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CONTRIBUTED POSTER

A MATHEMATICAL FORMULA TO CALCULATE THE DISTANCES OF EXOPLANETS' ORBITS FROM THEIR STARS

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Abstract

For distances of exoplanets from their stars, we can use a mathematical formula derived with an appropriate generalization and modification of the Titius-Bode law. Specifically it is applicable to seven planetary systems, in each one of which at least three planets have been discovered.

1) For the star 55Cancri, in which four planets have been found, we have:

Take the geometrical series:

0,024 0,048 0,096 0,192 0,384 0,768 1,536 3,072. In which each term is double the previous one. The first term is the **parameter κ.** With the addition of 0 as the first term, we have the series:

0 0,024 0,048 0,096 0,192 0,384 0,768 1,536 3,072. Adding 0,014 to each term produces a third series: 0,014 0,038 0,062 0,110 0,206 0,398 0,782 1,550 3,086 6,158.

0,014 is the **parameter λ.** The actual distances of the discovered planets are: [5]

0,038 AU (e) 0,115 AU(b) 0,24 AU(c) *(Not satisfactory)* 0,785 AU(f) and 5,901AU(d)

0.000	0.024	0.048	0.096	0.192	0.384	0.768	1.536	3.072	6.144
0.014	**0.038**	0.062	**0.110**	**0.206**	0.398	**0.782**	1.550	3.086	**6.158**
	0.038		**0.115**	**0.240**		**0.785**			**5.901**
	e		b	c		f			d

The above appear to be an adaptation of the well-known Titius Bode law to this planetary system.

For the above the following formula holds true: $\mathbf{D = 0.024 \cdot 2^x + 0.014}$

Planets	***x***	***D (AU)***	Actual distance (AU)	Deviation %
e	*0*	**0.038**	***0.0380***	**0.00**
	1	0.062		
b	*2*	**0.110**	***0.1150***	**4.35**
c	*3*	0.206	*0.2401*	**14.52***Not satisfactory
	4	0.398		
f	*5*	**0.782**	***0.7850***	**0.38**
	6	1.550		
	7	3.086		
d	8	**6.158**	**5.9010**	**-4.36**

THE GENERAL FORMULA

As regards the planets' distances from their star, as well as the satellites' distances from two big planets of the solar system, the following general formula holds true: $\mathbf{D=\lambda \cdot 2^x+\kappa}$

Where κ and λ are the constants of the system, with κ corresponding to the distance of a relatively small object orbiting near the center of the system.

2) For the star HD 69830. In this system, in which three planets have been found, the following formula seems to hold true: $\mathbf{D = 0.0367 \cdot 2^x + 0.0433}$ (κ=0.0433 λ=0.0367)

Planet	x	D (AU)	Actual Distance (AU) **[1]**	Deviation %
	-1	0.062		
b	0	**0.080**	**0.079**	1.25
	1	0.117		
c	2	**0.190**	**0.186**	2.16
	3	0.337		
d	4	**0.631**	**0.630**	0.08
	5	1.218		

3) For the star HR 8799 In this system, in which three planets have been found, the following formula seems to hold true: $\mathbf{D = 3.65 \cdot 2^{X} + 9.4}$

Planet	x	D (AU)	Actual Distance(AU) [2]	Deviation %
	0	**13.05**	**14.5**	10
	1	16.70		
d	2	**24.00**	**24**	0.00
c	3	**38.60**	**38**	1.58
b	4	**67.80**	**68**	-0.29
	5	126.20		

4) For the star Gliese 581 in which four planets have been found, the following formula seems to hold true: $\mathbf{D = 0.013 \cdot 2^{X} + 0.017}$

Planet	x	D (AU)	Actual Distance(AU) **[3]**	Deviation %
	-1	0.0235		
e	0	**0.0300**	**0.030**	0.00
b	1	**0.0430**	**0.041**	4.65
c	2	**0.0690**	**0.070**	-1.45
	3	0.1210		
d	4	**0.2250**	**0.220**	2.22
	5	0.4330		

5) For the star HD160691 in which four planets have been found, for three of which the following formula seems to hold true: $\mathbf{D = 0.3 \cdot 2^{X} + 0.3}$

Planet	x	D (AU)	Actual Distance(AU) [4]	Deviation %
	0	0.60		
d	1	**0.90**	**0.92**	-2.2
b	2	**1.50**	**1.50**	0.0
	3	2.70		
e	4	**5.10**	**5.20**	-2.0
	5	9.90		

The planet (c), which does not correspond to the formula, is located at a distance of 0.0909AU.

6) For the star HD 40307 In this system, three planets have been found, the following formula seems to hold true: $\mathbf{D = 0{,}031 \cdot 2^{X} + 0.016}$

Planet	x	D (AU)	Actual Distance(AU) **[7]**	Deviation %
	-1	0,0315		
b	0	0,0470	0,047	0,00

c	1	0,0780	0,081	-3,85
d	2	0,1400	0,134	4,29
	3	0,2640		

7) For the pulsar PSR B1257+12 four planets have been found, for three of which the following formula seems to hold true: $\mathbf{D = 0.035 \cdot 2^{x} + 0.325}$

Planet	**x**	**D (AU)**	Actual Distance(AU) **[8]**	Deviation %
	0	0,360	0,360	
c	1	0,395		
d	2	0,465	0,460	
	3	0,605		
e	4	0,885		
	5	1,445		
	6	2,565	2,600	

The planet (b), which does not correspond to the formula, is located at a distance of 0.19AU.

REMARKS

1) The planetary systems in which the formula applies must meet the following conditions: (a) to be coplanar (b) the planets do not have great eccentricity and (c) to not be located near the star of a planet with a very high mass compared with the mass of the star.

2) The formula also applies to the solar system and to the satellite systems of the planets Jupiter and Uranus. [9], http://www.polkarag.gr/FILES/astr/Armonie%20celeste.htm

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