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[illegible] 01.02.01 [illegible]

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[illegible] «[illegible]» [illegible]

[illegible]: [illegible]

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[illegible] «23» [illegible] 2016 [illegible] 14 [illegible] 00 [illegible] 212.125.14 [illegible]: 125993, [illegible] -80, [illegible] -3, [illegible] 4.

[illegible] http://www.mai.ru/events/defence/

[illegible]: 125993, [illegible] -80, [illegible] -3, [illegible] 4.

[illegible] «___» __________ 2016 [illegible]

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[illegible] 17-[illegible] [illegible] (1693). [illegible] (18[illegible]) [illegible] (19 [illegible]). [illegible]

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[illegible]

[illegible]

[illegible]

[illegible] Maple.

[illegible]

[illegible] D_j, [illegible]

[illegible]

[illegible] I_2 [illegible]

[illegible]

[illegible] 6×10^{6} [illegible]

[illegible]

[illegible]:

- [illegible]
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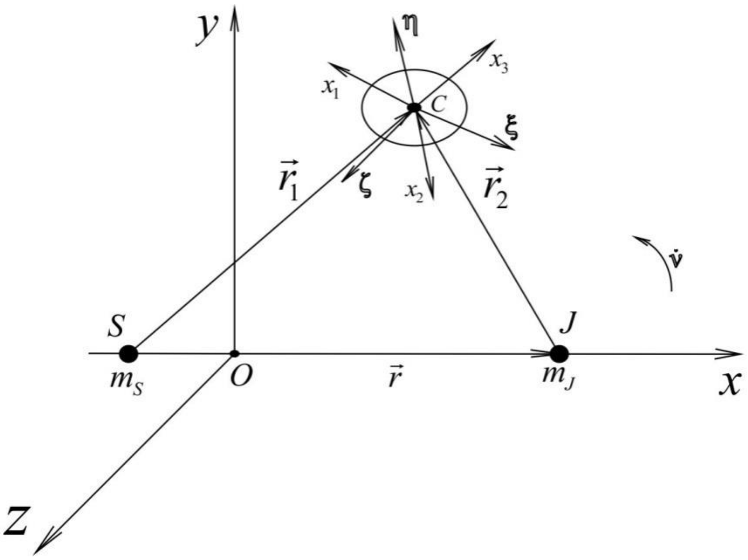
[illegible]

[illegible]:

- [illegible] XXXIX [illegible] 27 – 30 [illegible] 2015 г.
- [illegible] 2 - 6 [illegible] 2015 г. [illegible]
- [illegible]
- [illegible] 15 [illegible] 2015 г.
- VII [illegible] 26-30 [illegible] 2016 г., г. [illegible]



[illegible] 1. [illegible]

[illegible] $Oxyz$ -- [illegible] S [illegible] J, $C\xi\eta\zeta$ -- [illegible], $Cx_1x_2x_3$ - [illegible] $Cx_1x_2x_3$ [illegible] $C\xi\eta\zeta$ [illegible] $L, I_2, I_3, l, \varphi_2, \varphi_3$.

[illegible]

$$H = \frac{I_2^2 - L^2}{2}\left(\frac{\sin^2 l}{A} + \frac{\cos^2 l}{B}\right) + \frac{L^2}{2C} - U\ ,$$

$$U = -\frac{3}{2}(1-\mu)n_J^2\frac{a_J^3}{r_1^3}\left[\left(B-A\right)\gamma_{12}^2 + (C-A)\gamma_{13}^2\right] - \frac{3}{2}\mu n_J^2\frac{a_J^3}{r_2^3}\left[\left(B-A\right)\gamma_{22}^2 + (C-A)\gamma_{23}^2\right],$$

$$\gamma_{ij} = \frac{1}{r_i}\left[\left(\alpha_j\cos\nu + \beta_j\sin\nu\right)\left(x - x_i\right) + \left(\beta_j\cos\nu - \alpha_j\sin\nu\right)y + \gamma_j z\right].$$

[illegible]: $\mu = \dfrac{m_J}{m_S + m_J} = 0.0009533888249$, f - [illegible], $x_1 = -\mu r$, $x_2 = \left(1-\mu\right)r$ - [illegible] $n_J = \sqrt{f\left(m_S + m_J\right)/a_J^3}$ - [illegible] $r_i = \sqrt{\left(x - x_i\right)^2 + y^2 + z^2}$, γ_{ij} - [illegible] $r_i = m_i C$ [illegible] Cx_j, A, B, C - [illegible] Cx_1, Cx_2, Cx_3 [illegible], $\alpha_i, \beta_i, \gamma_i$ - [illegible] $C\xi\eta\zeta$ [illegible] $Cx_1x_2x_3$ [illegible]

[illegible] $Oxyz$, [illegible] $\mathbf{\upsilon}_1 = (n_J, n_C)$. [illegible] n_J, n_C - [illegible].

[illegible] $\varepsilon = n_J'$ $\left(n_J' = n_J/\Omega^* \sim 10^{-4}\right)$, [illegible] $\Omega^* \approx 1.65\cdot 10^{-4}$ [illegible]$/c$ -- [illegible] $n_J \approx 1.68\cdot 10^{-8}$ [illegible]$/c$ -- [illegible]

«[illegible]» [illegible] $I_1, I_2, I_3, w_1, w_2, w_3$ [illegible]:

$$H^* = P_M + \frac{n_c'}{\varepsilon} P_{M_1} + \frac{1}{\varepsilon} H_0 + \varepsilon H_1(I_1, I_2, I_3, w_1, w_2, w_3, M, M_1)$$

[illegible] $M = \varepsilon t$ -- "[illegible]" [illegible], M, P_M, M_1, P_{M_1} - [illegible].

