

# CENTRIPETAL FORCE

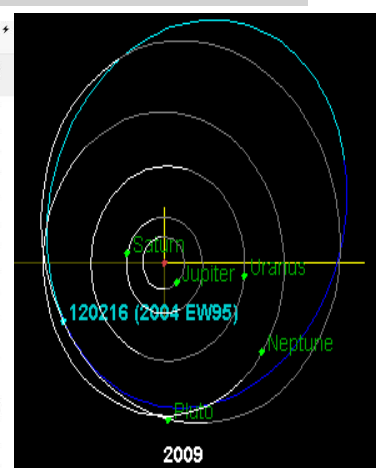
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Austin , Texas USA [jpcise@austinc.edu](mailto:jpcise@austinc.edu) & New York Times, May 10, 2018 by Nicholas St. Fleur

## This Asteroid Shouldn't Be Where Astronomers Found It



Discovery	
Discovered by	Kitt Peak Obs.
Discovery date	14 March 2004
Designations	
MPC designation	(120216) 2004 EW <sub>95</sub>
Minor planet category	TNO <sup>[N]</sup> · plutino <sup>[PE]</sup>
Orbital characteristics <sup>[d]</sup>	
Epoch 2018-Mar-23 (JD 2458200.5)	
Uncertainty parameter 2	
Observation arc	4847 days (13.27 yr)
Aphelion	52.590 AU (7.8674 Tm)
Perihelion	26.975 AU (4.0354 Tm)
Semi-major axis	39.783 AU (5.9515 Tm)
Eccentricity	0.32193
Orbital period	250.93 yr (91652 d)



An artist's impression of 2004 EW95, a relic of the primordial solar system, which scientists believe originated in the asteroid belt between Mars and Jupiter but now floats beyond Neptune.

By Nicholas St. Fleur

$R = 5.9515 \times 10^{12}$  m.  
around the sun

$T(\text{period}_{2004EW95}) = 91,652$  days

May 10, 2018 At first the astronomers thought it was a mistake. They had found a carbon-covered asteroid floating among countless icy bodies far away in our solar system. The newly discovered space rock, which they named **2004 EW95**, was something the scientists would have expected to have seen in the asteroid belt between Mars and Jupiter. Instead, it was dancing near Neptune. Their finding, which was published Wednesday, suggests that **2004 EW95 is the first of a new class of space objects lurking in the outer solar system**, in a vast, frigid region known as the Kuiper belt that **still contains many mysteries**. The researchers believe that the asteroid sling-shotted from the inner solar system some 4.5 billion years ago, and that it may provide insight into the early formation of our planets. Using the [European Southern Observatory's Very Large Telescope](#), [Tom Seccurl](#), a [doctoral student](#) at Queen's University Belfast in Northern Ireland, and his colleagues examined light signatures from the icy surfaces of Kuiper belt objects. They noticed something strange about one object that measured nearly 190 miles long and was located 2.5 billion miles from Earth. Their analysis showed that this object did not share the same frigid past as the ice balls drifting nearby. **That most likely meant that the asteroid once resided in a hotter environment much closer to the sun.** The team also found that the asteroid's chemistry was dominated by compounds called ferric oxides and phyllosilicates, which had never been seen before on Kuiper belt objects. These pieces of evidence led the team to conclude that **2004 EW95 was formed in the inner solar system, and had most likely been hurled to the outer solar system as the giant gas planets, Jupiter and Saturn, migrated away from the sun.** One of the prevailing ideas in astronomy is that [our solar system formed in chaos](#). Some 4.5 billion years ago, baby planets and discs of dust collided with one another violently over millions of years. At some point, the gas giants moved from their positions in the inner solar system to the outer solar system. This has been called the **"grand tack" hypothesis**. **The researchers aren't sure how exactly or at what point 2004 EW95 was flung from the interior, but they think it coincided with the gas giant migration.**

**INTRODUCTION:** Gravity keeps all objects in orbit about the sun: planets, meteors, comets, & objects like 2004EW95 in this article. Gravity provides required centripetal force

$$GmM/R^2 = m v^2/R, \text{ where}$$

$$v = R \omega = R2\pi f = 2\pi R/T$$

$$GM/R^2 = [4\pi R^2/T^2] / R, \text{ thus}$$

$$M = [4\pi^2/G] [R^3/T^2]$$

Kepler's 3rd. Law

**QUESTIONS:** (a) Find the period in seconds?, (b) Knowing R & T for 2004EW95 find mass of sun which it circles? , (c) How close did your computation for sun mass come using data for asteroid 2004EW95?

**HINTS:** G = gravitational constant =  $6.67 \times 10^{-11}$  N·m<sup>2</sup>/kg.<sup>2</sup>, 24 hrs./day, 3600 s./hr.

**ANSWERS:** (a)  $T_{2004EW95} = 7.9187 \times 10^9$  seconds,

(b)  $M_{\text{sun}} \approx 2 \times 10^{30}$  kg., (c) NASA's mass of sun is the same. Thus, Kepler had a great law using Newton's law of universal gravitation..... $G mM/R^2$ .