The Guitar nebula: Shocks at high velocity

Like a speedboat screaming across a lake, a neutron star hurtling through a cloud of interstellar gas and dust generates a wake. Visible as a trailing skirt of glowing gas, this luminous region constitutes a shock-generated nebula.

Astronomers have now discovered a prominent, curiously shaped nebula caused by the motion of the fastest star yet observed in the Milky Way. Plowing through a gas cloud at more than 800 kilometers per second, this racing neutron star – designated PSR 2224+65 – carries with it an intense magnetic field, which slams into the surrounding gas to create a shock wave that causes light emission.

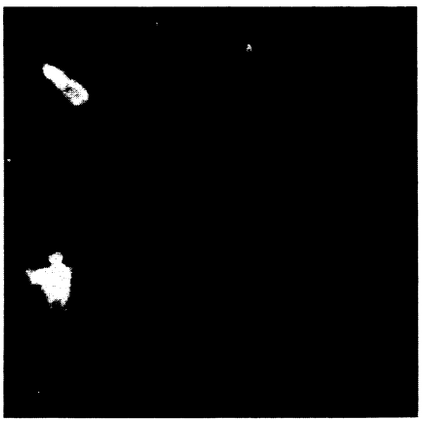
James M. Cordes and Scott C. Lundgren of Cornell University and Roger W. Romani of Stanford University describe their discovery in the March 11 NATURE.

The dense, compact remnant of an exploded star, PSR 2224+65 was originally detected as a pulsar – a spinning neutron star that sends out radio waves like a beacon. Created in a supernova about 1 million years ago, this object is roughly 20 kilometers wide and situated 6,000 light-years from Earth.

Though spinning relatively slowly, this neutron star is moving fast enough to eventually escape the galaxy. In the years since its birth, the star has moved 50 degrees across the sky along a path nearly parallel to the galactic plane.

"It's a fairly average pulsar, but its forward motion is exceptional," Cordes says.

This striking feature prompted Cordes and his collaborators to observe the star and its environment at visible wavelengths. Using the 5-meter Hale telescope atop Mount Palomar in California, the researchers discovered the star at the leading edge of an elongated blob of brightly glowing gas. This bright head trails off into a faintly glowing "body" of varying width, suggesting a guitar shape.



James Cordes, Cornell Univ.

A very fast pulsar – located at tip of bright patch (arrow) – shows a trailing, guitar-shaped nebula.

"The length of the nebula that we see now corresponds to how far the pulsar has moved in 300 years," Cordes says. The sudden increase in brightness shows where the pulsar apparently entered a region with a significantly higher gas density.

"Our observations provide some insights into the likelihood of finding shocks around other pulsars and the use of nebulae to find high-velocity neutron stars either not acting as pulsars or with their radiation beamed away from the Earth," the researchers note. – *I. Peterson*

Rubbery conductors aim at better batteries

Researchers eagerly want to build lightweight, durable, rechargeable batteries, especially for use in the mobile electronic consumer products – such as cellular telephones and lap-top computers – that are fast becoming integral parts of daily life. But finding electrolyte materials that can safely and efficiently conduct current between a battery's negatively charged anode and its positively charged cathode has proved difficult. Liquids leak out and catch fire. Highly conductive solid glasses crack apart under the stress of discharging and recharging. And rubbery polymers, while robust, have so far performed poorly as carriers of current.

Now, a group of physical chemists at Arizona State University in Tempe report that they've developed a new class of electrolytes that combines the high conductivity of glassy materials with the flexibility of rubbery polymers. "Our materials have the potential to carry higher current than any other polymer electrolyte," says lead scientist C. Austen Angell.

In the March 11 NATURE, the team describes how they reversed the usual procedure for making "salt-in-polymer" electrolytes. Instead of dissolving a small amount of salt in polymers, they dissolved small amounts of the polymers polypropylene oxide and polyethylene oxide into a cocktail of lithium salts. The resulting "polymer-in-salt" material has the consistency of rubber cement, making it stretchy enough to withstand changes in volume during the discharging and recharging of a battery. And it readily conducts lithium ions.

Indeed, the greater amount of salt in the material makes it 1,000 times more conductive at room temperatures than other polymer electrolytes developed so far. Angell's group tested the material using simple cells with a lithium anode and found that the current was carried predominantly by lithium ions. Electrolytes with single-ion conductors make the most efficient and powerful batteries, he explains.

"The incorporation of such electrolytes into high-energy, high-power-density, rechargeable lithium cells could widen the use of batteries in sensing and energy storage and give a fresh impetus to the development of electric vehicles," writes Malcolm Ingram, a chemist at the University of Aberdeen in Scotland, in a commentary that accompanies the NATURE report.

Scientists have long held high hopes for lithium batteries, but they haven't yet overcome the many practical obstacles, including the rapid degradation of the lithium anode (SN: 12/12/92, p.415). Terje Skotheim, president of Moltech Corp., a company based in Stony Brook, N.Y., that researches battery technologies, believes the new polymer-in-salt material may solve several problems at once. "With a new class of electrolytes, it's a new game," he says. "Perhaps the lithium anode will be more stable and better behaved. The possibilities look very exciting."

Angell notes that the new material could prove to be a useful electrolyte for many kinds of batteries. But first he and his colleagues must determine how well it performs in an actual battery prototype. – *K.F. Schmidt*

Flashbulb memories: Confident blunders

People often report vivid memories of what they thought and did just before, during, and after learning of a particularly startling event, such as the assassination of President Kennedy in 1963 or the 1986 space shuttle explosion. Psychologists refer to such recollections as "flashbulb memories" and have theorized that the brain harbors a special mechanism that preserves mental photographs of experiences linked to extremely surprising and emotional incidents.