[illegible], [illegible] $\Omega_1(I_1, I_2) = \partial H_0/\partial I_1$, $\Omega_2(I_1, I_2) = \partial H_0/\partial I_2$ [illegible] n_J', n_C' [illegible]

$$H^* = \tilde{P}_M + \frac{n_c'}{\varepsilon}\tilde{P}_{M_1} + \frac{1}{\varepsilon} H_0 + \varepsilon \bar{H}_1, \quad \bar{H}_1 = \frac{1}{(2\pi)^4}\int_0^{2\pi}\ldots\int_0^{2\pi} H_1\, dw_1\, dw_2\, dM\, dM_1$$

[illegible], [illegible] $2:5$ [illegible] $\bar{H}_1$ [illegible]:

$$\bar{H}_1 = -a_J{}^3\Omega^* F(I_1, I_2)\left[\frac{D_1}{2} - \frac{3}{2} G(I_2, I_3, w_3)\right]$$

[illegible]

$$G(I_2, I_3, w_3) = \left(D_2 \sin^2 w_3 + D_3 \cos^2 w_3 + D_4 \sin 2w_3 + D_5\right)\sin^2\delta_1 + \left(D_6 \sin w_3 + D_7 \cos w_3\right)\cos\delta_1 \sin\delta_1,$$

$$\cos\delta_1 = \frac{I_3}{I_2},\ w_3 = \varphi_3$$

[illegible] $F(I_1, I_2)$ [illegible] λ. [illegible] D_i [illegible]

$$D_i = \frac{1}{(2\pi)^2}\int_0^{2\pi}\int_0^{2\pi} Q_i(\nu, \nu_1)\, dM\, dM_1 = \frac{1}{(2\pi)^2}\int_0^{2\pi}\int_0^{2\pi} \frac{\left(1-e_J^2\right)^{\frac{3}{2}}}{\left(1+e_J\cos\nu\right)^2}\frac{\left(1-e_C^2\right)^{\frac{3}{2}}}{\left(1+e_C\cos\nu_1\right)^2} Q_i(\nu, \nu_1)\, d\nu\, d\nu_1$$

[illegible]:

$$Q_1 = \sum_{i=1}^{2}\mu_i \frac{(x-x_i)^2 + y^2 - 2z^2}{2r_i^5},\ Q_2 = \sum_{i=1}^{2}\mu_i \frac{\left((x-x_i)\cos\nu - y\sin\nu\right)^2}{2r_i^5},$$

$$Q_3 = \sum_{i=1}^{2}\mu_i \frac{\left((x-x_i)\sin\nu + y\cos\nu\right)^2}{2r_i^5},$$

$$Q_4 = \sum_{i=1}^{2} \mu_i \frac{\left(y\sin\nu - (x - x_i)\cos\nu\right)\left((x - x_i)\sin\nu + y\cos\nu\right)}{2r_i^5},$$

$$Q_5 = -\sum_{i=1}^{2} \mu_i \frac{z^2}{2r_i^5},\ Q_6 = \sum_{i=1}^{2} \mu_i \frac{z\left((x - x_i)\cos\nu - y\sin\nu\right)}{r_i^5},$$

$$Q_7 = -\sum_{i=1}^{2} \mu_i \frac{z\left((x - x_i)\sin\nu + y\cos\nu\right)}{r_i^5}, \mu_1 = 1 - \mu,\ \mu_2 = \mu .$$

[illegible]:

$$I_1 = const, I_2 = const,\ \bar{H}_1 = const$$

[illegible] $G = const$ [illegible] $\bar{H}_1 = const$, [illegible] $\mathbf{I}_2$ [illegible] $\mathbf{I}_2$, [illegible] G [illegible] A, B, C.

[illegible] x, y, z [illegible] D_j: $D_1 = 0.5791985815 \cdot 10^{-3}$,

$D_2 = 0.2896870643 \cdot 10^{-3}, D_3 = 0.2897883014 \cdot 10^{-3}, D_4 = 4.920297019 \cdot 10^{-8}, D_5 = -1.383920657 \cdot 10^{-7}$

$D_6 =$ -0.1174174249 $\cdot 10^{-4}$, $D_7 = 0.4707022248 \cdot 10^{-5}$

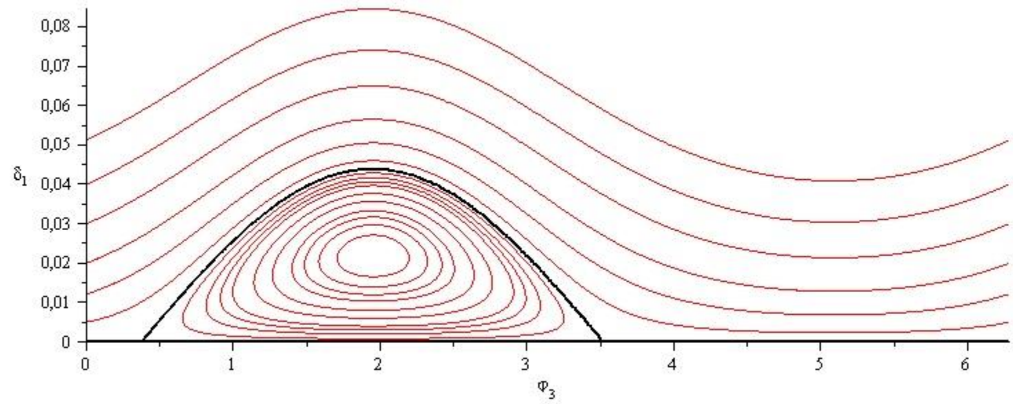
[illegible] $G = g$. [illegible] $\delta_1 = \delta_1^*, \varphi_3 = \varphi_3^*$ [illegible] $\mathbf{I}_2$ [illegible]:

$$\frac{\partial G}{\partial \varphi_3} \equiv \left[(D_2 - D_3)\sin 2\varphi_3 + 2D_4\cos 2\varphi_3\right]\sin^2\delta_1 + \frac{1}{2}\left(D_6\cos\varphi_3 - D_7\sin\varphi_3\right)\sin 2\delta_1 = 0$$

$$\frac{\partial G}{\partial \delta_1} \equiv \left(D_2\sin^2\varphi_3 + D_3\cos^2\varphi_3 + D_4\sin 2\varphi_3 + D_5\right)\sin 2\delta_1 + \left(D_6\sin\varphi_3 + D_7\cos\varphi_3\right)\cos 2\delta_1 = 0$$

[illegible] $\mathbf{I}_2$ [illegible] (2) [illegible]

$$\left\{\varphi_3^* = 1.952062662, \delta_1^* = 0.02183210425\right\}, \left\{\varphi_3^* = 5.093655316, \delta_1^* = 3.119760547\right\}.$$

