SCIENCE NEWS of the week

Double-Beta Decay Caught in the Act

The first direct, laboratory evidence of the rarest radioactive decay process ever observed in nature was announced this week by researchers at the University of California at Irvine. Michael K. Moe and his colleagues reported at the national meeting of the American Chemical Society in New Orleans that the half-life of this process – called "two-neutrino double-beta decay" – is around 10 billion times the age of the universe, or about 10^{20} years.

According to Peter Rosen at Los Alamos (N.M.) National Laboratory, the finding is an experimental triumph for scientists, who have been searching for this particular decay scheme – the emission of two electrons (which are known historically as beta rays) and two antineutrinos – for 40 years. And while the value of the measured half-life does not jibe exactly with some *nuclear* theories, the observation of the decay confirms a part of conventional *particle* physics theory, he says.

The first indirect observations of two-neutrino double-beta decay came from recent geochemical studies of billion-year-old ores of selenium and other minerals. By measuring the abundance of krypton-82, which is created when two neutrons in selenium-82 simultaneously become protons by casting off two electrons, researchers came up with a value for the half-life that was about 10 times longer than that predicted by nuclear theories, according to Moe. This disagreement and the possibility that krypton could have escaped from the rocks during their long history – tarnishing the half-life measurement – caused some to question the geochemical results. The matter could only be resolved in the laboratory.

However, detecting two-neutrino double-beta decay in the laboratory is not an easy feat, since the energies of the emitted particles are comparable to those found in much more common radioactive decay modes from elements such as uranium, which is present in most materials. With Alan A. Hahn and graduate student Steve R. Elliott, Moe found a way to pinpoint the double-beta decay of other reactions by using a relatively new device called a projection time chamber.

The chamber, when filled with helium gas that becomes ionized by particles escaping from a thin selenium-82 foil in its center, enabled the researchers to reconstruct the three-dimensional paths of emitted particles. Two electrons emerging from a common point and moving with the appropriate energies at the appropriate angles signal two-neutrino double-beta decay. Moe says they have seen one such event every three or four days.

"Mike Moe ... has been doing this experiment for quite a few years now, and little by little he's come to understand all the tricky background [decay events] that you normally don't think about," says Rosen.

From the recorded events, Moe's group measured a half-life that supports the earlier geochemical results. "By having the geochemical measurements and the direct measurements in agreement," he says, "the theorists [who calculate the probability of this decay mode occurring in the nucleus] have to face the fact that the half-life value we obtained is the correct one."

If nuclear physicists can fine-tune their theories in accordance to the new results, they will be in a much better position to interpret another class of ongoing experiments, which are hunting for postulated double-beta-decay reactions that do *not* emit neutrinos. These decay schemes, if found, would herald new physics beyond the standard model, which links the strong, weak and electromagnetic interactions between particles. These experiments are part of a larger slew of studies trying to determine whether the neutrino has mass (SN: 4/11/87, p.231; 5/30/87, p.342). The half-life measured in two-neutrino double-beta decay may indirectly help physicists get a better handle on the upper limit of neutrino mass in the neutrino-less double-beta-decay work.

As for confirming part of the conventional particle theory with the two-neutrino double-beta decay, says Moe, "It's an interesting result. It certainly [won't bring] a Nobel prize, but it's fun."

– S. Weisburd

Chinese folk remedy may promote cancer

Two families of plants commonly used as herbal remedies in mainland China may explain the high rate of nasopharyngeal cancer found in scattered regions of that country, new research suggests.

Epidemiologists have for years puzzled over the unusual geographic distribution of nasopharyngeal cancer in China. Epstein-Barr virus, which has been widely associated with the cancer, is especially common in Asian populations. But while the virus is widespread, nasopharyngeal cancer occurs most often in particular parts of China. And laboratory scientists have been unable to spur epithelial cells, which line the nasal passages, to become cancerous with the simple addition of Epstein-Barr virus.

Now researchers report in the Sept. 3 NATURE that they have transformed normal human epithelial cells into cancer cells by exposing them to Epstein-Barr virus, but that the transformation is dependent on the presence of phorbol esters, a class of chemicals found in certain tropical plants. L. David Tomei, Ronald Glaser and their colleagues at Ohio State University in Columbus drew upon previous research linking the distribution of phorbol-ester-producing plants and the occurrence of nasopharyngeal cancer in China. Their laboratory results provide some of the clearest evidence yet of the potentially important role of environmental factors as cancer promoters.

According to Glaser, the new findings don't necessarily conflict with earlier studies by researchers at the University of Southern California that linked nasopharyngeal cancer with consumption of salted, partially rotted fish – a common dietary item in parts of China (SN: 6/29/85, p.404). Both studies are compatible with current theories about the nature of carcinogenesis, he says, in which an "initiator" (such as Epstein-Barr virus) is thought to be potentiated by a "promoter," such as a phorbol ester. "There may be multiple factors at work here, both genetic and environmental," he says.

Unfortunately, Tomei notes, some plants that contain potent phorbol ester cancer promoters are used as traditional herbal medicinals in Asian and African cultures. "The Chinese make hot tea from these plants, and they spray the extract onto sore throats. So what you have ... is a folk procedure that has all the elements of tumor promotion in humans: Spraying hot extracts of phorbol ester plants onto chronically inflamed tissue in an area where nearly everybody has Epstein-Barr virus."

Hundreds of years ago, before Epstein-Barr virus became common in China, the extracts may indeed have been worthwhile, Tomei says. "But as the virus began to spread through various [ester-exposed] groups within China, it may have had a direct role in the emergence of nasopharyngeal cancer. Certainly some kind of educational process is needed to inform people that these folk remedies are potentially dangerous."

– R. Weiss