IRASS Journal of Multidisciplinary Studies
https://irasspublisher.com/journal-details/IRASSJMS
ISSN (Online) 3049-0073

# Analysis of Exoplanet HD80606b in Primary-centric Framework

**Bijay Kumar Sharma***

Retired Professor, National Institute of Technology, Patna 800005, Bihar, India

**Corresponding Author Bijay Kumar Sharma**

Retired Professor, National Institute of Technology, Patna 800005, Bihar, India

**Article History**

Received: 02 / 07 / 2025

Accepted: 15 / 07 / 2025

Published: 19 / 07 /2025

**Abstract:** The author in his quest for discovering the architectural layout of solar system and exo-solar systems struck upon the design rules of architectural layout of planets and stars in star pairs in the year 2011. In this paper the first section shows that a given stellar nebula falls in outer Clarke' configuration in the months/years. The first Clarke's Orbit is untenable in case of Star Pair HD80606A+HD80606B. The second Clarke's orbit of the star pair is the present semi-major axis of the star pair. This paper goes further to show that HD80606A is hosting a highly elliptical giant Jupiter exoplanet HD80606b which suffers from spin-orbital misalignment problem.. In spite of this misalignment the observed and theoretical value of ω/Ω have remarkable correspondence within the error bar of the Globe-orbit parameters of the exoplanet system. This is the umpteenth example of Primary -centric formulation since 2011.

**Keywords:** Sub-synchronous orbit; super-synchronous orbit, triple synchrony; Kinematic model.

**How to Cite in APA format:** Sharma, B. K., (2025). Analysis of Exoplanet HD80606b in Primary-centric Framework. *IRASS Journal of Multidisciplinary Studies, 2(7)17-23.*

## INTRODUCTION

**Introduction: Study of exo-Solar System HD80606**.[1]

In 2011[1A] propounded the design rules of star pairs , solar-system and exo-solar systems. HD 80606 is a well-studied binary star system located in the constellation **Ursa Major**, approximately **190 light-years** from Earth. This was born 11.4 billion years ago

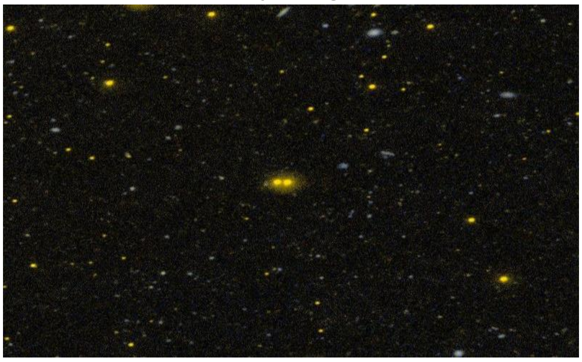


**Figure 1. A binary star system on GALEX sky survey. The brightest star pair in night sky is HD80606A and HD80606B.[Credit:NASA/GALEX/WikiSky - http://wikisky.org/snapshot?]**

*1.1. Exo-planet HD80606b orbiting HD80606A in a highly elongated orbit [2]..*

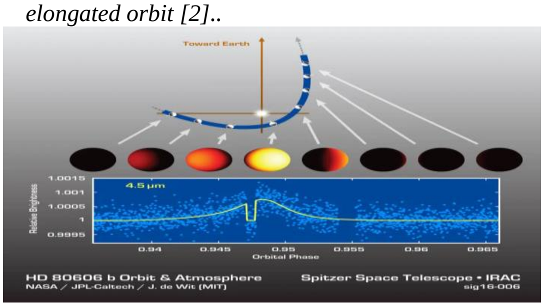



**Figure 2. Highly eccentric exo-planet HD80606b orbits around yellow star HD80606A. in 111days.[Credit:NASA/JPL-Caltech/J. de Wit (MIT)]**

Astronomers watched an exoplanet called HD 80606b heat up and cool off during its sizzling-hot orbit around its host star. The results are shown in this data plot Figure 2 from NASA's Spitzer Space Telescope. Spitzer measured the slight changes in infrared light coming from the distant planet and star.

HD 80606b is about d = 190 light-years away from Earth. Its 111-day orbit takes it almost as far away from its star as Earth is from the Sun, but at its closest approach, it sweeps blisteringly close to the star for a brief period.