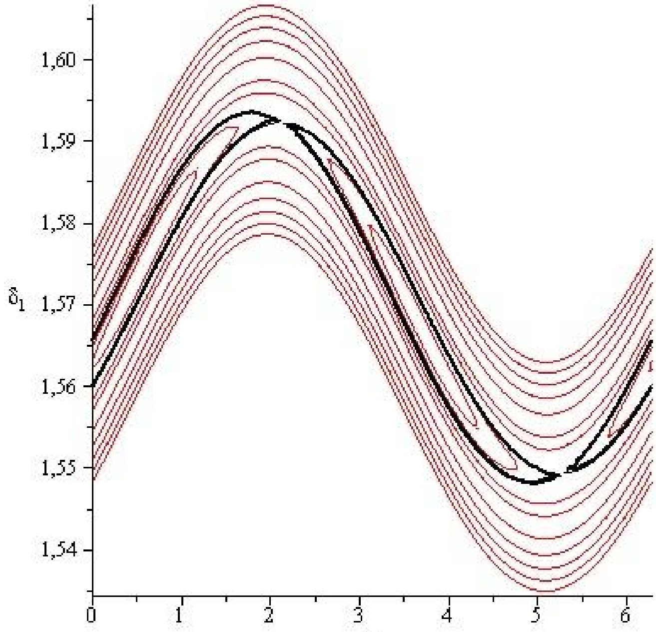


[illegible] 2. [illegible]

[illegible] β, [illegible] $\delta_1 = 0, \pi$ [illegible] $\mathbf{I}_2$ [illegible] $\delta_1^* = \beta$

[illegible] $\delta_1 = 0, \delta_1 = \pi$. [illegible] $\delta_1 = 0, \delta_1 = \pi$ [illegible] ([illegible] 2 [illegible]).

[illegible] $\left\{\varphi_3^* = 0.5714376802, \delta_1^* = 1.574923820\right\}$ $\left\{\varphi_3^* = 3.713030335, \delta_1^* = 1.566668834\right\}$ ([illegible] 3). [illegible] g=0.0002896666946 ([illegible] 3 [illegible]), [illegible] $\left\{\varphi_3^* = 5.283915161, \delta_1^* = 1.549358058\right\}$ [illegible] $\left\{\varphi_3^* = 2.142322507, \delta_1^* = 1.592234596\right\}$ [illegible].



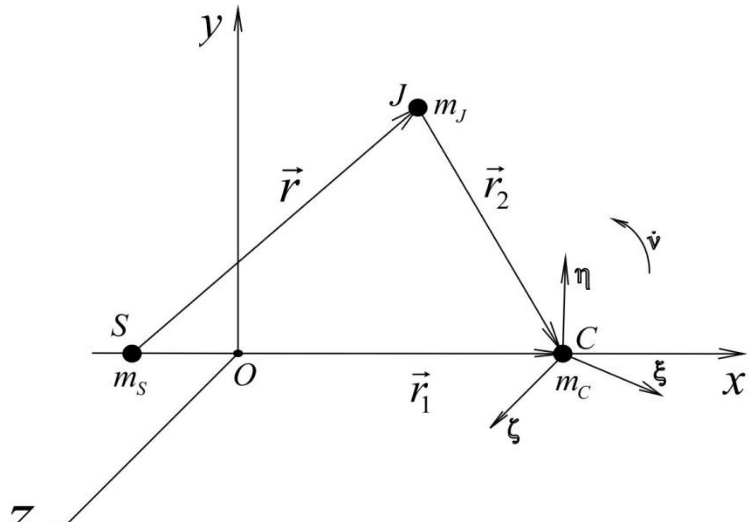
[illegible] 3. [illegible]

[illegible] $\delta_1^* = 26.73^\circ$, [illegible]

[illegible] J [illegible] S [illegible] S:

$$r = \frac{a_J\left(1 - e_J^2\right)}{1 + e_J \cos\nu_1}, \quad r_1 = \frac{a_C\left(1 - e_C^2\right)}{1 + e_C \cos\nu}$$

[illegible] r [illegible] r_1 - [illegible] S [illegible] J, S [illegible] a_J, e_J (a_C, e_C) -- [illegible] J [illegible]; [illegible] C [illegible] ($A=B$).



[illegible] 4. [illegible] C.

[illegible] $Oxyz$ [illegible] C [illegible] S, [illegible] $C\xi\eta\zeta$, [illegible] $Cx_1x_2x_3$, [illegible] $Cx_1x_2x_3$ [illegible] $C\xi\eta\zeta$ [illegible] $L, I_2, I_3, l, \varphi_2, \varphi_3$.

[illegible]

$$H=\frac{I_2^2-L^2}{2A}+\frac{L^2}{2C}-U\,,\quad U=-\frac{3}{2}\mu_S n_C^2\frac{a_C^3}{r_1^3}(C-A)\gamma_{13}^2-\frac{3}{2}\mu_J n_J^2\frac{a_J^3}{r_2^3}(C-A)\gamma_{23}^2$$

$$\gamma_{13}=\alpha_3\cos\nu+\beta_3\sin\nu\,,\quad \gamma_{23}=\frac{1}{r_2}\Big[(\alpha_3\cos\nu+\beta_3\sin\nu)(x_1-x_2)-(\beta_3\cos\nu-\alpha_3\sin\nu)y_2-\gamma_3 z_2\Big]$$

[illegible]:

$$\mu_S=\frac{m_S}{m_C+m_S}\,,\mu_J=\frac{m_J}{m_S+m_J}\,,\ \mu_C=\frac{m_C}{m_S+m_C}$$

[illegible] r_j [illegible].

[illegible] J ([illegible]) -- [illegible] $Oxyz$), [illegible] $T^*=1/Ω^*$. [illegible] $\varepsilon_1=n'_C\ \left(n'_C=n_C/\Omega^*\right)$, $\varepsilon_2=n'_J\ \left(n'_J=n_J/\Omega^*\right)$ [illegible].

[illegible]: $\varepsilon_3=(C'-A')=J_2$ [illegible], $C'=C/I^*$, $A'=A/I^*$, $I^*=m_C r_0^2$, r_0 - [illegible], J_2 [illegible]. [illegible] $m_J, m_C \ll m_S$, [illegible] $\varepsilon_J=$ [illegible], $\varepsilon_C=$ [illegible].

[illegible]:

$$H=H_0+\varepsilon_1^2\varepsilon_3 H_1+\varepsilon_2^2\varepsilon_3\varepsilon_4 H_2$$

[illegible]

$$H_0=\frac{I_2^2-L^2}{2A'I^*\Omega^*}+\frac{L^2}{2C'I^*\Omega^*}\,,\ H_1=\frac{3}{2}\Omega^*I^*\mu_S\frac{a_C^3}{r_1^3}\gamma_{13}^2,\ H_2=\frac{3}{2}\Omega^*I^*\frac{a_J^3}{r_2^3}\gamma_{23}^2$$

[illegible] Ω_1,Ω_2 [illegible] n'_C, n'_J [illegible] J [illegible].

