ASTRONOMY

Moon, June: Gone balloon?

The moon has been held responsible for inspiring everything from versification to the growth of plants. Suppose we didn't have it. Someday the earth may not, although by then perhaps we humans will have exterminated ourselves. Such is one of the possible conclusions of a study of the dynamics of the sun-earth-moon system by Victor Szebehely and R. McKenzie of the University of Texas at Austin (ASTRONOMICAL JOURNAL 82:303).

Earlier studies had concluded that the earth-sun-moon system is stable, but they had ignored certain of the smaller dynamic variables (the eccentricity of the earth's orbit and the effect of the moon's mass). Including these variables leads Szebehely and McKenzie to conclude that the system is in fact slightly unstable. Someday in the future the moon may come loose and become a planet in its own right. Alternately, the calculation may support a history in which the moon was originally part of the earth, then became detached and went into orbit and will eventually fall back.

The thing in the middle of the galaxy

We know less about the center of our own galaxy than we know about the centers of many distant ones. Clouds of dust lie between us and the center, and so we cannot see the center. However, radio and infrared waves do penetrate the dust, and from such studies we know that there is some kind of compact object or objects there. This is comforting because the centers of other galaxies show dense bright configurations.

Certain astrophysicists have suggested that the center of every galaxy is inhabited by a massive, star-eating black hole. The most active matter eaters and energy producers among these would appear to us as quasars, the less active as simply bright galactic centers. Presumably our own would be one of the less active ones.

In the June 1 ASTROPHYSICAL JOURNAL LETTERS, K. I. Kellermann, D. B. Shaffer and B. G. Clark of the National Radio Astronomy Observatory and B. J. Geldzahler of NRAO and the University of Pennsylvania report a high-resolution study of the compact radio source in the galactic center known as Sagittarius A West, using a very long baseline interferometer consisting of antennas in Tyngsboro, Mass., Green Bank, W. Va., and Goldstone, Calif.

They find that the dimensions of the object are about 200 times the diameter of the earth's orbit (200 AU), and that 25 percent of the radio emission comes from a region only 10 AU across. The observed dimensions are about those of a black hole of 100 million times the sun's mass. The observation does not prove that such a black hole exists, but neither does it go against the suggestion.

New fine-scale galaxy count

Counts of galaxies to determine their distribution across the sky are important basic data in cosmology. They help determine the degree of isotropy and homogeneity of the distribution of matter in the universe as well as saying something about its density. They are, of course, quite tedious to do.

Ten years ago C. D. Shane and C. A. Wirtanen published a catalog of galaxy counts based on observations made from the Lick Observatory which compared the counts of galaxies in blocks of the sky that measured $1° \times 1°$. Now M. Seldner, B. Siebers, Edward J. Groth and P. J. E. Peebles of Princeton University have reworked the data to refine the comparison cells to $10' \times 10'$ (ASTRONOMICAL JOURNAL, 82:249). The raw counts and the final counts as corrected for photographic errors and extinction by galactic dust and the earth's atmosphere are recorded on 2,400 feet of magnetic tape.

New way to spin down stars

The latest theories of particle physics provide astrophysicists with a new way for stars to lose energy and slow down their rotation rates, according to Karnig O. Mikaelian of the Stanford Linear Accelerator Center, who presents the theoretical argument in the May 15 ASTROPHYSICAL JOURNAL LETTERS. How spinning stars can lose angular momentum and slow down their spin rates is an important question in theories of stellar evolution, especially in the last stages of a star's existence, when neutron stars, black holes or white dwarfs are formed.

Until now, astrophysicists have accepted two means by which a star might lose rotational energy and angular momentum: the emission of electromagnetic waves and the emission of gravitational waves. To these Mikaelian adds two kinds of interaction between neutrinos produced in the interior of the star and the matter of the star, elastic scattering and coherent scattering. These interactions, which involve bouncing off nuclear particles or whole nuclei, are permitted by the newest theories of neutrino behavior, the unified field theories, but were forbidden by the older theories. By coherent and elastic scattering, the neutrinos can carry off a large amount of energy and exert a decelerating torque on the star's rotation. At times in a star's history when neutrino production is copious, Mikaelian says, the neutrinos can be visualized as a cloud escaping from the center of the star, which exerts friction on the star as it comes out and leaves the star with a spiraling motion in the direction of the star's rotation.

There are three epochs in stellar evolution when neutrino production is especially important: the first million years after the formation of a neutron star, the formation of a black hole and supernova explosions. Pulsars are believed to be spinning neutron stars, so Mikaelian suggests, the effects of this neutrino-induced spindown may be observable in them.

Infrared interferometry

Infrared interferometry is now good enough to resolve the sizes and shapes of certain stars, satellites in the solar system and other small celestial bodies. So conclude D. W. McCarthy, F. J. Low and R. Howell of the University of Arizona after trying out an interferometer with two- and three-meter baselines. In the June 1 ASTROPHYSICAL JOURNAL LETTERS they report observations at wavelengths of 8.3, 10.2 and 11.1 microns in which three stars, Alpha Orionis (Betelgeuse), VY Canis Majoris and IRC + 10216 were resolved, as well as Jupiter's satellite, Callisto.

Determination of sizes and shapes of celestial bodies in the infrared is an important adjunct to similar studies at optical and radio wavelengths. The apparent size and shape of a given body may vary from wavelength to wavelength depending on what parts of it are radiating at a given wavelength. Infrared, for example, may be produced in circumstellar clouds that are larger in diameter than the optical star.

Alpha Orionis is in fact a star that possesses such a circumstellar shell that radiates in the infrared, and the reported observations were intended to measure the diameter of the shell, which astronomers believed to be composed of gas and dust dominated by silicates. A shell with a diameter of 1.5 seconds of arc or greater would fit the observations at 10.2 and 11.1 microns, but a large part of the total emission is not accounted for. It seems, therefore, that silicate dust cannot account for most of the infrared emission at 9 microns and higher and that other explanations must be sought.