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The Secular Increase Of Astronomical Unit Due To The Loss Of The Solar Mass

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Abstract: *According To Our Published Articles[1][2], This Article Further Derives The Relationships Between The Inward / Outward Speed, The Central Mass, The Raduis And The Cross-Radial Velocity Of A Gravitationally Bound Point And Uses Real Data[3][4]To Verify The Equations With Error Less Than 2.2%. Besides, Using Our Method Of Raw Data Processing, We Find That Our Processed Data Is Consistent With G.A.Krasinsky's Conclusion Of 15(Cm/Year) For The Secular Increase Of Astronomical Unit [3]And Successfully Extracted Real Data From NASA Recently Published Raw Data[4]. Now, Using Our Equations, We Can Accurately Calculate / Theoretically Prove The Secular Increase Of Astronomical Unit Is Due To The Loss Of The Solar Mass To Answer The Questions That Can Not Be Answered By Known Theories[5].*
Keywords*: Gravity, Gravitational Field, Solar System, Universe, Inward / Outward / Speed, Astronomical Unit, Expansion.*

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I. Introduction

According To Our Published Articles[1][2], In This Article, We Do The Followings ;
1.Deriving Equation (4), The Relationship Between The Inward / Outward Speed, The Central Mass And The Raduis Of A Gravitationally Bound Point.
2.Deriving Equation (5), The Relationship Between The Inward / Outward Speed, The Raduis And The Cross-Radial Velocity Of A Gravitationally Bound Point.
3.Using Our Method Of Raw Data Processing To Extract Real Data From The Raw Data In **G.A.Krasinsky**'s Table 2[3].
4.Comparing The Extracted Real Data With **G.A.Krasinsky**'s Conclusion Of 15(Cm/Year) For The Secular Increase Of Astronomical Unit [3] To Confirm Our Method Of Raw Data Processing Is Credible.
5.Using The Proven Method Of Raw Data Processing To Extract Real Data From **NASA**'s Raw Data In FIG.2[4], To Eliminate Noise.
6.Using The Extracted Credible Data From **NASA**'s Raw Data FIG.2[4] And **G.A.Krasinsky**'s Conclusion Of 15(Cm/Year)[3] To Verify Equations (4) And (5) By Calculating A New Universal Constant Jp.
7.Using Equations (4) And (5) To Create **Table.1** To Demonstrate The Outward Speeds Of The 8 Planets In Our Solar System And To Compare The Calculation Results To Further Confirm Equations (4) And (5).

II. Derivation

Derivations Are Based On The Following Equations;

$$\frac{M_1}{M_0}=\frac{R_0}{R_1}=\frac{V_1}{V_0} \qquad (1)$$

Where, M_0 Is The Previous Central Mass, M_1 Is The Present Central Mass. R_0 Is The Previous Distance From The Orbiting Point P To The Centre, R_1 Is The Present Distance From The Orbiting Point P To The Centre. V_0 And V_1 Are Cross-Radial Velocities With Distances Of R_0 And R_1 To The Centre Respectively.

Equation (1)[1] Represents The Property Of A Gravitationally Bound Point P In Different Places (R_0, R_1), With Different Cross-Radial Velocities (V_0, V_1), Under Different Central Masses (M_0, M_1).

$$V_{i/o}1=\left[\frac{R_0}{R_1}\right]^3 V_{i/o}0 \qquad (2)$$

Where, Vi/o0 Is The Previous Inward / Outward Speed Of Gravitationally Bound Point P, Vi/o1 Is The Present Inward / Outward Speed Of Gravitationally Bound Point P. R_0 Is The Previous Distance From The Orbiting Point P To The Centre, R_1 Is The Present Distance From The Orbiting Point P To The Centre.

Equation (2)[2] Represents Property Of A Gravitationally Bound Point P In Different Places (R_0, R_1), With Different Inward / Outward Speed (Vi/o0, Vi/o1), Under Different Central Masses (M_0, M_1).

$$M = kRV^2 \qquad (3)$$

Where, M Is The Central Mass, K Is A Universal Constant (K = 2.50863E-06), V isThe Cross-Radial Velocity Of Point P With Distance Of R to The Centre.

Equation (3)[1] Represents Property Of A Gravitationally Bound Point P With The Cross-Radial Velocity V And The Radius R Under The Central Mass M.

1.Deriving Equation (4), The Relationship Between The Inward / Outward Speed, The Central Mass And The Raduis Of A Gravitationally Bound Point.