[illegible]

$$H^*=P_M+\frac{n'_J}{\varepsilon_1}P_{M_1}+\frac{1}{\varepsilon_1}H_0+\mu H_1+\varepsilon H_2\,,\qquad M=n'_C t,\ M_1=n'_J t$$

[illegible] $M=$ [illegible] t [illegible], $\mu=\varepsilon_1\varepsilon_3$ [illegible] $\varepsilon=\varepsilon_2^2\varepsilon_3\varepsilon_4\varepsilon_1^{-1}$ -- [illegible], M, P_M, M_1, P_{M_1} - [illegible].

[illegible] H^* [illegible]:

$$\bar H^*=P_M+\frac{n'_J}{\varepsilon_1}P_{M_1}+\frac{1}{\varepsilon_1}H_0+\mu\bar H_1+\varepsilon\bar H_2\,.$$

[illegible]

$$\bar{H}_1 = \frac{1}{(2\pi)^3}\int_0^{2\pi}...\int_0^{2\pi} H_1 dld\varphi_2 dM = \frac{3}{4\left(1-e_C^2\right)^{3/2}}\mu_S \text{ɋ}^* I^*\left[\sin^2\delta_2 + \frac{1}{2}\left(2-3\sin^2\delta_2\right)\sin^2\delta_1\right]$$

$$\bar{H}_2 = \frac{1}{(2\pi)^4}\int_0^{2\pi}...\int_0^{2\pi} H_2 dld\varphi_2 dMdM_1 = \frac{3}{2}\text{ɋ}^* I^* a_J^3\left[D_{12}\sin^2\delta_2 + \left(2-3\sin^2\delta_2\right)G_2\right]$$

$$G_2 = \left(D_{22}\sin^2\varphi_3 + D_{32}\cos^2\varphi_3 + D_{42}\sin 2\varphi_3 + D_{52}\right)\sin^2\delta_1 + \left(D_{62}\sin\varphi_3 + D_{72}\cos\varphi_3\right)\cos\delta_1\sin\delta_1$$

[illegible] D_{i2} [illegible]

$$D_{i2} = \frac{1}{(2\pi)^2}\int_0^{2\pi}\int_0^{2\pi} Q_{i2}\left(M, M_1\right)dMdM_1 = \frac{1}{(2\pi)^2}\int_0^{2\pi}\int_0^{2\pi}\frac{\left(1-e_C^2\right)^{\frac{3}{2}}}{\left(1+e_C\cos\nu\right)^2}Q_{i2}\left(\nu, M_1\right)d\nu dM_1,$$

[illegible] $Q_{i2}\left(\nu, M_1\right)$ [illegible].

[illegible]:

$$L=\text{const},\ I_2=\text{const}\ ,\ \bar{H}^* = \text{const}$$

[illegible] C [illegible] C [illegible] I_2 [illegible] δ_2 [illegible] I_2 [illegible] C [illegible]. [illegible] δ_2 [illegible]

[illegible] $\bar{H}^* = const$, [illegible]:

$$\mu_J\left(D_{22}\sin^2\varphi_3 + D_{32}\cos^2\varphi_3 + D_{42}\sin 2\varphi_3 + D_{52}\right)\sin^2\delta_1 +$$
$$+\mu_J\left(D_{62}\sin\varphi_3 + D_{72}\cos\varphi_3\right)\cos\delta_1\sin\delta_1 + \mu_S D\sin^2\delta_1 = \text{const}$$

[illegible] $\mu_S D\sin^2\delta_1 = \text{const}$.

[illegible] H^* [illegible] μ, ε [1] [illegible]

$$t \sim \frac{T^*}{\varepsilon_1\left\|(\mu,\varepsilon)\right\|} = \frac{T_C}{2\pi\left\|(\mu,\varepsilon)\right\|}\ \sim 10^6\ [illegible]$$

[illegible] T_C [illegible] u [illegible].

[illegible] I_3, φ_3 [illegible]:

$$\begin{cases} \dfrac{d\varphi_3}{d\tau} = \mu \dfrac{\partial \bar{H}_1}{\partial I_3} + \varepsilon \dfrac{\partial \bar{H}_2}{\partial I_3} \\ \dfrac{dI_3}{d\tau} = -\varepsilon \dfrac{\partial \bar{H}_2}{\partial \varphi_3} \end{cases}$$

[illegible] t. [illegible] J [illegible] $\mathbf{I}_2$ [illegible] $\mathbf{I}_2$, [illegible] μ, ε [illegible] 1, [illegible]:

$$\frac{d\varphi_3}{dt} = \frac{3}{4}\frac{n_C^2}{\left(1-e_C^2\right)^{3/2}}\left(A-C\right)\frac{\left(3\cos^2\delta_2 - 1\right)}{I_2}\cos\delta_1, \quad \delta_1, \delta_2 = \mathrm{const}$$

[illegible]

$$I_3 = I_3^{(0)}(\tau) + \varepsilon I_3^{(1)}(\tau) + \varepsilon^2 I_3^{(2)}(\tau) + \ldots, \quad \varphi_3 = \varphi_3^{(0)}(\tau) + \varepsilon\varphi_3^{(1)}(\tau) + \varepsilon^2\varphi_3^{(2)}(\tau) + \ldots$$

[illegible] $\varphi_3^{(0)}(\tau) = \omega_e t, \quad \omega_e = \dfrac{3}{2}\dfrac{n_C}{(1-e_C^2)^{3/2}\omega_r}\left(\dfrac{A-C}{C}\right)\cos\delta_1^{(0)}$ ($\delta_2 \approx 0$)

$$I_3^{(1)}(\tau) = -3\frac{\Omega^* I^*}{\omega_e}a_J^3[\left(D_{22}\sin^2(\omega_e\tau) - D_{32}\sin^2(\omega_e\tau) + D_{42}\sin(2\omega_e\tau)\right)\sin^2\delta_1^{(0)} +$$
$$+\left(D_{62}\sin(\omega_e\tau) + D_{72}\cos(\omega_e\tau) - D_{72}\right)\cos\delta_1^{(0)}\sin\delta_1^{(0)}],$$

$$\dot{\varphi}_3^{(1)}(\tau) = -\frac{6\Omega^* I^*\mu\mu_S a_C^3 D}{\left(\omega_r\right)^2}I_3^{(1)}(\tau) + 3\frac{I^*\Omega^* a_J^3}{\omega_r}\Bigg[\left(D_{62}\sin\omega_e\tau + D_{72}\cos\omega_e\tau\right)\left(2\sin\delta_1^{(0)} - \frac{1}{\sin\delta_1^{(0)}}\right) -$$
$$-2\left(D_{22}\sin^2\omega_e\tau + D_{32}\cos^2\omega_e\tau + D_{42}\sin 2\omega_e\tau + D_{52}\right)\cos\delta_1^{(0)}\Bigg]$$