Spitzer observed the combined light from the star plus planet for a total of 80 hours, using an infrared wavelength of 4.5 microns. This was long enough to catch the hottest part of the planet's orbit, where it brightened up enough relative to the total light in the system to be more easily measured. In this chart Figure 2 , an illustration of the planet's orbit is shown with each disk representing the hemisphere that faces our direction on Earth.

The short dip in the data reflects the period when the planet passed behind the star. For that period, only the light from the star alone was observed. This helps astronomers figure out just how bright the planet would be if we could see it by itself.

The planet heats up by 815.555 degrees celsius (1,500 degrees Fahrenheit) briefly only to cool down by the same amount in less than a day. Together with earlier Spitzer observations using 8-micron infrared light, these findings help scientists understand how

exotic planets like this form and evolve throughout the galaxy. It is notable primarily because one of its stars, **HD 80606A**, hosts a highly eccentric hot Jupiter-like exoplanet,

**HD 80606b**, which undergoes dramatic changes in temperature and radiation during its

orbit. Below are comprehensive details about the binary star system:

**Study of Wide Star pair: System Name: *HD 80606/HD 80607;***

**Stellar Components:** HD80606A+HD80607B;

**Constellation:** Ursa Major

**Distance from Earth:** d ~58 parsecs (~190 light-years)

**System Type:** Visual binary (wide binary system)
**Angular Separation:** ~20.6 arcseconds

**Projected Separation:** ~1,160 AU ± $1AU$=1.73501× $10^{14}$ m ± 1.49597870700× $10^{11}$ m ;

Globe-Orbital System Parameters of HD80606(Struve 1341B) Binary Star System;

Star binary is orbiting around the barycenter of the binary stars;
Age 11.4 by;

**HD80606A**

Spectral Type G5;Colour Yellow;mid-ranged temperature star;

In Constellation Ursa Major; the Big Bear;

Metallicity (dex)0.348± 0.057;

Parallax 5.63;

Distance from Earth d = 579.33ly;(58.83pc);

$T_{eff}$ (K) =5565.893± 92.189 ;
$L_*$ = ? ;

$M_*$ ($M_\odot$ ) = 1.047± 0.047=2.094×$10^{30}$ Kg;
vSin i (Km/s) = ;

$R_*$ ($R_\odot$ ) = 1.06648± 0.0243= 7.46536× $10^8$ m;
Stellar Spin Rate= 40 days (slow rotation);
**HD80606B**
**HD 80607 (Secondary - B):**

- **Spectral Type:** G5V (nearly identical to HD 80606)
- **Apparent Magnitude:** ~9.2
- **Mass:** ~1.0 M☉=2× $10^{30}$ Kg;
- **Radius:** ~1.0 R☉=7× $10^8$ m;
- **Temperature:** ~5550–5600 K
- **Metallicity [Fe/H]:** +0.40
- **Stellar Rotation Period:** ~40 days

**Binary Orbit and Dynamics:**

- **Binary Type: Wide visual binary** with no significant gravitational interaction in short timescales.
  - **Separation:** ~1,1600 AU± 1AU → orbital period on the order of **tens of thousands of years**.
  - **Mutual Orbit:** Not precisely constrained due to the large separation and slow orbital motion.

**Kepler's Third Law (Simplified in AU, M☉, yr):**

P^2=a^3/(M_A+M_B);

P^2 =(1200)^3/(1.08+1) ;

P = $1200^3$ =28823 years;

This is taken as 29,300 years.

**HD 80606B** orbits the **barycenter** of the binary system with an estimated period of approximately **29,300 years**, assuming the projected separation (~1200 AU) approximates the semi-major axis.