According To Equations(1)[1] And (2)[2] ;

$$\frac{M_1}{M_0} = \frac{R_0}{R_1} = \frac{V_1}{V_0} \qquad (1)$$

$$V_{i/o}1 = \left[\frac{R_0}{R_1}\right]^3 V_{i/o}0 \qquad (2)$$

$$V_{i/o}1 = \left[\frac{R_0}{R_1}\right]^3 V_{i/o}0 = \frac{M_1}{M_0}\left[\frac{R_0}{R_1}\right]^2 V_{i/o}0 \qquad (2b)$$

$$\frac{M_1}{V_{i/o}1R_1^2} = \frac{M_0}{V_{i/o}0R_0^2} = Jp \qquad (2c)$$

$$V_{i/o}0 = \frac{M_0}{JpR_0^2}$$

$$V_{i/o} = \frac{M}{JpR^2} \qquad (4)$$

$$\mathrm{M} = JpR^2V_{i/o} \qquad (4a)$$

$$Jp = \frac{M}{V_{i/o}R^2} \qquad (4b)$$

Where, M(Earth Mass) Is The Central Mass, Jp(Earth Mass * Year / Km^3) Is The New Universal Constant, Vi/o (Km / Year) Is The Inward / Outward Speed, R(Km) Is The Radius.

According To Equation (4), In A Variable Mass Centre System, The Inward / Outward Speed Vi/o Of A Gravitational Bound Point Will Decrease With The Decrease Of The Central Mass M And The Increase Of The Radius R.

2.Deriving Equation (5), The Relationship Between The Inward / Outward Speed, The Raduis And The Cross-Radial Velocity Of A Gravitationally Bound Point.

According To Equations (4a) And (3) ;

$$\mathrm{M} = JpR^2V_{i/o} \qquad (4a)$$

$$\mathrm{M} = kRV^2 \qquad (3)$$

$$JpR^2V_{i/o} = kRV^2$$

$$V_{i/o} = \frac{k}{Jp}\frac{V^2}{R} \qquad (5)$$

Where, K=2.50863E-6(Earth Mass * S^2 / Km^3) Is A Universal Constant, Jp(Earth Mass * Year / Km^3) Is The New Universal Constant, V(Km / S) Is The Cross-Radial Velocity, R(Km) Is The Radius.

According To Equation (5), In A Variable Mass Centre System, The Inward / Outward Speed Vi/o Of A Gravitational Bound Point Will Decrease With The Decrease Of The Cross-Radial Velocity V And The Increase Of The Radius R.

III. Data Analysis

Because There Is Noise In The Raw Data[3][4], To Eliminate Noise, We First Select The Minimum Value Of The Maximum As The Upper Limit And The Maximum Value Of The Minimum As The Lower Limit, Then, Use The Average Value Of The UpperLimit And LowerLimit As The True Data.

3.Using Our Method Of Raw Data Processing To Extract Real Data From The Raw Data In G.A.Krasinsky's Table 2[3].

To Verify This Method, According To **G.A.Krasinsky**'s Raw Data Table 2[3]: (21.5, 9.7, 7.9, 9.7, 14.4, 61.0, 21.3),We Eliminate The Maximum Value 61.0 And The Minimum Value 7.9,

$$Avreage\ value = \frac{21.5+9.7}{2} = 15.6(m/cy) = 15.6(cm/y)$$

4.Comparing The Extracted Real Data With G.A.Krasinsky's Conclusion Of 15(Cm/Year) For The Secular Increase Of Astronomical Unit [3] To Confirm Our Method Of Raw Data Processing Is Credible.

Because The Average Value Is Consistent With**G.A.Krasinsky**'s Conclusion Of15(Cm/Year)[3] And Within Its Range 15+/-4(Cm/Year), Our Method Of Raw Data Processing Is Proven Credible.

5.Using The Proved Method Of Raw Data Processing To Extract Real Data From NASA's Raw Data In FIG.2[4], To Eliminate Noise.

According To **NASA**'s Fig 2[4], The Minimum Value Of The Maximum (Point: AU=0.34) Is 1.5(M/Year) And The Maximum Value Of The Minimum Is 0.5(M/Year):

$$Avreage\ value = \frac{1.5+0.5}{2} = 1(m/y) = 100(cm/y)$$

6.Using The Extracted Credible Data From NASA's Raw Data FIG.2[4] And G.A.Krasinsky's Conclusion Of 15(Cm/Year)[3] To Verify Equations (4) And (5) By Calculating A New Universal Constant Jp.

