time since Saturn's signals could be separated from the more powerful emissions of Jupiter), Michael L. Kaiser and Michael D. Desch of the NASA Goddard Space Flight Center and colleagues originally reported a period of 10 hours 39 minutes 54 ± 18 seconds. Correcting a computer error, says Desch, showed the actual uncertainty of the number to be larger — ±36 seconds. More than six months of data have now been analyzed, however, and not only has the precision of the calculation improved, but it has shifted slightly, to $10^h39^m24 \pm 9^s$. This does not mean that the planet has speeded up, Desch points out, but merely that it is difficult to pinpoint Saturn's rotation "signature" in the noisy radio data. A comparison of different timespans in the data shows the period to be stable to within 1 second per rotation (it is probably even "tighter"), even though the measurement itself is known only to within 9 seconds per rotation. By a year after Voyager 1's Nov. 12 flyby of Saturn, says Desch, the rotation speed too should be known to within a second. (The period of Jupiter, by comparison, established from a quarter-century of earth-based radio observations, is now known to within a second in about three weeks, and pulsars have been measured as accurately as a second in about two and a half years.)

Several years ago, radio signals detected by the earth-orbiting IMP-6 satellite were reported as possibly being from Saturn, and consistent with a roughly 9.5-hour period for the planet (SN: 12/14/74, p. 372). They were at a higher frequency than the ones detected by the Voyagers, and intense enough (if they were indeed from Saturn) for the Voyagers to have seen them too. But the Voyager group reports in the Sept. 12 SCIENCE that no such frequencies have been seen. One possibility is that Saturn's emissions are "tightly beamed," which could mean that frequencies detected by IMP-6, facing the planet's southern latitudes, do not show in the northern-hemisphere viewpoint of the Voyager data. Or the IMP-6 detections may not have come from Saturn at all. Since that report, it has been concluded that when IMP-6 was picking up simultaneous emissions from two sources, it might indicate a single source whose direction corresponded to the intensity-weighted mean angle between the two actual locations. It is possible, according to the Voyager group, that the IMP-6 data may have represented "a signal coincident with the Saturn direction which was formed by a combination of signals from Jupiter and earth (or perhaps the sun)."

But even if not readily detectable from earth, Saturn is still a powerful radio beacon. If the planet were as close to earth as the "standard earth-Jupiter opposition distance" of 606 million kilometers, the authors report, its emissions at 250 kilohertz would be as intense to a terrestrial observer as the 8-MHZ peak in Jupiter's broadcasts. □

Neutrinos to iron out cosmic problem

Neutrino oscillations are beginning to shake up physics. "Neutrino oscillations" is the term for the apparent ability of one and the same neutrino to change its identity back and forth among two or more of the identities available to neutrinos. For the moment those identities number three: electron neutrinos, muon neutrinos and tau neutrinos, each named for another particle that the given neutrino accompanies in the reactions and interactions where it plays a part.

It has generally been believed that a neutrino born with a certain identity kept that identity throughout its existence. Now it seems they may be able to oscillate from one to another. Theorists are beginning to examine the consequences of such uncertain identity. One cosmological consequence is discussed in the Sept. 15 PHYSICAL REVIEW LETTERS by A. De Rújula of Massachusetts Institute of Technology and Sheldon L. Glashow of Harvard University.

Since the existence of the neutrino was first hypothesized, about 1930, physicists have believed that the neutrino's mass (and so the neutrino itself) would vanish if it ever came to rest. It had zero rest mass. Not if it can oscillate. Now it must have some rest mass. (The requirement springs from the long-recognized dual nature of every bit of matter: It is at the same time a particle and a packet of waves. For the waves of oscillating neutrinos to behave properly the particles have to have rest mass.)

If neutrinos have rest mass, they may be useful cosmologically. As De Rújula and Glashow point out, the universe and the galaxies in it need more mass than they show in observable matter and electromagnetic radiation. Studies of the velocities and distances of far-off galaxies lead to the conclusion that the space of the universe is very nearly flat, but the universe exhibits only half the mass that is dynamically necessary to achieve such flatness. Studies of the rotations of galaxies and the motions within them also lead to the conclusion that the galaxies generally need more mass than they show to maintain their stability against disruption.

Neutrinos with rest mass could very well solve both aspects of this "missing mass problem," De Rújula and Glashow propose. The original big bang should have left us with as many neutrinos as it did photons, the particles of the universal black body radiation. If some of the neutrinos are slightly heavy they could solve both aspects of the missing mass dilemma by clustering as haloes around galaxies.

