

**Orbit radius and speed of the Sun
around the center of gravity of the Solar System**

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Abstract.

The start of the 22-year cycle begins with a well-established dipole field component aligned along the solar rotational axis. The field lines tend to be held by the highly conductive solar plasma of the solar surface.

The solar dipole field, through similar processes, reverses again at the end of the 22-year cycle.

The new solar cycle by definition begins with the sun in the middle latitudes (around 30 ° north latitude and 30 degrees south latitude - Spörer's law) arises first sunspots. These spots have opposite magnetic polarity than the spots above the solar cycle.

Around the center of gravity of the Solar System $v_{\text{Sun}} = 377,64404380671797815401286112528$ m/s

and $R_{\text{Sun orbit}} = 0,41727286425040580889702383164445e+11$ m = 0,27892571139733008616111218692781 AU.

Keywords: center of mass, angular momentum, solar cycle, orbit radius of the Sun around the center of gravity of the Solar System

Theory

According CONSEQUENCES 2 , points 15,16 and 17 p.63 [4] analogically we have:

Angular momentum simplified using the center of mass

It is very often convenient to consider the angular momentum of a collection of planets about their [center of mass](#), since this simplifies the mathematics considerably. The angular momentum of a collection of planets is the sum of the angular momentum of each planet:

$$\mathbf{L} = \sum_i \mathbf{R}_i \times m_i \mathbf{V}_i$$

where \mathbf{R}_i is the position vector of planet i from the reference point, m_i is its mass, and \mathbf{V}_i is its velocity. The center of mass is defined by:

$$R_{pl} = \sum R_{pi} * M_{pi} / \sum M_{pi}$$

$$11,391686777624717602881320381142e+11 = R_{pl} = \sum R_{pi} * M_{pi} / \sum M_{pi} = \sum R_{pi} * M_{pi} / 26,688295206e+26 \text{ kg}$$

$$\sum R_{pi} * M_{pi} = 11,391686777624717602881320381142e+11 * 26,688295206e+26 =$$

$$\sum R_{pi} * M_{pi} = 3,0402469961553533886808135451493e+39 \text{ kgm}$$

where the total mass of all planets is given by

$$M_p = \sum M_{pi}$$

It follows that the velocity of the center of mass of planet is

$$v_p = \frac{\sum v_{pi} * M_{pi}}{\sum M_{pi}}$$

	Average orbital speed v_{pi} [m/s]	M_{pi} [kg]	$v_{pi} * M_{pi}$ [kg m/s]
Mercury	47 360	0,0033022e+26	156,392192e+26
Venus	35 020	0,048685e+26	1704,9487e+26
Earth	29 783	0,06046e+26	1800,68018e+26
Mars	24 077	0,0064185e+26	154,5382245e+26
Asteroid belt	17994 approximately	0,00003e+26	
Trojans	13 050 Jupiter	0,000006046e+26	0,0789003e+26
Jupiter	13 050	18,986e+26	247767,3e+26
Saturn	9 639	5,6846e+26	54793,8594e+26
Uranus	6 795	0,86810e+26	5898,7395e+26
Neptune	5 432	1,0243e+26	5563,9976e+26
Ceres	17 882	0,0000093e+26	0,1663026e+26
Pluto	4 666	0,0001471e+26	0,6863686e+26

Makemake	4 419	0,00003e+26	0,13257e+26
Haumea	4 484	0,00004006e+26	0,17962904e+26
Eris	3 436	0,000167e+26	0,573812e+26
Kuiper belt	4703,71 m/s	0,006e+26	28,22226e+26
		$\Sigma M_{pi} = 26,688295206e+26$ kg	$\Sigma v_{pi} * M_{pi} = 317870,49563904e+26$

$$v_p = \Sigma v_{pi} * M_{pi} / \Sigma M_{pi} = 317870,49563904e+26 / 26,688295206e+26 = 11910,483348055034250058422409074 \text{ m/s}$$

$$M_{Sun} / \Sigma M_{pi} = 1,9891e+30 / 26,688295206e+26 = 745,30800287041758975962969944376 \dots\dots\dots (M_{Sun} / \Sigma M_{pi})^{0,5} = 27,300329720910287748693188231177$$

$$v_p / v_{Sun} = 27,300329720910287748693188231177$$

$$v_{Sun} = 11910,483348055034250058422409074 / 27,300329720910287748693188231177 = 436,27617211276294415162885873497 \text{ m/s}$$

Planet	Distance from Sun at perihelion [m]	Distance from Sun at aphelion [m]	$0,5(R_{pi\ min} + R_{pi\ max}) = R_{pi}$ [m]	M_{pi} [kg]	$R_{pi} * M_{pi}$ [kg m]
Mercury	4,6001009e+10	6,9817445e+10	5,7909227e+10	0,0033022e+26	1,912278493994e+34
Venus	1,07476170e+11	1,08942780e+11	1,08209475e+11	0,048685e+26	5,268178290375e+35
Earth	1,47098291e+11	1,52098233e+11	1,49598262e+11	0,06046e+26	9,04471092052e+35
Mars	2,06655215e+11	2,49232432e+11	2,279438235e+11	0,0064185e+26	1,46305743113475e+35
Asterod belt			4,1 e+11 odhad	0,00003e+26	1,23e+33
Trojans			7,78340821e+11	0,000006046e+26	4,705848603766e+32
Jupiter	7,40679835e+11	8,16001807e+11 m	7,78340821e+11	18,986e+26	1,4777578827506e+39

