Computation of L_2 in 2+2 Body Problem When Perturbation Effects Act in Coriolis and Centrifugal Forces, Small Primary is a Radiating Body and Bigger Primary as a Triaxial Rigid Body

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Abstract

Collinear equilibrium point L_2 has been computed in 2+2 body problem when smaller primary is a radiating body, bigger primary is a triaxial rigid body and effect of perturbations in coriolis and centrifugal forces are taken into account to the system. Here two bodies are so small that gravitational attractions due to these bodies on other two bigger bodies are neglected but two smaller bodies attract each other according to the Newton's law of gravitation.

KEYWORDS: Collinear equilibrium points, Photo-gravitation, Triaxial rigid bodies, Coriolis force.

1. INTRODUCTION

Whipple (1984) studied 2+2 body problem in which M_1 and M_2 ($M_2 \leq M_1$) be two finite bodies. They move in circular Keplerian orbits about their centre of mass. Two minor bodies (m_1 and m_2) $\ll M_2$, move in the gravitational field of two primaries (M_1 and M_2) and they attract each other but do not perturb the primaries. He found fourteen equilibrium points in which six are collinear and eight triangular.

Sharma, Taqvi and Bhatnagar (2001) examined the existence and stability of libration points in the restricted three body problem when the bigger primary is a triaxial rigid body and a source of radiation.

Garain and Chakraborty (2007) studied Robe restricted three body problem when one of the primary is a triaxial rigid body. They considered perturbations in coriolis and centrifugal forces in the configuration.

2. EQUATION OF MOTION

Whipple's (1984) equation of motion of restricted problem of 2 + 2 bodies in synodic system be

$$\ddot{x}_i - 2\dot{y}_i = \frac{\partial T}{\partial x_i} \qquad (1)$$

$$\ddot{y}_i + 2\dot{x}_i = \frac{\partial T}{\partial y_i} \qquad (2)$$

$$\ddot{z}_i = \frac{\partial T}{\partial z_i}, \qquad (i= 1, 2) \qquad (3)$$

$$T = \sum_{i=1}^{2} \mu_i \left[\frac{(x_i^2+y_i^2)}{2} + \frac{(1-\mu)}{r_{1i}} + \frac{\mu}{r_{2i}} + \frac{\mu_{3-i}}{2r}\right]$$

$\mu = \frac{M_2}{M_1+M_2}$, $\mu_i = \frac{m_i}{M_1+M_2}$ (i = 1, 2), μ is the ratio between the masses of second primary with sum of the masses of first primary. In dimensionless unit $M_2 + M_1 = 1$ and in this case $M_2 = \mu$, $M_1 = 1 - \mu$.

$$r_{1i}^2 = (x_i - \mu)^2 + y_i^2 + z_i^2$$

$$r_{2i}^2 = (x_i + 1 - \mu)^2 + y_i^2 + z_i^2$$

$$r^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2$$

Here, we consider M_2, being the radiating one. Also, coriolis and centrifugal forces are taken in to account and M_1 to be a triaxial rigid body. Then using the idea of Garain , Chakraborty (2007) and Sharma, Taqvi, Bhatnagar (2001), we replace T by U as follows:

$$U = \sum_{i=1}^{2} \mu_i \left[\frac{\beta(x_i^2+y_i^2)}{2} + \frac{(1-\mu)}{r_{1i}} + \frac{q\mu}{r_{2i}} + \frac{\mu_{3-i}}{2r} + \frac{(1-\mu)(2\sigma_1-\sigma_2)}{2r_{1i}^3} - \frac{3(1-\mu)(\sigma_1-\sigma_2)y_i^2}{2r_{1i}^5}\right] \qquad (4)$$

Where $q = 1 - \in$ and $\beta = 1 + \in'$ i= 1, 2. $\in$ and $\in'$ the perturbation factors due to photo-gravitation and centrifugal forces respectively. When there is no perturbation i.e., $\in, \in'$ = 0 then q = 1 and $\beta = 1$. σ_1 and σ_2 are perturbing factors due to triaxial shape of the bigger primary. When a body is spherical, the entire mass is assumed to be centered at the centre of the body but when the body is not spherical then we get a force function different from spherical case. In this case, extra terms $\frac{1-\mu(2\sigma_1 - \sigma_2)}{2r_{1i}^3}$ and $-\frac{3(1-\mu)(\sigma_1 - \sigma_2)}{r_{1i}^5}$ are to be included in equation (4).