We have to examine if this configuration of the visual star pair fits the primary centric analysis.;

**According to Primary Centric Framework;**

$Total\ angular\ momentum\ of\ the\ binary\ star\ system\ =\ J_T$ =Cω + (m*$a_p^2$Ω) + I*ω' …..........2

C= moment of inertia of the primary component; ω = angular spin rate of the primary component;

$m^*$ reduced mass of the secondary component of the binary system; $a_p$ = the present semi-major axis of the secondary component; I = moment of inertia of the secondary component; ω' = angular spin rate of the secondary component; This is a wide binary with weak gravitational interaction hence spin period of

secondary star is 40 days but the orbital period of secondary star is 29,300 years;

In tight binaries the two quantities would be equal;
*In (2):*
Spin period of star (primary) per rotation =40d;

Angular Spin rate of the primary = ω = 1.81805× $10^{-6}$ radians /s;
Orbital Period of the secondary around the barycenter of the system =29,300 years;
Angular Orbital rate of the secondary = Ω

= 2π /(29300× 365. 25 × 24 × 3600) = 6.79529× $10^{-12}$ radians /s;

Spin rate of the secondary=ω' = 2π /(40 × 24 × 3600)=1.81805*10^-6 radians/s;
Here C= rotational moment of inertia of the Primary Component (HD80606A)

C = 0.4$M_{*A}$ × $R_{*A}^2$ = 0.4 ×2.094×$10^{30}$ × $(7.46536 \times 10^8)^2$

C = 4.66808×$10^{47}$ Kg.$m^2$ ;

I)= (m*$a^2$) rotational moment of inertia of the orbital …us (I) rotational moment of inertia of the secondary star; … moment of inertia of the orbital system== $\frac{M_{*B}}{1+\frac{M_{*B}}{M_{*A}}} a^2$

=(2*10^30)/(1 + (2*10^30)/(2.094*10^30))*(1.79517*10^14)^2

=(2*10^30/(1+ $\frac{2*10^{30}}{2.094*10}$))*$(1.79517 * 10^{14})^2$ =

1.02296*10^30*$(1.79517 * 10^{14})^2$

=3.29663*10^58 Kg-m^2 ;

The reduced mass of the secondary component= 1.02296*10^30 Kg ;

rotational moment of inertia of the secondary star= $0.4M_{*B} \times R_{*B}$

$=0.4 * 2 * 10^{30}$

$^2$

$* (7 * 10 )$ = 3.92*10^47Kg.$m^2$ ;

$Total\ angular\ momentum\ \ of\ the\ binary\ star\ system\ = J_T$

=Cω + (m*$a_p$)Ω + I*ω' ;........2

$Total\ angular\ momentum\ \ of\ the\ binary\ star\ system\ = J_T$

= 4.66808×$10^{47}$ Kg.$m^2$ *1.81805 × $10^{-6}$ radians /s+3.29663*10^58 Kg-m^2*

6.79529× $10^{-12}$ radians /s+3.92*10^47Kg.$m^2$ *1.81805× $10^{-6}$ radians /s……………3

In a tight Binary by circularization and synchronization, the orbital period of the secondary is equal to spin rate of the secondary. HD80606A+HD80607B is a visual binary but a very wide binary where gravitational interaction is very weak and the orbital period of the secondary is 29300 years and spin period of the secondary is 40 days.

Evaluating Eq.(3) we get

$To\ \ \ al\ angular\ momentum\ \ of\ the\ binary\ star\ system\ =$

$J_T$ =2.24017× $10^{47}$ $Kg-m^2$

……4 G = Quantity["GravitationalConstant"];

M = Quantity[2.094*10^30, "Kilograms"];

m = Quantity[2*10^30, "Kilograms"];

result = Sqrt[G*(M + m)];

UnitConvert[result, "Meters"^(3/2)/"Seconds"] B = 1.65301× $10^{10}$ (m^3/2)/s ;

Setting up the main equation of Primary Centric Formulation:

$\frac{\omega}{\Omega} = \frac{LOM}{LOD} = \frac{GB}{J_T} a_p^{3/2}$ - ($\theta_2'$ $a_p^2$ +$\theta_1$ ) = A.$a_p^{3/2}$ -F$a_p^2$

Where A= $\frac{J_T}{CB}$ and F= $\frac{reduced\ mass\ of\ the\ secondary}{J_T C}$ ;

A= $\frac{J_T}{CB}$ ;

$J_T$/(B C) /. {$J_T$ -> 2.24017*10^47, B -> 1.65301*10^10,

C -> 4.66808*10^47};

A= 2.90313*10^-11;

N[(2*10^30)/(1 + (2*10^30)/(2.094*10^30))]

Output; 1.022960429897410^9`*^30

N[(1.0229604298974*10^9`*10^30)/(4.66808`*10^47)]

F= $\frac{reduced\ mass\ of\ the\ secondary}{C}$ =2.19139× $10^{-18}$ 1 ;

