Jupiter's Rotation Equations

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Constants

$f_R := 2791.826$	Free Rotation Constant
$i_M := 0.127036$	Maximum Influenced Rotation Constant (for planets and moons only)
$i_{St} := 1.0121647 \cdot 10^{-12}$	Start Influenced Rotation Distance Constant
$i_{Ma} := 5.6964797 \cdot 10^{-10}$	Maximum Influenced Rotation Distance Constant
$i_{Sp} := 1.0686849 \cdot 10^{-9}$	Stop Rotation Distance Constant

Facts	Jupiter	Sun
Mass (kg)	$m := 1.8986 \cdot 10^{27}$	$M := 1.9891 \cdot 10^{30}$
Density (g/cm^3)	$\rho := 1.33$	$\rho_S := 1.408$
Axis Tilt (deg)	$t := 3.13$	$t_S := 7.25$
Semi-major Axis (km)	$a := 778570000$	
Orbit Eccentricity (deg)	$e := 0.04839266$	
Orbit Inclination (degree), with respect to equator	$i := 6.06$	

$$\omega_F := f_R \div \sqrt[6]{m} \cdot \sqrt[2]{\rho}$$

$\omega_F = 0.09149737$ Jupiter's Free Rotation (per day)

Part 1

Jupiter's Influenced Rotation by the influence of the Sun

$$q := a \cdot (1 - e)$$

$q = 740892926.7$ Jupiter's Perihelion Distance (km)

$$Q := a \cdot (1 + e)$$

$Q = 816247073.3$ Jupiter's Aphelion Distance (km)

$$i_r := \left(\left| \cos\left(\frac{i \cdot \pi}{180} \right) \right| + 1 \right) \div 2$$

$i_r = 0.99720594$ Jupiter's Influenced Rotation Reduction Factor by Orbit Inclination

$$\omega_{Mi} := \frac{\sqrt[6]{m \cdot i_r \div M} \div \sqrt[6]{\rho}}{i_M}$$

$\omega_{Mi} = 2.35428048$ Jupiter's Maximum Influenced Rotation by the Sun (p.d.)

$$S_t := \frac{\sqrt[6]{m \cdot i_r \div M}}{i_{St}}$$

$S_t = 309867312900.5$ Jupiter's Start Influenced Rotation Distance to the Sun (km)

$$M_a := \frac{\sqrt[6]{m \cdot i_r \div M}}{i_{Ma}}$$

$M_a = 550579958.7$ Jupiter's Maximum Influenced Rotation Distance to the Sun (km)

$$S_p := \frac{\sqrt[6]{m \cdot i_r \div M}}{i_{Sp}}$$

$S_p = 293479168.5$ Jupiter's Stop Rotation Distance to the Sun (km)

Calculating Jupiter's average distance to the Sun, if $(q < S_p < Q)$

$$x := if\left(q < S_p, if\left(S_p < Q, \frac{S_p - a}{e}, 0\right), 0\right)$$

$x = 0$ X value at Jupiter's orbit intersection with S_p Boundary (km)

$$b := a\sqrt{1 - e^2}$$

$b = 777657818.7$ Jupiter's Semi-minor Axis (km)

$$y := b\sqrt{a^2 - x^2} \div a$$

$y = 777657818.74$ Y value at the Jupiter's orbit intersection with S_p Boundary (km)

$$\theta := atan\left(\frac{-x}{y}\right) + \frac{\pi}{2}$$

$\theta = 1.57079633$ Half-angle of the Jupiter's orbit out of S_p Boundary (rad)

$$s := a \cdot \int_0^{\theta} \sqrt{1 - e^2 \cdot sin(\theta)^2}\, d\theta$$

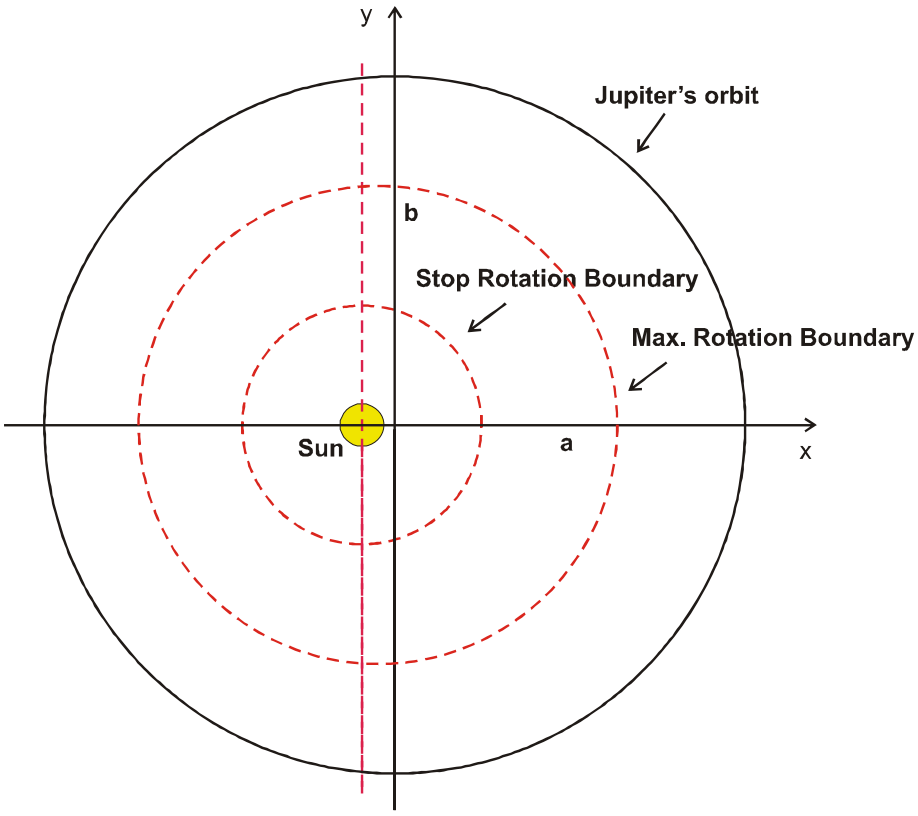
$s = 1222258575.65$ Half of Jupiter's orbit out of S_p Boundary (km)

