

天体と軌道の力学 正誤表 (1.0.4 beta)

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第2章

P.27 (2,28)式

$$[\text{誤}] \quad r = \frac{h^2/\mu}{1 + \sqrt{1 + (2Eh^2/\mu^2) \cos(\theta - \omega)}}$$

$$[\text{正}] \quad r = \frac{h^2/\mu}{1 + \sqrt{1 + (2Eh^2/\mu^2) \cos(\theta - \omega)}}$$

P.37 6行目

$$[\text{誤}] \quad v = \sqrt{x^{*2} + y^{*2}}$$

$$[\text{正}] \quad v = \sqrt{\dot{x}^{*2} + \dot{y}^{*2}}$$

P.39 (2.93)式

$$[\text{誤}] \quad \frac{\partial r}{\partial u} \cos f - r \sin f \frac{\partial f}{\partial u} = a \cos u$$

$$[\text{正}] \quad \frac{\partial r}{\partial u} \cos f - r \sin f \frac{\partial f}{\partial u} = -a \sin u$$

P.39 (2.94)式

$$[\text{誤}] \quad \frac{\partial r}{\partial u} \sin f + r \cos f \frac{\partial f}{\partial u} = a \eta \sin u$$

$$[\text{正}] \quad \frac{\partial r}{\partial u} \sin f + r \cos f \frac{\partial f}{\partial u} = a \eta \cos u$$

P.49 動径 r の逆数

$$[\text{誤}] \quad \frac{a}{r} = \frac{1}{1 - e \cos u} = 1 + e \cos u + e^2 \cos 2u + O(e^3)$$

$$[\text{正}] \quad \frac{a}{r} = \frac{1}{1 - e \cos u} = 1 + e \cos u + e^2 \cos^2 u + O(e^3)$$

P.50 (2.203)式

$$[\text{誤}] \quad f = l + 2e \sin 2l + \frac{5}{4}e^2 \sin 2l + O(e^2)$$

$$[\text{正}] \quad f = l + 2e \sin 2l + \frac{5}{4}e^2 \sin 2l + O(e^3)$$

P.53 (2.218)式

$$[\text{誤}] \quad \left\langle \left(\frac{a}{r} \right)^3 \cos f \right\rangle = \frac{1}{2\pi\eta} \int_0^{2\pi} (1 + e \cos f) \cos f df = \frac{e}{2\eta^3}$$

$$[\text{正}] \quad \left\langle \left(\frac{a}{r} \right)^3 \cos f \right\rangle = \frac{1}{2\pi\eta^3} \int_0^{2\pi} (1 + e \cos f) \cos f df = \frac{e}{2\eta^3}$$

P.57 一番下の式

$$[\text{誤}] \quad x^* + \epsilon_{n+1} = x^* + \epsilon_n - \frac{\epsilon_n f'(x^*) + \frac{\epsilon_n^2}{2} f''(x^*)}{f'(x_n) + \epsilon_n f''(x^*)}$$

$$[\text{正}] \quad x^* + \epsilon_{n+1} = x^* + \epsilon_n - \frac{\epsilon_n f'(x^*) + \frac{\epsilon_n^2}{2} f''(x^*)}{f'(x^*) + \epsilon_n f''(x^*)}$$

第3章

P.71 (3.24)式

$$[\text{誤}] \quad \left\{ 1 - \left(\frac{a_1}{a_2} \cos \alpha \right)^2 \right\} v_A^2 \geq 2(v_1^2 - v_2^2)$$

$$[\text{正}] \quad \left\{ 1 - \left(\frac{a_1}{a_2} \sin \alpha \right)^2 \right\} v_A^2 \geq 2(v_1^2 - v_2^2)$$

P.77 (3.42)式

$$[\text{誤}] \quad \mathbf{R} = \frac{\partial}{\partial \mathbf{d}_2} \left(\frac{1}{d_1} - \frac{\mathbf{d} \cdot \mathbf{d}_2}{d^3} \right) \equiv \frac{\partial}{\partial \mathbf{d}_2} V$$

$$[\text{正}] \quad \mathbf{R} = Gm_1 \frac{\partial}{\partial \mathbf{d}_2} \left(\frac{1}{d_1} - \frac{\mathbf{d} \cdot \mathbf{d}_2}{d^3} \right) \equiv \frac{\partial}{\partial \mathbf{d}_2} V$$

P.77 15行目

[\text{誤}] $d \ll d_2$ を満たす。

[\text{正}] $d \gg d_2$ を満たす。

P.77 (3.45)式

$$[\text{誤}] \quad \frac{1}{d_1} = \sum_{i=0}^{\infty} \left(\frac{d_2}{d} \right)^i P_i(\cos \theta)$$

$$[\text{正}] \quad \frac{1}{d_1} = \frac{1}{d} \sum_{i=0}^{\infty} \left(\frac{d_2}{d} \right)^i P_i(\cos \theta)$$

