

energies, you postulate that the various quantum states of the inside well give the fine structure. The intermediate structure comes from energy structure in the outer well. And the spontaneous fission is from particles trapped in the lowest level in the outer well that can't get out easily. The theorists have shown, using the model of Sven-Gosta Nilsson (University of Lund), that the shell model predicts the double-humped well.

So the picture has been one of states that are at quite high excitation, about 3 MeV, which are nevertheless highly stable against gamma-ray emission—not because they have high spins but because of the large change of shape that they need to undergo to get back to the normal state.

Although there has been a great deal of activity on shape isomers, there has been no direct demonstration that the fission isomers were states of very high deformation, as they would need to be if the model were correct. If indeed the fission isomers were highly deformed nuclei, they should be capable of showing rotational states based on the second minimum. (The normal rotational sequence is based on the ground state, and it lies in the ordinary first minimum.) Because the deformation is expected to be much bigger in the fission isomer minimum, the states should be correspondingly closer together than they are in the ground-state band.

The Munich experimenters studied the 4-nanosec isomer of Pu^{240} , produced by bombarding U^{238} with 25-MeV alpha particles from the Munich MP Tandem accelerator. Following a nuclear reaction, any population of the secondary minimum would lead to electromagnetic transitions that precede isomeric fission. In an even-even nucleus the final decay will go by E2 transitions within the rotational band built on the isomeric level, the experimenters say. The states should have lifetimes very much shorter than 0.1 nanosec, that is, small compared to the spontaneous fission lifetime. So to identify the band experimentally, rather than observing the gamma rays that link the fission isomer states, they measure delayed coincidences between conversion electrons and fission fragments.

The experimenters find a set of conversion electrons that they associate with transitions between states in a rotational sequence. Furthermore they check this out with the expected relationship between the level spacings. They find that indeed the deformation of the fission isomer minimum is much bigger than the ground state. In fact they report what they believe is the biggest nuclear deformation ever observed.

Thus the Munich group has demonstrated that Pu^{240} can exist in essentially two different states of quasiequi-

librium deformation, one that represents the normal ground state, on which the normal rotational band is based, and another of considerably greater deformation on which the "second ground-state" rotational band is based. The ground state of that second rotational band is a fission isomer.

—GBL

Cornell synchrotron energy increased from 10 to 12 GeV

The energy of the 10-GeV electrons at Cornell's Wilson Synchrotron Laboratory has been increased to 12 GeV, and the experimental hall housing the synchrotron is being enlarged.

The synchrotron energy has been increased by adding a new bank of rf cavities in one of the straight sections of the synchrotron. A new cavity design with high impedance and an 80-kV klystron provides the 20% increase in energy. The cavities run at the same frequency they did before the modification: 714 MHz. Modifications to the synchrotron began in late 1970.

Construction of the 120 × 70 foot addition to the 100 × 100 foot experimental hall was done at the end of the summer. The addition will give Cornell and visiting physicists greater flexibility in scheduling experiments that will take advantage of the increased energy of the synchrotron. It should also help to alleviate some of the crowding that was felt earlier.

Funds for the building expansion totalling \$975 000 have been granted by the National Science Foundation. Cornell received \$200 000 from NSF for upgrading the synchrotron.

Cave drawing is evidence of Crab nebula supernova

What appears to be the fourth independent record of the Crab nebula supernova in 1054 was discovered in a cave in northern California, according to Stephen Maran of NASA's Goddard Space Flight Center. The American Indian petroglyph consists of a drawing of a sphere and a crescent; the sphere is thought to represent the supernova and the crescent, the moon. The findings were reported at the Michigan State Meeting of the American Astronomical Society in August.

Maran told PHYSICS TODAY that the drawing came to light through the persistent efforts of Muriel Kennedy, the wife of the superintendent of Lava Beds National Monument, where the cave is located. Kennedy found the painting in July 1964 and after some research decided that it probably represented the supernova event. She

told Maran that she had been trying to interest scientists and science magazines in her find ever since then, but no one was interested.

When she saw an article in *Time* on an appeal by Maran and his colleagues, John C. Brandt and Theodore P. Stecker, for records of the Vela X supernova event, she wrote the magazine a letter that was forwarded to Maran. "A week later we were out there," he told us.

According to Maran, the probability is high that the picture does indeed represent the supernova. On the morning of 5 July 1054 in California the moon was in a crescent phase and only about 3 deg away from the supernova. This was confirmed by Robert Harrington of the Naval Observatory in Washington, who calculated the relative positions of the moon and the supernova to an accuracy of about one hour.

Another fact supporting the hypothesis that the picture represents a supernova is that crescents are extremely rare designs in American Indian petroglyphs. According to Maran, almost the only ones found after a search through thousands of records of wall paintings are two in Arizona that were discovered by William Miller of Hale Observatories and are also thought to represent the supernova event. Japanese and Chinese annals also contain records of the event. —SMH

NBS to base legal volt on the Josephson effect

The National Bureau of Standards has adopted a new procedure for maintaining the US legal volt based on the determination of the ratio of $2e/h$ using the ac Josephson effect. Recent work at the University of Pennsylvania and NBS has shown that $2e/h$ can be determined in terms of a particular unit of voltage to 1 part in 10 million or better.

In the past, the US legal volt has been determined as the mean emf of a large reference group of standard saturated cells kept at constant temperature, but this quantity may vary as much as several parts in 10 million per year.

Using the ac Josephson effect (in which the frequency of an ac current between two weakly coupled superconductors is governed by the relation $\nu = (2e/h)V$) and a special 100:1 fixed ratio potentiometer, it is possible to compare directly the standard-cell voltage (approximately 1.018 V) with the 10.18 mV of an appropriately tuned Josephson junction. This can be done to an uncertainty of only a few parts in 10^8 .