$\frac{\omega}{\Omega} = \frac{LOM}{LOD}$ = A.$a^{3/2}$ -F$a^2$ ;............................7

Eq.(7) is solved at the present semi-major axis a =1.73501*10^14 m ;

expr = 2.90313*10^-11* a^(3/2) - 2.19139× $10^{-18}$ a^2;

expr /. a -> 1.79517*10^14 m;

Theoretical value of $\frac{\omega}{\Omega}$ =1.502*10^11 ;.........................8

Observed value of $\frac{\omega}{\Omega} = \frac{1.81805\times10^{-6}}{6.79529\times10^{-12}}$ = 267546

;...........................................9

**According to Primary Centric Formulation:**

Theoretical value of $\frac{\omega}{\Omega}$ = 1.502*10^11 should be equal to

Observed value of $\frac{\omega}{\Omega} = \frac{1.81805\times10^{-6}}{6.79529\times10^{-12}}$ = 267546 ;

Due to the error bar in the observed values of Globe-Orbit parameters of the Binary Star the theoretical and observed values are not equal.

**Derivation of the Clarke Orbits:**

**Maximum of the function**

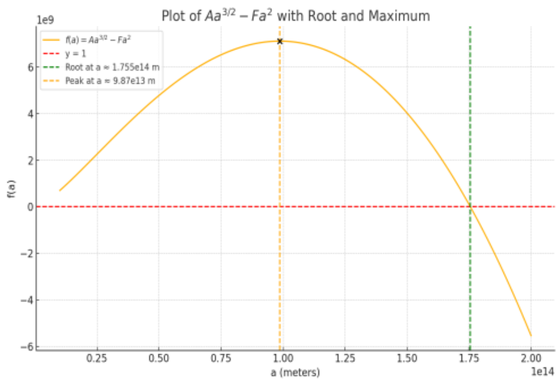



**Figure 3. The Plot of f(a) from 10^13m to 1.75*10^14m [Credit: ChatGPT]**

f(a)=A·a^3/2−F·a^2;

The maximum of f(a) occurs at a = 9.87225*10^13 m is f(a)=7.119*10^9;

The Plot of f(a) is:

Here is the plot showing:

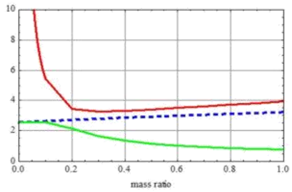
- The function f(a)=Aa^3/2−Fa^2;
- The horizontal red line y=1;
- The green vertical line where the function equals 1: ….a ≈1.755×10^14 m;
- The orange vertical line at the peak: a_peak≈9.872×10^13 m;
- where the maximum is only ~7.12×10^9;

**Final Summary**

- ✔ The function **has only one real solution** to f(a) =1;

- It never reaches 1 on the left (before the peak), ;

In Sharma 2023B ( Iapetus hypothetical sub-satellite re-visited and it reveals celestial body formation process in the Primary-centric Framework.presented at 39th COSPAR Scientific Assembly, Mysore, India from 14th July to 20th July 2012,) the correspondence between




Newtonian Formalism of Synchronous Orbit and Kinematic Formalism was found as shown in Figure 4.

**Figure 4. Plot of asynSS (×RIap)[Dashed Blue], aG1 (×RIap)[Thick Green] and aG2 (×RIap)[Thick Red] as a function of 'q'=mass ratio. Y-axis is a semi-major axis as a multiple of Iapetus Globe Radius. [Courtesy: Author]**

At mass ratios greater than 0.2, $a_{G1}$ is physically untenable and only $a_{G2}$ is perceptible. Outer Triple Synchrony Orbit seems to converge but does not actually converge to the classical formalism but remains offsetted right till the limit of q =1. Here again only outer Clarke's Orbit is perceptible. The actual Star pairs satisfy the Kinematic formalism and not the classical formalism.

Star Binary with mass ratio q ~ 1 has very definite properties in Primary Centric Formulation.

At mass ratios greater than 0.2 right up to unity, star pairs remain in outer Clarke's Configuration stably and its magnitude is more than Newtonian prediction.

Time Constant of Evolution is the inverse proportion of some power of mass ratio.