Equation of motion changes to

$$\ddot{x}_i - 2\dot{y}_i = \frac{\partial U}{\partial x_i} \tag{5}$$

$$\ddot{y}_i + 2\dot{x}_i = \frac{\partial U}{\partial y_i} \tag{6}$$

$$\ddot{z}_i = \frac{\partial U}{\partial z_i}, \qquad (i= 1, 2) \tag{7}$$

3. COLLINEAR EQUILIBRIUM POINTS

The equilibrium points are those points where

$$\dot{x}_i = \dot{y}_i = \dot{z}_i = \frac{\partial U}{\partial x_i} = \frac{\partial U}{\partial y_i} = \frac{\partial U}{\partial z_i} = 0, \ (i=1, 2)$$

Now differentiating both sides of equation (4) with respect to x_1, y_1, z_1, x_2, y_2 and z_2 respectively, we get

$$\beta x_1 - \frac{(1-\mu)(x_1-\mu)}{r_{11}^3} - \frac{q\mu(x_1-\mu+1)}{r_{21}^3} - \frac{\mu_2(x_1-x_2)}{r^3} - \frac{3(1-\mu)(2\sigma_1-\sigma_2)(x_1-\mu)}{2r_{11}^5} + \frac{15(1-\mu)(\sigma_1-\sigma_2)(x_1-\mu)y_1^2}{2r_{11}^7} = 0 \tag{8}$$

$$\beta y_1 - \frac{(1-\mu)y_1}{r_{11}^3} - \frac{q\mu y_1}{r_{21}^3} - \frac{\mu_2(y_1-y_2)}{r^3} - \frac{3(1-\mu)(2\sigma_1-\sigma_2)y_1}{2r_{11}^5} - \frac{3(1-\mu)(\sigma_1-\sigma_2)}{2}\left\{\frac{2y_1}{r_{11}^5} - \frac{5y_1^3}{r_{11}^7}\right\} = 0 \tag{9}$$

$$-\frac{(1-\mu)z_1}{r_{11}^3} - \frac{q\mu z_1}{r_{21}^3} - \frac{\mu_2(z_1-z_2)}{r^3} - \frac{3(1-\mu)(2\sigma_1-\sigma_2)z_1}{2r_{11}^5} + \frac{15(1-\mu)(\sigma_1-\sigma_2)y_1^2 z_1}{2r_{11}^7} = 0 \tag{10}$$

$$\beta x_2 - \frac{(1-\mu)(x_2-\mu)}{r_{12}^3} - \frac{q\mu(x_2-\mu+1)}{r_{22}^3} - \frac{\mu_1(x_2-x_1)}{r^3} - \frac{3(1-\mu)(2\sigma_1-\sigma_2)(x_2-\mu)}{2r_{12}^5} + \frac{15(1-\mu)(\sigma_1-\sigma_2)(x_2-\mu)y_2^2}{2r_{12}^7} = 0 \tag{11}$$

$$\beta\, y_2 - \frac{(1-\mu)y_2}{r_{12}^3} - \frac{q\mu y_2}{r_{22}^3} - \frac{\mu_1(y_2-y_1)}{r^3} - \frac{3(1-\mu)(2\sigma_1-\sigma_2)y_2}{2r_{12}^5}$$

$$-\frac{3(1-\mu)(\sigma_1-\sigma_2)}{2}\left\{\frac{2y_2}{r_{12}^5} - \frac{5y_2^3}{r_{12}^7}\right\} = 0 \qquad (12)$$

$$-\frac{(1-\mu)z_2}{r_{12}^3} - \frac{q\mu z_2}{r_{22}^3} - \frac{\mu_1(z_2-z_1)}{r^3} - \frac{3(1-\mu)(2\sigma_1-\sigma_2)z_2}{2r_{12}^5} + \frac{15(1-\mu)(\sigma_1-\sigma_2)y_2^2 z_2}{2r_{12}^7} = 0 \qquad (13)$$

From equations (10) and (13), we get $z_1 = 0$ and this value in (13) yields $z_2 = 0$. By inspection, it can be seen that equations (9) and (12) are satisfied when $y_1 = y_2 = 0$. Now we have to determine x_1 and x_2 such that the following simplified forms of equations (8) and (11) are satisfied.