P.78 (3.48)式

[誤] $\frac{d_2^2}{d_3^2} P_2(\cos \theta) = \frac{1}{2d_3^3} (2d_2^2 \cos^2 \theta - d_2^2)$

[正] $\frac{d_2^2}{d_3^3} P_2(\cos \theta) = \frac{1}{2d_3^3} (2d_2^2 \cos^2 \theta - d_2^2)$

P.82 (3.57)式

[誤] $\frac{d^2 \mathbf{d}_1}{dt^2} = -G(m_1 + m_3) \frac{\mathbf{d}_1}{d_1^3} + Gm_2 \left(-\frac{\mathbf{d}_2}{d_1^3} + \frac{\mathbf{d}}{d^3} \right)$

[正] $\frac{d^2 \mathbf{d}_1}{dt^2} = -G(m_1 + m_3) \frac{\mathbf{d}_1}{d_1^3} + Gm_2 \left(-\frac{\mathbf{d}_2}{d_1^3} + \frac{\mathbf{d}}{d^3} \right)$

P.89 (3.84)式

[誤] $\tilde{E} > 0$ のとき $\tilde{a} = -\frac{Gm_s}{2\tilde{E}}$ (楕円軌道)

$\tilde{E} < 0$ のとき $\tilde{a} = \frac{Gm_s}{2\tilde{E}}$ (双曲線軌道)

[正] $\tilde{E} < 0$ のとき $\tilde{a} = -\frac{Gm_s}{2\tilde{E}}$ (楕円軌道)

$\tilde{E} > 0$ のとき $\tilde{a} = \frac{Gm_s}{2\tilde{E}}$ (双曲線軌道)

第4章

P.99 (4.11)式

[誤] $\ddot{\eta} = \ddot{X} \sin \theta + \ddot{Y} \cos \theta + 2n' \dot{X} \cos \theta - 2n' \dot{Y} \sin \theta - n'^2 X \cos \theta - n'^2 Y \cos \theta$

[正] $\ddot{\eta} = \ddot{X} \sin \theta + \ddot{Y} \cos \theta + 2n' \dot{X} \cos \theta - 2n' \dot{Y} \sin \theta - n'^2 X \sin \theta - n'^2 Y \cos \theta$

P.99 (4.17)式

[誤] $U = -\left(\frac{m_1}{m_1 + m_2} \frac{a'^3}{r_1} + \frac{m_2}{m_1 + m_2} \frac{r'^3}{r_2} \right) n'^2$

[正] $U = -\left(\frac{m_1}{m_1 + m_2} \frac{a'^3}{r_1} + \frac{m_2}{m_1 + m_2} \frac{a'^3}{r_2} \right) n'^2$

P.101 (4.29)式

[誤] $\frac{1}{2} (\dot{\xi}^2 + \dot{\eta}^2 + \dot{\zeta}^2) - n' (\xi \dot{\eta} - \eta \dot{\xi}) - \frac{Gm_1}{r_1} - \frac{Gm_2}{r_2} - \frac{Gm_2 \mathbf{d} \cdot \mathbf{r}}{d^3} = const$

[正] $\frac{1}{2} (\dot{\xi}^2 + \dot{\eta}^2 + \dot{\zeta}^2) - n' (\xi \dot{\eta} - \eta \dot{\xi}) - \frac{Gm_1}{r_1} - \frac{Gm_2}{r_2} + \frac{Gm_2 \mathbf{d} \cdot \mathbf{r}}{d^3} = const$

P.102 (4.32)式

[誤] $\frac{a'}{2a} + \sqrt{\left(1 + \frac{m_2}{m_1}\right) \frac{a}{a'} (1 - e^2) \cos I}$
 $= -\frac{m_2}{m_1} \left(\frac{a'}{r_2} - \frac{a \mathbf{d} \cdot \mathbf{r}}{d^3} \right) + const$

[正] $\frac{a'}{2a} + \sqrt{\left(1 + \frac{m_2}{m_1}\right) \frac{a}{a'} (1 - e^2) \cos I}$
 $= -\frac{m_2}{m_1} \left(\frac{a'}{r_2} - \frac{a' \mathbf{d} \cdot \mathbf{r}}{d^3} \right) + const$

