Habitable zone in binaries

1) 1406.1357.

$$F_{pl}(f, T_{pr}, T_{sec}) = W_{pr}(f, T_{pr}) \frac{L_{pr}(T_{pr})}{r^2_{pl-pr}} + W_{sec}(f, T_{sec}) \frac{L_{sec}(T_{sec})}{r^2_{pl-sec}}$$

$$W_{pr}(f, T_{pr}) \frac{L_{pr}(T_{pr})}{\ell^2_{x-bin}} + W_{sec}(f, T_{sec}) \frac{L_{sec}(T_{sec})}{\ell^2_{x-sec}} = \frac{L_{sun}}{\ell^2_{x-sun}}$$

ℓ_x; $x = (in, out)$ – boundaries of HZ [in solar system or in the binary]

$$\ell_{x-star} = \ell_{x-sun} \left[\frac{L/L_{sun}}{1 + \alpha_x(T_i)\ell^2_{x-sun}} \right]^{1/2} \qquad \ell_i \text{ – in AU}$$

$$T_i(K) = T_{star}(K) - 5780$$

$$\alpha_x(T_i) = a_x T_i + b_x T_i^2 + c_x T_i^3 + d_x T_i^4$$

$$\frac{\ell^2_{x-star}}{\ell^2_{x-sun}} = \frac{L}{L_{sun}} \cdot \frac{1}{1 + \alpha_x(T_i)\cdot \ell^2_{x-sun}}$$

a_x, b_x, c_x, d_x – in tables.

$$F_{x-star}(f, T_{star}) = F_{x-sun}(f, T_{star}) \left[1 + \alpha_x(T_i) \ell^2_{x-sun} \right]$$

$$W_i(f, T_i) = \left[1 + \alpha_x(T_i) \ell^2_{x-sun} \right]^{-1}$$

2) 1211.2812

$$S_1 = \frac{2\pi hc^2}{\lambda^5} \cdot \frac{1}{e^{hc/\lambda k T_{eff,1}} - 1} \left(\frac{R_{*,1}}{r_1} \right)^2 \qquad S = S_1 + S_2$$

$$S_2 = \frac{2\pi hc^2}{\lambda^5} \frac{1}{e^{hc/\lambda k T_{eff,2}} - 1} \left(\frac{R_{*,2}}{r_2} \right)^2$$

3) 1407.0601

On-line calculator

Approach used then by 1406.1357.

Kozai - Lidov 1601.07175

(2)

$$j_z = \sqrt{1-e_1^2}\cos i_{TOT} = \text{const}$$

For e_2 $(e_{out}) = 0$

$$j_{z,1} = \sqrt{1-e_{1\,max/min}^2}\cdot\cos i_{1,max/min} = \sqrt{1-e_{1,0}^2}\cos i_{1,0}$$

$i_1 = i_{TOT}$ for $m_2 \to 0$

for $e_{1,0} = 0$ $\omega_{1,0} = 0$

$$e_{max} = \sqrt{1-\frac{5}{3}\cos^2 i_0}$$

$$\cos i_{min} = \pm\sqrt{\frac{3}{5}} \Rightarrow i_{min} = \begin{cases} 40° \\ 140° \end{cases}$$

System can become unstable if

$$\frac{a_2}{a_1} < 2{,}8\left(1+\frac{m_3}{m_1+m_2}\right)^{2/5}\frac{(1+e_2)^{2/5}}{(1-e_2)^{6/5}}\left(1-\frac{0{,}3\,i_{TOT}}{180°}\right)$$