$$a_a := if\left[q < S_p, if\left[S_p < Q, a\frac{\int_{\pi - \frac{s}{a}}^{\pi} (1 - e \cdot cos(E)) \cdot \sqrt{1 - e^2 \cdot cos(E)^2}\, dE}{\int_{\pi - \frac{s}{a}}^{\pi} \sqrt{1 - e^2 \cdot cos(E)^2}\, dE}, 0\right], 0\right]$$

$a_a = 0$ Jupiter's average distance to the Sun outside S_p Boundary (km)

$$n := \frac{2 \cdot s}{2 \cdot a \cdot \int_0^{\pi} \sqrt{1 - e^2 \cdot sin(\theta)^2}\, d\theta} \cdot \sqrt{\frac{a_a^3}{a^3}}$$

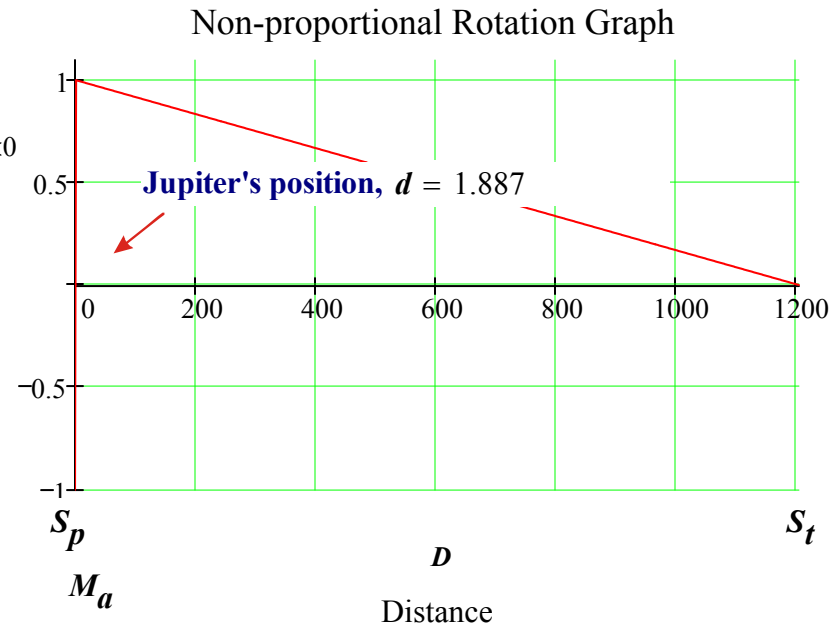
$n = 0$ Ratio of the Jupiter's orbit out of S_p Boundary to the whole orbit



$$d := if\left(q < S_p, if\left(S_p < Q, \frac{a_a - S_p}{M_a - S_p}, \frac{a - S_p}{M_a - S_p}\right), \frac{a - S_p}{M_a - S_p}\right)$$

$d = 1.88677301$ Jupiter's corresponding distance to the Sun relative to S_p on the X axis of the graph

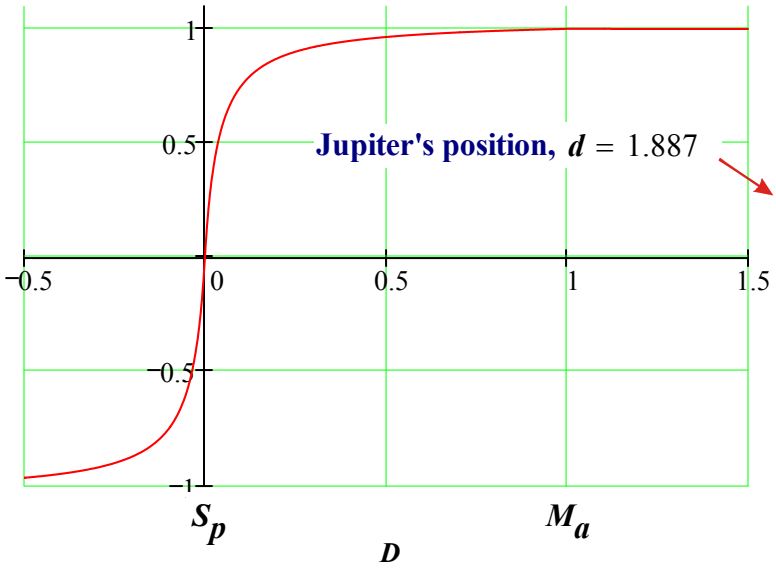
$$\text{Rotation} := \begin{cases} -1 - \dfrac{0.04}{D - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } D < 0 \\ \dfrac{-0.04}{D + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le D \le 1 \\ \dfrac{-D + 1}{\dfrac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < D \end{cases}$$



Rotation

$$\begin{cases} -1-\dfrac{0.04}{D-\left(\sqrt{0.29}-0.5\right)}-\left(\sqrt{0.29}-0.5\right) & \text{if } D<0 \\ \dfrac{-0.04}{D+\left(\sqrt{0.29}-0.5\right)}+\left(0.5+\sqrt{0.29}\right) & \text{if } 0\le D\le 1 \\ \dfrac{-D+1}{\frac{S_t-M_a}{M_a-S_p}}+1 & \text{if } 1<D \end{cases}$$