P.102 下から7行目行頭

[誤] I_3 とするとき、

[正] I_2 とするとき、

P.105 図4.2

図の距離感がおかしいので見難い。ノートに描き直しあり。

P.108 8行目

[誤] c) $X < -\nu$ (P_2 より左の領域) : L_3

[正] c) $X < -\nu$ (P_1 より左の領域) : L_3

P.111 図4.3

規格化の方法に関する記述はないが、自分のノートに書いてあるとおり $n'a' = 1$ という規格化をすると次のような結果になる。

[誤] (b) $C = 1.9823$, (d) $C = 1.8562$, (f) $C = 1.6787$

[正] (b) $C = 1.9023$, (d) $C = 1.7761$, (f) $C = 1.5985$

P.112 下から3行目

[誤] F点は左へ移り L_1 点で一致する

[正] F点は左へ移り L_2 点で一致する

P.115 (4.90)式

[誤] $\lambda^4 + (4 + a + c) \lambda^2 + ac - b^2 = 0$

[正] $\lambda^4 + (4n'^2 + a + c) \lambda^2 + ac - b^2 = 0$

P.115 (4.91)式

[誤] $\sigma^2 + (4 + a + c) \sigma + ac - b^2 = 0$

[正] $\sigma^2 + (4n'^2 + a + c) \sigma + ac - b^2 = 0$

P.116 下から2行目

[誤] 方程式(4.90)へ代入すると

[正] 方程式(4.91)へ代入すると

P.117 4.6.2小節全体

$a' = 1, G = 1, m_1 + m_2 = 1$ で規格化されているが、それについて説明がない。

P.119-120 4.7節全体

$a' = 1, G = 1, m_1 + m_2 = 1, n' = 1$ で規格化されているが、それについて説明がない。

P.119 下から1-2行目

[誤] $X = r' \tilde{X}, Y = r' \tilde{Y}$

[正] $X = r' \tilde{X}, Y = r' \tilde{Y}, Z = r' \tilde{Z}$

誤植ではなく追記

P.124 (4.133)式

[誤] $a^* = \frac{1}{2}(a+c) + \frac{1}{2} \cos 2\alpha + b \sin \alpha$

[正] $a^* = \frac{1}{2}(a+c) + \frac{1}{2}(a-c) \cos 2\alpha + b \sin \alpha$

P.124 (4.139)式

[誤] $a^* = \frac{1}{2}(a+b-\sqrt{D^*})$
 $= -\frac{3}{2}(1-\sqrt{1-3\nu(1-\nu)})n'^2 < 0$

[正] $a^* = \frac{1}{2}(a+c+\sqrt{D^*})$
 $= -\frac{3}{2}(1-\sqrt{1-3\nu(1-\nu)})n'^2 < 0$

P.124 (4.140)式

[誤] $c^* = \frac{1}{2}(a+b+\sqrt{D^*})$
 $= -\frac{3}{2}(1+\sqrt{1-3\nu(1-\nu)})n'^2 < 0$

[正] $c^* = \frac{1}{2}(a+c-\sqrt{D^*})$
 $= -\frac{3}{2}(1+\sqrt{1-3\nu(1-\nu)})n'^2 < 0$

P.125 (4.145)式

[誤] $\ddot{x} - 2n'y^* + a^*x^* = 0$

[正] $\ddot{x}^* - 2n'y^* + a^*x^* = 0$

第5章

P.137 (5.12)式

[誤] $\frac{1}{2}\dot{x}^2 + \frac{1}{2}\omega_0^2 + \frac{1}{3}\epsilon x^3 = E$

[正] $\frac{1}{2}\dot{x}^2 + \frac{1}{2}\omega_0^2 x^2 + \frac{1}{3}\epsilon x^3 = E$

P.137 (5.13)式

[誤] $\frac{1}{2}\omega_0^2 + \frac{1}{3}\epsilon x^3 \leq E$

[正] $\frac{1}{2}\omega_0^2 x^2 + \frac{1}{3}\epsilon x^3 \leq E$

P.139 (5.29)式

[誤] $x = a \cos t + \epsilon a^2 \left(-\frac{1}{2} + \frac{1}{6} \cos 2t \right)$
 $+ \epsilon^2 a^3 \left(\frac{5}{12} t \sin t + \frac{1}{48} \cos 3t + O(\epsilon^3) \right)$

[正] $x = a \cos t + \epsilon a^2 \left(-\frac{1}{2} + \frac{1}{6} \cos 2t \right)$
 $+ \epsilon^2 a^3 \left(\frac{5}{12} t \sin t + \frac{1}{48} \cos 3t \right) + O(\epsilon^3)$

P.143 (5.68)式

[誤] $\frac{da}{dt} \sin \theta - a \frac{d\phi}{dt} \cos \theta = \epsilon a^2 \cos^2 \theta$

[正] $\frac{da}{dt} \sin \theta + a \frac{d\phi}{dt} \cos \theta = \epsilon a^2 \cos^2 \theta$