$$\Rightarrow\ \beta x_1 - \frac{(1-\mu)(x_1-\mu)}{|x_1-\mu|^3} - \frac{q\mu(x_1-\mu+1)}{|x_1-\mu+1|^3} - \frac{\mu_2(x_1-x_2)}{|x_1-x_2|^3}$$

$$-\frac{3(1-\mu)(2\sigma_1-\sigma_2)(x_1-\mu)}{2|x_1-\mu|^5} + \frac{15(1-\mu)(\sigma_1-\sigma_2)(x_1-\mu)y_1^2}{2|x_1-\mu|^7} = 0 \qquad (14)$$

and

$$\beta x_2 - \frac{(1-\mu)(x_2-\mu)}{|x_2-\mu|^3} - \frac{q\mu(x_2-\mu+1)}{|x_2-\mu+1|^3} - \frac{\mu_2(x_2-x_1)}{|x_2-x_1|^3}$$

$$-\frac{3(1-\mu)(2\sigma_1-\sigma_2)(x_2-\mu)}{2|x_2-\mu|^5} + \frac{15(1-\mu)(\sigma_1-\sigma_2)(x_2-\mu)y_2^2}{2|x_2-\mu|^7} = 0 \qquad (15)$$

The solutions of equations (14) and (15) can be obtained with the help of power series.

Let $\in_i = \dfrac{\mu_i}{(\mu_1+\mu_2)^{\frac{2}{3}}},\ (i=1,2)$

$$\therefore \mu_2 \in_1 = \frac{\mu_1\mu_2}{(\mu_1+\mu_2)^{\frac{2}{3}}} = \mu_1 \in_2$$

$$\therefore \mu_2 \in_1 = \mu_1 \in_2 = k \qquad \text{(Let)} \qquad (16)$$

Now, let $x_1 = L_2' + \sum_{j=1}^{n} a_{1j} \in_2^j$, for $i = 1,\ 2,\ 3$ (17)

Where L_2' be one of the collinear equilibrium points in photo-gravitational restricted problem of three bodies when bigger primary is a triaxial rigid body perturbed by coriolis and centrifugal forces and x_1 be the x - coordinate of first small body.

Similarly, let $x_2 = L_2' + \sum_{j=1}^{n} a_{2j} \in_1^j$ for $i = 1, 2, 3$ (18)

Similar to Whipple,

$$a_{11}\Omega^{\circ}_{xx} \in_2 - \frac{\mu_2(x_1 - x_2)}{|x_1 - x_2|^3} = 0 \quad (19)$$

$$a_{21}\Omega^{\circ}_{xx} \in_1 - \frac{\mu_1(x_2 - x_1)}{|x_2 - x_1|^3} = 0 \quad (20)$$

From equations (19) and (20), we get

$$a_{11} = -a_{21} \quad (21)$$

From equations (19), (20) and (21), we have

$$a_{11} = (\pm 1)\frac{1}{(\Omega^{\circ}_{xx})^{\frac{1}{3}}} \quad (22)$$

$$\Rightarrow x_1 = L_2' + \frac{(\pm 1)}{(\Omega^{\circ}_{xx})^{\frac{1}{3}}} \frac{\mu_2}{(\mu_1 + \mu_2)^{\frac{2}{3}}} \quad (23)$$

and $x_2 = L_2' - \frac{(\pm 1)}{(\Omega^{\circ}_{xx})^{\frac{1}{3}}} \frac{\mu_1}{(\mu_1 + \mu_2)^{\frac{2}{3}}}$ (24)

$$\Omega^{\circ}_{xx} = A_2 - B_2 \in + C_2 \in' + 2D_2\sigma_1 - D_2\sigma_2 \quad (25)$$

Where $A_2 = 3(1-\mu)(1+2a_2) + \mu\left(1 + \frac{2}{a_2^3}\right)$, $B_2 = 6(1-\mu)b_2 - \left(\frac{6b_2}{a_2^4} - \frac{2}{a_2^3}\right)\mu$,