Left end of the Rotation Graph



Distance

$$\omega(d) := \begin{cases} -1-\dfrac{0.04}{d-\left(\sqrt{0.29}-0.5\right)}-\left(\sqrt{0.29}-0.5\right) & \text{if } d<0 \\ \dfrac{-0.04}{d+\left(\sqrt{0.29}-0.5\right)}+\left(0.5+\sqrt{0.29}\right) & \text{if } 0\le d\le 1 \\ \dfrac{-d+1}{\frac{S_t-M_a}{M_a-S_p}}+1 & \text{if } 1<d \end{cases}$$

$\omega(d) = 0.99926292$ Jupiter's corresponding Influenced Rotation by the Sun on the Y axis of the graph

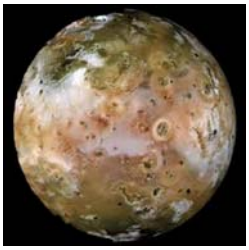
$$t_r := if\left(a < M_a, if\left(\omega_{Mi} > \omega_F, \frac{t\cdot\omega_F}{90}, \frac{t\cdot\omega_{Mi}}{90}\right), if\left(\omega(d)\cdot\omega_{Mi} > \omega_F, \frac{t\cdot\omega_F}{90}, \frac{t\cdot\omega(d)\cdot\omega_{Mi}}{90}\right)\right)$$

$t_r = 0.00318208$ Jupiter's Maximum and Free Rotational Speed Reduction by Axis Tilt

$$\omega i_1 := if\left[a > M_a, \omega(d)\cdot\omega_{Mi}+\omega_F-t_r, \left[\omega(d)\cdot\left(\omega_{Mi}+\omega_F-t_r\right)\cdot if\left(q < S_p, if\left(Q > S_p, n, 0\right), 1\right)\right]\right]$$

$\omega i_1 = 2.44086049$ **Jupiter's end result Rotation (p.d.)**

Part 2



Jupiter's Influenced Rotation by the influence of the Io

$if\left(q < S_t\right)$

Io's Facts

$a_m := 421800$ Io Semi-major Axis (km)

$e_m := 0.0041$ Io Orbit Eccentricity (degree)

$i_m := 0.036$ Io Orbit Inclination (degree)

$t_m := 0.00$ Io Axis Tilt (degree)

$m_m := 8.93 \cdot 10^{22}$ Io Mass (kg)

$q := a_m \cdot \left(1 - e_m\right)$

$q = 420070.6$ Io's Perihelion Distance (km)

$Q := a_m \cdot \left(1 + e_m\right)$

$Q = 423529.4$ Io's Aphelion Distance (km)

$i_r := \left(\left|cos\left(\frac{t_m \cdot \pi}{180}\right)\right| + 1\right) \div 2$

$i_r = 1$ Io's Orbit Inclination Reduction Factor

$\omega_{Mi} := \sqrt[6]{m_m \cdot i_r \div m} \div \sqrt[6]{\rho} \div i_M \div \sqrt{M \div m_m}$

$\omega_{Mi} = 0.00030218$ Jupiter's Maximum Influenced Rotation by the Io (p.d.)

$S_t := \sqrt[6]{m_m \cdot i_r \div m} \div i_{St} \div \sqrt{M \div m_m}$

$S_t = 39772470.1$ Jupiter's Start Influenced Rotation Distance to the Io (km)

$M_a := \sqrt[6]{m_m \cdot i_r \div m} \div i_{Ma} \div \sqrt{M \div m_m}$

$M_a = 70668.7$ Jupiter's Maximum Influenced Rotation Distance to the Io (km)

$S_p := \sqrt[6]{m_m \cdot i_r \div m} \div i_{Sp} \div \sqrt{M \div m_m}$

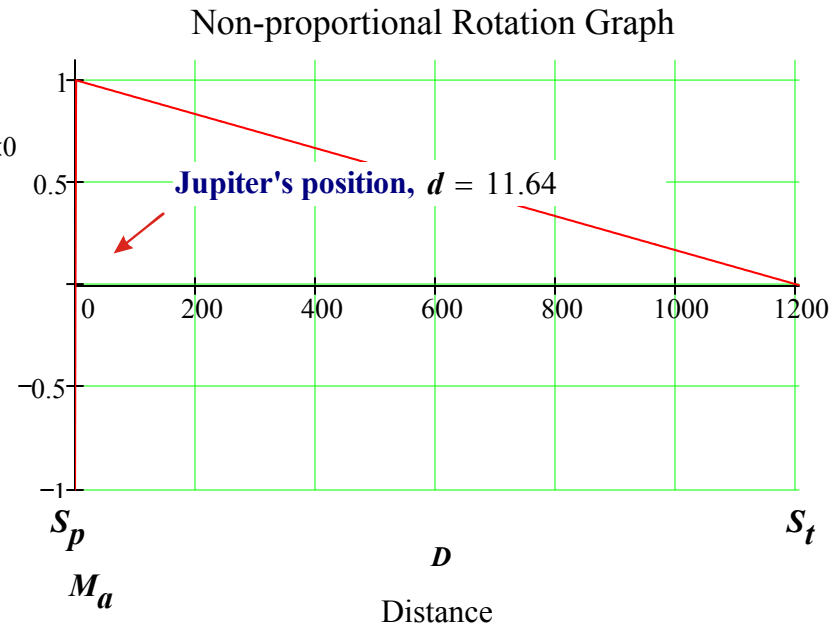
$S_p = 37669$ Jupiter's Stop Rotation Distance to the Io (km)

$$d := \frac{a_m - S_p}{M_a - S_p}$$

$d = 11.64043335$ Jupiter's corresponding distance to the Io relative to S_p on the X axis of the graph

