

1           **Research of formulas for calculating distances between the sun and planet**  
2           (Short Titles: Formula for the distance between the sun and the planet)  
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18           **Abstract**

19           The purpose of the research was to analyze the distance between the sun and the planet and investigate  
20           what kind of rules exist.

21           The distance of a planet from the sun has been found to be related to the size of the circumference of  
22           the sun's surface.

23           In the sun, current flows due to the temperature difference, and this current generates a magnetic field,  
24           and this magnetic field generates a magnetic force.

25           This magnetic force rotates the sun and orbits the planets in the solar system.

26           The magnetic force of the sun is related to the size of the circumference of the sun.

27           As a result of this research, a formula was created to calculate the distance of the planet from the sun  
28           by calculating the solar magnetic force wave size and the solar magnetic force wave frequency.

29           than previously announced distances between the sun and the planets, the result calculated by the  
30           formula is judged to be more accurate.

31           Using this formula, it is expected that the expected position of a new object in the solar system can be  
32           scheduled.

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34           Keywords: Titius-Bode Law, Solar magnetic force, Planet distance  
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40     **1. Introduction**

41     An electric current flow due to the temperature difference of the sun, and this electric current forms a  
42     magnetic field, and this magnetic field generates a magnetic force (Fleming's left-hand rule) [1].

43     This magnetic force rotates the sun.

44     And make it orbit the planets and dwarf planets of the solar system.

45     This magnetic force propagates around the sun in the form of magnetic force waves.

46     This magnetic force wave frequency propagates in the form of a sinusoidal wave from the sun.

47     This magnetic force propagates at the same speed as electromagnetic waves.

48     As a result of the research, the magnetic force of the sun is related to the size of the circumference of  
49     the sun's surface,

50     The distance between the sun and the planet is n.25 (or n.75) times this magnetic force.

51     In the case of Earth, it orbits around the sun at a position of 34.25 times the solar magnetic force.

52     In the case of Earth, it orbits around the sun at a position (149,597,888 km) 34.25 times the solar  
53     magnetic force (Table2).

54     In the case of Mercury, it orbits around the sun at a position (57,873,636 km) at 13.25 times the solar  
55     magnetic force.

56     In the case of Mars, it orbits the sun at a position of 52.25 times the solar magnetic field (228,218,676  
57     km).

58     In the case of Jupiter, it orbits around the sun at a position (778,564,191 km) 178.25 times the solar  
59     magnetic force.

60     In the case of Saturn, it orbits around the sun at a position (1,433,737,423 km) 328.25 times the solar  
61     magnetic force.

62     In the case of Uranus, it orbits around the sun at a position (2,870,750,711 km) 657.25 times the solar  
63     magnetic force.

64     Neptune orbits the sun at 1,030.25 times the solar magnetic field (4,499,948,148 km).

65     In the case of Venus, it orbits around the sun at a position (108,103,583 km) at 24.75 times the solar  
66     magnetic force.

67

68     **2. Titius-Bode law analysis**

69     In the Titius-Bode law, if the earth is the first planet and the average distance is expressed as 1 AU,  
70     the average distance a of the nth planet can be expressed by the following formula.

71      $a=0.4 + 0.3 \times 2^n$

72     If you organize this formula and analyze the deviation, it is as shown in Table1 "Deviation of Titius-  
73     Bode's Law".

74     The Titius-Bode law predicts planets will be present at specific distances in astronomical units [2].

75 This means that the distance of a planet from the sun is related to a multiple of some number of suns.

76 As shown in Table 1, Titius-Bode's law shows a large error for planets far from the sun.

77

78

**Table1 Deviations from Titius-Bode's law,**

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Sequence	0	1	2	4	16	32	64	64
3 times	0	3	6	12	48	96	192	192
+4	4	7	10	16	52	100	196	196
Distance Bode's Law	4	7	10	15	52	96	192	192
T-B rule distance (AU)	0.4	0.7	1.0	1.6	5.2	10.0	19.6	38.8
Distance (AU) (Computed)	0.39	0.72	1.00	1.52	5.2	9.55	19.22	30.11
Bode's Deviation (AU)	-0.1	+0.02	0	-0.08	-0.00	-0.45	-0.38	-8.69
Bode's Deviation(km)	15,000,000	+3,000,000	0	12,000,000	0	67,500,000	57,000,000	1,303,500,000
Research deviation(km)	+35,541	-103,583	0	-218,675	-16,991	-262,576	+221,510	+51,850