P.144 (5.75)式

[誤] $\frac{d\phi_1}{dt} = \frac{1}{4} (2 \cos \theta_0 + \cos 3\theta_0)$

[正] $\frac{d\phi_1}{dt} = \frac{1}{4} a_0 (3 \cos \theta_0 + \cos 3\theta_0)$

P.144 下から4行目

ϕ_0 が定数であれば、この後の一般解を導出することはできるが、テキストではさらに $\phi_0 = 0$ の条件を導入して、計算を簡略化している。しかし、それについての説明がない。

P.145 (5.86)式

[誤] $x = (a_0 + \epsilon a_1 + \epsilon^2 a_2) (\theta^* + \epsilon \phi_1 + \epsilon^2 \phi_{2p})$

[正] $x = (a_0 + \epsilon a_1 + \epsilon^2 a_2) \cos (\theta^* + \epsilon \phi_1 + \epsilon^2 \phi_{2p})$

P.147 7行目

- [誤] $-\partial g_1/\partial c_l, \partial g_2/\partial c_l, -\partial g_3/\partial c_l$
 [正] $-\partial g_1/\partial c_l, -\partial g_2/\partial c_l, -\partial g_3/\partial c_l$

P.148 (5.102)式

- [誤] $\frac{dq_i}{dt} = \frac{\partial F}{\partial p_i} = p + \frac{\partial V}{\partial p_i}$
 [正] $\frac{dq_i}{dt} = \frac{\partial F}{\partial p_i} = p_i + \frac{\partial V}{\partial p_i}$

P.148 (5.108)式

- [誤] $\sum_{j=1}^6 \frac{\partial f_i}{\partial c_j} \frac{dc_j}{dt} = \frac{\partial V}{\partial p_1}$
 [正] $\sum_{j=1}^6 \frac{\partial f_i}{\partial c_j} \frac{dc_j}{dt} = \frac{\partial V}{\partial p_i}$

P.154 6行目

- [誤] $t=0$ 軌道要素 $c_j(0)$
 軌道 $x_i^*(t)$ 考、
 [正] 軌道要素 $c_j(0)$ 値変化
 軌道 $x_i^*(t)$ 考、

P.156 (5.166)式

- [誤] $\frac{de}{dt} = -\frac{\eta}{na^2e} (1-\eta) \frac{\partial R}{\partial \epsilon} - \frac{\eta}{na^2e} \frac{\partial R}{\partial \omega}$
 [正] $\frac{de}{dt} = -\frac{\eta}{na^2e} (1-\eta) \frac{\partial R}{\partial \epsilon} - \frac{\eta}{na^2e} \frac{\partial R}{\partial \tilde{\omega}}$

P.158 (5.180)式

- [誤] $\frac{\partial R}{\partial \tilde{\omega}} = p \frac{\partial R}{\partial q} - q \frac{\partial R}{\partial q}$
 [正] $\frac{\partial R}{\partial \tilde{\omega}} = q \frac{\partial R}{\partial p} - p \frac{\partial R}{\partial q}$

P.169 図5.4

$d\beta$ に注意。テキストの図では軌道と軌道の角度が $d\beta$ のようにみえるが、軌道面と軌道面の角度が $d\beta$ である。

P.169 (5.244)式

- [誤] $-d\omega = N'H = \cos Id\Omega$
 [正] $-d\omega = NH = \cos Id\Omega$
 正確にはノートのように単位球面に写して考えるべき

P.172 (13-17行目)

ρ についての説明が間違い。方程式の右辺が正弦級数となるのは a, e, I 、余弦級数となるのは $\rho, \tilde{\omega}, \Omega, \epsilon$ 。もちろん、これに応じて各軌道要素の1次の解が余弦級数となるのは、 a, e, I 。正弦級数となるのは、 $\rho, \tilde{\omega}, \Omega, \epsilon$ 。

P.172 下から6行目

- [誤] $j_1 = j_2 = 0$
 [正] $j_1 = j_1' = 0$

P.172-173 (5.264),(5.266),(5.267),(5.268),(5.270)式
P.176 1行目

- [誤] j_4
 [正] j_1'

P.173 (5.265)式

- [誤] $\frac{da}{dt} = -\frac{2}{n_0 a_0} j_1 C_p \sin \theta_p$
 [正] $\frac{da}{dt} = -\frac{2}{n_0 a_0} \sum_{j_1 \neq 0, j_1' \neq 0} j_1 C_p \sin \theta_p$

第6章

P.184 3行目

- [誤] $dl = (a/r)^2 / \eta df$
 [正] $dl = \frac{r^2}{a^2 \eta} df$

P.185 (6.16)式

- [誤] $\frac{d\Omega}{dt} = -\frac{1}{na^2 \eta \sin I} \frac{\partial R_s}{\partial I}$
 [正] $\frac{d\Omega}{dt} = \frac{1}{na^2 \eta \sin I} \frac{\partial R_s}{\partial I}$