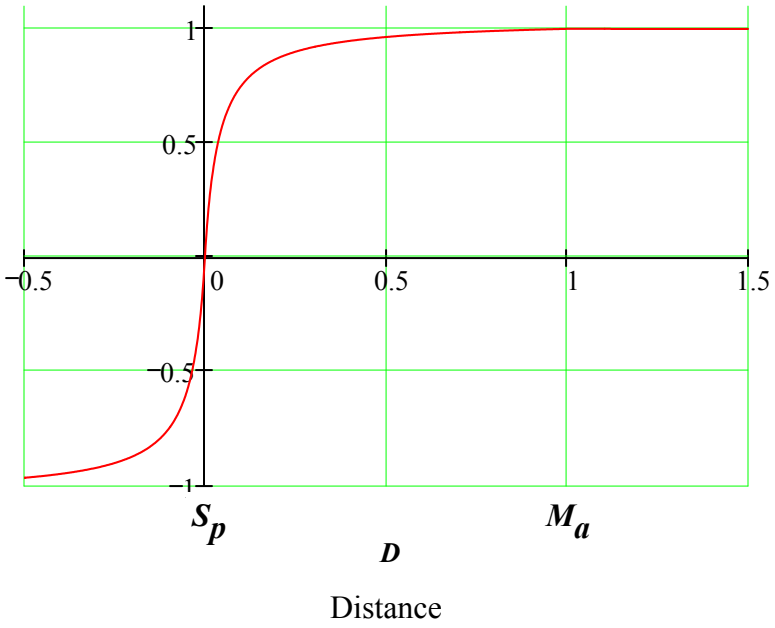
Rotation

$$\begin{cases} -1 - \dfrac{0.04}{D - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } D < 0 \\ \dfrac{-0.04}{D + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le D \le 1 \\ \dfrac{-D + 1}{\dfrac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < D \end{cases}$$



Rotation

$$\begin{cases} -1 - \dfrac{0.04}{D - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } D < 0 \\ \dfrac{-0.04}{D + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le D \le 1 \\ \dfrac{-D + 1}{\dfrac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < D \end{cases}$$



$$\omega(d) := \begin{cases} -1\cdot\left(\frac{S_p}{M_a - S_p}\right) - \frac{0.04\cdot\left(\frac{S_p}{M_a - S_p}\right)}{d - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } d < 0 \\ \frac{-0.04}{d + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le d \le 1 \\ \frac{-d + 1}{\frac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < d \end{cases}$$

$\omega(d) = 0.99115578$ Jupiter's corresponding Influenced Rotation by the Io on the Y axis of the graph

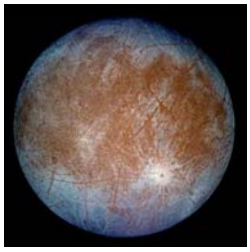
$$t_r := \text{if}\left(a_m < M_a, \text{if}\left(\omega_{Mi} > \omega_F, \frac{i_m\cdot\omega_F}{90}, \frac{i_m\cdot\omega_{Mi}}{90}\right), \text{if}\left(\omega(d)\cdot\omega_{Mi} > \omega_F, \frac{i_m\cdot\omega_F}{90}, \frac{i_m\cdot\omega(d)\cdot\omega_{Mi}}{90}\right)\right)$$

$t_r = 1.1980278\times10^{-7}$ Jupiter's Maximum and Free Rotational Speed Reduction by Axis Tilt

$$\omega i_2 := \text{if}\left[a_m < M_a, \omega(d)\cdot\left(\omega_{Mi} - t_r\right), \text{if}\left(q < S_t, \omega(d)\cdot\omega_{Mi} - t_r, 0\right)\right]$$

$\omega i_2 = 2.9938716\times10^{-4}$ **Jupiter's end result Influenced Rotation by the Io (p.d.)**
(Negative number means the reduction amount from Jupiter's Free Rotation)

Part 3



Jupiter's Influenced Rotation
by the influence of the Europa

$if\left(q < S_t\right)$

Europa's Facts

$a_m := 671100$ Europa Semi-major Axis (km)

$e_m := 0.0094$ Europa Orbit Eccentricity (degree)

$i_m := 0.469$ Europa Orbit Inclination (degree)

$t_m := 0.02$ Europa Axis Tilt (degree)

$m_m := 4.8 \cdot 10^{22}$ Europa Mass (kg)

$q := a_m \cdot \left(1 - e_m\right)$

$q = 664791.7$ Europa's Perihelion Distance (km)

$Q := a_m \cdot \left(1 + e_m\right)$

$Q = 677408.3$ Europa's Aphelion Distance (km)

$$i_r := \left(\left|\cos\left(\frac{t_m \cdot \pi}{180}\right)\right| + 1\right) \div 2$$

$i_r = 0.99999997$ Europa's Orbit Inclination Reduction Factor

$$\omega_{Mi} := \sqrt[6]{m_m \cdot i_r \div m} \div \sqrt[6]{\rho} \div i_M \div \sqrt{M \div m_m}$$

$\omega_{Mi} = 0.000199768$ Jupiter's Maximum Influenced Rotation by the Europa (p.d.)

