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Study on Kuiper Belt- Unexplored Reservoir of Solar System's Secrets

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Abstract:

Kuiper belt is a very vast elliptical plane which is home to our dwarf planet Pluto as well as Haumea which is considered as minor planet and is a trans-Neptunian object-its orbit is beyond that of the farthest ice giant in the solar system. Haumea takes 3.9 hours to make a full rotation and it has by far the fastest spin, and thus calculates to uphold the shortest day in our solar system for any planet or KBOs. Kuiper Belt is still a very mysterious place, and we have a lot to learn about it and through it, about our solar system.

Besides Haumea most of the Kuiper belt objects are way too pale for meaningful compositional study but the objects discovered till date assumed to hold the capability to reveal the secret of generation of our solar system as the studies done till date suggests that the residues and all of the other leftovers after and whilst formation of solar system dived into the Kuiper Belt. Since the atmospheric condition in the belt id dynamically less the objects might be still in its earliest of form rather being degraded with the time.

Keywords: *Kuiper Belt, Solar System, Haumea, Comets.*

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Introduction

The Kuiper Belt is a massive stretch of space, elsewhere the past identified gaseous gigantic planet of the Solar System, which is the Neptune. The Kuiper Belt is as ancient as the Solar System. It was at the time of the creation of our Solar System that greatest of rock stones, soils and vapors were used up to form the Sun and the 8 celestial bodies. The residual rock stones, soils and vapors were then brushed off to the Sun or the external peripherals of the Solar System. This space is composed of icy objects (Baidya, 2014).

It's Discovery-

In 1950, Jan Oort, a Dutch astronomer declared that the comets that we generally notice in our familiar solar system truly initiate from far extents of the solar system. But before Jan, Kenneth Edgeworth, a different astronomer, announced in 1943 that huge celestial bodies and comets might be present afar from Neptune. Lastly, astronomer Gerard Kuiper, in 1951 foretold that there is a presence of a massive stretch of icy entity afar from Neptune. This massive extension, today is termed as Kuiper Belt. (Baidya, 2014)

Location of Kuiper Belt-

The Kuiper Belt spreads roughly from the track of Neptune (at 30 Astronomical Units to about 55 Astronomical Units) from the Sun. The chief frame of this belt conceals most of this area, stretching from almost 40 AU to 48 AU. It is dense in most of the places and astronomers have defined it as an entity, which is torus in shape than a normal belt would be. Other counties of the Kuiper Belt contain a ring of dispersed substances that contribute to the population of worlds called Trans-Neptunian Objects.

Its Shape and Size-

Kuiper Belt is elliptical in shape. It extends up to an expanse of 4.5 to 7.4 billion kilometers from Sun. This is nearly 30 to 50 times the distance between the Earth and the Sun.

Kuiper Belt Object (KBO)-

The largest Kuiper Belt Objects are- our dwarf planet: innumerable comets, Quaoar, Makemake, Pluto, Haumea, and Varuna, Ixion. All of the above-mentioned are frequently mentioned as Trans-Neptunian Objects (TNOs).

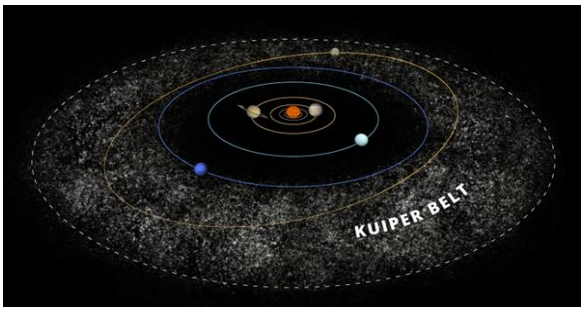

Figure no.1: Kuiper Belt in Solar System

Review of Literature

Malhotra, 1996 described in her article that the Solar system afar from Neptune is supposed to be the reservoir of tiny primeval forms which was left over from formation process of the planet. Her work describes the subtleties of tiny entities close to the chief orbital reverberations with Neptune. She explained that near orbital resonance with Neptune, the phase resonance is more stable. Assessments of the thicknesses of constant reverberation regions along with the qualities of resonant orbits were acquired from the planar, circular constrained three-body model. Though her model didn't held the complete intricacy of the extended term orbital subtleties but somehow provides a standard for the stage arrangement and assets of trans-Neptunian Solar system.