P.187 (6.22)式

- [誤] $R_{p2} = \frac{\eta a_E^2}{a_3} J_2 C_2 P_2$
 [正] $R_{p2} = \frac{\eta a_E^2}{a^3} J_2 C_2 P_2$

P.188 (6.30)式

- [誤] $\frac{d\sigma}{dt} = -\mu a_E^2 J_2 C_1 \left[\frac{\eta^2}{na^5 e} C_1 \int \frac{\partial P_1}{\partial e} dt \right. \\ \left. + \frac{2}{na} \frac{\partial}{\partial a} \left(\frac{1}{a^3} \right) \int P_1 dt \right]$

$$\begin{aligned} \text{[誤]} \quad \Delta_1 \sigma = & -\mu a_E^2 J_2 C_1 \left[\frac{\eta^2}{na^5 e} \int \frac{\partial P_1}{\partial e} dt \right. \\ & \left. + \frac{2}{na} \frac{\partial}{\partial a} \left(\frac{1}{a^3} \right) \int P_1 dt \right] \end{aligned}$$

P.188 (6.31)式

$$\begin{aligned} \text{[誤]} \quad \frac{d\omega}{dt} = & \frac{\mu a_E^2}{a^3} J_2 \left(-\frac{\cos i}{na^2 \eta \sin I} \frac{\partial C_1}{\partial I} \int P_1 dt \right. \\ & \left. + \frac{\eta}{na^2 e} C_1 \int \frac{\partial P_1}{\partial e} dt \right) \\ \text{[正]} \quad \Delta_1 \omega = & \frac{\mu a_E^2}{a^3} J_2 \left(-\frac{\cos I}{na^2 \eta \sin I} \frac{\partial C_1}{\partial I} \int P_1 dt \right. \\ & \left. + \frac{\eta}{na^2 e} C_1 \int \frac{\partial P_1}{\partial e} dt \right) \end{aligned}$$

P.188 (6.32)式

$$\begin{aligned} \text{[誤]} \quad \frac{d\Omega}{dt} = & \frac{\mu a_E^2}{na^5 \eta \sin I} \frac{\partial C_1}{\partial I} \int P_1 dt \\ \text{[正]} \quad \Delta_1 \Omega = & \frac{\mu a_E^2}{na^5 \eta \sin I} J_2 \frac{\partial C_1}{\partial I} \int P_1 dt \end{aligned}$$

P.188 下から4行目

$$\begin{aligned} \text{[誤]} \quad \partial P / \partial e \\ \text{[正]} \quad \partial P_1 / \partial e \end{aligned}$$

P.188 (6.33)式

$$\begin{aligned} \text{[誤]} \quad \frac{\partial P_1}{\partial e} = & 3 \left[\left(\frac{a}{r} \right)^3 \cos f - \frac{e}{\eta^5} \right] \\ \text{[正]} \quad \frac{\partial P_1}{\partial e} = & 3 \left[\left(\frac{a}{r} \right)^4 \cos f - \frac{e}{\eta^5} \right] \end{aligned}$$

P.189 (6.34)式

$$\begin{aligned} \text{[誤]} \quad \frac{1}{n\eta} \int \frac{r}{a} df \\ \text{[正]} \quad \frac{1}{n\eta} \int \frac{a}{r} df \end{aligned}$$

P.189 (6.38)式

$$\begin{aligned} \text{[誤]} \quad \int \frac{\partial P_1}{\partial e} \\ \text{[正]} \quad \int \frac{\partial P_1}{\partial e} dt \end{aligned}$$

$$\text{[誤]} \quad \Delta_1 \Omega = -\frac{3}{2} J_2 \left(\frac{a_E}{a\eta^2} \right)^2 B \cos I$$

$$\text{[正]} \quad \Delta_1 \Omega = -\frac{3}{2} J_2 \left(\frac{a_E}{p} \right)^2 B \cos I$$

間違いではないが、この形の方が自然。

P.189 (6.42)式

$$\begin{aligned} \text{[誤]} \quad \Delta_1 \sigma = & -n^2 a^3 a_E^2 J_2 \left[\frac{\eta^2}{na^5 e} C_1 \frac{3}{n\eta^5} (eB + Q) - \frac{6}{na^5} \frac{B}{n\eta^3} \right] \\ \text{[正]} \quad \Delta_1 \sigma = & -n^2 a^3 a_E^2 J_2 \left[\frac{\eta^2}{na^5 e} \frac{3}{n\eta^5} (eB + Q) - \frac{6}{na^5} \frac{B}{n\eta^3} \right] \end{aligned}$$