$$S_t := \sqrt[6]{m_m \cdot i_r \div m} \div i_{St} \div \sqrt{M \div m_m}$$

$S_t = 26293137.6$ Jupiter's Start Influenced Rotation Distance to the Europa (km)

$$M_a := \sqrt[6]{m_m \cdot i_r \div m} \div i_{Ma} \div \sqrt{M \div m_m}$$

$M_a = 46718.3$ Jupiter's Maximum Influenced Rotation Distance to the Europa (km)

$$S_p := \sqrt[6]{m_m \cdot i_r \div m} \div i_{Sp} \div \sqrt{M \div m_m}$$

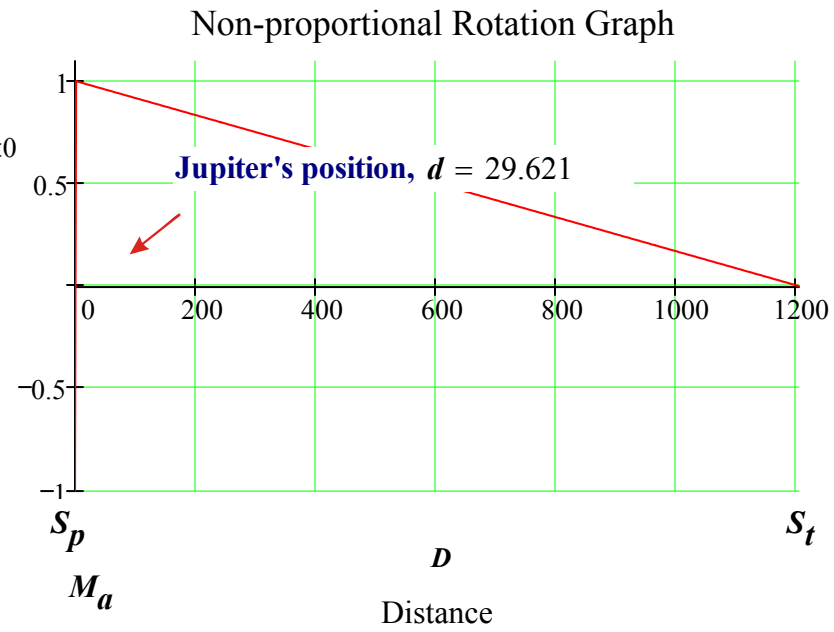
$S_p = 24902.6$ Jupiter's Stop Rotation Distance to the Europa (km)

$$d := \frac{a_m - S_p}{M_a - S_p}$$

$d = 29.62069034$ Jupiter's corresponding distance to the Europa relative to S_p on the X axis of the graph

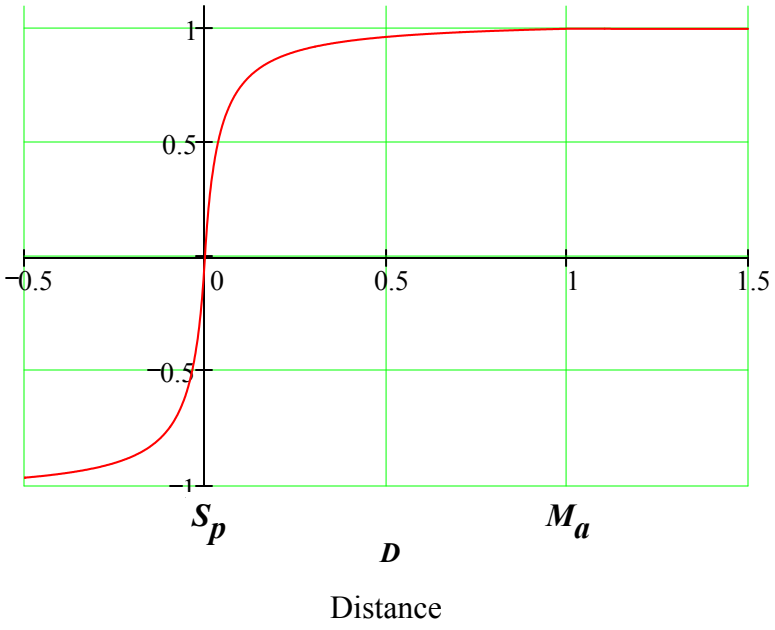
Rotation

$$\begin{cases} -1 - \dfrac{0.04}{D - (\sqrt{0.29} - 0.5)} - (\sqrt{0.29} - 0.5) & \text{if } D < 0 \\ \dfrac{-0.04}{D + (\sqrt{0.29} - 0.5)} + (0.5 + \sqrt{0.29}) & \text{if } 0 \le D \le 1 \\ \dfrac{-D + 1}{\dfrac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < D \end{cases}$$



Rotation

$$\begin{cases} -1 - \dfrac{0.04}{D - (\sqrt{0.29} - 0.5)} - (\sqrt{0.29} - 0.5) & \text{if } D < 0 \\ \dfrac{-0.04}{D + (\sqrt{0.29} - 0.5)} + (0.5 + \sqrt{0.29}) & \text{if } 0 \le D \le 1 \\ \dfrac{-D + 1}{\dfrac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < D \end{cases}$$



$$\omega(d) := \begin{cases} -1 \cdot \left(\frac{S_p}{M_a - S_p}\right) - \frac{0.04 \cdot \left(\frac{S_p}{M_a - S_p}\right)}{d - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } d < 0 \\ \frac{-0.04}{d + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le d \le 1 \\ \frac{-d + 1}{\frac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < d \end{cases}$$

$\omega(d) = 0.97621079$ Jupiter's corresponding Influenced Rotation by the Europa on the Y axis of the graph

$$t_r := \text{if}\left(a_m < M_a, \text{if}\left(\omega_{Mi} > \omega_F, \frac{i_m \cdot \omega_F}{90}, \frac{i_m \cdot \omega_{Mi}}{90}\right), \text{if}\left(\omega(d) \cdot \omega_{Mi} > \omega_F, \frac{i_m \cdot \omega_F}{90}, \frac{i_m \cdot \omega(d) \cdot \omega_{Mi}}{90}\right)\right)$$

