SPACE SCIENCES

The size of Herculina's possible moon

On June 7, two observers monitoring the occultation of a star by the asteroid 532 Herculina detected a secondary occulation that has been tentatively concluded to be a natural satellite in orbit around the asteroid (SN: 7/15/78, p. 36). Analysis of the secondary event, says Edward Bowell of Lowell Observatory in Arizona, now indicates that the possible moon is 45.6 ± 3.6 kilometers in diameter, and that when observed it was 977 ± 1 km from Herculina. The asteroid itself, according to Bowell, is 243.0 ± 1.4 km across.

There have been attempts to photograph asteroid and moon together, but the difference in their magnitudes (assuming that they have equal albedoes) is about 3.6, making the tiny satellite a dim target indeed. The U.S. Naval Observatory's 1.55-meter astrometric telescope in Flagstaff, Ariz., was used to make 15 photographic observations over a five-night period, but no "elongations" were detected that could not be attributed to the asteroid's motion across the sky. The only real hope of further confirmation may be to take advantage of additional occultations, and one may take place on August 22, when viewers in South America may see Herculina pass in front of a star known as SAO 140552.

Deuterium observed in Saturn's methane

The heavy hydrogen isotope called deuterium is believed by many researchers to have been produced only in the primordial fireball at the birth of the universe. Because it is affected differently than ordinary hydrogen in stellar nuclear reactions and other processes, measurements of the present deuterium/hydrogen ratio in the universe are seen as keys to an understanding of primordial conditions, including density calculations relating to whether the universe is "open" or "closed."

A new addition to such research is the detection of "deuterated" methane in spectra of the planet Saturn. This is a methane molecule (CH_4) one of whose hydrogen atoms is a deuterium atom, producing a molecule described as CH_3D. The observations, reported in the July 28 SCIENCE, were made at the 5-micron band by Uwe Fink and Harold P. Larson of the University of Arizona, using a Fourier-transform spectrometer and the 154-centimeter telescope at Catalina Observatory. The calculated temperature (175 ± 30°K) for the level at which the spectral absorption features were observed suggests that they were "fairly deep" in Saturn's atmosphere. The CH_3D abundance (2.6 ± 0.8 cm-amagat), according to the scientists, yields a deuterium/hydrogen ratio of about 2×10^{-5}.

This ratio is considerably lower than that calculated for the earth and for meteorites (consistent with past studies which have found both earth and meteorites to be enriched in deuterium). It is, however, in the range of past estimates for Jupiter. A research group (R. Beer et al.) detected CH_3D in the atmosphere of Jupiter several years ago, and calculated D/H ratios for that planet ranging from 2.8×10^{-5} to 7.5×10^{-5}. Another team (J. T. Trauger et al.) used the detection of deuterated hydrogen (HD), which could be directly compared with the ordinary hydrogen that is most of the planet's atmosphere, to yield a D/H ratio of 2×10^{-5}. More recently, HD measurements have been used to calculate ratios of 5.1×10^{-5} for Jupiter and 5.5×10^{-5} for Saturn.

Jupiter and Saturn are good subjects for such calculations, since they are massive enough to have retained most or all of the hydrogen with which they formed. "If stellar processing of the deuterium that formed the solar system is minimal," Fink and Larson conclude, "the D/H ratio obtained for Jupiter and Saturn may be the most representative value determined so far for the primordial D/H ratio at the time of formation of the universe."

ASTRONOMY

A very far out quasar

To the ranks of extremely distant astronomical objects add the radio source called PKS 1402+044. According to a report in ASTROPHYSICAL JOURNAL LETTERS (vol. 222, p. L81) by Bruce A. Peterson of the Anglo-Australian Observatory, David L. Jauncey and Alan E. Wright of the Commonwealth Scientific and Industrial Research Organization in Sydney and James J. Condon of Virginia Polytechnic Institute and State University, the object's redshift is 3.20. That is not the greatest redshift ever measured (which is slightly more than 3.5), but it puts PKS 1402+044 into a select company because there are fewer than a dozen objects with known redshifts greater than 3.

To measure the redshift, the object must be visible and have emission or absorption lines in its spectrum from which the shift can be measured. PKS 1402+044 had been identified with a reddish object of magnitude 18.5, which looked like a small galaxy on Palomar Sky Survey plates but appears stellar on plates taken with the United Kingdom Schmidt telescope, and is thus probably a quasar as are the other farthest out objects. If the value of the Hubble constant is taken as 55, a point over which there is more than a little controversy, a 3.20 redshift gives a distance of about 10.5 billion light-years.

PKS 1402+044 has a weak continuous spectrum with strong emission lines, and that may indicate one reason for the dearth of known objects with redshifts above 3.5. They may be too faint to be seen unless one of their strong emission lines falls into the spectral range of the Palomar Sky Survey plates.

X-ray source identifications by HEAO-1

One of the important tasks in X-ray astronomy at the present time is the identification of X-ray sources with visible objects so as to see what sort of known objects—if any—emit X-rays. The work involved is to narrow down the locations of the X-ray sources. X-ray observing equipment characteristically locates a source within a certain "error box" that may contain several candidates for visual identification, and the task is to make the error box smaller or pick the likeliest candidate.

The scanning modulation collimator on HEAO-1 has succeeded in making four such identifications that may prove very interesting according to two slightly overlapping groups of astronomers from the Harvard-Smithsonian Center for Astrophysics and Massachusetts Institute of Technology (Herbert Gursky, Hale Bradt et al.). One of these is the confirmation of a suggestion in the fourth Uhuru catalog of X-ray sources that the X-ray source 4U1651+39 is identical with the BL Lacertae object known as Markarian 501. If the identification holds up, the opportunity to study the X-ray spectrum of a BL Lacertae object will be interesting. BL Lacertae objects are rare, and to look at them, they seem to occupy a place somewhere between quasars and active galaxies such as Seyferts. They may occupy an important astrophysical niche.

The scanning modulation collimator has also provided precise positions for the first three X-ray sources discovered in the Large Magellanic Cloud, LMC X-1, X-2, and X-3. The error box for LMC X-1 contains a supergiant star of the B5 class, and X-3's contains a possibly variable BIII-IV star. The importance of such identifications is that stellar X-ray sources — if the stars are indeed the sources — in the LMC could be more easily studied than many in our own galaxy because the LMC stands at a high angle above the plane of our galaxy (in the southern sky) and so can be seen without much interference from interstellar dust. The positions charted for the LMC sources are precise to about 20 seconds of arc. There was an earlier suggestion that the source LMC X-1 had a spatially extended component, but this group finds no evidence of it.