Quiterons: Deep-freeze transistors

A new superconducting electronic device that can amplify incoming signals and switch on and off rapidly shows potential as a low-temperature version of conventional semiconductor transistors, reports a researcher at IBM. Because this superconducting transistor dissipates much less power than the best, currently available, high-speed semiconductor transistors, a large number of these devices can be packed into a small space to provide high levels of circuit integration.

The inventor, Sadeg M. Faris of the IBM Thomas J. Watson Research Center in Yorktown Heights, N.Y., recently described the patented device, which he calls a "quiteron," at an applied superconductivity conference in Knoxville, Tenn. "We're very excited about the potential for this device, but there remains a lot of research to be done," Faris says. "In the process of finding the optimum way of utilizing it, we will learn a lot of physics."

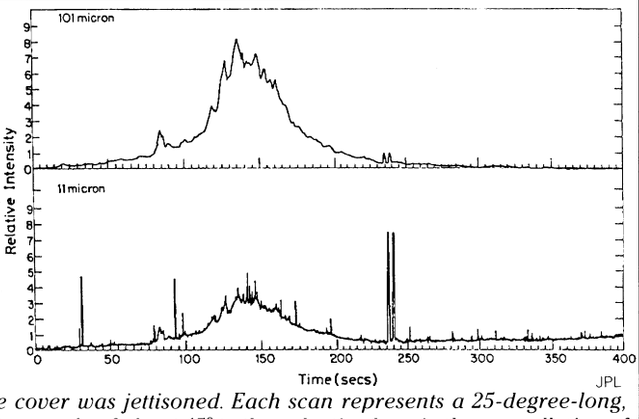
The device consists of three thin layers of niobium or a lead alloy, which become superconducting or lose all resistance to the flow of electricity at temperatures close to absolute zero, separated by even thinner films of insulating materials. Such a structure has two junctions through which quasiparticles (electrons under superconducting conditions that, as a result of interactions in the material, have an effective charge smaller than that on a bare electron) can tunnel under the right conditions.

Initially, the superconducting materials are in thermal equilibrium and, like semiconductors such as silicon and gallium arsenide, have energy gaps or forbidden energy values that electrons cannot take on. When a large number of quasiparticles are injected into the middle layer by shining light on one of the junctions or using a battery to apply a voltage, the material is driven far from equilibrium and the energy gap disappears. This alters the characteristics of the second junction so that tunneling occurs and current now flows. The resistance of the junction changes from very high to very low in less than a billionth of a second. In addition, the amplified output current can drive other devices. Thus, the device controls current like a transistor and can be used for digital switching applications, for example, in computers. A superconducting transistor's power dissipation is low because the energy gaps involved are in the millivolt range, in contrast to semiconducting devices, which have gaps on the order of 1 electron-volt.

The name "quiteron" is derived from "heavy-quasiparticle-injection tunneling effect," which telegraphically summarizes the device's operating principle.

—I. Peterson

IRAS: Early looks hint at bright future



JPL

Scientists are ebullient over early results from the American - Dutch - British Infrared Astronomy Satellite (IRAS), designed to make the first survey of the entire IR sky. Graph shows scans of the Milky Way galaxy from two of the IRAS telescope's detectors, recorded one hour after the telescope's protective cover was jettisoned. Each scan represents a 25-degree-long, north-south sweep at an angle of about 45° to the galactic plane in the constellation of the Southern Cross. Upper tracing shows brightness of emissions at 101-micron wavelength, produced by sources as cold as 30 kelvin (detectable thanks to the telescope's 2K focal-plane temperature and cooled optics), including cold dust associated with the material from which the galaxy's stars are formed. Details represent individual clouds of dust and molecular gas hundreds of light-years across. Lower trace (11 microns) shows the much hotter emissions of stars themselves, with the central bulge due to the largest stellar concentration and the gradual rise at right caused by warm dust in the plane of the solar system. (Twin spikes at the 140- and 145-second points on each scan are calibration marks.) The satellite may also exceed its planned 221-day operating lifetime by several weeks, thanks to slower-than-expected depletion of its cryogenic helium coolant. One reason is believed to be that slight inward heat leakage, such as does not occur in space, may have been encountered during the ground-testing on which the lifetime estimate was based. Revised estimate as of this writing was 230 to 240 days, and it could be longer. *—J. Eberhart*

Fore! Pulling turf from under a telescope

The future of a radiotelescope that is now used mainly to search for the communications of intelligent extraterrestrials is endangered by what seems to be rather poor terrestrial communication. The telescope, the Ohio State University-Ohio Wesleyan University Radio Observatory in Delaware, Ohio, is famous for the systematic radio maps of the sky and catalog of some 20,000 radio sources compiled during the 1960s. Founded in 1956, the joint facility is operated by people from Ohio State.

The telescope stands on land owned by Ohio Wesleyan, which now seems about to literally sell the ground out from under it. The ground is being bought by the Delaware Golf Club, which wants to expand its course from nine to eighteen holes. Ohio State people claim the decision to sell the land caught them by surprise. A spokesman for Ohio Wesleyan says Ohio State officials were repeatedly informed of Ohio Wesleyan's intention to sell the tract. But Robert S. Dixon of OSU, assistant director of the observatory, says the sale of the land was never brought up at last spring's meeting of the joint observatory committee, the body that oversees operation of the telescope. OSU spokesmen acknowledge that informal notice of the intention to sell was given to certain OSU officials, but they claim that there was an understanding that the five acres on which the telescope actually stands (out of 250 acres) would be exempted from the sale.

OWU claims that letters detailing the intention to sell the whole tract were sent to the former president of OSU, Harold Enarson and the current OSU president, Edward Jennings. OSU says it has no record of the letters, and Larry Thompson, special assistant to Jennings, says the first official notice OSU had was at a meeting early in January.

Furthermore, OWU president Thomas Wenzlau says the school was acting on an opinion given by Anne Reynolds, former OSU provost, that OSU researchers would not want the telescope after 1984. Dixon alleges that if Reynolds made such a statement, it was on her own motion and did not reflect the attitudes of people working with the telescope. Reynolds has since left OSU.

Dixon says OSU would buy the actual telescope grounds if it can. As of now OWU has a contract of sale with the Delaware Golf Club and would probably have to convey the whole tract if the golf club insists; then the telescope would have to be razed. It could be moved, Dixon says, if a site can be found, but that would be expensive. Attorneys for OSU are negotiating with attorneys for the golf club in the hope of finding another way. *—D. E. Thomsen*