$t_r = 1.0162459 \times 10^{-6}$ Jupiter's Maximum and Free Rotational Speed Reduction by Axis Tilt

$$\omega i_3 := \text{if}\left[a_m < M_a, \omega(d) \cdot \left(\omega_{Mi} - t_r\right), \text{if}\left(q < S_t, \omega(d) \cdot \omega_{Mi} - t_r, 0\right)\right]$$

$\omega i_3 = 1.9399895 \times 10^{-4}$ **Jupiter's end result Influenced Rotation by the Europa (p.d.)**
(Negative number means the reduction amount from Jupiter's Free Rotation)

Part 4

Jupiter's Influenced Rotation
by the influence of the Ganymede

$if\left(q < S_t\right)$

Ganymede's Facts

$a_m := 1070400$ Ganymede Semi-major Axis (km)

$e_m := 0.0011$ Ganymede Orbit Eccentricity (degree)

$i_m := 0.17$ Ganymede Orbit Inclination (degree)

$t_m := 0.075$ Ganymede Axis Tilt (degree)

$m_m := 1.48 \cdot 10^{23}$ Ganymede Mass (kg)

$q := a_m \cdot \left(1 - e_m\right)$

$q = 1069222.6$ Ganymede's Perihelion Distance (km)

$Q := a_m \cdot \left(1 + e_m\right)$

$Q = 1071577.4$ Ganymede's Aphelion Distance (km)

$i_r := \left(\left|cos\left(\frac{t_m \cdot \pi}{180}\right)\right| + 1\right) \div 2$

$i_r = 0.99999957$ Ganymede's Orbit Inclination Reduction Factor

$\omega_{Mi} := \sqrt[6]{m_m \cdot i_r \div m} \div \sqrt[6]{\rho} \div i_M \div \sqrt{M \div m_m}$

$\omega_{Mi} = 0.000423193$ Jupiter's Maximum Influenced Rotation by the Ganymede (p.d.)

$S_t := \sqrt[6]{m_m \cdot i_r \div m} \div i_{St} \div \sqrt{M \div m_m}$

$S_t = 55700108$ Jupiter's Start Influenced Rotation Distance to the Ganymede (km)

$M_a := \sqrt[6]{m_m \cdot i_r \div m} \div i_{Ma} \div \sqrt{M \div m_m}$

$M_a = 98969.3$ Jupiter's Maximum Influenced Rotation Distance to the Ganymede (km)

$S_p := \sqrt[6]{m_m \cdot i_r \div m} \div i_{Sp} \div \sqrt{M \div m_m}$

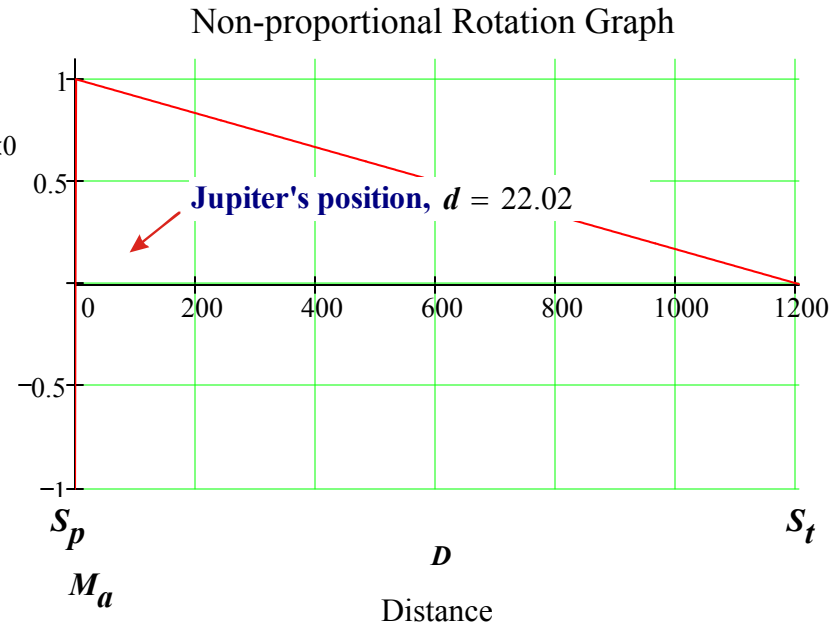
$S_p = 52754.3$ Jupiter's Stop Rotation Distance to the Ganymede (km)

$$d := \frac{a_m - S_p}{M_a - S_p}$$

$d = 22.01977794$ Jupiter's corresponding distance to the Ganymede relative to S_p on the X axis of the graph

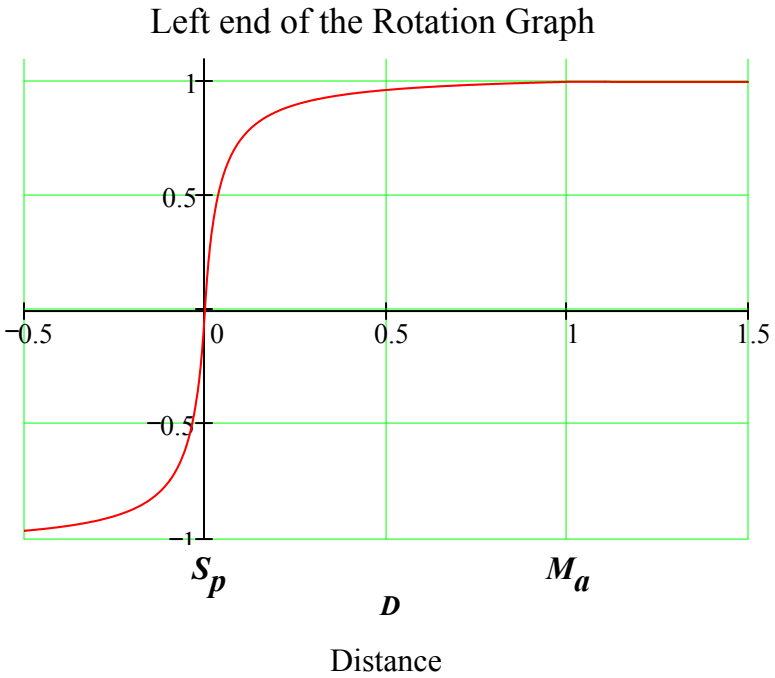
Rotation

$$\begin{cases} -1 - \dfrac{0.04}{D - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } D < 0 \\ \dfrac{-0.04}{D + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le D \le 1 \\ \dfrac{-D + 1}{\frac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < D \end{cases}$$