For q = 0.0001, it is Gy and as q increases , time-constant decreases from Gy to My to kY to years. This is valid for mass scales encountered in Solar and Exo-Solar Systems. Between 0.2 to 1, a stellar nebula falls into outer Clarke's Configuration by hydro-dynamic instability within months/years .

Angular separation of the binary stars HD80606A+HD80607B is 20.6 arcsec;

2π radians = 360 degree= 360 degree× 60min/degree× 60seconds/minute ;

1 radian = $\frac{360\times3600}{2\pi}$ arc sec;

Therefore: 1 arc sec= $\frac{2\pi}{360\times3600}$ radian ;

Therefore 20.6 arcsec= $\frac{s}{d}$ where s = separation of the binary and d =distance from Earth;

From parallax , d=56.38 pc;

Angular separation is 20.6 arcs

Therefore s = $\frac{2\pi}{360\times3600}$ radian /arcs×20.6 arcs × $56.3\ pc$ = 0.005622277 pc = 1160 AU

- Δd=0.045 pc (from Gaia parallax uncertainty)

*Compute Error in Projected Separation*

We now calculate:

Δs=θ·Δd=4.5×10^−6 pc

Convert parsecs to AU:

1 pc=206265 AU⇒Δs=4.5×10−6·206265≈0.93 AU

*Final Result*

- **Projected separation**: s=1160 AUs ;
- **Error bar**: Δs≈ ±0.93 AU

So the final value of separation is:

**1160 ± 1 AU (rounded)**

In our case where q~ 1, the stellar nebula falls into outer Clarke's configuration that is star separation is $a_{G2}$ = 1.755×10^14 m which is equivalent to binary separation of 1.79517×10^14 m within the error bar of observed value of separation of the binary components.(1160AU± $1AU$) ;

So we conclude that the star binary HD80606+HD80607 satisfies the Primary-centric formulation. Now we will test the exoplanetary system HD80606A+HD80606b to see if it satisfies the Primary-centric Formulation.

**3. Analysis of exo-planetary system HD80606b+HD806060A:[2]**

**HD 80606b (Orbiting HD 80606A):**

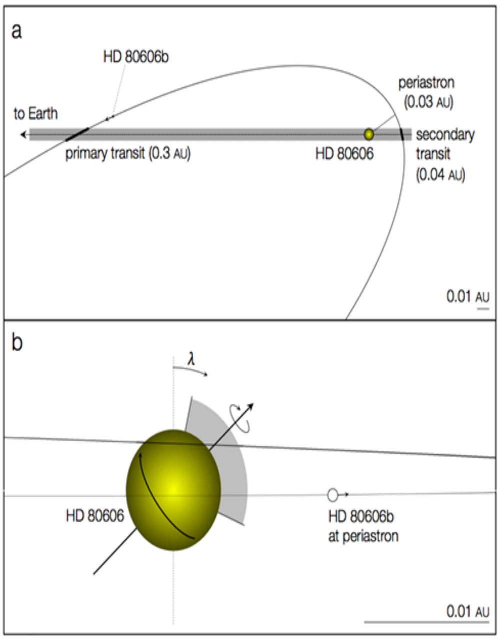



**Fig. 4.** Geometry of the HD 80606 system according to our best-fit solution, **(a)** from above the orbit, **(b)** seen from Earth.

**[Credit: Reference 3]**

There is misalignment in the orbit and spin of HD80606b as shown in Figure 4,

This misalignment was observed through the detection of Rossieter-McLaughlin anomaly [4].The spin-orbit misalignment hypothesis is reinforced with a positive projected angle between the planetary orbit axis and the stellar spin axis. As HD80606A is a component of a binary system,, the peculiar orbit of the exo-planet is a result of the Kozai mechanism[5]. If this misalignment were absent then the orbital period of the exoplanet would be synchronized with the spin period of the exoplanet but the misalignment results in an orbital period of 111d and spin period of exoplanet as 40 days.

