

$$\begin{aligned} \Sigma v^2 &= v \frac{1 + \sqrt{1+s^2}}{s}, \quad s = \frac{v^2 b}{G M} \\ \Sigma t^2 &= \frac{b}{v} \left(\frac{s}{1+s} \right)^2 \end{aligned} \quad \left\{ \begin{aligned} \Sigma r^2 &= \frac{b^2 s}{1+s^2} \end{aligned} \right.$$

$$\Sigma j^2 = \Sigma v^2 \Sigma r^2 = b v \quad I_1 = \frac{2}{5} \mu_{\text{HAB}} \frac{G}{c^5} M \cdot \frac{\Sigma r^4 j^2}{\Sigma t^2 s^5}$$

$$\omega = \frac{j}{R^2} = \frac{b v}{s^2 (1+s)^2} \cdot \frac{1}{b^2} \left(\frac{1+s}{s} \right)^2 = \frac{1}{s}$$

$$\frac{dj}{dt} = \frac{2}{5} \mu_{\text{HAB}} \frac{G}{c^5} \frac{M}{b v} \left(\frac{2 s v (1+s)^2}{(1+s)^2 s^2} \right)^{1/2} I_1 : \frac{dj}{dt} = \Lambda_G I_1$$

$$\begin{aligned} \Lambda_G &= \frac{2}{5} \mu_{\text{HAB}} \frac{G}{c^5} \frac{M}{b v^2} \left(\frac{1 + \sqrt{1+s^2}}{s} \right)^4 = \\ &= \frac{2}{5} \mu_{\text{HAB}} \left(\frac{v}{c s} \right)^5 (1 + \sqrt{1+s^2})^4 \quad \left[\frac{v}{c s} = \frac{G M}{b c v} \right] \end{aligned}$$

$$r v^{(2)} + \frac{G M}{r} - v^2 \omega^2 = \frac{2}{5} \mu_{\text{HAB}} \frac{G}{c^5} M \frac{\Sigma r^4 j^2}{\Sigma t^2 s^5} I_2$$

$$\frac{\Sigma r^2}{\Sigma t^2} \left(r v^{(2)} + \frac{G M}{r v^2} \frac{1}{r} - v^2 \omega^2 \right) = \frac{2}{5} \mu_{\text{HAB}} \frac{G}{c^5} M \frac{I_2^2}{\Sigma t^2}$$

$$\frac{2}{5} \mu_{\text{HAB}} \frac{G}{c^5} M \cdot \frac{b^2 s^2 v^2 (1+s)^4}{(1+s)^2 b^4 s^4} = \frac{1}{r} \frac{1}{1 + \sqrt{1+s^2}}$$

$$\frac{1}{r} \frac{G M}{4} \frac{b^2}{v^2} \left(\frac{s}{1+s} \right)^4 \frac{(1+s)^2}{b^2 s^2} = \frac{1}{r} \frac{1}{1 + \sqrt{1+s^2}}$$

$$\frac{1}{2} \frac{d}{dt} \left(\dot{r}^2 + \frac{j^2}{v^2} - \frac{2}{1 + \sqrt{1+s^2}} \frac{1}{r} \right) = \Lambda_G (I_1 \omega + I_2 \dot{r})$$

$$|v| \ll c$$

$$\frac{v}{c} \ll 1 \quad s \gg 1 \quad v \ll c$$

$$\frac{v}{c} \ll c$$

$$s \ll 1$$

$$\frac{v^2 b}{G M} \ll 1$$

$$\frac{G M}{b v^2} \gg 1 \quad (s \ll 1)$$

$$\frac{G M}{v^2 c^2} \ll 1$$

$$\Sigma r^2 = b \quad s \gg 1$$

$$\frac{G M}{b c^2} \ll 1$$

$$\frac{G M}{b v c} \ll 1$$

$$s \gg 1$$

$$\left(\frac{G M}{b c^2} \right)^2 \ll 1 \quad \left(\frac{G M}{b v c} \right)^2 \ll 1$$