P.192 (6.60)式

$$\begin{aligned} \text{[誤]} \quad \omega^* = & \left[\frac{3}{4} J_2 \left(\frac{a_E}{p_0} \right)^2 (5 \cos^2 I - 1) \right] n_0 t + \omega_0 \\ \text{[正]} \quad \omega^* = & \left[\frac{3}{4} J_2 \left(\frac{a_E}{p_0} \right)^2 (5 \cos^2 I_0 - 1) \right] n_0 t + \omega_0 \end{aligned}$$

P.192 (6.61)式

$$\begin{aligned} \text{[誤]} \quad \Omega^* = & - \left[\frac{3}{2} J_2 \left(\frac{a_E}{p_0} \right)^2 \cos I \right] n_0 t + \Omega_0 \\ \text{[正]} \quad \Omega^* = & - \left[\frac{3}{2} J_2 \left(\frac{a_E}{p_0} \right)^2 \cos I_0 \right] n_0 t + \Omega_0 \end{aligned}$$

P.197 (6.81)式

$$\begin{aligned} \text{[誤]} \quad \ddot{y} = & -\frac{\mu}{r^3} x - \frac{3}{2} J_2 \frac{a_E^2}{r^5} y \\ \text{[正]} \quad \ddot{y} = & -\frac{\mu}{r^3} y - \frac{3}{2} J_2 \frac{a_E^2}{r^5} y \end{aligned}$$

P.197 (6.83)式

$$\begin{aligned} \text{[誤]} \quad R_3 = & -\frac{\mu a_E^3}{r^4} J_3 P_3(\sin \phi) \\ & = -\frac{\mu a_E^3}{2r^4} J_3 \sin \phi (5 \sin^2 \phi - 3) \\ \text{[正]} \quad R_3 = & -\frac{\mu a_E^3}{r^4} J_3 P_3(\sin \varphi) \\ & = -\frac{\mu a_E^3}{2r^4} J_3 \sin \varphi (5 \sin^2 \varphi - 3) \end{aligned}$$

P.197 (6.84)式

$$[\text{誤}] \quad R_3 = \frac{\mu a_E^3}{2r^4} J_3 \left[\frac{3}{8} \sin I (5 \cos^2 I - 1) \sin(f + \omega) + \frac{1}{8} \sin 3(f + \omega) \right]$$

$$[\text{正}] \quad R_3 = \frac{\mu a_E^3}{r^4} J_3 \left[\frac{3}{8} \sin I (5 \cos^2 I - 1) \sin(f + \omega) + \frac{5}{8} \sin^3 I \sin 3(f + \omega) \right]$$

P.198 (6.85)式

$$[\text{誤}] \quad R_{3s} = \frac{1}{2\pi} \int R_3 dl = P(a, e, I) e \sin \omega$$

$$[\text{正}] \quad R_{3s} = \frac{1}{2\pi} \int R_3 dl = P(a, e, I) \sin \omega$$

P.198 (6.86)式

$$[\text{誤}] \quad P(a, e, I) = \frac{3}{8} \frac{\mu a_E^3}{a^4 \eta^5} J_3 \sin I (5 \cos^2 I - 1)$$

$$[\text{正}] \quad P(a, e, I) = \frac{3}{8} \frac{\mu a_E^3}{a^4 \eta^5} J_3 e \sin I (5 \cos^2 I - 1)$$

P.198 (6.88)式

$$[\text{誤}] \quad \frac{dI}{dt} = \frac{3}{8} \frac{\mu a_E^3}{n a^6 \eta^4} J_3 e \cos I (5 \cos^2 I - 1) \cos \omega$$

$$[\text{正}] \quad \frac{dI}{dt} = \frac{3}{8} \frac{\mu a_E^3}{n a^6 \eta^6} J_3 e \cos I (5 \cos^2 I - 1) \cos \omega$$

P.199 1行目

[誤] 式定式(6.89)

[正] 方程式(6.87)

P.200 (6.100)式

$$[\text{誤}] \quad \frac{\partial n_2}{\partial e} = 3J_2 \frac{en}{a^2 \eta^6} (5 \cos^2 I - 1)$$

$$[\text{正}] \quad \frac{\partial n_2}{\partial e} = 3J_2 \frac{a_E^2 en}{a^2 \eta^6} (5 \cos^2 I - 1)$$

P.200 (6.101)式

$$[\text{誤}] \quad \frac{\partial n_2}{\partial I} = -\frac{15}{2} J_2 \frac{n \sin I \cos I}{a^2 \eta^4}$$

$$[\text{正}] \quad \frac{\partial n_2}{\partial I} = -\frac{15}{2} J_2 \frac{a_E^2 n \sin I \cos I}{a^2 \eta^4}$$

