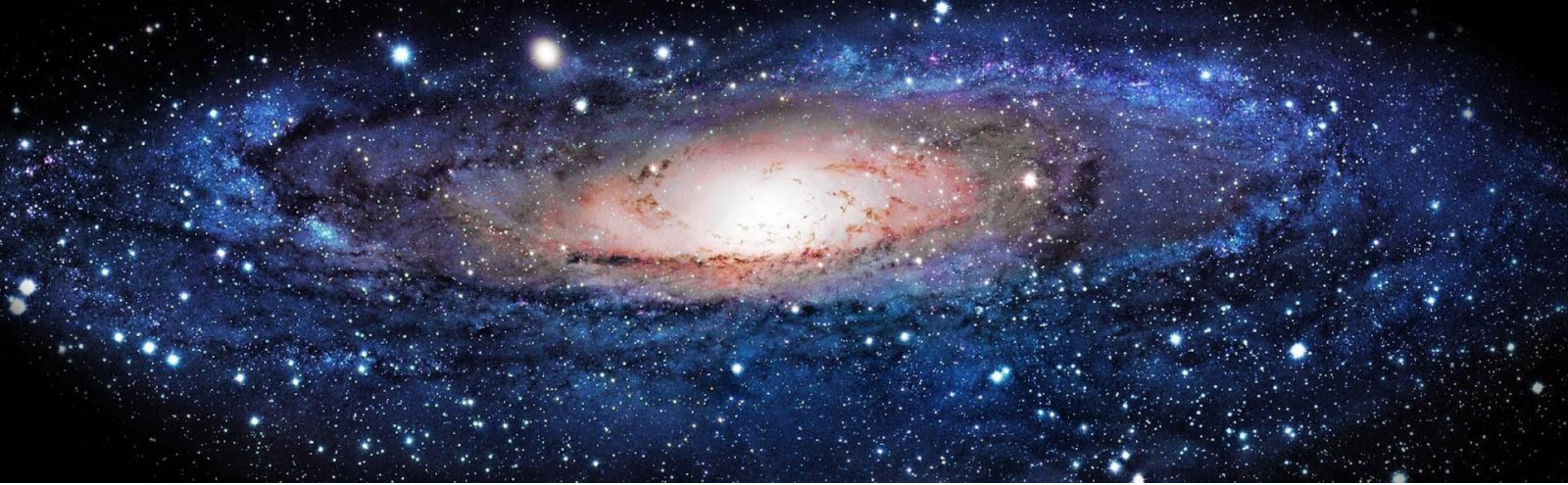


Модуль. Астрофизика.

Семинар 3. (13.11)

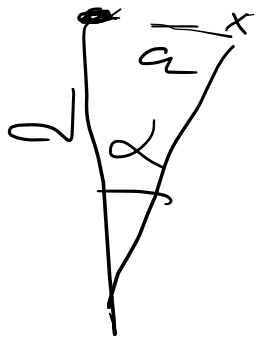
① $d = 40 пк \quad \alpha = 0,''1$

$a = d \cdot \sin\alpha = \frac{d\alpha''}{206265} =$

$= d[пк][\alpha''] = 4ae$

$P^2 = \frac{4\pi^2 a^3}{G M_\odot} = \frac{4\pi^2 (1.5 \cdot 10^3 \cdot 4)^3}{10^{-7} \cdot 2 \cdot 10^{33}} 1,5$

$P \simeq 8$ лет.



15. $L = 3L_\odot$ $R_p = 1{,}5\,R_\odot$

Наиболее $A = 0{,}5$ $T = 1000\,K$

$L_{\omega\delta c.} = 4\pi R_p^2 \sigma_{SB} T^4$ $\sigma_{SB}[CI] = 5{,}67 \cdot 10^{-5}$