Saturn	1,349,823,615e+12	1,503509229e+12m	1,426666422e+12	5,6846e+26	8,1100279425012e+38
Uranus	2,734998229e+12	3,006318143e+12m	2,870658186e+12	0,86810e+26	2,4920183712666e+38
Neptune	4,459753056e+12	4,537039826e+12m	4,498396441e+12	1,0243e+26	4,6077074745163e+38
Ceres	0,380951528e+12	0,446428973e+12	0,4136902465e+12	0,0000093e+26	3,84731929245e+32
Pluto	4,436756954e+12	7,376124302e+12	5,906440628e+12	0,0001471e+26	8,688374163788e+34
Makemake	5,671928586e+12	7,894762625e+12	6,7833456055e+12	0,00003e+26	2,03500368165e+34
Haumea	5,157623774e+12	7,706399149e+12	6,4320114615e+12	0,00004006e+26	2,5766637914769e+34
Eris	5,765732799e+12	14,594512904e+12	10,1801228515e+12	0,000167e+26	1,7000805162005e+35
Kuiper belt			52,5e+11 m odhad	0,006e+26	3,15e+36
				$\Sigma M_{pi} =$ 26,688295206e+26 kg	$\Sigma R_{pl} * M_{pi} =$ =3,00378507281293173e+39 Correctly : $\Sigma R_{pl} * M_{pi} =$ =3,040246996155353388680 8135451493e+39
Another planets	?	?	?	? kg	3,6461923342421658680813 545149e+37

$$\Sigma M_{pi} = 26,688295206e+26 \text{ kg} \quad (v_{pl} * R_{pl}) / (v_{Sun} * R_{Sun \text{ orbit}}) = 745,30800287041758975962969944389 = M_{Sun} / \Sigma M_{pi}$$

M_{Sun}	v_{Sun}	R_{Sun}	$M_{Sun} * v_{Sun} * R_{Sun}$ [kg m ² /s]
1,9891e+30 kg	377,644043806717978154m/s	0,41727286425040580889702383164445e+11 m 0,27892571139733008616111218692781 AU	3,1344359498376282010196134814286e+43

$$v_{Sun} * R_{Sun \text{ orbit}} = 3,1344359498376282010196134814286e+43 / 1,9891e+30 = 1,5758061182633493544917869797537e+13$$

$$v_{\text{Sun}} * R_{\text{Sun orbit}} = 1,5758061182633493544917869797537e+13$$

$$(v_{\text{pl}} * R_{\text{pl}}) / (v_{\text{Sun}} * R_{\text{Sun orbit}}) = 11,744609109138419806115260194893e+15 / 1,5758061182633493544917869797537e+13 =$$

$$(v_{\text{pl}} * R_{\text{pl}}) / (v_{\text{Sun}} * R_{\text{Sun orbit}}) = 745,30800287041758975962969944389 = M_{\text{Sun}} / \Sigma M_{\text{pi}}$$

$$M_{\text{Sun}} / \Sigma M_{\text{pi}} = 1,9891e+30 / 26,688295206e+26 = 745,30800287041758975962969944376$$

$$\Sigma R_{\text{pi min}} * v_{\text{pi max}} * M_{\text{pi}} / \Sigma M_{\text{pi}} = 3,1344359498376282010196134814286e+43 / 26,688295206e+26 \text{ kg} = v_{\text{pl}} * R_{\text{pl}}$$

$$v_{\text{pl}} * R_{\text{pl}} = 11,744609109138419806115260194893e+15$$

Approximately is valid generalized law of inertia [4] p.14:

$$2 * \pi * R_{\text{Sun}} = 262180272974,28919108564838351392 \text{ m}$$

$$262180272974,28919108564838351392 \text{ m} / (377,644043806717978154 \text{ m/s}) = 694252371,44340000000002364360457 \text{ s} = 22,0000000000000000000000749236621 = \mathbf{22 \text{ Tropical years 1900}}$$

$$\Sigma R_{\text{pi min}} * v_{\text{pi max}} * M_{\text{pi}} = \mathbf{L} = M_{\text{Sun}} * v_{\text{Sun}} * R_{\text{Sun}} \quad \mathbf{\text{Tropical year 1900 in seconds} = 3,15569259747e+7s}$$

For 22 Tropical years 1900 = 69,42523714434e+7 s :