$C_2 = 1 + 6(1-\mu)c_2 - \frac{6\mu c_2}{a_2^4}$, $D_2 = 6\left\{(1-\mu)(5a_2 - d_2 + 1) + \frac{\mu d_2}{a_2^4}\right\}$

$$a_2=\left[\frac{\mu}{3(1-\mu)}\right]^{\frac{1}{3}}-\frac{1}{3}\left[\frac{\mu}{3(1-\mu)}\right]^{\frac{2}{3}}-\frac{10}{9}\left[\frac{\mu}{3(1-\mu)}\right],$$

$$b_2=\frac{1}{3}\left[\left\{\frac{\mu}{3(1-\mu)}\right\}^{\frac{1}{3}}-\frac{2}{3}\left\{\frac{\mu}{3(1-\mu)}\right\}^{\frac{2}{3}}-\frac{10}{3}\left\{\frac{\mu}{3(1-\mu)}\right\}\right],$$

$$c_2=\left[\frac{1}{9}-\frac{13}{27}\left\{\frac{\mu}{3(1-\mu)}\right\}^{\frac{1}{3}}+\frac{47}{81}\left\{\frac{\mu}{3(1-\mu)}\right\}^{\frac{2}{3}}+\frac{533}{729}\left\{\frac{\mu}{3(1-\mu)}\right\}\right] \text{ and}$$

$$d_2=\frac{1}{2}\left[\frac{1}{3}+\frac{2}{9}\left\{\frac{\mu}{3(1-\mu)}\right\}^{\frac{1}{3}}-\frac{28}{27}\left\{\frac{\mu}{3(1-\mu)}\right\}^{\frac{2}{3}}-\frac{457}{243}\left\{\frac{\mu}{3(1-\mu)}\right\}\right]$$

Putting the values of Ω°_{xx} and L_2' in (23) and (24) we get values of x_1 and x_2 as follow:

$$x_1=a_{21}-b_{21}\in+c_{21}\in'-2d_{21}\sigma_1+d_{21}\sigma_2$$

Where $a_{21}=\mu-1+a_2+\dfrac{(\pm1)\mu_2}{A_2^{\frac{1}{3}}(\mu_1+\mu_2)^{\frac{2}{3}}}$, $\mathrm{b}_{21}=b_2-\dfrac{(\pm1)\mu_2 B_2}{3A_2^{\frac{4}{3}}(\mu_1+\mu_2)^{\frac{2}{3}}}$

$$c_{21}=c_2-\frac{(\pm1)\mu_2 C_2}{3A_2^{\frac{4}{3}}(\mu_1+\mu_2)^{\frac{2}{3}}},\quad d_{21}=d_2+\frac{(\pm1)\mu_2 D_2}{3A_2^{\frac{4}{3}}(\mu_1+\mu_2)^{\frac{2}{3}}}$$

$$x_2=a_{22}-b_{22}\in+c_{22}\in'-2d_{22}\sigma_1+d_{22}\sigma_2$$

Where, $a_{22}=\mu-1+a_2-\dfrac{(\pm1)\mu_1}{A_2^{\frac{1}{3}}(\mu_1+\mu_2)^{\frac{2}{3}}}$, $\mathrm{b}_{22}=b_2+\dfrac{(\pm1)\mu_1 B_2}{3A_2^{\frac{4}{3}}(\mu_1+\mu_2)^{\frac{2}{3}}}$

$$c_{22}=c_2+\frac{(\pm1)\mu_1 C_2}{3A_2^{\frac{4}{3}}(\mu_1+\mu_2)^{\frac{2}{3}}},\quad d_{22}=d_2-\frac{(\pm1)\mu_1 D_2}{3A_2^{\frac{4}{3}}(\mu_1+\mu_2)^{\frac{2}{3}}}$$

The particular values of x_1 and x_2 may be shown by the following tables.

Table 1

For Collinear Equilibrium Solutions L_2

$(\mu_1=\mu_2=10^{-10},\ x_1 = a_{21} - b_{21}\,\epsilon + c_{21}\epsilon' - 2d_{21}\sigma_1 + d_{21}\sigma_2)$

