Tenth Planet Has a Moon

October 3 2005

Scientists are over the moon at the W.M. Keck Observatory and the California Institute of Technology over a new discovery of a satellite orbiting the Solar System's 10th planet (2003 UB313). The newly discovered moon orbits the farthest object ever seen in the Solar System.

The existence of the moon will help astronomers resolve the question of whether 2003 UB313, temporarily nicknamed "Xena," is more massive than Pluto and hence the 10th planet. A paper describing the discovery was submitted to the Astrophysical Journal Letters on October 3, 2005.

"We were surprised because this is a completely different type of satellite from anything we've seen before," said Dr. Mike Brown, professor of Planetary Sciences at the California Institute of Technology in Pasadena. "It is essentially a new class of satellites to large Kuiper Belt objects. It is tiny compared to the primary, and much fainter. We have never seen satellites like this before."

The newly discovered moon, which is 60 times fainter than its parent body, is affectionately called "Gabrielle" after the faithful traveling companion to Xena on the syndicated TV series. Future observations with the 10-meter Keck II telescope and the Hubble Space Telescope will determine the moon's orbital characteristics, which has an estimated period of about 14 days, and will therefore reveal the precise mass and density of Xena.

"What is interesting is that Xena, Pluto and Santa, three of the four largest objects in the Kuiper belt, all have moons," said Dr. Marcos van

Dam, adaptive optics scientist at the W. M. Keck Observatory and co-author on the paper describing the discovery. "These moons suggest that these Kuiper belt objects may have formed differently than smaller objects in the same region."

The moon circling Xena was first discovered with the Keck II telescope on September 10, 2005 (UT) using the Laser Guide Star Adaptive Optics system (LGS AO). Since 2003, this system has been providing very high spatial resolution imaging in the infrared comparable to that of visible light images from Hubble Space Telescope.

With LGS AO, observers not only get higher resolution, but the light from distant objects is concentrated over a much smaller area on the instrument detector, making faint detections possible. The results are quickly advancing the understanding of binary Kuiper belt objects, a region in the Solar System beyond the orbit of Neptune.

The Keck LGS AO system has also been used to look at other recently discovered large bodies in the Kuiper belt. A small moon was found circling around 2003 EL61 (codenamed "Santa") but none was found orbiting 2005 FY9 ("Easterbunny"), the two largest known Kuiper belt objects after Xena and Pluto.

"When we test collision models to predict how Pluto and Charon formed, the models kept producing tiny satellites, much smaller than Charon," added Brown "But we had never seen satellites that small before in the Kuiper belt. But then we found a moon in the Santa system, and then we found another moon circling Xena, and they both look very similar to one another. This leads us to conclude that the largest objects in the Kuiper belt may have been subject to collisions."

Van Dam described the discovery: "At first we saw this little faint thing that kept cropping up in all the images, and we knew it was not a

background star or galaxy because it moved across the sky with the primary. We could also tell that it was not an image artifact because it did not rotate with the sky and was consistent in each of the 24 images. By morning we knew that we had made a major discovery."

The discovery of the moon's primary, Xena, was announced July 29th by planetary astronomers Mike Brown of Caltech, Chad Trujillo of Gemini Observatory and David Rabinowitz of Yale University. It is currently about 97 astronomical units from the Sun (an astronomical unit is the 93-million-mile distance between the Sun and Earth), and is larger than the size of Pluto.

It takes 560 years to complete one trip around the Sun (versus 250 years for Pluto) and has a very steep angle in relation to the other planets, about 45 degrees off from the orbital plane of the other nine planets. Xena also has a very elliptical orbit, coming in as close as 3.5 billion miles (38 AU) and as far away as 9 billion miles.

The names "Xena," "Gabrielle," "Santa" and "Easterbunny" are temporary nicknames until the International Astronomical Union (IAU) rules on their official names. The proposed names have been submitted to the IAU and will follow the mythological and spiritual traditions of Kuiper belt objects.

Meanwhile, the IAU has stated it will not rule on a name until the IAU Working Group in charge of defining a planet determines a minimum size for a planet. Until then, the IAU considers all objects discovered in the outer solar system as "Trans-Neptunian" objects.

Adaptive Optics is a technique that corrects the effect of atmospheric blurring to produce images with a resolution comparable to what would be obtained from space. To measure atmospheric distortion, the adaptive optics system relies on a relatively bright guide star very close in the

field of view to the scientific object of study.

Since there was no naturally-occurring guide star sufficiently bright enough with which to study Xena, astronomers used the Keck Laser Guide Star system to create an artificial star instead.

The team responsible for the discovery of Gabrielle, a moon orbiting 2003 UB313, are Michael E. Brown and Antonin H. Bouchez of California Institute of Technology in Pasadena; Marcos A. van Dam, David Le Mignant, Randall D. Campbell, Jason C. Y. Chin, Al Conrad, Scott K. Harman, Erik M. Johansson, Robert E. Lafon, Paul J. Stomski Jr., Douglas M. Summers and Peter L. Wizinowich of the W. M. Keck Observatory in Hawaii; Chadwick A. Trujillo of Gemini Observatory in Hawaii and David L. Rabinowitz of Yale University in Connecticut.