Stern and Colwell, 1997 studied that how does the Kuiper belt and its trans-Neptunian ring of comets and minor celestial bodies initiated and developed to its current mass and architecture. They used time-dependent model of collisional evolution of the EKB and based upon their findings they concluded that a extensive variety of conventions, collisional progress should have exhausted the figure of the 30-50 AU region by >90% initially in the past of the solar system, thereby generating a gap or a deep scar in the surface mass density through an extensive area afar from Neptune and that Neptune has had far less dynamical impact beyond 50 AU. In the end it was further mentioned that unless the solar nebula was abridged near 50 AU, then surface mass density of solids might somewhere be beyond ~50 AU may upsurge again vividly.

Gladman et al., 2001 in his paper has described structure of Kuiper belt in terms of radial extent and size distribution. The facts in the paper was included

by studying Kuiper's apparent magnitude distribution via the ESO Very Large Telescope UT1 and the deep imaging on the Canada-France-Hawaii Telescope. The finding of the paper was that the complete variety of experimental substances (magnitudes mR ~ 20–27) is finely characterized by an uninterrupted power law, with the amount of substances per square degree brighter than magnitude R being of the form Σ (mR < R) = 10 , with R0 = 23.5 and α = 0.69. Also that there was abrupt size dissemination in the perceived variety according to the luminosity function's slope. In the paper it was concluded that roll over is for diameters of less than 50 km, in arrangement with collisional models and a belt weight between 30 and 50 AU of order 0.1 M$\oplus$, relatively unresponsive to the roll over diameter as long as the latter is 1 km.

Brown, 2001 developed a common technique for defining the impartial disposition distribution of the Kuiper belt by only making use of the inclination and latitude of known Kuiper belt objects (KBOs). He used the data of all 379 known KBOs to determine the inclination distribution. They established their results as that of a natural methodical procedure for the predisposition dissemination is a sin of the inclination multiplied by a Gaussian. On the basis of which he reported that the inclination distribution of all KBOs is well fitted by sin I multiplied by a sum of two Gaussians with widths 2 6 and 15° ± 1°. For this inclination distribution, the Kuiper belt has an effective area of 8100 deg2 and a FWHM of 12.5° ± 3.5° in latitude. Further added that in every other scenario of angle, observance etc. the inclinations of the Kuiper belt objects appear larger than anticipated from dynamical recreations of probable turbulences.

Trujillo and Brown, 2002 studied between the co-relation of Kuiper's belt color and inclination. The calculated broadband optical BVR photometry of 24 standard and dispersed Kuiper belt objects (KBOs) by replicating the available set of colors for these groups of articles and described a substantial assumption. In their study, they eliminate the modest roots of color variety like coloring agent or effects. They concluded through their data that specious association brought by sampling preference, as inclination and perihelion are interconnected in the specimens of KBOs detected. But somehow they fail to establish the fact that whether the inclination and color trend is because of ecological reasons, like as primordial population effects, or collisional resurfacing.

Levison and Morbidelli, 2003 mentioned Kuiper Belt as 'dynamically cold Kuiper belt'. Their work was majorly done on the creation of the belt through external passage of the bodies especially during the phenomena of Neptune's movement through the belt. They reported that the belt comprises of articles on low-inclination orbits between ~40 and ~50 AU from the Sun and presently holds substance adding up less than a tenth the weight of the Earth. They established that the whole Kuiper belt is made nearer to the Sun and was transported outwardly during the concluding phases of planet foundation. And also, matters would not have developed to their current dimension unless the cold Kuiper belt formerly was comprised of tens of Earth multitudes of solids, though there are significant limitations in the observance mechanism of mass depletion.

Elliot et al., 2005 majorly worked on the study of core population of Kuiper Belt and its dynamical classification. There was search optimized with Blanco and Mayall 4 m telescopes at the Cerro Tololo Inter-American Observatory and Kitt Peak National Observatory their survey has a mean 50% sensitivity at VR magnitude 22.5. They reported findings of 320 labelled KBOs and Centaurs for the period 2000 March through 2003 December. They concluded that inclination dissemination approves the existence of "hot" and "cold" inhabitants, the cold population demonstrates a concerted "core" with a complete breadth at half-maximum of nearly 4 6, whereas the hot population seems like a "halo," outspreading past 30°. Also that, secondary latitude dissemination is rationally constant with the latitude distribution consequent from through observation.

Conclusion

Solar system that stretches afar up to Neptune is thought to be a reservoir of tiny primitive entities. Kuiper belt is one of the oldest belt known in solar system which is located beyond Neptune (at 30 AU out to almost 55 astronomical unit). And came to light during 1950 that all the comets originate from this region which is full of icy objects. Astronomers like Oort and Kuiper strongly support this theory. Levison and Morbidelli believe and refer to it as dynamically cold belt, and have studied majorly the formation of this belt. Although many studies and observations have been made, yet universe remains a mystery that needs to unfold many hidden secrets, in order to explore this area many more discoveries are yet to be made.

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