Earth-orbiting asteroid Toro discovered by Dr. Alfven, grad student Wing-huen Ip

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Scientists at the University of California, San Diego have discovered that the earth has a "little brother" in the heavens.

The discovery that another celestial body in addition to the moon, lies within earth's gravitational field was announced today (October 7, 1971) by Nobel laureate Dr. Hannes Alfven, professor in residence at UCSD, and one of his graduate students, Wing-Huen Ip.

The "little brother" is the asteroid Toro, a relatively tiny body measuring perhaps 1.2 miles in diameter. Toro's elliptical orbit intersects the earth's path twice every eight years, Ip explained, being attracted to these "encounters" by the gravitational force of the earth.

This Toro-earth relationship means, said Alfven, that earth is part of a "triplet" sub-system in the solar system, comprised of three bodies instead of only two - the earth, and the moon.

Toro circles the sun once every 1.6 years while earth makes the round-trip once annually, Alfven explained. Thus earth makes eight revolutions around the sun while Toro is making five. In the course of these circlings, the orbit of "Toro" - influenced by the pull of earth's gravitational force - "encounters" earth's path once every eight years in January, and once in the same time-period in August though in different years. The next August encounter will occur in 1972, and the next January intersection in 1975.

"It is as if earth were practicing tennis shots, using Toro as the ball," Alfven explained. "Said another way, twice every eight years this 'little brother' of earth comes very close to its big brother, takes one terrified look at that big ball of smog and noise, and rushes away into outer space to recover its composure."

The discovery is significant not only because it is now clear that earth has two celestial bodies in its gravitational field, but also because Toro - due to its unique relationship with earth - may become a target for an upcoming space mission.

Alfven, who won the Nobel Prize in physics in 1970, said the Toro studies were financed under a grant from the National Aeronautics and space Administration. The grant resulted from a proposal made by Alfven and Dr. Gustaf Arrhenius, UCSD professor of oceanography, to send an unmanned spacecraft to an asteroid. By making a soft landing on an asteroid, they argue, such a spacecraft might unlock clues to many secrets of the universe which are still unresolved. Asteroids, Alfven and Arrhenius believe, may have orbited in space undisturbed for eons, without suffering the damaging effects of erosion and other influences which have disturbed the surfaces of moon and earth.

Toro, passing relatively close to earth during its January and August encounters, could become a logical target for such an unmanned mission. At the time of these intersections with earth's orbit, said Alfven, Toro is approximately one-tenth of an astronomical unit from the earth, or some 9.3 million miles distant. Said another way, this is about 50 times the distance between earth and the moon. A spacecraft, depending on its velocity, could reach Toro from earth in from six months to a year, Alfven estimated.

Discovery of Toro's unique behavior was established by computer-aided calculations made by Ip and Dr. L. Danielsson, of the Royal Institute of Technology in Stockholm, Sweden. The studies were begun late in 1970 at UCSD, continued in Stockholm, and concluded at UCSD this year.

Calculations made by Ip and Danielsson cover Toro's orbits for 200 years before and after 1971 - a total of 400 years.

"But Toro has probably been in this quasi-moon relationship with the earth for some thousands of years at least, and possibly even from the time the solar

system originated, 4.6 billion years ago," said Alfven. "It will probably remain in that relationship for thousands of years to come. We cannot know for certain unless and until further computer calculations are made."

According to calculations already made, he noted, chances of a collision between earth and Toro are remote, "at least for the next 200 years.

"My personal belief," said Alfven, "is that such an encounter could not occur for at least a thousand years, if then."

Asked what would happen should Toro ever smash into earth, Alfven said "it would be a terrible catastrophe. The extent of the damage would vary, of course, depending on where it landed."

Toro was discovered by Dr. Samuel Herrick, professor of astronomy and mechanics and structures at UCLA, in 1964. He gave the asteroid his wife's surname, Toro, and named still another asteroid Betulia, his wife's given name.

Commenting on the newly announced earth-Toro relationship, Herrick said:

"Toro is always within the earth's gravitational field, which extends to infinity. What is significant here is not that it comes within the field, but that it does so regularly and in such a relationship that the earth's gravitational field becomes important."

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