79

### 80 **3. Develop formulas for distances between the sun and the planets**

81 An electric current flow due to the temperature difference of the sun, and this electric current forms a  
82 magnetic field and generates a magnetic force (Fleming's left-hand rule).

83 This magnetic force causes the sun to rotate and the planets and dwarf planets to orbit around it.

84 The distance between the sun and the planet is related to the frequency of the solar magnetic force  
85 wave.

86 The circumference of the sun (based on the equator) is 4,379,000 km, but the wavelength of the solar  
87 magnetic force was 4.367,821.547 km as a result of calculations in this research.

88 What this means is that the distance of a planet from the sun is related to the size of the sun's  
89 circumference.

90 The wavelength of the solar magnetic force is calculated as:

91 Since the sun's equatorial circumference is 4.379,000 km [3], the solar magnetic field wavelength is  
92 Calculated as 4.379,000 km,

93 In the case of the Earth, since the distance between the Sun and the Earth is 149,597,888 km,  
94  $149,597,888 \text{ km} \div 4.379,000 \text{ km} \div 34.16$

95 This is the magnetic force wave frequency  $34.16\text{Hz}=34\text{Hz} + 0.16\text{Hz}$

96 That is, the earth is at a position of 34.16 Hz from the sun.  
97 However, since the +maximum of the wavelength is 1/4Hz (-maximum is 3/4Hz),  
98 It can be inferred that the Earth is at a position of 34.25 Hz from the Sun.  
99 So, recalculating at 34.25Hz is 149,597,888km.  
100  $(SP) \div 34.25 = 4,367,821.54744 \div 4,367,821.547 \text{ km (Rm)}$ .  
101 Calculated by the distance between the sun and the planet (SP),  $SP = 4,367,821.547 \text{ km (Rm)} \times 34.25 =$   
102  $149,597,887.984$   
103  $\div 149,597,888 \text{ km}$   
104  $SP = \{4,367,821.547 \text{ km (Rm)} \times 34\} + (4,367,821.547 \times 0.25) = 148,505,932.598 + 1,091,955.38675$   
105  $= 149,597,887.984 \div 149,597,888 \text{ km}$

106 Figure 1 shows the “Sun's magnetic force wavelength”.

107 The Sun's gravitational-wave source changes between strong and weak in the shape of a sinusoidal  
108 wave depending on the distance from the Sun, with planets Mercury, Venus, Earth, and Mars revolving  
109 at the “strong” point where the gravitational-wave source has the same force as the universal  
110 gravitation with a direction (revolving) difference of 90°, which causes the Earth to revolve around the  
111 Sun [4].

112 "Sun's gravitational-wave source" is magnetic force.