P.200 (6.102)式

$$[\text{誤}] \quad \frac{\partial P}{\partial e} = \frac{3}{8} J_3 \frac{n^2}{a \eta^7} (1 + 4e^2) \sin I (5 \cos^2 I - 1)$$

$$[\text{正}] \quad \frac{\partial P}{\partial e} = \frac{3}{8} J_3 \frac{a_E^3 n^2}{a \eta^7} (1 + 4e^2) \sin I (5 \cos^2 I - 1)$$

P.200 (6.103)式

$$[\text{誤}] \quad \frac{\partial P}{\partial I} = \frac{3}{8} J_3 \frac{n^2}{a \eta^5} \cos I (15 \cos^2 I - 11)$$

$$[\text{正}] \quad \frac{\partial P}{\partial I} = \frac{3}{8} J_3 \frac{a_E^3 e n^2}{a \eta^5} \cos I (15 \cos^2 I - 11)$$

P.200 (6.104)式

$$[\text{誤}] \quad \frac{d\delta\omega}{dt} = \frac{3}{8} J_3 \frac{n_0}{a_0^3 \eta_0^6} \frac{(5 \cos^2 I_0 - 1) (\sin^2 I_0 - e_0^2 \cos^2 I_0)}{e_0 \sin I_0} \sin \omega^*$$

$$[\text{正}] \quad \frac{d\delta\omega}{dt} = \frac{3}{8} J_3 \frac{a_E^3 n_0}{a_0^3 \eta_0^6} \frac{(5 \cos^2 I_0 - 1) (\sin^2 I_0 - e_0^2 \cos^2 I_0)}{e_0 \sin I_0} \sin \omega^*$$

P.201 (6.113)式

$$[\text{誤}] \quad \delta(l + \omega) = \frac{J_3 a_E}{2J_2 p_0} \left(\frac{1 + \eta_0 + \eta^2}{1 + \eta_0} \sin I_0 + \frac{\cos^2 I_0}{\sin I_0} \right) e_0 \cos \omega^*$$

$$[\text{正}] \quad \delta(l + \omega) = \frac{J_3 a_E}{2J_2 p_0} \left(-\frac{1 + \eta_0 + \eta_0^2}{1 + \eta_0} \sin I_0 + \frac{\cos^2 I_0}{\sin I_0} \right) e_0 \cos \omega^*$$

P.202 P_ω の式

$$[\text{誤}] \quad P_\omega = 5.233 \times 10^6 \text{秒}$$

$$[\text{正}] \quad P_\omega = 5.233 \times 10^7 \text{秒}$$

P.206 (6.131)式

$$[\text{誤}] \quad \frac{1}{2\pi} \int_0^{2\pi} R_S d\lambda_S = \frac{Gm_s}{a_s^3} \left[\frac{1}{8} (3 \cos^2 \bar{I} - 1) + \frac{3}{8} \sin^2 \bar{I} \cos 2\bar{L} \right]$$

$$[\text{正}] \quad \frac{1}{2\pi} \int_0^{2\pi} R_S d\lambda_S = \frac{Gm_s r^2}{a_s^3} \left[\frac{1}{8} (3 \cos^2 \bar{I} - 1) + \frac{3}{8} \sin^2 \bar{I} \cos 2\bar{L} \right]$$

P.207 (6.132),(6.133)式の後ろへ追加

$$\frac{1}{2\pi} \int_0^{2\pi} \left(\frac{r}{a} \right)^2 \sin 2f dl = 0$$

P.207 (6.134)式

$$[\text{誤}] \quad R_{S,sec} = \frac{Gm_s}{a_s^3} \left[\frac{1}{8} \left(1 + \frac{3}{2}e^2 \right) (3 \cos^2 \bar{I} - 1) + \frac{15}{16} e^2 \sin^2 \bar{I} \cos 2\bar{\omega} \right]$$

$$[\text{正}] \quad R_{S,sec} = \frac{Gm_s a^2}{a_s^3} \left[\frac{1}{8} \left(1 + \frac{3}{2}e^2 \right) (3 \cos^2 \bar{I} - 1) + \frac{15}{16} e^2 \sin^2 \bar{I} \cos 2\bar{\omega} \right]$$

P.208 (6.141)式

$$[\text{誤}] \quad C = \frac{3}{16} \alpha \sin^2 \epsilon^2$$

$$[\text{正}] \quad C = \frac{3}{16} \alpha \sin^2 \epsilon$$

P.208 (6.145)式

$$[\text{誤}] \quad R_{SEC} = n^2 a^3 \left[-(3A - C)q^2 - (3A + C)p^2 + 2Bq \right]$$

$$[\text{正}] \quad R_{SEC} = n^2 a^3 \left[-(3A - C)q^2 - (3A + C)p^2 + 2Bq + 2A \right]$$