Rotation

$$\begin{cases} -1 - \dfrac{0.04}{D - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } D < 0 \\ \dfrac{-0.04}{D + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le D \le 1 \\ \dfrac{-D + 1}{\frac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < D \end{cases}$$



$$\omega(d) := \begin{cases} -1 \cdot \left(\frac{S_p}{M_a - S_p} \right) - \frac{0.04 \cdot \left(\frac{S_p}{M_a - S_p} \right)}{d - \left(\sqrt{0.29} - 0.5 \right)} - \left(\sqrt{0.29} - 0.5 \right) & \text{if } d < 0 \\ \frac{-0.04}{d + \left(\sqrt{0.29} - 0.5 \right)} + \left(0.5 + \sqrt{0.29} \right) & \text{if } 0 \le d \le 1 \\ \frac{-d + 1}{\frac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < d \end{cases}$$

$\omega(d) = 0.98252858$ Jupiter's corresponding Influenced Rotation by the Ganymede on the Y axis of the grap

$$t_r := if\left(a_m < M_a, if\left(\omega_{Mi} > \omega_F, \frac{i_m \cdot \omega_F}{90}, \frac{i_m \cdot \omega_{Mi}}{90} \right), if\left(\omega(d) \cdot \omega_{Mi} > \omega_F, \frac{i_m \cdot \omega_F}{90}, \frac{i_m \cdot \omega(d) \cdot \omega_{Mi}}{90} \right) \right)$$

$t_r = 7.8539852 \times 10^{-7}$ Jupiter's Maximum and Free Rotational Speed Reduction by Axis Tilt

$$\omega i_4 := if\left[a_m < M_a, \omega(d) \cdot \left(\omega_{Mi} - t_r \right), if\left(q < S_t, \omega(d) \cdot \omega_{Mi} - t_r, 0 \right) \right]$$

$\omega i_4 = 4.1501382 \times 10^{-4}$ **Jupiter's end result Influenced Rotation by the Ganymede (p.d.)**
(Negative number means the reduction amount from Jupiter's Free Rotation)

Part 5

Jupiter's Influenced Rotation
by the influence of the Callisto

$if\left(q < S_t\right)$

Callisto's Facts

$a_m := 1882700$ Callisto Semi-major Axis (km)

$e_m := 0.0074$ Callisto Orbit Eccentricity (degree)

$i_m := 0.187$ Callisto Orbit Inclination (degree)

$t_m := 0.348$ Callisto Axis Tilt (degree)

$m_m := 1.08 \cdot 10^{23}$ Callisto Mass (kg)

$q := a_m \cdot \left(1 - e_m\right)$

$q = 1868768$ Callisto's Perihelion Distance (km)

$Q := a_m \cdot \left(1 + e_m\right)$

$Q = 1896632$ Callisto's Aphelion Distance (km)

$$i_r := \left(\left|\cos\left(\frac{t_m \cdot \pi}{180}\right)\right| + 1\right) \div 2$$

$i_r = 0.99999078$ Callisto's Orbit Inclination Reduction Factor

$$\omega_{Mi} := \sqrt[6]{m_m \cdot i_r \div m} \div \sqrt[6]{\rho} \div i_M \div \sqrt{M \div m_m}$$

$\omega_{Mi} = 0.000343015$ Jupiter's Maximum Influenced Rotation by the Callisto (p.d.)

$$S_t := \sqrt[6]{m_m \cdot i_r \div m} \div i_{St} \div \sqrt{M \div m_m}$$

$S_t = 45147124.5$ Jupiter's Start Influenced Rotation Distance to the Callisto (km)

$$M_a := \sqrt[6]{m_m \cdot i_r \div m} \div i_{Ma} \div \sqrt{M \div m_m}$$

$M_a = 80218.5$ Jupiter's Maximum Influenced Rotation Distance to the Callisto (km)

$$S_p := \sqrt[6]{m_m \cdot i_r \div m} \div i_{Sp} \div \sqrt{M \div m_m}$$

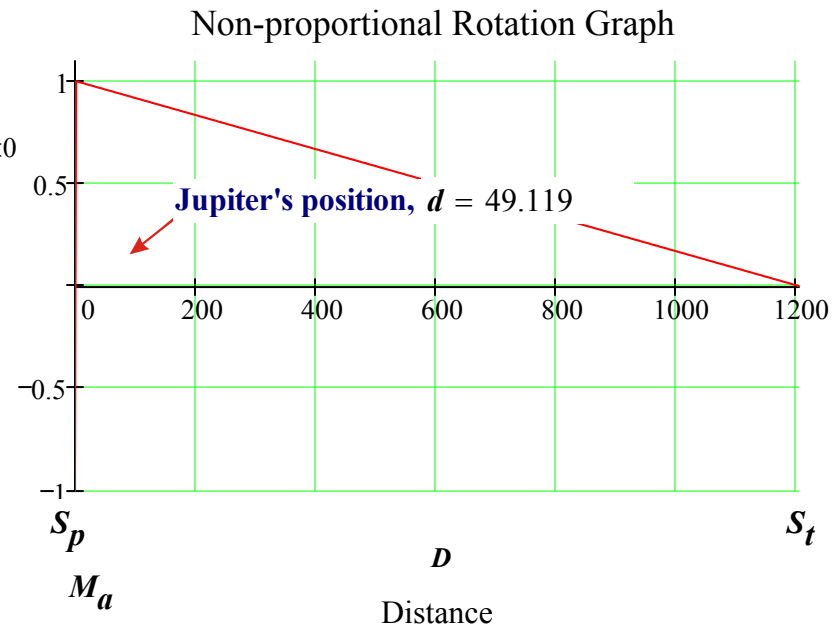
$S_p = 42759.4$ Jupiter's Stop Rotation Distance to the Callisto (km)