$L_{отр}$: $f_p = \frac{L}{4\pi a^2}$ $L_{отр} = f_p \cdot S_p \cdot A = f_p \cdot \pi R_p^2 \cdot A$

$$\frac{L_{\omega\delta c}}{L_{отр}} = \frac{4\pi R_p^2 \sigma_{SB} T^4}{f_p \pi R_p^2 A} = \frac{4\sigma_{SB} T^4 \cdot 4\pi a^2}{L \cdot A} =$$

$$= \frac{16\pi \cdot 5.67 \cdot 10^{-5} \cdot 10^{12} \cdot 16 \cdot (1{,}5 \cdot 10^{13})^2}{3 \cdot 3{,}84 \cdot 10^{33} \cdot 0.5} = \frac{16 \cdot 5{,}67 \cdot 10^{8} \cdot 2{,}4 \cdot 10^{27}}{10^{33}} =$$

$$= 1.6 \cdot 10^3$$

(2) Astrometria

$$\frac{M_p}{M_*} = \frac{a_*}{a_p}$$

$$\Delta = 2 \cdot a_* = 2 a_p \frac{M_p}{M_*}$$

$M_p \ll M_*$ ⇒ $a_p \simeq a = \left(\frac{G M_* P^2}{4\pi^2} \right)^{1/3}$

$$\alpha_\Delta = 2 \frac{1}{d} \frac{M_p}{M_*} \left(\frac{G M_*}{4\pi^2} P^2 \right)^{1/3} =$$

$$= 2 \left(\frac{d}{pc} \right)^{-1} \left(\frac{M_p}{M_*} \right) \left(\frac{a_p}{1\,ua} \right) \text{arcsec}$$

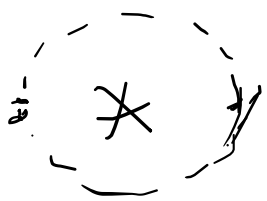
$$= 2 \left(\frac{d}{pc} \right)^{-1} \left(\frac{M_p / M_\odot}{M_* / M_\odot} \right) \left(\frac{a_p}{ua} \right) \text{mas}$$

(3) Луч. скор. $M_p a_p = M_* a_*$

$$v_* = \frac{2\pi a_*}{P_{orb}} = 2\pi \frac{a_p}{P_{orb}} \frac{M_p}{M_*} =$$

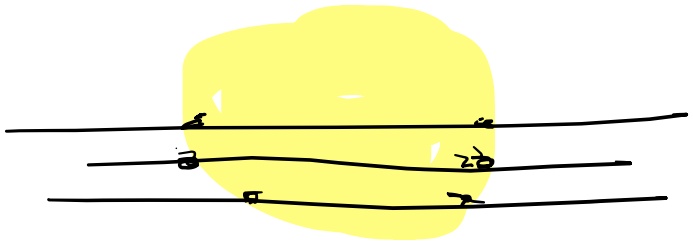
$$= g \frac{cm}{c} \left(\frac{a_p}{a_e}\right) \left(\frac{P_{orb}}{2y}\right)^{-1} \frac{(M_p/M_\oplus)}{(M_*/M_\odot)}$$

$$v_{Pluto} = \frac{2\pi R_*}{P_{Pluto}} = \frac{2\pi \cdot 6{,}9 \cdot 10^{10}\,cm}{30 \cdot 24 \cdot 3600\,c} \simeq 1{,}7 \cdot 10^5 \frac{cm}{c}$$



(4) Dunt. Dang.

$a \gg R_*$



$P_{orb} \sim a^{3/2}$

$$T = \frac{2R_*}{v_{orb}} = \frac{2R_* P_{orb}}{2\pi a} = \frac{1}{\pi} P_{orb} \frac{R_*}{a} =$$

$$= 1{,}5 \cdot 10^{-3} P_{orb} \frac{R_*}{R_\odot} \left(\frac{a}{a_e}\right)^{-1}$$

$$\frac{dv_r}{dt} = \dot{v}_r = \frac{v_*^2}{a} = \frac{v_*}{a} v_* = \frac{2\pi a}{P \cdot a} v_* = \frac{2\pi v_*}{P}$$

$$\ddot{v}_r = \frac{\epsilon M_p}{a^2} = \frac{\epsilon M_p}{R_p^2} \frac{R_p^2}{a^2} = g_p \frac{R_p^2}{a^2} = \frac{2\pi v_*}{P}$$

$$\underline{g_p} = \frac{2\pi v_*}{P} \frac{a^2}{R_p^2} = \frac{2\pi v_*}{P} \left(\frac{a^2}{R_*^2}\right) \left(\frac{R_*^2}{R_p^2}\right)$$

$\rightarrow P$

$2\pi\delta$. транз

$$T \quad \frac{S_p}{S_*} \sim \left(\frac{R_p}{R_*}\right)^2$$

характеризация $\rightarrow$ транз.

