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# Einstein's Nemesis # 2: And most studied binary stars
# As Camelopardis Binary Stars High Rate Apsidal Motion Puzzle Solution

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Abstract: This is the solution to the 40 years most studied Binary Stars with high rate orbit axial rotations puzzle that made astrophysicists wipe their glasses and wipe their high tech telescopes eyepieces and sent Einstein's space-time physics research papers solutions back to sender and said "NO" to the 100,000 space-time Physicists and Astrophysicists in their hideouts after they could not solve this motion puzzle by any said or published Physics for fourty years including 109 years of Nobel Prize winner Physics and physicists and 400 years of astronomy. This motion puzzle is posted Smithsonian-NASA website SAO/NASA and type "apsidal motion of As Cam".

Universal Mechanics Solution: For 350 years Physicists Astronomers and Mathematicians missed Kepler's time dependent equation introduced here and transformed Newton's equation into a time dependent Newton' equation and together these two equations explain apsidal motion as light aberrations along the line of sight due to differences between time dependent measurements and time independent measurements These two equations combines classical mechanics and quantum mechanics into one Universal mechanics solution and in practice it amounts to "Visual" effects.

All there is in the Universe is objects of mass m moving in space (x, y, z) at a location $\mathbf{r} = \mathbf{r}$ (x, y, z). The state of any object in the Universe can be expressed as the product
$\mathbf{S} = m\,\mathbf{r}$; State = mass x location:

$\mathbf{P} = d\,\mathbf{S}/d\,t = m\,(d\,\mathbf{r}/d\,t) + (dm/d\,t)\,\mathbf{r}$ = Total moment
= change of location + change of mass
$= m\,v + m'\,r$; $v$ = velocity $= d\,r/d\,t$; $m'$ = mass change rate

$\mathbf{F} = d\,\mathbf{P}/d\,t = d^2\mathbf{S}/dt^2$ = Total force
$= m\,(d^2\mathbf{r}/dt^2) + 2(dm/d\,t)\,(d\,\mathbf{r}/d\,t) + (d^2m/dt^2)\,\mathbf{r}$
$= m\,\boldsymbol{\gamma} + 2m'\mathbf{v} + m''\,\mathbf{r}$; $\gamma$ = acceleration; $m''$ = mass acceleration rate

In polar coordinates system

$$\mathbf{r} = r\,\mathbf{r}_{(1)}\,;\ \mathbf{v} = r'\,\mathbf{r}_{(1)} + r\,\theta'\,\boldsymbol{\theta}_{(1)}\,;\ \boldsymbol{\gamma} = (r'' - r\theta'^2)\mathbf{r}_{(1)} + (2r'\theta' + r\,\theta'')\boldsymbol{\theta}_{(1)}$$

$$\mathbf{F} = m\,[(r''-r\theta'^2)\,\mathbf{r}_{(1)} + (2r'\theta' + r\,\theta'')\,\boldsymbol{\theta}_{(1)}] + 2m'[r'\,\mathbf{r}_{(1)} + r\,\theta'\,\boldsymbol{\theta}_{(1)}] + (m''\,r)\,\mathbf{r}_{(1)}$$

$$= [d^2(m\,r)/dt^2 - (m\,r)\theta'^2]\mathbf{r}_{(1)} + (1/mr)[d(m^2r^2\theta')/d\,t]\boldsymbol{\theta}_{(1)} = [-GmM/r^2]\mathbf{r}_{(1)}$$

Proof**:**

First **r** = r [cosine θ **î** + sine θ **Ĵ**] = r **r** (1)

Define **r** (1) = cosine θ **î** + sine θ **Ĵ**

Define **v** = d **r**/d t = r' **r** (1) + r d[**r** (1)]/d t

= r' **r** (1) + r θ'[- sine θ **î** + cosine θ Ĵ]

= r' **r** (1) + r θ' **θ** (1)

Define **θ** (1) = -sine θ î +cosine θ Ĵ;

And with **r** (1) = cosine θ î + sine θ Ĵ

Then d [**θ** (1)]/d t= θ' [- cosine θ î - sine θ Ĵ= - θ' **r** (1)

And d [**r** (1)]/d t = θ' [-sine θ î + cosine θ Ĵ] = θ' **θ** (1)