$$d := \frac{a_m - S_p}{M_a - S_p}$$

$d = 49.11860936$ Jupiter's corresponding distance to the Callisto relative to S_p on the X axis of the graph

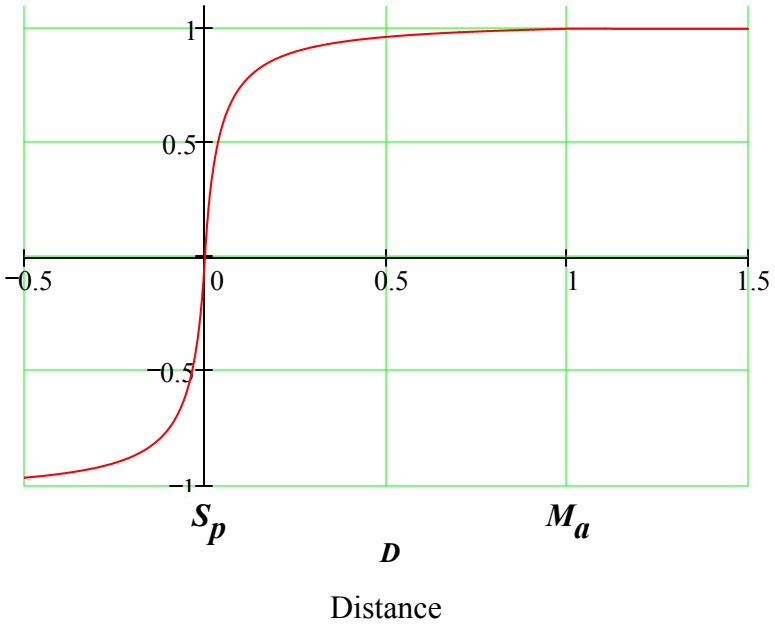
Rotation

$$\begin{cases} -1 - \dfrac{0.04}{D - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } D < 0 \\ \dfrac{-0.04}{D + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le D \le 1 \\ \dfrac{-D + 1}{\frac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < D \end{cases}$$



Rotation

$$\begin{cases} -1 - \dfrac{0.04}{D - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } D < 0 \\ \dfrac{-0.04}{D + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le D \le 1 \\ \dfrac{-D + 1}{\frac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < D \end{cases}$$



$$\omega(d) := \begin{cases} -1\cdot\left(\frac{S_p}{M_a - S_p}\right) - \frac{0.04\cdot\left(\frac{S_p}{M_a - S_p}\right)}{d - \left(\sqrt{0.29} - 0.5\right)} - \left(\sqrt{0.29} - 0.5\right) & \text{if } d < 0 \\ \frac{-0.04}{d + \left(\sqrt{0.29} - 0.5\right)} + \left(0.5 + \sqrt{0.29}\right) & \text{if } 0 \le d \le 1 \\ \frac{-d + 1}{\frac{S_t - M_a}{M_a - S_p}} + 1 & \text{if } 1 < d \end{cases}$$

$\omega(d) = 0.96000432$ Jupiter's corresponding Influenced Rotation by the Callisto on the Y axis of the graph

$$t_r := if\left(a_m < M_a, if\left(\omega_{Mi} > \omega_F, \frac{i_m\cdot\omega_F}{90}, \frac{i_m\cdot\omega_{Mi}}{90}\right), if\left(\omega(d)\cdot\omega_{Mi} > \omega_F, \frac{i_m\cdot\omega_F}{90}, \frac{i_m\cdot\omega(d)\cdot\omega_{Mi}}{90}\right)\right)$$

$t_r = 6.8420275\times10^{-7}$ Jupiter's Maximum and Free Rotational Speed Reduction by Axis Tilt

$$\omega i_5 := if\left[a_m < M_a, \omega(d)\cdot\left(\omega_{Mi} - t_r\right), if\left(q < S_t, \omega(d)\cdot\omega_{Mi} - t_r, 0\right)\right]$$

$\omega i_5 = 3.2861124\times10^{-4}$ **Jupiter's end result Influenced Rotation by the Callisto (p.d.)**
(Negative number means the reduction amount from Jupiter's Free Rotation)

Part 6

Jupiter's Total Rotation

$$\omega_S := \sum_{i=1}^{5} \omega i_i$$

$\omega_S = 2.4420975$ Jupiter's Total Rotation (p.d.)

$$T := if\left(\omega i_1 \le 0, 0, if\left(t \le 90, \frac{1}{\omega_S}, \frac{-1}{\omega_S}\right)\right)$$

$T = 0.40948$ **Jupiter's Sidereal Rotation Period (day)**
If (T = 0 , Jupiter's Synchronous Tropical Rotation)

Observation

$T_O := 0.41354$ **Jupiter's Sidereal Rotation Period (day)**
If (*T* = 0 , Jupiter's Synchronous Tropical Rotation)

$$\%Diff := \frac{(T - T_O)\cdot 200}{T + T_O}$$

$\%Diff = -0.9856$ Percentage deference between the calculation and the observation