Verifying Equation (4):

$$Jp = \frac{M}{V_{i/o}R^2} \qquad (4b)$$

According To Earth's Data: M = M_{sun} =333000(Earth Mass), R = 149598023(Km), Vi/o = 15(Cm / Year)[3],

$$Jp = \frac{M}{V_{i/o}R^2} = \frac{333000}{(15E-5)\cdot(149.598023E+6)^2} = 9.919762311E-8(Earth\ mass\cdot y/km^3)$$

According To Mercury's Data: M = M_{sun} =333000(Earth Mass), R = 57.91E+6(Km), Vi/o = 100(Cm / Year),

$$Jp = \frac{M}{V_{i/o}R^2} = \frac{333000}{(100E-5)\cdot(57.91E+6)^2} = 9.928722316E-8(Earth\ mass\cdot y/km^3)$$

Average Jp = 9.924742314E-8(Earth Mass * Y /Km^3)

Because The Difference Between These Two Calculations Is 0.1%, Equation (4) Is Proven Correct.

Verifying Equation (5):

$$V_{i/o} = \frac{k}{Jp}\frac{V^2}{R} \qquad (5)$$

According To Earth's Data: K =2.50863E-6(Earth Mass * S^2 / Km^3), R = 149598023(Km), V = 29.78(Km / S),

$$V_{i/o} = \frac{k}{Jp}\frac{V^2}{R} = 25.27652528\cdot\frac{29.78^2}{149.598023E+6} = 1.498\mathrm{E}-4(km/y) = 14.98(cm/y)$$

According To Mercury's Data: K =2.50863E-6(Earth Mass * S^2 / Km^3), R = 57.91E+6(Km), V = 47.36(Km / S),

$$V_{i/o} = \frac{k}{Jp}\frac{V^2}{R} = 25.27652528 \cdot \frac{47.36^2}{57.91E+6} = 9.79\text{E}-4(km/y) = 97.9(cm/y)$$

Comparing With Vi/o = 15(Cm / Year)[3] And Vi/o = 100(Cm / Year)[4], The Maximum Difference Is 2.1%, Equation(5) Is Proven Correct.

7.Using Equations (4) And (5) To Create Table.1 To Demonstrate The Outward Speeds Of The 8 Planets In Our Solar System And To Compare The Calculation Results To Further Confirm Equations (4) And (5).

Table.1

Planet	V_0 (Km/S)	R_0 (Km)	$V_{i/o} = \frac{M}{JpR^2}$ (cm/y)	$V_{i/o} = \frac{k}{Jp}\frac{V^2}{R}$ (cm/y)	Error
Neptune	5.43	4.50E+09	0.0166	0.0166	1.55E-03
Uranus	6.8	2.87E+09	0.0407	0.0407	-6.08E-04
Saturn	9.68	1.43E+09	0.163	0.165	-1.19E-02
Jupiter	13.06	7.79E+08	0.554	0.554	-4.06E-04
Mars	24.07	2.28E+08	6.46	6.43	5.23E-03
Earth	29.78	1.50E+08	15	15	5.35E-04
Venus	35.02	1.08E+08	28.7	28.6	2.49E-04
Mercury	47.36	5.79E+07	100	97.9	2.17E-02

Where, M=333000, K =2.50863E-6, Jp = 9.924742314E-8, Maximum Error Is 2.17%.

According To Table.1, Equations (4) and (5) Have The Same Calculation Results As That Of Equation (16)[2] In Table 2[2]. Therefore, Equation (16)[2] Is Also Proven Correct.

IV. Conclusion

Equations (4) And (5) Are Newly Proven Physical Laws, Have The Same Physical Meanings As Those Shown In Table 1[2] In Our Previous Article[2],Can Be Used To Theoretically Explain / Accurately Calculate The Secular Increase Of Astronomical Unit Is Due To The Loss Of The Solar Mass As Well As The Expansion Of The Solar System. These Findings Answer Questions That Cannot Be Answered By Known Theories[5] And Are Meaningful For Understanding The Expansion And Contraction Of The Universe.

Other Findings Include The New Universal Constant Jp And The Method Of Raw Data Processing, Which Is Proven Simple, Reasonable, Creditable And Useful.

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