Errata to “Tidal friction in close-in satellites and exoplanets. The Darwin theory re-visited”

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Correction of misprints in the equations giving the cumulative orbital variations in the orbital elements of an exoplanet due to tides in both star and planet. Correction of the equations of variation in the argument of perihelion. Variation of the node in the same approximation.

Equations 92 and 93

Misprints were found in Eqs. 92 and 93. The right equations are:

$$\begin{aligned}\langle \dot{n} \rangle &= \frac{9n^2 k_d a m_B R_A^5 |\varepsilon'_{0A}|}{2m_A a^5} \left(1 + 23e^2 + D(7e^2 + S_B^2) + \frac{\Omega_A}{2n} (19e^2 + S_A^2) \right) \\ \langle \dot{e} \rangle &= -\frac{27ne k_d a m_B R_A^5 |\varepsilon'_{0A}|}{2m_A a^5} \left(1 + \frac{7}{9}D + \frac{7}{18} \frac{\Omega_A}{n} \right)\end{aligned}$$

Appendix B: Variations in the argument of pericenter and node

The results are incomplete. To obtain the variations up to second-degree in e , I , it is necessary to consider in U_2 terms up to fourth degree and

$$\varphi \simeq v + \omega - \frac{1}{4} \sin(2v + 2\omega) \sin^2 I - \left(\frac{1}{8} \sin(2\omega + 2v) - \frac{1}{32} \sin(4\omega + 4v) \right) \sin^4 I$$

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instead of the approximation given in Eq. 8.

The corrected second-degree results are

$$\begin{aligned} \langle \dot{\omega}_{\text{lag}} \rangle = & \frac{9k_d n M R^5}{16ma^5} \left[(3\varepsilon'_0 - \varepsilon'_2 - \varepsilon'_5 + 3\varepsilon'_6 - 3\varepsilon'_8 - \varepsilon'_{15} + \varepsilon'_{16} + 3\varepsilon'_{25}) e^2 \right. \\ & \left. - \frac{1}{2} (6\varepsilon'_0 - \varepsilon'_2 - \varepsilon'_5 - 6\varepsilon'_7 - 12\varepsilon'_8 + \varepsilon'_{11} + \varepsilon'_{12} - 2\varepsilon'_{15} + 2\varepsilon'_{16}) S^2 \right] \sin 2\omega \end{aligned}$$

and

$$\langle \dot{\omega}^U \rangle = \frac{15k_f n M R^5}{2ma^5} \left(1 + \frac{13}{2} e^2 \right).$$

At the same approximation, the tidal variation of the node is given by

$$\langle \dot{\Omega}_{\text{lag}} \rangle = -\frac{9k_d n M R^5}{16ma^5} (3\varepsilon'_0 - \varepsilon'_2 - \varepsilon'_5 + 3\varepsilon'_6 - 3\varepsilon'_8 - \varepsilon'_{15} + \varepsilon'_{16} + 3\varepsilon'_{25}) e^2 \sin 2\omega.$$

Equation 24

It is also necessary to consider third-degree terms in U_{lag} to complete Eq. 24. The missing terms, however, do not affect the results given in the paper (except in Appendix B). The complete second-degree expression of F_2 is:

$$\begin{aligned} F_2(\mathbf{r}) = & \frac{3k_d G M^2 R^5}{8a^7} \left[eS(8\varepsilon'_0 - 7\varepsilon'_1 - \varepsilon'_2 + 6\varepsilon'_5 - 12\varepsilon'_8 + 4\varepsilon'_9 + 6\varepsilon'_{15} + 2\varepsilon'_{16}) \cos \omega \right. \\ & - eS(8\varepsilon'_0 - 7\varepsilon'_1 - \varepsilon'_2 + 6\varepsilon'_5 + 4\varepsilon'_8 - 12\varepsilon'_9 - 6\varepsilon'_{14} + 14\varepsilon'_{17}) \cos(2\ell + \omega) \\ & \left. - 4S(\varepsilon'_8 - \varepsilon'_9) \cos(\ell + \omega) \right]. \end{aligned}$$

With this correction, Eqs. 22–24 are equivalent to the second-degree expansion of the components of the force given by [Mignard \(1979\)](#).

New frequencies

The frequencies of the new phase lags appearing in the above equations are given below:

Subscript no.	Frequency
11	$2\Omega - n$
12	n
14	$\Omega + n$
15, 16	$\Omega - n$
17	$\Omega - 3n$
25	$\Omega - 2n$

References

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