[illegible]:

$$\delta_1(\tau) = \delta_1^{(0)} - \frac{I_3^{(1)}(\tau)}{C\omega_r\sin\delta_1^{(0)}}\varepsilon - \left[\left(\frac{I_3^{(1)}(\tau)}{C\omega_r}\right)^2\frac{\cos\delta_1^{(0)}}{2\sin^3\delta_1^{(0)}} + \frac{I_3^{(2)}(\tau)}{C\omega_r\sin\delta_1^{(0)}}\right]\varepsilon^2 + O\left(\varepsilon^3\right)$$

[illegible]:

$$T = \frac{2\pi}{\omega_e} - 6\varepsilon\frac{I^*\Omega^* a_J^3\pi}{\omega_r\omega_e^2}\left(D_{22} + D_{32} + 2D_{52}\right)\cos\delta_1^{(0)} + o(\varepsilon),$$

$$\omega = \omega_e + \varepsilon 3\frac{I^*\Omega^* a_J^3}{\omega_r}\left(D_{22} + D_{32} + 2D_{52}\right)\cos\delta_1^{(0)} + o(\varepsilon)$$

[illegible] $t = T^*\tau/\varepsilon_1$, [illegible] $T = \dfrac{T_C}{2\pi}T$.

[illegible] 2:5 [illegible] $\alpha = 2n_J - 5n_C \sim 10^{-2}$ [illegible] ε, Ů

[illegible] x_2, y_2, z_2 [illegible] D_{ij}:

D_{11}=0.0005789460169, D_{21}=D_{31}=0.0002894730085, D_{41}=0, D_{12}=0.001278447239, D_{22}=0.000639299081, D_{32}=0.0006397384723, D_{42}=-1.718411258×10^{-6}, D_{52}=-2.951574337×10^{-7}, D_{62}=-0.00001018866987, D_{72}=-0.00001386094073

[illegible] [2], [4], [illegible] C [illegible] J_2. [illegible] [3].

[illegible]:

$$I_2 = \tilde{C} m_C r_0^2 \omega_r, \ \tilde{C} = C' + \sum_j \frac{m_j a_j^2 n_j}{m_C r_0^2 \omega_r},$$

[illegible] m_j, a_j, n_j [illegible] j-[illegible]. [illegible] J_2 [illegible]

$$\tilde{J}_2 = J_2 + \frac{1}{2} \sum_j \frac{m_j a_j^2}{m_C r_0^2}.$$

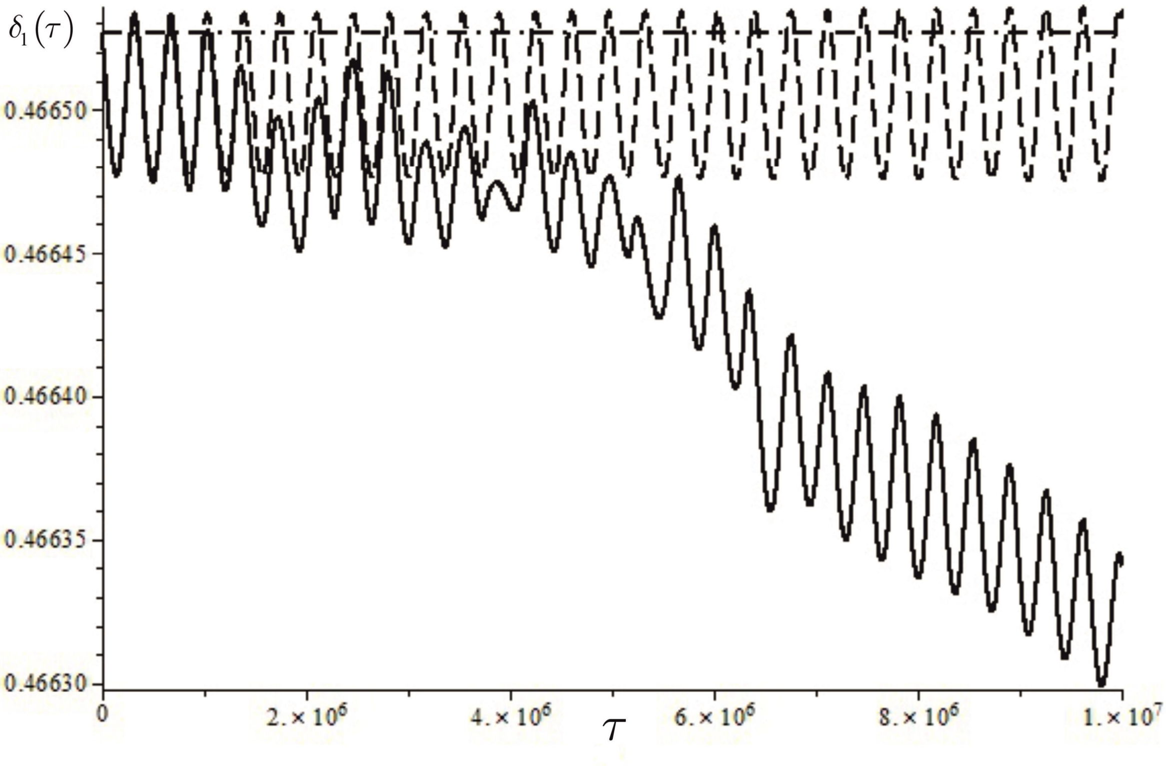
[illegible] C' [illegible] J_2. [illegible] $\delta_1 = 26°44'$ [illegible] [2]:

$$\omega_e = \frac{3}{2} \frac{n_C^2}{\tilde{C}\omega_r} \tilde{J}_2 \cos\delta_1 = 0''.7679 \ [illegible]^{-1}$$

[illegible] (5) [illegible] 4.69·10^7 [illegible]).