μ	$\mu_2/(\mu_1+\mu_2)^{2/3}$	a_{21}	b_{21}	c_{21}	d_{21}
0.00001	0.000292401774	-0.984990393889	0.004925743724	0.104494576862	0.169290360379
0.00002	0.000292401774	-0.981145259900	0.006187085573	0.102443674365	0.169441587414
0.00003	0.000292401774	-0.978452071626	0.007066794161	0.101030547947	0.169585673275
0.00004	0.000292401774	-0.976310252258	0.007764025366	0.099913827990	0.169712749723
0.00005	0.000292401774	-0.974503005665	0.008350614531	0.098974401753	0.169825516538
0.00006	0.000292401774	-0.972924280711	0.008861681011	0.098155018973	0.169926852536
0.00007	0.000292401774	-0.971513319750	0.009317335141	0.097423246337	0.170018971662
0.00008	0.000292401774	-0.970231688460	0.009730292971	0.096758728112	0.170103524735
0.00009	0.000292401774	-0.969053349937	0.010109165561	0.096147755270	0.170181756466
0.0001	0.000292401774	-0.967959754336	0.010460085684	0.095580605248	0.170254623603
0.0002	0.000292401774	-0.959733540940	0.013076495306	0.091304047932	0.170800618806
0.0003	0.000292401774	-0.953971343016	0.014882456957	0.088291234406	0.171171234543
0.0004	0.000292401774	-0.949387056235	0.016301862396	0.085881580852	0.171455160357
0.0005	0.000292401774	-0.945516851847	0.017487325666	0.083837822126	0.171686258755
0.0006	0.000292401774	-0.942133996297	0.018513352653	0.082044101557	0.171881426272
0.0007	0.000292401774	-0.939108668506	0.019422557223	0.080434087730	0.172050418470
0.0008	0.000292401774	-0.936358788141	0.020241856935	0.078965826003	0.172199419933
0.0009	0.000292401774	-0.933828776597	0.020989462967	0.077610890320	0.172332616763
0.001	0.000292401774	-0.931479054006	0.021678334308	0.076349022241	0.172452983472
0.002	0.000292401774	-0.913738320267	0.026696306529	0.066715734963	0.173260494060
0.003	0.000292401774	-0.901220413281	0.030023123242	0.059811458592	0.173729672622
0.004	0.000292401774	-0.891191754184	0.032547688455	0.054221465170	0.174052389912
0.005	0.000292401774	-0.882668672703	0.034588650939	0.049432760242	0.174293788433
0.006	0.000292401774	-0.875171150367	0.036301055573	0.045193456135	0.174484053827
0.007	0.000292401774	-0.868424747075	0.037773330185	0.041358775061	0.174639641717
0.008	0.000292401774	-0.862256173308	0.039061191741	0.037836869265	0.174770488330
0.009	0.000292401774	-0.856548230561	0.040202250389	0.034565356176	0.174883033655
0.01	0.000292401774	-0.851217549129	0.041223213447	0.031499686582	0.174981675110
0.02	0.000292401774	-0.809919745806	0.047617245352	0.007455556403	0.175623698142
0.03	0.000292401774	-0.779476887672	0.050559603126	-0.010550066506	0.176094821688
0.04	0.000292401774	-0.754193787776	0.051844998770	-0.025670044895	0.176581271592
0.05	0.000292401774	-0.732035751012	0.052107824212	-0.039054187997	0.177127219586
0.06	0.000292401774	-0.712016309870	0.051652550135	-0.051269478216	0.177746311995
0.07	0.000292401774	-0.693575169241	0.050650197638	-0.062643148607	0.178442950800
0.08	0.000292401774	-0.676361033262	0.049206594969	-0.073383754566	0.179218323332
0.09	0.000292401774	-0.660138183491	0.047391617284	-0.083633725184	0.180072492232
0.1	0.000292401774	-0.644740452217	0.045253538193	-0.093495458937	0.181005208935
0.2	0.000292401774	-0.519293323804	0.010581947384	-0.181888135258	0.194709849465
0.3	0.000292401774	-0.426973052155	-0.045245888306	-0.267303947464	0.217458089900
0.4	0.000292401774	-0.363427037328	-0.126600764262	-0.361359264997	0.252772195190
0.5	0.000292401774	-0.337211631439	-0.246169774217	-0.474520451563	0.307961232959

Table 2

For Collinear Equilibrium Solutions L_2

($\mu_1=\mu_2=10^{-10}$, $x_2 = a_{22} - b_{22}\epsilon + c_{22}\epsilon' - 2d_{22}\sigma_1 + d_{22}\sigma_2$)

