Astronomy

Dietrick E. Thomsen reports from Tucson, Ariz., at the conference on the Galaxy and the Solar System

An orbit for Nemesis

Astronomers disagree forcefully over the existence of a companion star to the sun, usually called Nemesis, which is postulated to send showers of comets into the inner solar system every 26 million years (SN: 4/21/84, p. 250). Supposing, however, that Nemesis does exist, Armand Delsemme of the University of Toledo in Ohio has used a new approach to calculate its orbit.

His method begins with a statistical survey of what he calls "new" comets arriving in the inner solar system. Astronomers generally agree that the source of comets is the Oort cloud, a band or spherical shell of cometary lumps orbiting the sun about 2 light-years away. New comets are those that left the Oort cloud within the last 20 million years or so. Delsemme did a statistical study of the motions of 126 of these — not a large number, he admits, but still he claims 95 percent statistical confidence.

He determines that the majority of such comets move in a retrograde direction — that is, opposite to the motion of nearly all planetary motions. From the directions of the comets' momenta he calculates that the Oort cloud received a gravitational impulse from some other object less than 20 million years ago. Neither a fast-moving object passing by the solar system nor the passage of the solar system through one of the interstellar gas clouds fits, he says — thus disposing of two hypotheses of those who don't believe in Nemesis. However, a slow-moving object with a speed of 0.2 or 0.3 kilometers per second would fit, he says. "Nemesis is a good explanation of this."

From the dynamics, Delsemme calculates that the 26-million-year orbit of Nemesis should be almost perpendicular to the ecliptic, or the plane of the earth's orbit. (The orbits of the other planets and their natural satellites are inclined at most a few degrees to the ecliptic.) Delsemme further calculates that Nemesis should now be near its aphelion point, its farthest distance from the sun, and its direction should be about 5° from the pole of the ecliptic.

Interstellar comets?

Most experts in the field accept the "classic" idea that the Oort cloud, the source of comets, is populated by objects left over from the formation of the solar system. However, Michael A'Hearn of the University of Maryland in College Park wonders whether some comets might be of interstellar origin. Specifically his question is whether, as the solar system moves through the giant molecular clouds (GMCs) that populate interstellar space, the Oort cloud can be alternately stripped of its contents by the gravity of such clouds and then replenished from the matter in the GMCs.

Studying the physical chemistry of comets, A'Hearn finds that they can be put into two groups according to their composition. He suggests that this may mean that one group represents matter put into the Oort cloud by the last GMC the solar system passed through, while the other represents the last previous GMC.

As comets strike their suns

On a few recent occasions comets have been seen to hit the sun. Astronomers do not like to believe that any situation in nature is unique, so they quite generally suppose that if the sun has comets, so must other stars. And if occasionally one of its comets strikes the sun, reasons H. C. Bhatt of the Physical Research Laboratory in Ahmedabad, India, then occasionally one of their comets ought to strike other stars.

Such an encounter could result in tidal disruption, vaporization or ionization of the comet, or all three. Observers of the star might then see a flare or the sudden appearance of emission lines in its spectrum from the ionized cometary matter.

Chemistry

A diamond coat for chips

Diamond is an excellent conductor of heat and a poor conductor of electricity. These properties would make diamond a useful material in the manufacture of integrated-circuit chips, if it were possible to produce paper-thin diamond films that could be used as electrical insulators. Recently, researchers at the Hitachi Research Laboratory in Japan took some of the first steps toward bringing diamond films into microelectronics.

The Japanese researchers, reporting their findings at last month's International Chemical Congress of Pacific Basin Societies (PAC CHEM '84) held in Honolulu, found that microscopic diamonds are produced when microwaves irradiate a mixture of methane and hydrogen gas. This treatment forces the gases to decompose to create a plasma of charged particles. Over a period of hours, tiny diamonds, not more than 30 micrometers in diameter, form on the surface of a solid support, such as a silicon wafer, set inside the microwave chamber.

The method, however, is far from ready for industrial application. The ideal conditions for producing diamonds have yet to be identified. Sometimes, for example, graphite and other types of carbon rather than diamonds are deposited, and depending on the position of the solid support, occasionally no deposit forms and silicon is etched away instead.

Ringing in a new chemical method

One of the most widely used reactions in the chemical industry is something called the Diels-Alder reaction, which forms compounds that contain a circle or ring of six atoms, usually carbon. Now, chemist Barry M. Trost of the University of Wisconsin in Madison has discovered a reaction that mimics the Diels-Alder reaction but creates five-membered rings instead of six-membered rings. This new method, reported at PAC CHEM '84, may streamline the manufacture of several existing drugs and industrial chemicals, says Trost, by cutting down on the number of steps it takes to make the compounds.

Trost's method involves the use of various metal catalysts and a new silicon-containing compound. These substances initiate the formation of a five-membered ring from two molecules, one containing two carbon atoms and an "activator substituent" and the other containing three carbon atoms to which various other chemical groups may be attached. Surprisingly, the catalysts generally control the nature of the products created.

Soaking in silver

Almost a century ago and for decades later, silver compounds were used in clinical medicine as antiseptics — for example, to prevent or treat the effects of burns. Medical interest in silver revived during the 1970s when a series of studies showed that electrically generated silver ions inhibit the growth of bacteria and fungi. The first attempt to apply this technique clinically was for the treatment of osteomyelitis, a bone disease. Tissue was exposed to silver ions generated when a small current passed through thin silver wires or silver-coated nylon fabric. However, questions remained about the effectiveness of using coated fibers. Now, in this month's JOURNAL OF THE ELECTROCHEMICAL SOCIETY, a team of medical researchers at the Louisiana State University Medical School in Shreveport report that commercially available, silver-coated nylon fabrics can produce the levels of silver ions necessary to stop the growth of microbes at relatively low currents and voltages.

The concept of applying an antiseptic by passing a current through a metallized fabric is appealing, the researchers say, because the dose can be regulated by controlling the current. In addition, the fabric can be chosen to provide the best kind of dressing for a wound, and the cost would still be low because only a thin coating of silver is required.