- **Type:** Eccentric hot Jupiter

- **Mass:** ~4.0 MJ=4*1.8982*10^21Kg= 7.5928*10^21 Kg;

**Volumetric mean radius**=69.911*10^6*1.07=7.48048*10^7 m;

- **Orbital Period:** 111.4 days

- **Semi-major Axis:** ~0.45 AU =6.732*10^10 m;
- **Eccentricity: ~0.93** (extremely high)
- **Periastron Distance:** ~0.03 AU (closer than Mercury)
- **Apastron Distance:** ~0.87 AU
- **Temperature Swing:** ~<400 K to >1500 K during periastron
- **Transit:** Yes (partial), with **secondary eclipse** observed by Spitzer

**Evolutionary and Formation Considerations:**

- The high eccentricity of **HD 80606b** may be due to **Kozai–Lidov interactions** with the stellar companion HD 80607, followed by **tidal circularization**.
- Both stars being metal-rich makes them favorable for giant planet formation.

**Astrophysical Significance:**

- HD 80606b serves as a natural laboratory for studying:
  - Tidal heating
  - Atmospheric dynamics under sudden irradiation
  - Kozai migration in planet-star-binary systems
- The binary system is often used in comparative stellar studies since both stars are "solar twins" but only one has a detected planet.

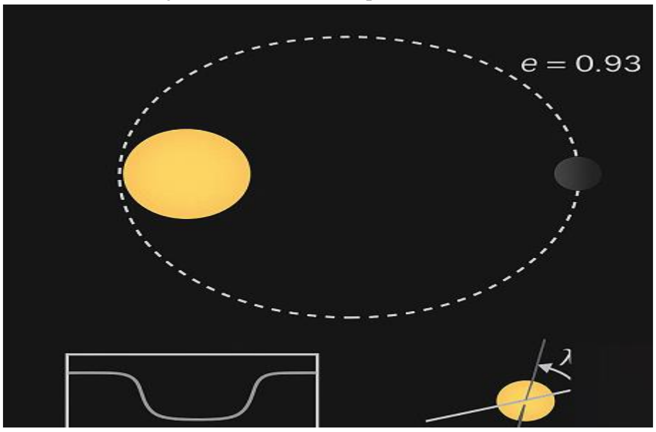



**Figure 3 . Misalignment of spin and orbit of HD80606b. [Credit: ChatGPT retrieved on 26/06/2025 at 14:51]**

HD80606b (planet of this star HD80806)

…..$m_{planet}$ = 4.164$m_{jup}$ (gas giant, super jupiter)=7.90381×$10^{21}$ Kg;

…..$r_{planet}$ = 1.07$r_{jup}$ = 7.48048× $10^{7}$ m; ;

Orbital period = 111.436765 d;

Orbital plane inclination= 89.24degre;

Orbit-spin misaligned therefore orbit and spin of the planet are not synchronized;

Orbit-spin misalignment= λ =53◦± 6 ◦;

Spin Period = 90 h =93 $^{+85}_{-35}$ h ;

….ecccentrity = 0.93183 (highly elliptical);

…..a(semi-major axis)=0.45 AU= 6.732*10^10 m;

$J_{orbit-exoplanet} = \frac{m}{1+} \times a^2 \times \Omega = \frac{7.90381\times10^{21}}{1+\frac{7.90381\times10^{21}}{}} \times (6.732 * 10^{10})^2 \times \Omega = 3.58199 \times 10^{43}\ Kg - m^2 \times \Omega = 3.58199\times 10^{43} \times \frac{2\pi}{111436765*24*3600} \frac{Kg-m^2}{s}$ =2.33756× $10^{37}$ $\frac{Kg-m^2}{s}$ ;

Cosλ × $J_{spin-exoplanet}$ = contribution to the total angular momentum of exo-planetary system=

$J_{T-exo}$;

$J_{T-exo}$= $C_{HD80606A}$ × ω + Cosλ × $J_{spin-exoplanet}$+$J_{orbit-exoplanet}$;

$C_{HD80606A}$ × ω = 4.66808*10^47 *1.81805*10^-6 = 8.4868× $10^{41}$ $\frac{Kg-m^2}{s}$ ;

$J_{spin-exoplanet}$ = 0.4*$m_{exo-planet}$ *$R^2_{exo-planet}$

= 0.4*7.5928*10^21*(7. 48048 * 10 ) =

1.6955× $10^{37}$ Kg-$m^2$ ;

$J_{T-exo}$= $C_{HD80606A}$ × ω + Cosλ × $J_{spin-exoplanet}$+$J_{orbit-exoplanet}$;