CHEOPS

$$\rho_p = \frac{M_p}{\frac{4}{3}\pi R_p^3} = \frac{3\rho_p}{4\pi R_p} = \frac{3}{4\pi G} \frac{1}{R_*} \left(\frac{R_*}{R_p}\right) g_p$$

$$R_* = \theta \cdot d = \theta / \pi$$

$$\rho_p = \frac{3 g_p \frac{1}{\pi}}{4\pi G \theta} \cdot \frac{R_*}{R_p}$$

5) $d = 50\,pc$ $\quad M_* = 0{,}1\,M_\odot$

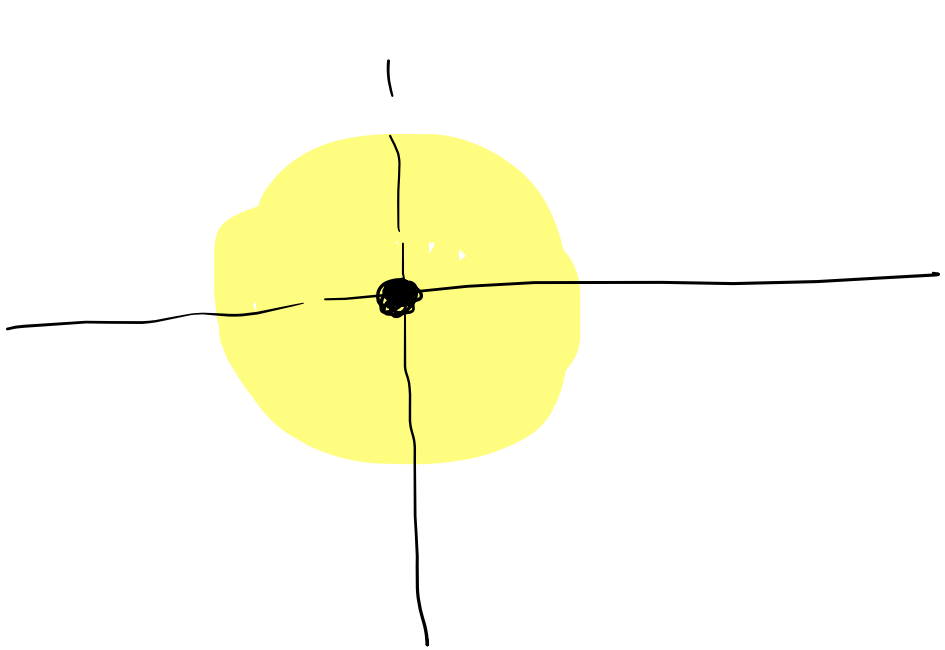
$P_{orb} = 10^5\,d$ $\quad M_p = 0{,}001\,M_\odot$

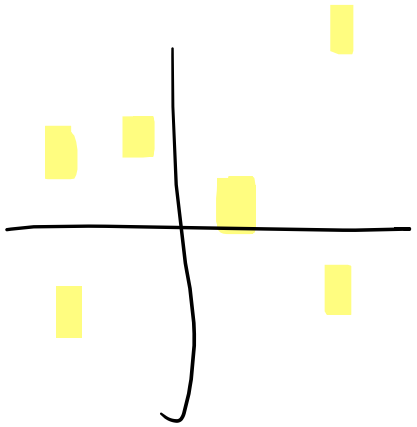
$$a = \left[\frac{G(M_* + M_p)}{4\pi^2} P_{orb}^2 \right]^{1/3} = 3\cdot 10^{12}\,cm = 0{,}2\,ae$$

