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Study of 2003 YT1 Asteroid

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Abstract

The asteroid 2003 YT1 was at approximately 25 million kilometers from the Earth on May 05-2011 (U.T) [1]. It has an orbital period of 1.17 years and it was estimated to have a size of 2.63 kilometers [2]. From our Observatory, located in Pasto-Colombia, we captured several pictures, videos and astrometry data during three days. Our data was published by the Minor Planet Center (MPC) and also appears at the web page of NEODyS [3]. Our observatory's code at the MPC is "H78". Pictures of the asteroid were captured with the following equipment: 14" LX200 GPS MEADE (f/10 Schmidt-Cassegrain Telescope) and STL-1001 SBIG camera. This asteroid has a rotation period of 2.343 hours [4] and its binary nature was noted by the Modra and Ondrejov Observatories independently [5]. Nolan used radar observations to determine that this is a binary with sizes of approximately 1 and 0.2 km and primary rotation period of $P < 2.6$ h [6]. The asteroid will be at approximately 0.0348 A.U from the Earth on October 31-2016 and at approximately 0.0113 A.U from the Earth on October 31-2016 [7]. Astrometry was carried out, and we calculated the orbital elements. It was designed a computing program on Visual Basic 6.0. SPACEWEATHER published our video of 2003YT1 on May 5/2011 [8].

1. Introduction

After having processed adequately all the photographies (bias reduction, dark frames correction and correction of flat frames), we employed the software "The Sky6**"** and the "CcdSoft-Version 5" in order to identify the stars appearing on the images, so we could have the coordinates of any standard star. It is necessary to use many reference stars so we can have a higher precision on determining the asteroid's coordinates. The asteroid is identified superposing the photos and designing a small video to appreciate clearly enough its movement with regard to the fixed stars.

1.1 Calculating the orbital parameters

Making polynomial interpolation with Lagrange's method [9]:

Be : $\alpha_1 , \alpha_{2,} \ldots\ldots\ldots , \alpha_n$
the right ascensions of the standard stars

$\delta_1 , \delta_{1,} \ldots\ldots\ldots , \delta_n$
the declinations of the standard stars

Then the R.A and the Dec of the asteroid are calculated with the expressions:

$$\alpha_A = \alpha_1 l_1 / g_1 + \alpha_2 l_2 / g_2 + \ldots + \alpha_n l_n / g_n \quad (1)$$

$$\delta_A = \delta_1 l_1 / g_1 + \delta_2 l_2 / g_2 + \ldots + \delta_n l_n / g_n \quad (2)$$

$$g_n = (r_n - r_1) (r_n - r_2) \ldots . (r_n - r_{n-1}) \quad (3)$$

$$l_n = (r - r_1) (r - r_2) \ldots . (r - r_{n-1}) \quad (4)$$

We use the fundamental vectorial triangle to transform the asteroid's equatorial geocentric coordinates into equatorial heliocentric and finally transforming them to ecliptic, through the rotation described by the following equations:

$$x' = x \qquad y' = z \operatorname{sen}(\varepsilon) + y \cos(\varepsilon) \quad (5)$$
$$z' = z \cos(\varepsilon) - y \operatorname{sen}(\varepsilon)$$

x, y, z (equatorial coordinates), x´,y´,z´ (ecliptic coordinates)

The obliquity of the ecliptic with respect to the equator is:

$\varepsilon = 23.439291-0.0130042\ T-0.00000016\ T^2$ (6)

$T = (JD - 2451545)/36525$ (J.D = julian day) (7)

Note: To calculate the orbital parameters we employed the Laplace and Gauss methods.

2. Summary and Conclusions

We obtained the following orbital parameters: eccentricity = 0.29137550, semi-major axis = 1.10890668 A.U, orbital inclination = 44.01734 deg, longitude of the ascending node = 38.36315 deg, argument of perihelion = 90.86792 deg, orbital period = 1.17 years (426.51 days), mean motion = 0.84403716 deg/d, perihelion distance = 0.78579839 A.U, aphelion distance = 1.43201498 A.U. The parameters were calculated based on 104 observations (2011 May: 5-10 U.T) with RMS error = 0.354 arcseconds.

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