$J_{T-exo}$= 8.4868× $10^{41}$ + Cos53 ◦ × 1.6955× $10^{37}$ +2.33756× $10^{37}$ ;

$J_{T-exo}$= 8. 48714 × $10^{41}$ $\frac{Kg-m^2}{s}$;

A= $\frac{J_{T-exo}}{BC}$ and F = $\frac{m_{reduced}}{C}$ ;

Mathematica Command for calculating B:

G = Quantity["GravitationalConstant"];

M = Quantity[2.094*10^30, "Kilograms"];

m = Quantity[7.5928*10^21, "Kilograms"];

result = Sqrt[G*(M + m)];

UnitConvert[result, "Meters"^(3/2)/"Seconds"]

B= $G(M + m)$ = 1.1822× $10^{10}$ $m^{3/2}s$

Therefore A= $\frac{J_{T-exo}}{BC}$ = 1.53791× $10^{-16}$ $\frac{1}{m^{3/2}}$ ;

F = $\frac{m_{reduced}}{C} = \frac{7.91\times10^{21}}{47}$ = 1.69234× $10^{-26}$ $\frac{1}{2}$ ;

(Orbital Period of exo-planet / Spin Period of Star) expression is set up from system parameters). This gives:

$\frac{\omega}{\Omega} = \frac{LOM}{LOD}$ = A.$a_p^{3/2}$ -F$a_p^{2}$ where $a_p$ = present semi major axis = 0.45 AU= 6.732*10^10 m;

Theoretical value of $\frac{\omega}{}$ =2.68618= $\frac{orbital\ period\ of}{exoplanet}$ =2.68618 ;...........relation 1

$Observed\ value\ of\ \frac{\omega}{\Omega} = \frac{111\ d}{90h} = \frac{111*24*3600}{90*3600} = 29.6$ ;....................................relation 2

The maximum spin period of PHS = 29.75d;

$Observed\ value\ of\ \frac{\omega}{\Omega}\ at\ the\ maximum\ spin\ period\ of\ PHS = \frac{111d}{29.75d}$ = 3.73 ;........relation 3

Comparing relation 1 and relation 3 . Thus we see that the observed value and theoretical value within the error bar are equal.

How did we get the minimum spin period of PHS 29.75d:

The misalignment does not change the actual orbital period of the exoplanet which follows Kepler's Law.

$P_{orb}$ = 111.4367 days;

By Kepler's law:

$$P_{orb}^2 = \frac{4\pi^2 a^3}{G(M_* + M_+)}$$

……………………………………………………………relation 4

The effective orbital period of HD80606b remains at 111.4367 days despite misalignment of

$\lambda = 53^\circ\ to\ 60^\circ$;

The spin period of PHS is 90 hours and orbital period of exoplanet is 111days.

Stellar spin period of PHS:

$R_* = 1R_\odot = 6.96\times 10^8$ m ;

Projected rotational velocity = vSin i = 1.7Km/s
If Sin i = 1 ……i.e. i = 90◦

Therefore $P_{spin\ of\ PHS} = \frac{2\pi R_*}{v}$ = 29.8 days;

We usually do not know the true rotational velocity of PHS but only its projection along our line of sight vSin i where i = the inclination of PHS spin axis.

$R_* = 1R_\odot = 6.96\times 10^8$ m ;

Projected rotational velocity of exoplanet= vSin i = 1.7Km/s;

Maximum spin period (assuming Sin i = 1) = $\frac{2\pi R_*}{v} = \frac{2\pi\times 6.96\times 10^8}{1.7\times 10^3}$ second =$2.571\times 10^6$ s =29.7582 days;

29.75 days is the longest possible spin period of PHS assuming we are viewing the star along the equatorial plane. If the equatorial plane of the star is less than 90 degree the spin period is less than 29.75 days.

- **Interpretation**

- This **29.75 days** is the **longest possible spin period**, assuming we're viewing the star equator-on (i=90◦).
- If the spin axis is tilted **toward us**, then the **true spin period is shorter** than 29.75 days.

$Observed\ value\ of\ \frac{\omega}{\Omega}\ at\ the\ maximum\ spin\ period\ of\ PHS = \frac{111d}{29.75d}$ = 3.73 ;........relation

**Discussion:** Thus we see that the star pair HD80606A+HD806067B satisfies the Primary Centric formulation as well as exo-planetary system HD80606A+HD80606b satisfy the Primary -centric formulation.

