conservative, noting that it doesn't even attempt to measure many of the toxic organic solvents that have in recent years been found in drinking water (SN:1/16/88, p.39).

In related news, the EPA last week said it would stop work on its design of guidelines for the incineration of toxic wastes at sea. The announcement was considered a major victory for environmentalists and members of Congress who had opposed the EPA's proposed plan to burn hazardous wastes on giant incinerator ships off U.S. coasts. *– R. Weiss*

Is dark matter causing a glow?

Cosmologists have believed for a long time that the universe has to contain a large amount of dark matter, which cannot be made of ordinary neutrons and protons, but must be some less ordinary subatomic particle. On the supposition that the dark matter consists of an astronomically large number (110 per cubic centimeter) of neutrinos that decay radioactively, three scientists now suggest that the decay of the neutrinos sets aglow large clouds of hydrogen that have recently been observed around the universe. If the neutrino-decay mechanism they propose is correct, it will prompt important changes in particle physics and solve a couple of seemingly unconnected astrophysical puzzles.

As Adrian L. Melott, Douglas W. McKay and John P. Ralston, of the University of Kansas at Lawrence, point out in the Jan. 15 ASTROPHYSICAL JOURNAL LETTERS, a number of observations in recent years have found large amounts of ionized, glowing hydrogen in different parts of the universe. The ionization requires the presence of a background flux of ultraviolet light. As Melott told SCIENCE NEWS, "It's something people have been puzzled about. No one can figure where it comes from. Quasars can't do it."

What can do it, suggest Melott, McKay and Ralston, is decay of neutrinos in the dark matter. There are three known kinds of neutrinos, and here one kind would decay into another, emitting ultraviolet as it did so. If this mechanism is correct, particle physicists would have what they call a generation-changing interaction, which would be very important to the unification of their discipline.

As Ralston told SCIENCE NEWS, the particles of physics can be divided into three separate generations, exemplified by the electron and the electron neutrino, the muon and the muon neutrino, and the tau particle and the tau neutrino. The generations seem to parallel each other without any connection between them or any reason for there being more than one. Physicists have searched for an interaction that would cross from one generation to another and point a way to unifying them. This decay of one neutrino to another is such a generational link. The link goes by way of a new particle, a resonance that Ralston calls eta.

Eta makes only a virtual appearance in the neutrino decay; it is really only part of the quantum mechanical calculation, Ralston says. However, it makes a real appearance in the mechanism he suggests to explain the strange radiation coming from the X-ray pulsar Cygnus X-3. A detector deep in a mine in northern Minnesota has shown evidence for highly energetic particles coming straight to us from Cyg X-3 (SN: 4/11/87, p.228). Ralston suggests that these mystery particles are neutrinos.

In known processes all neutrinos are emitted as left-handed – that is, they spin to the left in the direction they are going, like left-handed screws. However, neutrinos have a small magnetic moment. They are like little magnets, and a magnetic field could flip them over and make them right-handed. It happens that this model of neutrinos gives them a much larger magnetic moment than the standard one, so it is plausible that on the way from Cyg X-3 some of them are flipped over by the galactic magnetic field. When these now right-handed neutrinos enter the earth, they interact with electrons and produce the eta particle. (Left-handed neutrinos can't make eta particles.) The eta decays, and its decay products are the muons the detector sees.

This high magnetic moment also makes possible a mechanism to solve the solar neutrino puzzle put forward by the Russian physicists M. Voloshin, M. Visotsky and L. Okun. Detectors looking for neutrinos from the sun find far fewer than scientists think they should, and lately they have noted that the flux is lower when the number of sunspots is high and vice versa. These things could be explained if solar magnetic fields were flipping left-handed neutrinos to right-handed ones on the way out of the sun. The detectors are not equipped to record right-handed ones.

Ralston sees two possible ways of seeking evidence for the eta particle, which is the key point in checking the theory. Certain aspects of a much-studied decay, that of a muon into an electron and a neutrino, might give some evidence. Or, direct evidence of the eta – which is expected to have a mass between 30 billion and 60 billion electron-volts – could show up in machines like the Japanese KEK accelerator.

– D.E. Thomsen

Lightning pattern found in storms

Atmospheric scientists have discovered that in many thunderstorms, the most dangerous lightning develops on only one side of the storm instead of striking randomly throughout the entire area. This observation will aid those who are studying the development of thunderstorms, and may provide a warning system for locating potentially damaging parts of a storm.

Using a large network of instruments that monitor individual lightning flashes, researchers from the State University of New York at Albany found that many storms, especially during the fall and winter, display an unexpected organization. At the downwind end of the storm, most lightning flashes are positive, meaning that they transfer positive charge from the cloud to the ground. Meanwhile, 100 kilometers away at the rear of the storm, most flashes lower negative charge to ground.

Richard E. Orville and his colleagues discovered this so-called bipolar pattern when they linked several small lightning-detection networks. "The pattern has been there, but we've never had a lightning network large enough to observe it," Orville told SCIENCE NEWS. Orville, Ronald W. Henderson and Lance F. Bosart report their findings in the February GEOPHYSICAL RESEARCH LETTERS.

Scientists have measured electrical currents in positive lightning that are sometimes twice as strong as those found in negative lightning. If scientists can predict where positive lightning is likely to occur, they can forecast which areas of a thunderstorm will be the most hazardous.

The Albany scientists speculate that horizontal winds may help cause the bipolar arrangement in storms. Individual thunderclouds normally have a vertical organization with positively charged tops and negatively charged bottoms. But observations have shown that when horizontal winds develop at the level of the cloud top, the cloud begins to tilt, with the positive charge drifting downwind.

Over time, suggest the researchers, this drift would build a center of positive charge at the downwind end of the storm, leading to positively charged lightning in that area.

Such a theory, however, does not explain the entire phenomenon. Horizontal winds are normally too slow to carry enough charge to the storm front. The researchers believe that another mechanism may help generate the positive-charge center. In future studies they will address this issue by combining satellite and radar data with records from the lightning network. *– R. Monastersky*