113 The current in the celestial body creates a magnetic field and rotates the celestial body [5].

114 Figure 1 is the basic theory of these principles.

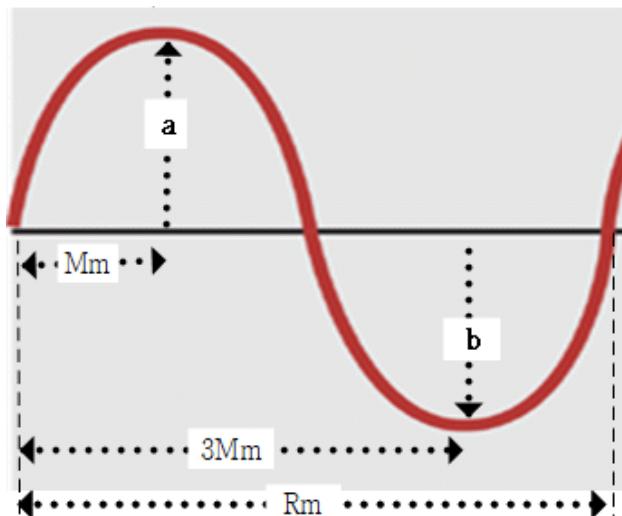
115 The distance of the planet (dwarf planet) from the sun  $SP = (\text{solar magnetic force wavelength} \times$   
116  $\text{magnetic wave frequency}) + \text{solar magnetic force wavelength}/4$  or  $SP = (\text{solar magnetic force}$   
117  $\text{wavelength} \times \text{magnetic wave frequency}) + \text{solar magnetic force wavelength} \times 3/4$ .

118 Expressed as a formula:  $SP = (Rm \times n) + (Rm \times 1/4)$ , or  $SP' = (Rm \times n) + (Rm \times 3/4)$ .

119  $SP$ : distance of the planet (dwarf planet) from the sun,  $SP'$ : “-“ maximum (3Mm)

120  $Rm$ : solar magnetic force wavelength,  $n$ : magnetic force wave frequency (Hz)

121



122

a: Magnetic force wavelength + Maximum value.  
 $(Rm \times n) + Rm/4$  Wavelengths}: Mercury, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Ceres, Eris, Haumei.  
 b: Magnetic force wavelength - Maximum value.  
 $\{(Rm \times n) + Rm3/4$  Wavelengths}: Venus, Pluto, Makemake  
 Mm: Wavelength of "+" maximum magnetic force  
 3Mm: Wavelength of "-" maximum magnetic force  
 Rm: Sun's magnetic force wavelength (1Hz)

123

### Figure1 Sun's magnetic force wavelength

125 As shown in Figure 1 Sun's magnetic force wavelength, the planet's position is at the "a" or "b"  
 126 wavelength position, and the planet orbits the sun.

127 In other words, as shown in Figure 1, the solar magnetic force decreases through the "+" maximum  
 128 point (a) in a sinusoidal waveform curve, goes to the "-" maximum point (b), and propagates while  
 129 repeating this pattern.

130 The planets orbit the sun at either the "+" maximum (a) or the "-" maximum (b).

131

### Table2. The distance from the sun to the planet by the distance formula.

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
SP (km) (Distance)	57,909,176	108,000,000	149,597,888	228,000,000	778,547,200	1,434,000,000	2,870,972,220	4,500,000,000
Formula $(Rm \times n) + (Rm/4)$ $=4,367,821.547n$ $+1,091,955.4$	$(Rm \times 13)$ $+Mm =$ 57,873,636		$(Rm \times 34)$ $+Mm =$ 149,597,888	$(Rm \times 52)$ $+Mm =$ 228,218,676	$(Rm \times 178)$ $+Mm =$ 778,564,191	$(Rm \times 328)$ $+Mm =$ 1,433,737,423	$(Rm \times 657)$ $+Mm =$ 2,870,750,712	$(Rm \times 1030)$ $+Mm =$ 4,499,948,149
Formula $(Rm \times n) + (Rm3/4)$ $=4,367,821.547n$ $+3,275,866.2$		$(Rm \times 24)$ $+3Mm =$ 108,103,583						
Mm (Rm 1/4) $-1,091,955.4$	56,817,221		148,505,933	226,908,045	777,455,245	1,432,908,045	2,869,880,265	4,498,908,045
3Mm (Rm 3/4) $-3,275,866.16$		104,724,134						
n=Rm/Mm, Rm: 4,367,821.547	13.008137 (13)		34.00 (34)	51.949935 (52)	177.99611 (178)	328.060116 (328)	657.050714 (657)	1030.011871 (1030)
n=Rm/3Mm Rm: 4,367,821.547		23.976285 (24)						
Deviation (%)	+0.008137	-0.023715	0	-0.050065	-0.00389	-0.060116	+0.050714	+0.011871
Deviation (km)	+35,541	-103,583	0	-218,675	-16,991	-262,576	+221,510	+51,850

### Formula: Formula for the distance between the sun and the planet (dwarf planet)

SP: distance of the planet (dwarf planet) from the sun,

Rm: solar magnetic force wavelength, n: magnetic force wave frequency (Hz)

133 Therefore, the result of calculating the distance between the sun and the planet is shown in Table 2.  
 134 Table 3 shows the result of calculating the distance between the sun and the dwarf planet.