Define **γ** = d [r' **r** (1) + r θ' **θ** (1)] /d t

= r'' r (1) + r'd [**r** (1)]/d t + r' θ' **r** (1) + r θ'' **r** (1) +r θ'd [θ (1)]/d t

**γ** = (r'' - rθ'²) **r** (1) + (2r'θ' + r θ'') **θ** (1)

With d² (m r)/dt² - (m r) θ'² = -GmM/r²   Newton's Gravitational Equation   (1)

And d (m²r²θ')/d t = 0   Central force law   (2)

<u>(2)</u> : d(m²r²θ')/d t = 0 <==> m²r²θ' = [m²(θ,0) m²(0,t)][ r²(θ,0)r²(0,t)][θ'(θ, t)]

= [m² (θ, t)] [r² (θ, t)] [θ' (θ, t)]

= [m² (θ, 0)] [r² (θ, 0)] [θ'(θ, 0)]

= [m² (θ, 0)] h (θ, 0); h (θ, 0) = [r² (θ, 0)] [θ'(θ, 0)]

= H (0, 0) = m² (0, 0) h (0, 0)

= m² (0, 0) r² (0, 0) θ'(0, 0)

<u>With m = m (θ, 0) m (0, t) = m (θ, 0) Exp [λ (m) + ì ω (m)</u>] t; Exp = Exponential

And m (0, t) = Exp [λ (m) + ỉ ω (m)] t

<u>Also, r = r (θ, 0) r (0, t) = r (θ, 0) Exp [λ (r) + ì ω (r)] t</u>

With r (0, t) = Exp [λ (r) + ỉ ω (r)] t

<u>Then θ'(θ, t) = {H(0, 0)/[m²(θ,0) r(θ,0)]}Exp{-2{[λ(m) + λ(r)]t + ì [ω(m) + ω(r)]t}}</u> -----I

<u>And θ'(θ, t) = θ' (θ, 0)]} Exp {-2{[λ (m) + λ (r)] t + ì [ω (m) + ω (r)] t}}</u> --------------------I

And, θ'(θ, t) = θ' (θ, 0) θ' (0, t)

And θ' (0, t) = Exp {-2{[λ (m) + λ(r)] t + ì [ω (m) + ω(r)] t}

Also θ'(θ, 0) = H (0, 0)/ m² (θ, 0) r² (θ, 0)

And θ'(0, 0) = {H (0, 0)/ [m² (0, 0) r (0, 0)]}

<u>With (1)</u>: d² (m r)/dt² - (m r) θ'² = -GmM/r² = -Gm³M/m²r²

And   d² (m r)/dt² - (m r) θ'² = -Gm³ (θ, 0) m³ (0, t) M/ (m²r²)

Let m r =1/u

Then d (m r)/d t = -u'/u² = - (1/u²) (θ') d u/d θ = (- θ'/u²) d u/d θ = -H d u/d θ

And d² (m r)/dt² = -Hθ'd²u/dθ² = - Hu² [d²u/dθ²]

-Hu² [d²u/dθ²] - (1/u) (Hu²)² = -Gm³ (θ, 0) m³ (0, t) Mu²

$[d^2u/ d\theta^2] + u = Gm^3 (\theta, 0)\ m^3 (0, t)\ M/ H^2$

$t = 0;\ m^3 (0, 0) = 1$
$u = Gm^3 (\theta, 0)\ M/ H^2 + A \text{ cosine } \theta = Gm (\theta, 0)\ M (\theta, 0)/ h^2 (\theta, 0)$

And $m\, r = 1/u = 1/ [Gm (\theta, 0)\ M (\theta, 0)/ h (\theta, 0) + A \text{ cosine } \theta]$
$= [h^2/ Gm (\theta, 0)\ M (\theta, 0)]/ \{1 + [Ah^2/ Gm (\theta, 0)\ M (\theta, 0)] [\text{cosine } \theta]\}$
$= [h^2/Gm (\theta, 0)\ M (\theta, 0)]/ (1 + \varepsilon \text{ cosine } \theta)$