[illegible] I_3, φ_3, [illegible]

[illegible] $\delta_1(\tau)$ ([illegible]), [illegible]



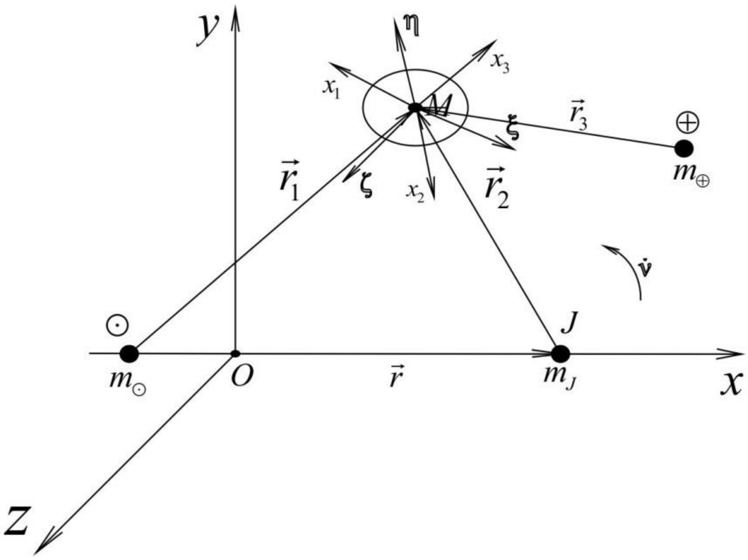
[illegible] 5. [illegible].

[illegible] 0.003° [illegible].

[illegible] $T = \frac{T_C}{2\pi}\breve{T}$ [illegible] T= 1.677×10^6 [illegible] [4] [illegible] 3547 [illegible].

[illegible] $m_\odot$, m_J, $m_\oplus$ [illegible] ($m_\odot > m_J > m_\oplus$), [illegible] $(A=B)$ [illegible].

[illegible] $\oplus, M, J$ [illegible] $\odot$ -- [illegible] ([illegible] 6) [illegible].



[illegible] 6. [illegible]

$Oxyz$ [illegible] Oz [illegible] $\odot$ [illegible] J, $M\xi\eta\zeta$ - [illegible] $Mx_1x_2x_3$ [illegible] $Mx_1x_2x_3$ [illegible] $M\xi\eta\zeta$ [illegible] $L, I_2, I_3, l, \varphi_2, \varphi_3$

[illegible]:

$$H = \frac{I_2^2 - L^2}{2A} + \frac{L^2}{2C} - U \,,$$

$$U = -\frac{3}{2}(1-\mu)n_J^2\frac{a_J^3}{r_1^3}(C-A)\gamma_{13}^2 - \frac{3}{2}\mu n_J^2\frac{a_J^3}{r_2^3}(C-A)\gamma_{23}^2 - \frac{3}{2}\mu_\oplus n_\oplus^2\frac{a_\oplus^3}{r_3^3}(C-A)\gamma_{33}^2 \quad ,$$

$$\gamma_{ij} = \frac{1}{r_i}\Big[\big(\alpha_j\cos\nu + \beta_j\sin\nu\big)\big(x - x_i\big) + \big(\beta_j\cos\nu - \alpha_j\sin\nu\big)\big(y - y_i\big) + \gamma_j\big(z - z_i\big)\Big].$$

[illegible]:

$$\mu = \frac{m_J}{m_S + m_J} = 0.0009535918308\,,\quad \mu_\oplus = \frac{m_\oplus}{m_S + m_\oplus} = 0.000003002655505\,.$$

[illegible], [illegible] r_j [illegible].

[illegible] J ([illegible]) -- [illegible] ([illegible] $Oxyz$), [illegible]

[illegible] $T^*=1/Ý^*$. [illegible] $\varepsilon_1 = n'_C \ \left(n'_C = n_C / \Omega^*\right)$, $\varepsilon_2 = n'_J \ \left(n'_J = n_J / \Omega^*\right)$ [illegible].

[illegible] M -- -- [illegible] ([illegible] $Oxyz$), [illegible] $Oxyz$ [illegible] $\mathbf{x}_2 = \left(n_J, n_\oplus\right)$, [illegible] $n_J, n_\oplus$ - [illegible].

[illegible] - $\varepsilon_1 = n'_J \ \left(n'_J = n_J / \Omega^* \sim 10^{-4}\right)$, $\varepsilon_2 = n'_\oplus \ \left(n'_\oplus = n_\oplus / \Omega^* \sim 10^{-3}\right)$, [illegible] $\Omega^* \approx 7.0882711\cdot10^{-5}$ [illegible] - [illegible] $n_J \approx 1.6784899\cdot10^{-8}$ [illegible] $n_\oplus \approx 1.990986576\cdot10^{-7}$ [illegible] - [illegible]

«[illegible]» [illegible]:

$$H^* = P_M + \frac{n'_M}{\varepsilon_1} P_{M_1} + \frac{n'_\oplus}{\varepsilon_1} P_{M_2} + \frac{1}{\varepsilon_1} H_0 + \varepsilon_1 H_{11} + \varepsilon_2 H_{12}, \quad \left(\bar{\varepsilon}_2 = \varepsilon_2^2 \varepsilon_1^{-1} \sim 10^{-2}\right)$$

[illegible] $\tau = \varepsilon_1 t \ \left(\tau = M\right)$ - "[illegible]" [illegible], M, P_M, $M_1, P_{M_1}, M_2, P_{M_2}$ - [illegible].

[illegible] $\Omega_1 = \partial H_0 / \partial L$, $\Omega_2 = \partial H_0 / \partial I_2$ [illegible] $n_M, n_J, n_\oplus$ [illegible]

$$H^* = P_M + \frac{n'_M}{\varepsilon_1} P_{M_1} + \frac{n'_\oplus}{\varepsilon_1} P_{M_2} + \frac{1}{\varepsilon_1} H_0 + \varepsilon_1 \bar{H}_1, \ \bar{H}_1 = \frac{1}{(2\pi)^5} \int_0^{2\pi} \dots \int_0^{2\pi} \left(H_{11} + \frac{\varepsilon_2^2}{\varepsilon_1^2} H_{12} \right) dl d\varphi_2 \, dM \, dM_1 \, dM_2$$

[illegible] $\bar{H}_1$ [illegible]:

$$\bar{H}_1 = -a_J^3 \Omega^* F\left(I_2, L\right) \left[\frac{D_1}{2} - \frac{3}{2} G\left(I_2, I_3, \varphi_3\right) \right],$$

$$G\left(I_2, I_3, \varphi_3\right) = \left(D_2 \sin^2 \varphi_3 + D_3 \cos^2 \varphi_3 + D_4 \sin 2\varphi_3 + D_5\right) \sin^2 \delta_1 + \left(D_6 \sin \varphi_3 + D_7 \cos \varphi_3\right) \cos \delta_1 \sin \delta_1,$$

$$F\left(I_2, L\right) = \left(C - A\right)\left(2 - 3\sin^2 \delta_2\right), \ \cos \delta_1 = \frac{I_3}{I_2}, \cos \delta_2 = \frac{L}{I_2}$$