135

136 **Table3. The distance from the sun to the Dwarf planet by the distance formula.**

Dwarf planet	Pluto	Ceres	Eris	Makemake	Haumea
SP (km) (Distance)	5,913,000,000	180,000,000	15,000,000,000	780,000,000,000	6,482,700,000
(Formula) $(Rm \times n) + (Rm/4)$ $= 4,367,821.547n$ $+ 1,091,955.4$		$(Rm \times 41)$ $+ Mm =$ <b>180,172,639</b>	$(Rm \times 3434)$ $+ Mm =$ <b>15,000,191,148</b>		$(Rm \times 1484)$ $+ Mm =$ <b>6,482,939,131</b>
(Formula) $(Rm \times n) + (Rm3/4)$ $= 4,367,821.547n$ $+ 3,275,866.2$	$(Rm \times 1353)$ $+ 3Mm =$ <b>5,912,938,419</b>			$(Rm \times 178,578)$ $+ 3Mm =$ <b>780,000,112,086</b>	
Mm (Rm 1/4) -1,091,955.4		178,908,045	14,998,908,045		6,481,608,045
3Mm (Rm 3/4) -3,275,866.16	5,909,724,134			779,996,724,134	
n=Rm/Mm, Rm: 4,367,821.547		40.960475 (41)	3433.956237 (3434)		1,483.945252 (1484)
n=Rm/3Mm Rm: 4,367,821.547	1353.014099 (1353)			178,577.974338 (178,578)	
Deviation (%)	+0.014099	-0.039525	-0.043763	-0.025662	-0.054748
Deviation (km)	+61,582	-172,638	-191,149	-112,087	-239,129

**Formula: Formula for the distance between the sun and the planet (dwarf planet)**

SP: distance of the planet (dwarf planet) from the sun,  
 Rm: solar magnetic force wavelength, n: magnetic force wave frequency (Hz)

137

138 For Earth, Formula is  $(Rm \times n) + (Rm/4)$  Because of,

139 The distance between the Sun and the Earth (SE) is  $SE = (4,367,821.547 \times 34) + (4367,821.547/4)$   
 140  $= 148,505,932.598 + 1,091,955.4 = 149,597,887.998 \div 149,597,888.$

141 For Mercury, Formula is  $(Rm \times n) + (Rm/4)$  Because of,

142 The distance between the Sun and the Mercury (SM) is  $SM = (4,367,821.547 \times 13) + (4367,821.547/4)$   
 143  $= 56,781,680.111 + 1,091,955.4 = 57,873,635.511 \div 57,873,636$

144 For Venus, Formula is  $(Rm \times n) + (Rm3/4)$  Because of,

145 The distance between the Sun and the Venus (SV) is  $SV = (4,367,821.547 \times 24) + (4367,821.547 \times$   
 146  $3/4) = 104,827,717.128 + 3,275,866.16 = 108,103,583.288 \div 108,103,583,288$

147

148 **4. Comparison of Titius-Bode's law and this research's deviation.**

149 A comparison of Titius-Bode's law known in the present method and the deviation of this research is  
 150 shown in Table 4.