Calculations that combine gravitational theory with quantum statistics lead to the conclusion that the heavy variety of neutrino postulated here should have a rest mass of at least 24 electron-volts, huge for a neutrino, but minuscule compared to other particles (an electron's is 511,000 electron-volts). A massive neutrino, if that can be called massive, should also be subject to radioactive decay. Yet for these heavy neutrinos to have survived from the big bang in large numbers, their average lifetime must be greater than 10^{10} years, the age of the universe. Other considerations raise it to 10^{16} years.

In spite of that long life (which is a statistical average), some of these neutrinos are decaying all the time, and when one does, it sometimes yields a lighter neutrino and a photon of ultraviolet light. The final kicker in this story is that the ultraviolet from this source coming from our galaxy or the Andromeda galaxy might be on the verge of being detectable. □

Scanning bubbles from the deep

A small probe is attached to a scuba diver's chest shortly after the diver surfaces. On a screen connected to the probe, researchers view what appear to be tiny BBs moving through opening and closing valves.

Using the recently engineered "two-dimensional ultrasound phased array sector scanner," these researchers are watching in real-time as gas bubbles move through the heart of a potential victim of decompression sickness. According to the accepted theories of diving medicine, decompression sickness, or "the bends," can strike a diver who surfaces too rapidly from a deep dive of long duration (see p. 187). When a diver goes deep, the gas breathed under pressure is pushed into the bloodstream in liquid form. The longer the diver stays at a deep level, the more gas dissolves into solution. But when the diver begins to surface, ambient pressure is lowered, and the gases in the blood start to come back out. If the unloading process is hurried along, not allowing the gas enough time to slowly diffuse out of solution, the gas forms bubbles. The bubbling phenomenon is similar to the carbon dioxide fizzing that occurs when a bottle of champagne is uncorked. In the diver, the "fizzing" includes formation of nitrogen bubbles that can collect at the joints, causing pressure on the nerves and resulting in pain. In addition, researchers now say the interface between the surface of the bubble and the blood may activate clotting factors and cause capillary leakage. In extreme cases of the bends, paralysis, unconsciousness and eventual death can result.

To better understand the lead role gaseous bubbles play in decompression sickness, Richard D. Vann, Olaf von Ramm and colleagues of Duke University Medical

Center in Durham, N.C., are using the two-dimensional imaging capability of their ultra-sound scanner. "The hope there is that we'll eventually be able to tell how much gas is released into the blood after decompression by knowing the size and total number of the bubbles per unit time," says von Ramm. The researchers then will be able to correlate the amount of gas released with onset and duration of decompression sickness. In terms of its diving application, however, the real value of the scanner lies not in predicting cases of decompression sickness, but rather in researching bubble behavior, Vann says.

Prior to its recent application to the field of diving, the ultrasound scanner was used mainly for detecting various cardiac problems, such as defective valve operation. The scanner is similar to a radar in that it sends out a burst of sound energy and receives the reflections, or echoes. These sound wave echoes are converted into electrical signals, which in turn are processed and displayed on a screen. Says Vann, the view of natural processes on that screen "is a very effective presentation." □

Legal pot

You may not be able to pick it up at your local drugstore, but the government announced plans last week for distribution of tetrahydrocannabinol (THC), the active ingredient in marijuana that in some cases has proved effective in mitigating the nausea and vomiting of cancer patients undergoing chemotherapy. Cancer specialists licensed by the National Cancer Institute and the Drug Enforcement Agency will soon be able to write prescriptions for THC.

But the controversy behind the drug remains. The Food and Drug Administration's nine-member oncologic advisory board mustered only a one-vote margin last June in recommending release of the drug. Other researchers claim THC's occasional psychogenic side effects should rule it out as a therapy.

On the other end of the scale, some NCI researchers, cancer sufferers and marijuana lobbying organizations believe that marijuana smoked in cigarettes is far more effective in controlling chemotherapy's side effects than is the oral THC being released by the government.