[illegible] D_i [illegible]

$$D_i = \frac{1}{(2\pi)^3}\int_0^{2\pi}\int_0^{2\pi}\int_0^{2\pi} Q_i dM\, dM_1 dM_2 = \frac{1}{(2\pi)^3}\int_0^{2\pi}\int_0^{2\pi}\int_0^{2\pi} \frac{\left(1-e_J^2\right)^{\frac{3}{2}}}{\left(1+e_J\cos\nu\right)^2}\frac{\left(1-e_M^2\right)^{\frac{3}{2}}}{\left(1+e_M\cos\nu_1\right)^2}\frac{\left(1-e_\oplus^2\right)^{\frac{3}{2}}}{\left(1+e_\oplus\cos\nu_2\right)^2} Q_i d\nu\, d\nu_1 d\nu_2$$

[illegible] $Q_i(\nu,\nu_1,\nu_2)$ [illegible] $Q_i(\nu,\nu_1)$, [illegible])

[illegible]:

$$L = const\,,\, I_2 = const\,,\; \bar{H}_1 = const\,,\, G = const$$

[illegible] $G = const$ [illegible] $\mathbf{I_2}$ [illegible] $\mathbf{I_2}$, [illegible] G [illegible] A, C

[illegible] x, y, z [illegible] x_3, y_3, z_3 [illegible] D_j:

$D_1 = 0.1429559651\,, D_2 = 0.07154463109\,, D_3 = 0.07150226249\,, D_4 = 0.000008246177674,$

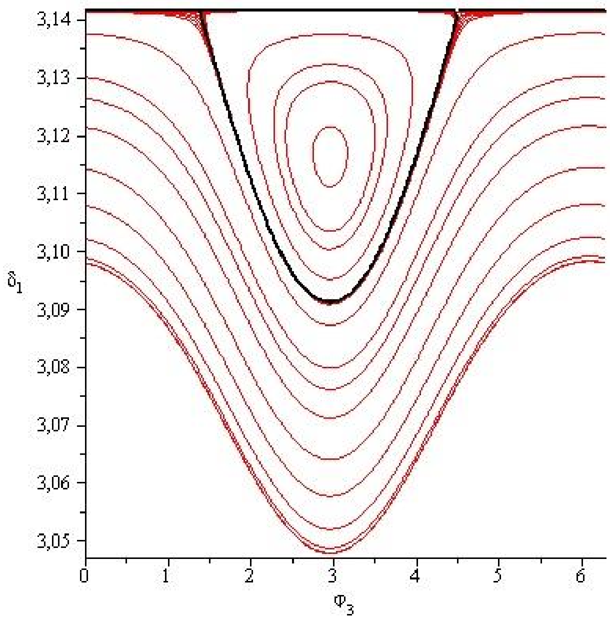
$D_5 = \text{-}0.4546425415\cdot 10^{-4}\;,\; D_6 = 0.0006645690058\;,\; D_7 = \text{-}0.3543987113\cdot 10^{-2}.$

[illegible] $G = g$. [illegible] $\delta_1 = \delta_1^*, \varphi_3 = \varphi_3^*$ [illegible] $\mathbf{I}_2$ [illegible]:

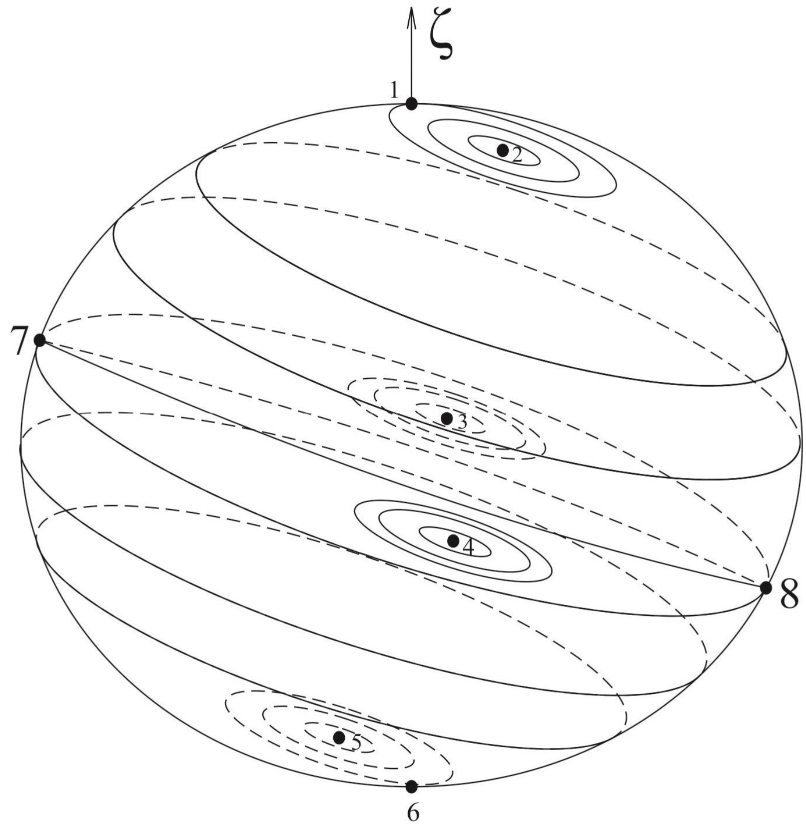
$$\frac{\partial G}{\partial \varphi_3} \equiv \left[(D_2 - D_3)\sin 2\varphi_3 + 2D_4\cos 2\varphi_3\right]\sin^2\delta_1 + \frac{1}{2}\left(D_6\cos\varphi_3 - D_7\sin\varphi_3\right)\sin 2\delta_1 = 0$$

$$\frac{\partial G}{\partial \delta_1} \equiv \left(D_2\sin^2\varphi_3 + D_3\cos^2\varphi_3 + D_4\sin 2\varphi_3 + D_5\right)\sin 2\delta_1 + \left(D_6\sin\varphi_3 + D_7\cos\varphi_3\right)\cos 2\delta_1 = 0$$

[illegible] 7. [illegible] 7 [illegible] $\mathbf{I_2}$ [illegible]



[illegible] 7. [illegible]



[illegible] 8. [illegible]

[illegible] (2) [illegible] (5) [illegible]: $\{\varphi_3^* = 349.37922056^\circ, \delta_1^* = 1.44439823^\circ\}$ [illegible] $\{\varphi_3^* = 169.37922055^\circ, \delta_1^* = 178.555602^\circ\}$ [illegible]. [illegible] $\delta_1^* = 1.44439823^\circ$ [illegible] $\beta = 1.444426100^\circ$ [illegible]

[illegible] (7) [illegible] (8), [illegible]
$\left\{\varphi_3^* = 132.08670022^\circ, \delta_1^* = 88.85081593^\circ\right\}$ [illegible] $\left\{\varphi_3^* = 312.08670023^\circ, \delta_1^* = 91.14918407^\circ\right\}$, [illegible] «[illegible]» [illegible].