Then $m (\theta, 0)\ r (\theta, 0) = [a (1-\varepsilon^2)/ (1+\varepsilon\cos\theta)]\ m (\theta, 0)$
Dividing by $m (\theta, 0)$
<u>Then $r (\theta, 0) = a (1-\varepsilon^2)/ (1+\varepsilon\cos\theta)$</u>
This is Newton's Classical Equation solution of two body problem which is the equation of an ellipse of semi-major axis of length a and semi minor axis $b = a \sqrt{(1 - \varepsilon^2)}$ and focus length $c = \varepsilon a$
And $m\, r = m (\theta, t)\ r (\theta, t) = m (\theta, 0)\ m (0, t)\ r (\theta, 0)\ r (0, t)$
<u>Then, $r (\theta, t) = [a (1-\varepsilon^2)/ (1+\varepsilon\cos\theta)] \{\text{Exp } [\lambda(r) + \dot{\imath}\, \omega (r)] t\}$</u> ---------------------------------- II
<u>This is Newton's time dependent equation that is missed for 350 years</u>
<u>If $\lambda (m) \approx 0$ fixed mass and $\lambda(r) \approx 0$ fixed orbit; then</u>
Then $r (\theta, t) = r (\theta, 0)\ r (0, t) = [a (1-\varepsilon^2)/ (1+\varepsilon \text{ cosine } \theta)] \text{ Exp } i\, \omega (r)\, t$
And $m = m (\theta, 0) \text{ Exp } [i\, \omega (m)\, t] = m (\theta, 0) \text{ Exp } \dot{\imath}\, \omega (m)\, t$

We Have $\theta'(0, 0) = h (0, 0)/r^2 (0, 0) = 2\pi ab/ Ta^2 (1-\varepsilon)^2$
$= 2\pi a^2 [\sqrt{(1-\varepsilon^2)}]/T a^2 (1-\varepsilon)^2$
$= 2\pi [\sqrt{(1-\varepsilon^2)}]/T (1-\varepsilon)^2$
Then $\theta'(0, t) = \{2\pi [\sqrt{(1-\varepsilon^2)}]/ T (1-\varepsilon)^2\} \text{ Exp } \{-2[\omega (m) + \omega (r)] t$
$= \{2\pi [\sqrt{(1-\varepsilon^2)}]/ (1-\varepsilon)^2\} \{\text{cosine } 2[\omega (m) + \omega (r)] t - \dot{\imath} \sin 2[\omega (m) + \omega (r)] t\}$
$= \theta'(0, 0) \{1- 2\sin^2 [\omega (m) + \omega (r)] t\}$
$- \dot{\imath}\, 2i\, \theta'(0, 0) \sin [\omega (m) + \omega (r)] t \text{ cosine } [\omega (m) + \omega (r)] t$
Then $\theta'(0, t) = \theta'(0, 0) \{1 - 2\text{sine}^2 [\omega (m) t + \omega (r) t]\}$
$- 2\dot{\imath}\, \theta'(0, 0) \sin [\omega (m) + \omega(r)] t \text{ cosine } [\omega (m) + \omega(r)] t$
$\Delta \theta' (0, t) = \text{Real } \Delta \theta' (0, t) + \text{Imaginary } \Delta \theta (0, t)$
$\text{Real } \Delta \theta (0, t) = \theta'(0, 0) \{1 - 2 \text{ sine}^2 [\omega (m) t\ \omega(r) t]\}$

Let $W (ob) = \Delta \theta' (0, t)$ (observed) $= \text{Real } \Delta \theta (0, t) - \theta'(0, 0)$
$= -2\theta'(0, 0) \text{ sine}^2 [\omega (m) t + \omega(r) t]$
$= -2[2\pi [\sqrt{(1-\varepsilon^2)}]/T (1-\varepsilon)^2] \text{ sine}^2 [\omega (m) t + \omega(r) t]$
If this apsidal motion is to be found as visual effects, then
With, $v°$ = spin velocity; $v^*$ = orbital velocity; $v°/c = \tan \omega (m) T°$; $v^*/c = \tan \omega (r) T^*$
Where $T°$ = spin period; $T^*$ = orbital period
And $\omega (m) T°$ = Inverse tan $v°/c$; $\omega (r) T^*$= Inverse tan $v^*/c$
$W (ob) = -4 \pi [\sqrt{(1-\varepsilon^2)}]/T (1-\varepsilon)^2] \text{ sine}^2$ [Inverse tan $v°/c$ + Inverse tan $v^*/c$] radians
Multiplication by $180/\pi$
$W (ob) = (-720/T) \{[\sqrt{(1-\varepsilon^2)}]/ (1-\varepsilon)^2\} \text{ sine}^2$ {Inverse tan $[v°/c + v^*/c]/ [1 - v°\, v^*/c^2]$} degrees and multiplication by 1 century = 36526 days and using T in days
$W° (ob) = (-720x36526/Tdays) \{[\sqrt{(1-\varepsilon^2)}]/ (1-\varepsilon)^2\}$ x