**Conclusions:** The results of this research clearly points out that the primary-centric formulation gives the architectural layout of star binaries as well as the exo-planetary system.

**Acknowledgement:**

This research is sponsored by UNIVERSITY GRANTS COMMISSION, India, under Emeritus Fellow scheme, EMERITUS/2012-13-GEN-855/. Lastly but not the least I acknowledge the services I have availed from the computer system installed at the Petrol Pump , Village Mahanth Maniari, District Muzaffarpur, Bihar, in preparing this paper.

**Conflict of Interest:**

There is no conflict of interest financial or otherwise with anybody

**Declaration of generative AI and AI assisted technologies in the writing process:** During the preparation of this work the Author used ChatGPT and deepseek in order to reason. After using this service the author reviewed and edited the content as needed and took full responsibility for the content of the publication.

**"Ethics, Consent to Participate and Consent to Publish Declaration" not applicable. Author's contribution:**

The author collected data regarding LOD (Length of Earth Day) from popular science books by Isaac Asimov, George Gamow and Carl Sagan (COSMOS). After receiving the Press Release of NASA on Silver Jubilee Anniversary of Man's landing on Moon on 20th July 1994 that Moon has receded by 1m in last 25 years, author redid the Earth-Moon analysis and presented at 82nd Session of Indian Science Congress at Jadavpur University,Kolkata,in 1995. The Author further elaborated the analysis of the E-M system and presented the Kinematic Model of the E-M System at World Science Congress,Houston, in 2002. In 2004, at the 35th Scientific assembly of COSPAR, Author presented the New Perspective on Birth and Evolution of our Solar System and exo-planetary systems. In 2012, at the 39th Scientific Assembly at Mysore,India, paper B03- 0011-12, "Iapetus sub-satellite revisited and it reveals the celestial body formation in Primary Centric Framework. In 2017,at CELMEC VII, Rome, the Advanced Kinematic Model of Earth-Moon System was presented and finally published in Journal Of Geography And Natural Disasters where the perfect match between the Observed LOD curve and Theoretical LOD curve was achieved. A sequential paper on the Past, Present and Future of Earth-Moon Globe Orbit Dynamics and its habitability was published in JMTCM. The present paper is a paper in the same series where the author is trying to study different binary systems in Primary-Centric

Framework. In this paper a wide binary star system HD80606A+HD80607B and its exoplanet HD808606b are studied in the

Primary-Centric Framework.

**Funding Declaration:**

This research is sponsored by UNIVERSITY GRANTS COMMISSION, India, under Emeritus Fellow scheme, Grant ID: EMERITUS/2012-13-GEN-855/.

**Clinical Trial Number not applicable.**

**References:**

1. Mardling, R. A. (2007). "Resonance, chaos and stability in the general three-body problem," *Proceedings of the International Astronomical Union*, **3** (S246), 199-208. https://doi.org/10.1017/S1743921308015615
2. Sharma,Bijay Kumar (2011); "The Architectural Design Rules of the Solar System based on the New Perspective," *Earth, Moon and Planets,* **108,** 15-37, (2011);
3. Naef,D; Lathan,D.W.;Mayor,M.: et.al. (2001); "HD80606b, a planet onan extremely elongated orbit." *Astronomy and Astrophysics,* **375,**L27-L30,(2001); *DOI: 10.1051/0004-6361:20010853@ESO2001*
4. Pont,F.;Hebsard G.;Irwin,J.M.; et.al. (2009); "Spin-Orbit misalignment in the HD80606 Planetary System," *Astronomy & Astrophysics,* **502,** (2); 2009; *DOI: 10.1051/0004-6361/200912463;*
5. Boue, G.: et.al. (2013); " New Analytical expression of the Rossiter-McLaughlin effect adapted to different observation techniques," *Astronomy & Astrophysics*, **550,** A53; 2013; *DOI: 10.1051/0004-6361/201220146;*
6. Lidov, Mikhail L.;(1962); " The evolution of orbits of artificial satellites of planets under the action of gravitational perturbations of external bodies," *Planetary and Space Science,* **9,** (10),719-759, doi:10.1016/0032-0632(62)90129-0;