少し自信ない

P.208 (6.150)式

$$[\text{誤}] \quad p = -c \sqrt{\frac{1 + C/3A}{1 - C/3A}} \sin(\rho t + \gamma)$$

$$[\text{正}] \quad p = -c \sqrt{\frac{1 - C/3A}{1 + C/3A}} \sin(\rho t + \gamma)$$

P.210 (6.150)式

$$[\text{誤}] \quad R = \frac{\mu}{r} \sum_{n=2}^{\infty} \sum_{m=1}^n P_n^m(\sin \varphi) (C_{n,m} \cos m\psi + S_{n,m} \sin m\psi)$$

$$[\text{正}] \quad R = \frac{\mu}{r} \sum_{n=2}^{\infty} \sum_{m=1}^n \left(\frac{a_E}{r} \right)^n P_n^m(\sin \varphi) (C_{n,m} \cos m\psi + S_{n,m} \sin m\psi)$$

P.212 (6.162)式

$$[\text{誤}] \quad \beta = \tan^{-1} \left(\frac{S_{2,2}}{C_{2,2}} \right) = 29.4^\circ$$

$$[\text{正}] \quad \beta = \tan^{-1} \left(-\frac{S_{2,2}}{C_{2,2}} \right) = 29.4^\circ$$

P.212 下から1行目

$$[\text{誤}] \quad 0 < \psi + \beta/2 < \pi/2$$

$$[\text{正}] \quad 0 < \psi + \beta/2 < \pi$$

P.213 (6.169)式

$$[\text{誤}] \quad |\chi| \leq \alpha$$

$$[\text{正}] \quad |\chi| < \alpha$$

P.215 (6.176)式

$$[\text{誤}] \quad \sin^2 I = q^2 + p^2 = 4g^2 \sin^2 \rho t$$

$$[\text{正}] \quad \sin^2 I = q^2 + p^2 = 2g^2(1 - \cos \rho t) \sim (g\rho t)^2$$

P.215 (6.177)式

$$[\text{誤}] \quad \sin I = 2g \sin \rho t$$

$$[\text{正}] \quad \sin I = g\rho t$$

P.215 (6.178)式

$$[\text{誤}] \quad I \sim 2g \sin \rho t \sim 2g\rho t = 6.653 \times 10^{-6} nt = (2^\circ.40 \times 10^{-3}/\text{日})t$$

$$[\text{正}] \quad I \sim g\rho t = 6.653 \times 10^{-6} nt = (2^\circ.40 \times 10^{-3}/\text{日})t$$

P.219 1行目

$$[\text{誤}] \quad \text{式(6.190)代入}$$

$$[\text{正}] \quad \text{式(6.191)代入}$$

P.219 3行目

$$[\text{誤}] \quad \frac{365.22}{2 \times 17} \times 0.12 = 1.3m/s$$

$$[\text{正}] \quad \frac{365.25}{2 \times 17} \times 0.12 = 1.3m/s$$

付録P.221 下から2行目

$$[\text{誤}] \quad \text{直行行列}$$

$$[\text{正}] \quad \text{直交行列}$$

P.222 (A.11)式

$$[\text{誤}] \quad [\sigma, \Omega] = \left(\frac{\partial \gamma^*}{\partial \sigma} \right)^t B_1 \dot{\mathbf{r}} - \mathbf{r}^{*t} B_1^t \frac{\partial \dot{\mathbf{r}}^*}{\partial \sigma}$$

$$[\text{正}] \quad [\sigma, \Omega] = \left(\frac{\partial \mathbf{r}^*}{\partial \sigma} \right)^t B_1 \dot{\mathbf{r}} - \mathbf{r}^{*t} B_1^t \frac{\partial \dot{\mathbf{r}}^*}{\partial \sigma}$$

P.225 下から4行目[誤] 単位をベクトルを \boldsymbol{i}^* [正] 単位ベクトルを \boldsymbol{i}^* P.231 (B.47)式[誤] $\frac{(\boldsymbol{r} \times \dot{\boldsymbol{r}}) \times \boldsymbol{r}}{r^3}$ [正] $\frac{(\boldsymbol{r} \times \dot{\boldsymbol{r}}) \times \boldsymbol{r}}{r^3}$ P.231 (B.50)式[誤] $\frac{de}{dt} = \frac{\mu}{na} [R \sin f + S(\cos f + \cos u)]$ [正] $\frac{de}{dt} = \frac{\eta}{na} [R \sin f + S(\cos f + \cos u)]$ P231 4式目[誤] $\frac{\partial r}{\partial a} = \frac{r}{a} + \frac{ae}{\eta} \sin f \frac{dn}{dt} t$ [正] $\frac{\partial r}{\partial a} = \frac{r}{a} + \frac{ae}{\eta} \sin f \frac{dn}{da} t$