μ	$\mu_2/(\mu_1+\mu_2)^{2/3}$	a_{22}	b_{22}	c_{22}	d_{22}
0.00001	0.000292401774	-0.985269646231	0.004926383292	0.103215810425	0.167137401551
0.00002	0.000292401774	-0.981424012607	0.006187897018	0.101452151331	0.167719350464
0.00003	0.000292401774	-0.978730472012	0.007067727552	0.100178660995	0.168072788148
0.00004	0.000292401774	-0.976588371103	0.007765056650	0.099150134581	0.168332072391
0.00005	0.000292401774	-0.974780886041	0.008351729043	0.098273500564	0.168538957100
0.00006	0.000292401774	-0.973201952107	0.008862868693	0.097502050491	0.168712130029
0.00007	0.000292401774	-0.971790803856	0.009318588585	0.096808580758	0.168861647505
0.00008	0.000292401774	-0.970509002029	0.009731606449	0.096175678751	0.168993573644
0.00009	0.000292401774	-0.969330506372	0.010110534487	0.095591441732	0.169111861654
0.0001	0.000292401774	-0.968236764647	0.010461506284	0.095047328444	0.169219239565
0.0002	0.000292401774	-0.960009443539	0.013078311203	0.090903592304	0.169964124367
0.0003	0.000292401774	-0.954246461309	0.014884556621	0.087955264071	0.170431219069
0.0004	0.000292401774	-0.949661546042	0.016304191832	0.085586301067	0.170775977056
0.0005	0.000292401774	-0.945790808183	0.017489851835	0.083571491894	0.171050323942
0.0006	0.000292401774	-0.942407484315	0.018516052838	0.081799856798	0.171278462987
0.0007	0.000292401774	-0.939381736200	0.019425414652	0.080207482632	0.171473772159
0.0008	0.000292401774	-0.936631472617	0.020244858618	0.078753775103	0.171644473390
0.0009	0.000292401774	-0.934101107572	0.020992598481	0.077411142722	0.171796002459
0.001	0.000292401774	-0.931751055915	0.021681595072	0.076159872650	0.171932150731
0.002	0.000292401774	-0.914007817901	0.026700542603	0.066587650363	0.172830339074
0.003	0.000292401774	-0.901488128155	0.030028079173	0.059713034111	0.173343303991
0.004	0.000292401774	-0.891458035014	0.032553240266	0.054141796871	0.173693555759
0.005	0.000292401774	-0.882933732444	0.034594722810	0.049366479511	0.173954498817
0.006	0.000292401774	-0.875435135146	0.036307595484	0.045137430008	0.174159651998
0.007	0.000292401774	-0.868687764540	0.037780299855	0.041310977511	0.174327119630
0.008	0.000292401774	-0.862518306661	0.039068561641	0.037795896153	0.174467763337
0.009	0.000292401774	-0.856809546387	0.040209996948	0.034530184450	0.174588589686
0.01	0.000292401774	-0.851478102133	0.041231317360	0.031469542072	0.174694365806
0.02	0.000292401774	-0.810174422246	0.047628313514	0.007455356418	0.175377683074
0.03	0.000292401774	-0.779727272871	0.050573104966	-0.010534458887	0.175869214406
0.04	0.000292401774	-0.754440623783	0.051860708757	-0.025643485703	0.176368858423
0.05	0.000292401774	-0.732279472289	0.052125628458	-0.039019035249	0.176924445032
0.06	0.000292401774	-0.712257199115	0.051672390148	-0.051227081950	0.177551088788
0.07	0.000292401774	-0.693813421394	0.050672047279	-0.062594359495	0.178253914940
0.08	0.000292401774	-0.676596787103	0.049230449113	-0.073329142189	0.179034515215
0.09	0.000292401774	-0.660371539197	0.047417485563	-0.083573686308	0.179893198801
0.1	0.000292401774	-0.644971481939	0.045281441231	-0.093430276939	0.180829877180
0.2	0.000292401774	-0.519501868040	0.010632708080	-0.181776783923	0.194557671909
0.3	0.000292401774	-0.427155270325	-0.045165071551	-0.267144906702	0.217311957297
0.4	0.000292401774	-0.363573598233	-0.126479955795	-0.361146377396	0.252617777063
0.5	0.000292401774	-0.337306465113	-0.245996719965	-0.474247005233	0.307783121949

3. CONCLUSION

We get the values of L_2 which are $(x_1, 0, 0)$ and $(x_2, 0, 0)$ respectively. For different values μ, μ_1 and μ_2 we may compute x_1 and x_2 for L_2 with the help of Tables-1 & 2. In tables, particular values of L_2 have been obtained for given values of μ, μ_1 *and* μ_2. This concept will be very helpful for obtaining L_2 for a given configuration of heavenly bodies.

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