A group of NCI researchers reported in last December's ANNALS OF INTERNAL MEDICINE that while smoked or swallowed synthetic THC prevented vomiting, "smoked THC was more reliable than oral THC in achieving therapeutic blood concentrations." Oral administration, they noted, was associated with variable absorption from the gastrointestinal tract. Alice O'Leary, director of the Alliance for Cannabis Therapeutics, says New Mexico researchers are reporting a 90 percent success rate for marijuana cigarettes, and 60 percent for oral THC. □

Let them eat fungus

Calling its new product "the nylon of the food trade," a British manufacturer is trying to put a fungus on the supper menu. Ranks Hovis McDougall received qualified approval from the United Kingdom Ministry of Agriculture, Fisheries and Food to market for human consumption processed mycelia (filaments) of the fungus *Fusarium graminearum*. Several microorganisms already are grown and processed as supplements to animal feed, but none are offered for human consumption.

The processed fungal mycelia are themselves unpalatable, colorless and tasteless, but with added flavor and color they can be made into passable imitations of fish, chicken, veal and ham, according to the Sept. 4 NATURE. The company began work on the fungus with the thought of selling it to developing countries, but since has shifted its goal to the convenience-food market at home. To make mycoprotein inexpensive enough to attract customers, J. Edelman of RHM estimates the company would need to produce and sell 10,000 tons each year. That is 0.25 percent of current British meat consumption. At present, a pilot plant in High Wycombe, Buckinghamshire, is producing 100 tons of the mycoprotein annually.

Mycoprotein has been fed to laboratory animals for several generations with no ill effects reported. Small-scale, short-term human tests of the mycoprotein have been carried out at the Massachusetts Institute of Technology and RHM has performed some larger trials. The only problem was one case of allergy. The fungal product also looks good nutritionally; it contains 45 percent protein and only 10 to 15 percent fat and cholesterol.

The recipe for mycoprotein is to grow the fungal strain, which has lost the ability to cause disease in plants, in glucose-syrup and ammonia in 1,300-liter tanks at 30°C. Then RHM heats the mycelia to 64°C, inactivates the enzymes that break down protein but still allows other fungal enzymes to degrade nucleic acids into products that are washed from the cells. The heat treatment also changes the texture of the mycelia to make it more like that of meat fiber.

The Ministry of Agriculture, Fisheries and Food has asked RHM to do further animal experiments to determine the effects of mycoprotein on the body's mineral balance because mycoprotein lacks the iron and zinc found in meat, but the high fiber content (20 to 25 percent) could lead to retention of minerals from other foods. Limited-scale marketing should reveal if the public has a taste for it. □

Pain differences, similarities found

Despite the millions of people in the United States who suffer from chronic pain and the 300 or so clinics set up to treat them, very little is known about the sociology of pain — whether groups of people react to or sense pain differently. New research presented at the recent meeting of the American Pain Society in New York indicates that patients' and physicians' attitudes toward chronic pain differ relative to ethnic group and sex.

James A. Lipton and J.J. Marbach of the Columbia University Dental School reported on their study of the relationship between ethnicity and the response to pain. They analyzed the responses of 166 patients suffering from facial pain of unknown origin to 41 agree/disagree statements on pain. The patients were identified as Hispanic, Black Italian, Irish, Jewish, other white Catholic, or other white Protestant.

The researchers found conformity in emotional responses, such as whether the pain evoked tears or moans, but they found definite differences in how different ethnic groups viewed their pain. Hispanics and Blacks were five to seven times more likely to fear their pain was cancer-related than were Italians, Jews and other white Protestants. Irish respondents were less likely to feel they had brought the pain on themselves than were Italians, other white Catholics and Blacks. Other white Catholics were more likely to believe that the pain was imagined than were the other ethnic groups questioned. Hispanics were less likely to admit losing control when they described their pain than were Italians, Blacks, other white Protestants and Jews.

The researchers also found differences in how the patients described their pain. Other white Catholics were more likely to describe their pain as stabbing than were Italian, Irish and Jewish respondents. Blacks were more likely to call their pain unbearable than were Hispanics.

The findings, Lipton says, echo a late 1940s study of pain reactions in first and second generation Americans. "We didn't expect the findings we came up with," Lipton says. "Our population was mostly third or more generation. We thought they'd be more in conformity with each other."

Roughly eighty percent of the 166 sequential visitors to the facial pain clinic were women. Dorothea Lack, a clinical psychologist and pain clinic director in Binghamton, N.Y., produced evidence at the meeting that many women with complaints of chronic pain are subjected to sex-role stereotyping by the medical profession, and end up searching wider and longer for proper medical care.

In a comparison of the previous medical histories of men and women before they visited her pain clinic, Lack found that