[illegible] $\mathbf{I_2}$ [illegible] (3), (4) [illegible] $\{\varphi_3^* = 222.10425195^\circ, \delta_1^* = 89.12509615^\circ\}$ [illegible] $\{\varphi_3^* = 42.10425194^\circ, \delta_1^* = 90.87490385^\circ\}$, [illegible] (7) [illegible] (8) ([illegible] 8) [illegible] g= 0.07150070095.

[illegible] $\delta_1^* = 25.19^\circ$, [illegible]

[illegible] m_S [illegible] m_J (m_S>m_J), [illegible] m_T, [illegible] a_T.

[illegible] N,J,T [illegible] S -- [illegible] 6.

[illegible]:

$$H = \frac{I_2^2 - L^2}{2A} + \frac{L^2}{2C} - U \ ,$$

$$U = -\frac{3}{2}(1-\mu)n_J^2\frac{a_J^3}{r_1^3}(C-A)\gamma_{13}^2 - \frac{3}{2}\mu n_J^2\frac{a_J^3}{r_2^3}(C-A)\gamma_{23}^2 - \frac{3}{2}\mu_T n_T^2\frac{a_T^3}{r_3^3}(C-A)\gamma_{33}^2,$$

$$\gamma_{ij} = \frac{1}{r_i}\Big[\big(\alpha_j\cos\nu + \beta_j\sin\nu\big)\big(x - x_i\big) + \big(\beta_j\cos\nu - \alpha_j\sin\nu\big)\big(y - y_i\big) + \gamma_j\big(z - z_i\big)\Big].$$

[illegible]:

$$\mu = \frac{m_J}{m_S + m_J} = 0.0009535918308\ ,\ \mu_T = \frac{m_T}{m_T + m_N} = 0.0002088795273,$$

[illegible] , [illegible] r_j [illegible].

[illegible] N - [illegible] $Oxyz$, [illegible] $\mathbf{x}_1 = (n_J, n_N)$, [illegible] n_J, n_N - [illegible]. [illegible] T - [illegible] $Oxyz$ [illegible] $\mathbf{x}_2 = (n_J, n_N, n_T)$. [illegible] n_T - [illegible]

[illegible] - $\varepsilon_1 = n'_J$ $\left(n'_J = n_J/\Omega^* \sim 10^{-4}\right)$, $\varepsilon_2 = n'_T$ $\left(n'_T = n_T/\Omega^* \sim 10^{-1}\right)$

[illegible] $\Omega^* \approx 1.0931271 \cdot 10^{-4}$ [illegible]/c - [illegible] $\Delta = \dfrac{\rho}{a_*} \approx 0.0698$,

$\rho = 24764$ [illegible] - [illegible], $a_* = a_T = 354\ 759$ [illegible].

«[illegible]» [illegible]:

$$H^* = P_M + \frac{n'_N}{\varepsilon_1}P_{M_1} + \frac{n'_T}{\varepsilon_1}P_{M_2} + \frac{1}{\varepsilon_1}H_0 + \Delta_1 H_{11} + \Delta_2 H_{12},$$

[illegible] $\Delta_1 = \varepsilon_1 \cdot \Delta^2 \sim 10^{-8}$, $\Delta_2 = \dfrac{\varepsilon_2^2 \cdot \Delta^2}{\varepsilon_1} \sim 10^{-2}$.

[illegible] $M = \varepsilon_1 t$ - "[illegible]" [illegible], M, P_M, $M_1, P_{M_1}, M_2, P_{M_2}$ [illegible]

[illegible]

[illegible], [illegible] $\Omega_1 = \partial H_0/\partial L$, $\Omega_2 = \partial H_0/\partial I_2$ [illegible] n_N, n_J, n_T [illegible]

$$\bar{H}^* = P_M + \frac{n'_N}{\varepsilon_1}P_{M_1} + \frac{n'_T}{\varepsilon_1}P_{M_2} + \frac{1}{\varepsilon_1}H_0 + \Delta_1\bar{H}_1,\ \bar{H}_1 = \frac{1}{(2\pi)^5}\int_0^{2\pi}\ldots\int_0^{2\pi}\left(H_{11} + \frac{\Delta_2}{\Delta_1}H_{12}\right)dl\,d\varphi_2\,dM\,dM_1\,dM_2\,\Lambda$$

[illegible] $\bar{H}_1$ [illegible]

[illegible], [illegible] D_i .

[illegible]:

$$L=\text{const},\ I_2=\text{const},\ \bar{H}_1 = const,\ G=\text{const}$$

[illegible] G=const [illegible] $\mathbf{I_2}$ [illegible] $\mathbf{I}_2$, [illegible] G [illegible] A, C.

[illegible] x, y, z [illegible] x_3, y_3, z_3 [illegible] D_j:

D_1=0.1391264379, D_2=0.180124171 , D_3=0.134933727 , D_4=0.0377352403, D_5=-0.08796573046 , D_6=-0.09855538557, D_7=0.1738860962.

[illegible] G=g [illegible] $\delta_1^* = 29.56^\circ$, [illegible] [illegible] ([illegible]), [illegible]

[illegible] , [illegible].

[illegible]

1 [illegible] // [illegible]. 2016. [illegible]. 54. [illegible] 2. [illegible]. 135–142.

2 [illegible] // [illegible] 2015. [illegible].11. [illegible] 2. C. 329-342.

3 [illegible] // [illegible]. 2017 [illegible]. ([illegible]).

4 [illegible] XXXIX [illegible]

[illegible] 2015. С. 81

5 [illegible], 2015. [illegible]. 51

6 [illegible] VII [illegible], 2016, [illegible]. 58

[illegible]

1. [illegible], 2015, 528 [illegible]
2. French R. G. et. Geometry of the Saturn System from the 3 July 1989 Occultation of 28 Sgr and Vojager Observations //ICARUS. 1993. V. 103. № 2. P. 163-214.
3. Goldreich P. Inclination of Satellite Orbits about an Oblate Precessing Planet. //The Astronomical Journal. 1965. V. 70. № 1. P. 5-9.
4. Ward W.R., Hamilton D.P. Tilting Saturn. I. Analytic model //The Astronomical Journal. 2004. V. 128. № 5. P. 2501-2509.