physical sciences notes

ASTRONOMY

Total lunar eclipse on April 12

If the weather is clear on Friday evening, April 12, observers across the United States will have their best opportunity to see a total lunar eclipse between now and 1971.

From the eastern U. S., the whole eclipse will occur in a dark sky, with mid-eclipse about 15 minutes before midnight Eastern Standard Time. In the Far West, the moon will enter earth's umbral shadow before evening twilight ends, yet all of the 50 minutes of totality will be visible under favorable conditions.

During the eclipse the first magnitude star Spica and the moon will be in conjunction, making a lovely sight for naked eye and binocular viewers. A conjunction between a particular star and the eclipsed moon is a rare event. It last happened with Spica 19 years ago, on the night of April 12-13, 1949, but will not happen again for many centuries, according to the April SKY AND TELESCOPE.

ANALYTICAL CHEMISTRY

Standards for atmospheric gases

Increased interest in the composition of the atmosphere, including normal components as well as accidental contaminants or pollutants, has sparked an intensive program in gas chemistry at the National Bureau of Standards.

The program involves the development or improvement of gas analytical methods, as well as the development and certification of standard reference gases.

The expanded program has resulted so far in an improved method for determining the carbon dioxide content of air, a new absolute method to determine the oxygen content of air, and a new method to determine low concentrations of oxygen in inert gases.

LASER PHYSICS

Electroluminescent gallium arsenide

The simplest laser yet devised, a solid state electroluminescent system, although a laboratory curiosity now, could have applications including burglar alarms, range finding and data handling.

The new device is the first of its kind to operate without built-in electric fields, or junctions. It consists of a very thin, small slice of gallium arsenide cut in the shape of a dumbbell. When an electric pulse is applied, the connecting bridge radiates infrared laser light.

The junctionless laser was developed by Dr. David P. Southgate of RCA's microwave research laboratory in Princeton, N.J., working under Dr. Kern K. N. Chang. So far the lasing action occurs only in a few minute spots along the bridge between the dumbbell ends; in theory the entire bridge could produce laser light.

COMMUNICATIONS

Molecular beams on the moon

Modulated molecular beams—transfer of information by bursts of material particles instead of the radio waves customarily used elsewhere—may be a way for astronauts to communicate on the moon. The moon's vacuum is so high and its gravity is so weak that such beams of gas atoms or molecules could maintain their modulation and direction over long distances, says Yale University Prof. John Bennett Fenn.

A molecule could travel for 200,000 miles above the moon's surface before it would be likely to collide with another. The speed of communication by molecular beams, would be about a mile a second, compared to 186,000 miles a second for light or radio.

In addition to communications, Prof. Fenn sees other molecular beam possibilities on the moon. Improved atomic clocks are one. High-power miscroscopy, analogous to electron microscopy, is another. Such molecular-beam microscopes would be gentle enough to study large fragile molecules like DNA without destroying them.

MATHEMATICS

Ancient three-body problem solved

Complete solution of the Pythagorean three-body problem shows a final configuration in which two of the bodies form a close binary system and the third moves away to infinity.

Victor Szebehely and C. Frederick Peters of Yale Observatory have succeeded in solving the three-body problem, which, like Fermat's last theorem and the question of how many crayons it takes to color a map, has been around a long time.

To define its initial conditions, one places three bodies at the corners of a 3, 4, 5 right triangle, with the $M_3=3$ at the apex opposite the 3 side, $M_4=4$ opposite the 4 side and $M_5=5$ opposite the 5 side.

The question then is: What happens when the three bodies move freely under the influence of gravity? The main difficulty in a computer solution is that one loses much time and accuracy at moments of very close approaches when one body is having an unusually large influence on another.

Szebehely and Peters found a solution to this problem. Their results were plotted automatically at the Yale Computer Center. If masses are in grams and distances in centimeters, a unit of time would be 1.08 hours. For 3, 4, and 5 solar masses at distances 3, 4, 5 parsecs (3.26 light years), the time unit would be 1.43×10^7 years.

Their solution disposes of the question whether a periodic motion results, it is reported in PHYSICS TODAY (March). When $t=31.66$, the bodies are nearly at their starting points with velocities near zero, but the subsequent motion shows that the problem is very sensitive to initial conditions.

The astronomers find that there is a periodic motion for initial conditions near those of the Pythagorean problem.