$\text{sine}^2$ {Inverse tan [v°/c + v*/c]/ [1 - v° v*/c²]} degrees/100 years

Approximations I

With v° << c and v* << c, then v° v* <<< c² and [1 - v° v*/c²] ≈ 1

Then W° (ob) ≈ (-720x36526/Tdays) {[√ (1-ε²)]/ (1-ε) ²} x sine² Inverse tan [v°/c + v*/c] degrees/100 years

Approximations II

With v° << c and v* << c, then sine Inverse tan [v°/c + v*/c] ≈ (v° + v*)/c

W° (ob) = (-720x36526/Tdays) {[√ (1-ε²)]/ (1-ε) ²} x [(v° + v*)/c] ² degrees/100 years

This is the apsidal motion equation for two body problem

The circumference of an ellipse: 2πa (1 - ε²/4 + 3/16(ε²)²- --.) ≈ 2πa (1-ε²/4); R =a (1-ε²/4)

Where v (m) = √ [GM²/ (m + M) a (1-ε²/4)]

And v (M) = √ [Gm² / (m + M) a (1-ε²/4)]

As Camelopardis Apsidal motion solution:

Data T=3.431; $r_{(m)}$ =0.1499 m=3.3$M_{(0)}$ $R_{(m)}$ =2.57$R_{(0)}$ [$v°_{(m)}$,$v°_{(M)}$]=[40,30]

ε = 0.1695; 1-ε = 00.8305; $r_{(M)}$ =0.1111 M=2.5$M_{(0)}$ $R_{(M)}$ = 2.5$R_{(0)}$ ;m + M=5.8$M_{(0)}$

G=6.673x10^-11; $M_{(0)}$ = 1.98892x10^30kg; $R_{(0)}$ = 0.696x10^9m

1- ε²/4 = 0.9928; [√ (1-ε²)]/ (1-ε) ² = 1.43

a = [$R_{(m)}$/$r_{(m)}$] = (2.57/0.1499) (0.696x10^9) m

With a (1-ε²/4) = (2.57/0.1499) (0.696x10^9) (0.9988) = 11.8470x10^9m

And v (m) = √ [GM²/ (m + M) a (1-ε²/4)] = 110.1786325km/sec

And v (M) = √ [Gm²/ (m + M) a (1-ε²/4)] = 145.435795km/sec

And v* (cm) = ∑m v/∑m = 125.3756853km/sec

Then σ* = √ {∑ [v*-v* (cm)] ²/2}

=√ {[(110.1786325-125.3756853)² + (145.435795-125.3756853)²]/2}

= 25.1659669

Spin: v° = v° (m) + v° (M) = 40km/s + 30km/s = 70km/sec

With v* (m) = 110.1786325km/sec; v* (M) = 145.435795km/sec

And v* (cm) = 125.3756853km/sec; σ* = 25.1659669km/sec

If v* = v* (m) + v* (M) + σ* = 280.7804472 km/sec

Then v* + v° = 280.7804472 + 70 = 350.7804472 km/sec

W (ob) = (-720x36526/T) x {[√ (1-ε²)]/ (1-ε) ²} {[v* + v°]/c} ²= 15.0°/100 years

If v* = 2v* (cm) + σ* = 275.9173375km/sec

Then v* + v° = 275.9173375 + 70 = 345.9173375 km

W (ob) = (-720x36526/T) x {[√ (1-ε²)]/ (1-ε) ²} {[v* + v°]/c} ²= 14.6°/100 years

3- Khailullin: 1983 v (p) =110.4; v(s) = 145.8; σ = 25.2685

2∑ m v/∑m + σ + 70=346.0185

W = 14.6 °/century same as reported [same as published]

References:

Apsidal motion of As Cameloparids by Khailullin: 1983

Apsidal motion of As Camelopardis Edward Guinan and Frank Maloney: 1986