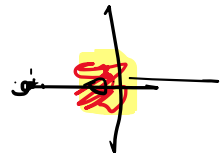
$$\alpha'' = 206265 \frac{3\cdot 10^{12}\,cm}{50\cdot 3{,}1\cdot 10^{18}\,cm} = 0{,}004''$$

$$\alpha[rad] = 1{,}22 \frac{\lambda}{D} \qquad D = \frac{1{,}22\lambda}{\alpha''} 206265 \approx 3460\,m \approx 34{,}6\,m$$

$$\beta = 2a_*/d = 2\frac{M_p}{M_* M_p}\frac{a}{d} \approx 0{,}00008 \sim 1''$$





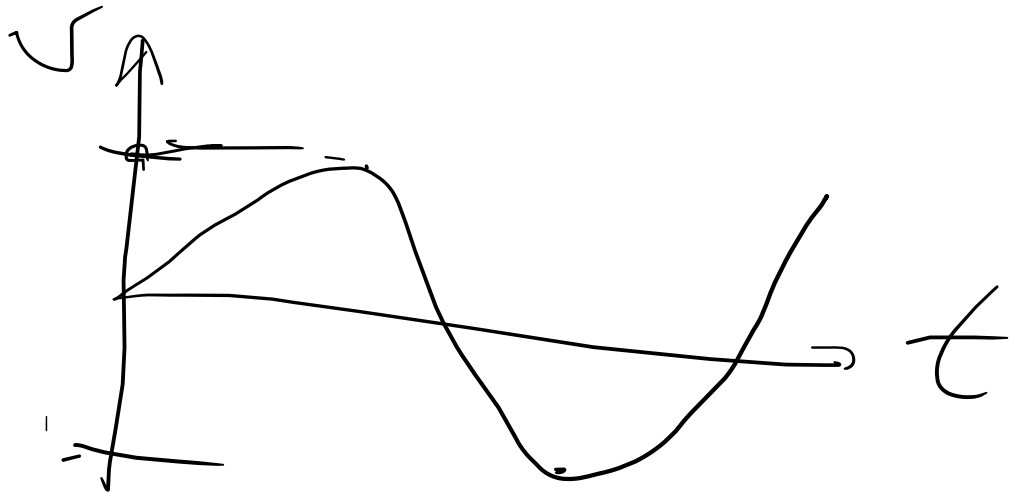


1 pc → 1"

10 kpc = 10⁻⁴"


$\Delta t \sim 10^{-2}$
$\sim 10^{-4}$
$R_p \sim R_y$
$R_{rad} = R_{WD} \simeq R_\oplus$

6



$A = 0,5\ м/с$

$P = 0,5\ года$

$M_* = 0,5\ M_\odot$

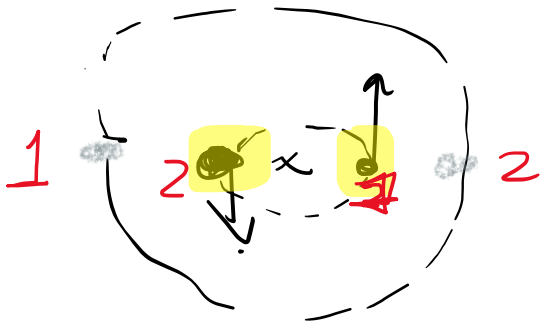
$A = 2 \cdot v_{orb}$

$K = v_{orb} \cdot \sin i$, $i = 1$

$a^3 = \frac{G M_* P^2}{4\pi^2}$

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

$a = a_p + a_*$



$a_* = a \frac{M_p}{M_*}$, т.к. $M_p \ll M_*$, то $a_p \approx a$

$A = \frac{4\pi}{P} a \frac{M_p}{M_*}$

$M_p = M_* \frac{A \cdot P}{4\pi a} = M_* \frac{AP}{4\pi} \left[\frac{G M_* P^2}{4\pi^2}\right]^{-1/3} \approx 4,2 \cdot 10^{-4} M_\odot = 1,4 M_\oplus$

RNAAS

TESS

> 10 mm.