152 **Table4. Comparison of Titius-Bode's law and this research's deviation (Planet)**

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
T-B rule distance (AU)	0.4	0.7	1.0	1.6	5.2	10.0	19.6	38.8
Distance (AU) (Computed)	0.39	0.72	1.00	1.52	5.186	9.55	19.22	30.11
Bode's Deviation (AU)	-0.1	+0.02	0	-0.08	-0.014	-0.45	-0.38	-8.69
Bode's Deviation(km)	15,000,000	+3,000,000	0	-12,000,000	-2,100,000	-67,500,000	-57,000,000	-1,303,500,000
Research deviation(km)	+35,541	-103,583	0	-218,675	-16,991	-262,576	+221,510	+51,850
Research Sm (n)	13.008137 (13)	23.976285 (24)	34.00 (34)	51.949935 (52)	177.99611 (178)	328.060116 (328)	657.050714 (657)	1030.011871 (1030)
Research deviation (%)	+0.008137	-0.023715	0	-0.050065	-0.00389	-0.060116	+0.050714	+0.011871

153  
154 **Table5. Comparison of Titius-Bode's law and this research's deviation (Dwarf planet)**

Dwarf planet	Pluto	Ceres	Eris	Makemake	Haumea
T-B rule distance (AU)	38.8	2.8	77.2	38.8	38.8
Distance (AU) (Computed)	39.54	2.77	67.78	45.71	43.22
Bode's Deviation (AU)	+0.74	-0.03	-9.42	+6.91	+4.42
Bode's Deviation(km)	+111,000,000	-4,500,000	-1,413,000,000	+1,036,500,000	+663,000,000
Research deviation(km)	+61,582	-172,638	-191,149	-112,087	-239,129
Research Sm (n)	1353.014099(1353)	40.960475(41)	3433.956237(3434)	178,577.974338(178,578)	1,483.945252(1484)
Research deviation (%)	+0.014099	-0.039525	-0.043763	-0.025662	-0.054748

155  
156 **5. Discussion**

157 The position of a planet in the solar system is related to the magnitude of the solar magnetic wave and  
 158 the frequency of the magnetic force.

159 Judging from the results of this Research, since the distance of the planet by the formula is very  
 160 accurate, it is expected that the exact distance of celestial bodies such as planets in the solar system  
 161 can be measured.

162 The sun-to-planet distance formula predicts where new objects will be discovered.

163 In other words, there is a high probability of discovering a new solar system object  $\{(R_m \times n) + (R_m / 4)\}$

164 or  $\{(Rm \times n) + (Rm \times 3/4)\}$  away from the sun.

165 The formula  $\{(Rm \times n) + (Rm/4)\}$  or  $\{(Rm \times n) + (Rm \times 3/4)\}$  is expected to be applied to the distance  
166 between the black hole and the galaxy, as well as the distance between the central black hole and the  
167 galaxy expected to apply.

168  
169 **Data Availability:** Data supporting the findings of this manuscript are available from the  
170 corresponding author upon reasonable request.

171 Further documentation about data processing is available at  
172 “Research of distances between the sun and planets” <https://github.com/>

173  
174 **Code Availability:** Custom codes that support the findings of this study are available at a dedicated  
175 “Journal of Robotics and Automation Research” (<https://github.com/>)

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183 The cost will be paid by the author himself.

184  
185 **Author Contribution:** The author (Dongil Song) confirms sole responsibility for the following: study  
186 conception and design, data collection, analysis and interpretation of results, and manuscript  
187 preparation.

188  
189 **References**

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203 ===== Supplementary material =====

204

205 **Table6. Distance by calculation of the position of the planets in the solar system**

206 (Calculated with the magnetic wavelength of 4,379,358 km)