Calculation average $R_{\text{Sun orbit}}$:

$$v_{\text{Sun}} * R_{\text{Sun orbit}} = \Sigma R_{\text{pi min}} * v_{\text{pi max}} * M_{\text{pi}} / M_{\text{Sun}} = 3,1344359498376282010196134814367e+43 / 1,9891e+30 = 1,5758061182633493544917869797577e+13$$

$$6,283185307179586476925286766559 * R_{\text{Sun orbit}} / 69,42523714434e+7 \text{ s} = v_{\text{Sun}}$$

$$v_{\text{Sun}} * R_{\text{Sun orbit}} = \Sigma R_{\text{pi min}} * v_{\text{pi max}} * M_{\text{pi}} / M_{\text{Sun}} = 1,5758061182633493544917869797577e+13 \text{ m}^2/\text{s}$$

$$R_{\text{Sun orbit}} / v_{\text{Sun}} = 69,42523714434e+7 \text{ s} / 6,283185307179586476925286766559 = 1,1049369666848770950833505262469e+8 \text{ s}$$

$$v_{\text{Sun}} * R_{\text{Sun orbit}} = 1,5758061182633493544917869797577e+13 \text{ m}^2/\text{s}$$

$$R_{\text{Sun orbit}} / v_{\text{Sun}} = 1,1049369666848770950833505262469e+8 \text{ s}$$

$$(R_{\text{Sun orbit}})^2 = 1,5758061182633493544917869797577e+13 \text{ m}^2/\text{s} * 1,1049369666848770950833505262469e+8 \text{ s} =$$

$$(R_{\text{Sun orbit}})^2 = 1,7411664323973759414409869974244e+21 \text{ m}^2$$

$$R_{\text{Sun orbit}} = 0,41727286425040580889702383164445e+11 \text{ m}$$

$$R_{\text{Sun orbit}} = 0,27892571139733008616111218692781 \text{ AU}$$

Calculation average speed of Sun about center of mass Solar system is constant $v_{\text{Sun}} = 377,64404380671797815401286112528 \text{ m/s}$:

$$6,283185307179586476925286766559 * R_{\text{Sun orbit}} / 69,42523714434e+7 \text{ s} = v_{\text{Sun}}$$

$$6,283185307179586476925286766559 * 0,41727286425040580889702383164445e+11 \text{ m} / 69,42523714434e+7 \text{ s} =$$

$$= 377,64404380671797815401286112528 \text{ m/s} = v_{\text{Sun}}$$

ΣM_{pi} [kg]	v_{pl} [m/s]	R_{pl} [m]	$\Sigma R_{pi \min} * v_{pi \max} * M_{pi} = L =$ The angular momentum of a collection of planets [kg m ² /s]
26,688295206e+26 kg	10309,80691306128950110051711218 m/s	11,391686777624717602881320381142e+11	3,1344359498376282010196134814288e+43

$$\Sigma R_{pi \min} * v_{pi \max} * M_{pi} / \Sigma M_{pi} = 3,1344359498376282010196134814286e+43 / 26,688295206e+26 \text{ kg} = v_{pl} * R_{pl}$$

$$v_{pl} * R_{pl} = 11,744609109138419806115260194893e+15$$

Examination:

$$10309,806913061289501100517112182 * 11,391686777624717602881320381142e+11 = 11,744609109138419806115260194894e+15$$

$$v_{pl} * R_{pl} = 11,744609109138419806115260194894e+15$$

List of solar cycles

Cycle	Started	Finished
Solar cycle 1	1755 March	1766 June
Solar cycle 2	1766 June	1775 June
Solar cycle 3	1775 June	1784 September
Solar cycle 4	1784 September	1798 May
Solar cycle 5	1798 May	1810 December
Solar cycle 6	1810 December	1823 May
Solar cycle 7	1823 May	1833 November
Solar cycle 8	1833 November	1843 July
Solar cycle 9	1843 July	1855 December
Solar cycle 10	1855 December	1867 March

Solar cycle 11	1867 March	1878 December
Solar cycle 12	1878 December	1890 March
Solar cycle 13	1890 March	1902 February
Solar cycle 14	1902 February	1913 August
Solar cycle 15	1913 August	1923 August
Solar cycle 16	1923 August	1933 September
Solar cycle 17	1933 September	1944 February
Solar cycle 18	1944 February	1954 April
Solar cycle 19	1954 April	1964 October
Solar cycle 20	1964 October	1976 June
Solar cycle 21	1976 June	1986 September
Solar cycle 22	1986 September	1996 May
Solar cycle 23	1996 May	2008 December
Solar cycle 24	2008 December	

2008-1755= 253 253/23 = 11 11*2 = 22 Yrs , see you too [1].

The new solar cycle by definition begins with the sun in the middle latitudes (around 30 ° north latitude and 30 degrees south latitude - **Spörer's law**) arises first sunspots. These spots have opposite magnetic polarity than the spots above the solar cycle, see you [2].

References

[1] Babcock, H. W. (1961). «The Topology of the Sun's Magnetic Field and the 22-Year Cycle». *Astrophys. J.* **133** (2): 572–587.

[2] [Official list of solar cycles](#)

ftp://ftp.ngdc.noaa.gov/STP/SOLAR_DATA/SUNSPOT_NUMBERS/docs/maxmin.new

[3] Usoskin, I. G.; Mursula, K.; Arlt, R.; Kovaltsov, G. A. (2009). "A Solar Cycle Lost in 1793-1800: Early Sunspot Observations Resolve the Old Mystery". *The Astrophysical Journal* **700** (2): L154.

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