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
SP(km) (Distance)	58,000,000	108,000,000	150,000,000	228,000,000	777,920,000	1,430,180,000	2,869,330,000	4,507,450,000
(Formula) (Rm×n)+(Rm/4) 4,379,358n +1,094,840	58,026,494 (13 times+Mm)	106,199,432 (24 times+Mm)	149,993,012 (34 times+Mm)	228,821,456 (52 times+Mm)	776,241,206 (177 times+Mm)	1,428,765,548 (326 times+Mm)	2,869,574,330 (655 times+Mm)	4,507,454,222 (1029 times+Mm)
Mm (Rm 1/4) -1,094,840	56,905,160		148,905,160	226,905,160	776,825,160	1,429,085,160	2,868,235,160	4,506,355,160
3Mm (Rm 3/4) -3,284,519		104,715,481						
Rm (n) 4,379,358	12.99 times(13)	23.9111(24)	34.00 times(34)	51.81 times(52)	177.38(177)	326.32(326)	654.94 times(655)	1028.99(1029)
Deviation (%)	-0.01	-0.0889	0	-0.19	+0.38	+0.32	-0.06	-0.01
Deviation (km)	-43,794	-389,325	0	-832,078	+1,664,156	+1,401,395	-262,761	-43,794

207

208 **Table7. Distance by solar system dwarf planet position calculation formula**

209 (Calculated with the magnetic wavelength of 4,379,358 km)

Dwarf planet	Pluto	Ceres	Eris	Makemake	Haumea
SP (km) (Distance)	5,913,000,000	180,000,000	15,000,000,000	780,000,000,000	6,482,700,000
(Formula) (Rm×n) + (Rm/4) 4,379,358n +1,094,840	5,913,228,140 (1350 times+Mm)	180,648,518 (41 times+Mm)	15,000,395,990 (3425 times+Mm)	779,999,789,504 (178,108 times+Mm)	6,482,544,680 (1,480 times+Mm)
Mm (Rm 1/4) -1,094,840	5,911,905,160	178,905,160	15,998,905,160	779,998,905,160	6,481,605,160
3Mm (Rm 3/4) -3,284,519					
Rm (n) 4,379,358	1349.95 times (1350)	40.85 times (41)	3424.9 times (3425)	178,108.05 times (178,108)	1,480.035 times (1480)
Deviation (%)	-0.05	-0.15	-0.1	+0.05	+0.035
Deviation (km)	-68,978	-656,904	-437,936	+218,968	+153,278

210

211

212 **Table8. Distance by calculation of the position of the planets in the solar system**213 **(Calculate 4,379,000 km around the sun as the value of the magnetic force wavelength)**

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
SP (km) (Distance)	57,909,176	108,000,000 [108,208,926]	149,597,888	228,000,000	778,547,200	1,434,000,000	2,870,972,220	4,500,000,000
Mm (Rm 1/4) -1,094,750	56,814,426		148,503,138	226,905,250		1,432,905,250		
3Mm (Rm 3/4) -3,284,250		104,715,750			775,262,950		2,867,687,970	[4,496,715,750]
Rm (n) 4,379,000km	12.97 (13)	23.91 (24)	33.91 (34)	51.82 (52)	177.04 (177)	327.22 (327)	654.87 (655)	1026.88 (1027)
Deviation (%)	-0.03	-0.09	-0.09	-0.18	+0.04	+0.22	-0.13	-0.12
Deviation(km)	-131,370	-394,110	-394,110	-788,220	+175,160	+963,380	-569,270	-525,480

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215 **Table9. Deviation Comparison (Planet)**

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Research deviation (%) 4,367,821.547	+0.008137	-0.023715	0	-0.050065	-0.00389	-0.060116	+0.050714	+0.011871
Deviation (%) 4,379,358	-0.01	-0.0889	0	-0.19	+0.38	+0.32	-0.06	-0.01
Deviation (%) 4,379,000km	-0.03	-0.09	-0.09	-0.18	+0.04	+0.22	-0.13	-0.12

216

217 **Table10. Deviation Comparison (Dwarf Planet)**

Dwarf planet	Pluto	Ceres	Eris	Makemake	Haumea
Research deviation (%) 4,367,821.547	-0.00004	-0.00366	-0.00003	+0.0000003	+0.00002
Deviation (%) 4,379,358	-0.01	-0.0889	0	-0.19	+0.38
Deviation (%) 4,379,000	+0.058	0.1447	0.0608	0.109	0.156

218

219