A new study, however, suggests that flashbulb memories give off a misleading sheen of precision.

"What makes flashbulb memories special, to a great extent, is the undue confidence people place in their accuracy," contends Charles A. Weaver III, a psychologist at Baylor University in Waco, Texas.

Weaver's assertion follows increasing skepticism regarding the infallibility of flashbulb memories (SN: 6/4/88, p.358). Many investigators now assume that such memories achieve various levels of accuracy and may change over time with exposure to new information, much as misleading suggestions can alter eyewitness memories. For example, college students who were asked both the day after the space shuttle disaster and three years

later how they had learned of the tragedy often provided substantially different descriptions (SN: 2/2/91, p.78).

Unlike many previous studies, Weaver's experiment compared flashbulb memories to those associated with an everyday event. The Texas psychologist instructed a group of college students to do their best to remember all the circumstances surrounding their next meeting with a friend or roommate. Immediately following these incidents, participants wrote down answers to a questionnaire inquiring about what they did during the encounter, what time and where it took place, what clothes they wore, what they thought during the meeting, and who was there. Volunteers also rated the amount of emotion and surprise they felt during the meeting and their confidence in the accuracy of their memories.

By coincidence, on the same day students received the questionnaire — Jan. 16, 1991 — the United States began the bombing of Iraq that signaled the beginning of the Persian Gulf War. When students arrived at class two days later with their first set of completed questionnaires, Weaver administered a similar questionnaire asking about their memory of the bombing and the degree to which it had surprised and upset them.

A total of 22 students participated in the study, which included three-month and one-year follow-up questionnaires.

Assuming that participants' original memories were on the mark, memories of both events decreased comparably in accuracy three months later and held steady when assessed at one year, Weaver reports in the March JOURNAL OF EXPERIMENTAL PSYCHOLOGY: GENERAL. The amount of detail correctly recalled after one year remained impressive, indicating that the decision to remember even a trivial event can make a big impact, he maintains.

Students consistently rated their confidence in memories of the bombing considerably higher than their confidence in memories of the personal meeting. However, greater confidence did not lead to markedly improved accuracy in recalling bombing-related events.

Rather than entering a special preservation system in the brain, flashbulb memories may serve as benchmarks in our lives that connect personal histories to cultural history, Weaver suggests. People often choose to enshrine memories of individual experiences that provide a link to a significant public event; communications media then maintain the memory of the public event, inflating confidence in associated personal memories.

"In the future, these students will confidently report memories of where they were when the first war of their generation took place, but they may be no more accurate than memories for other personal events," Weaver concludes.

— B. Bower

Fungi study harvests Westinghouse prize

The outcome of this year's Westinghouse Science Talent Search would have made Swedish botanist Carolus Linnaeus smile.

That's because first-place winner Elizabeth Michele Pine, 17, following in the footsteps of the 18th-century taxonomist, tackled the classification of a group of fungi called false truffles. Last week, Pine, of Chicago, received a $40,000 college scholarship for this research, part of a $205,000 pot awarded to 40 young scientists.

AP/Wide World Photo

Westinghouse Electric Corp.

President Clinton with Science Talent Search finalists; top winners (above, left to right): Pine, Merlo, and Ng.

Though often identified by the stem and cap that poke out of the ground, mushrooms and other fungi can fool even experts. "[Some] can look very similar; yet they are no more closely related than a skunk is to a sea otter," Pine explains. A student at the Illinois Mathematics and Science Academy in Aurora, Pine studied whether the shape of microscopic spores would prove a better indicator of kinship among these plants. She compared DNA from false truffles with DNA from *Laccaria* mushrooms, which produce similar spores. Her results indicate that taxonomists should probably reclassify false truffles as belonging to the *Laccaria* genus. Understanding these relationships is a necessary first step to studying and using fungi, Pine adds.

The judges awarded a second-place, $30,000 scholarship to Xanthi M. Merlo, a 17-year-old senior from Washington Park H.S. in Racine, Wis., for her work examining the role of a recently discovered blood protein in clotting. Sixteen-year-old Lenhard Lee Ng from Chapel Hill (N.C.) H.S. took third, earning a $20,000 award for a mathematics project.

Three students received $15,000 scholarships. Fourth-place winner Constance Lee Chen, 17, of La Jolla (Calif.) H.S. studied two genes important in the development of cancer. For his fifth-place project, Ryan David Egeland, 18, of Wayzata Senior H.S. in Plymouth, Minn., examined how deicing salts affect the long-term survival of common freshwater crustaceans called daphnia. Wei-Hwa Huang, 17, of Montgomery Blair H.S. in Silver Spring, Md., captivated the judges and onlookers at the weekend exhibit of projects with the new strategies he developed for variations of a peg-hopping game called peg solitaire.

Four more finalists each earned $10,000 scholarships, the first three for mathematics or computer science projects. They are Mahesh Kalyana Mahanthappa, 16, of Fairview H.S. in Boulder, Colo.; Steve Shaw-Tang Chien, 17, and Elizabeth Dexter Mann, 17, both from Montgomery Blair H.S. in Silver Spring, Md.; and Zachary Zisha Freyberg, 17, of Midwood High School at Brooklyn College in New York City for biochemical research.

The remaining finalists each received $1,000 toward college expenses.

Just as serendipity often plays a role in important research discoveries, it also helped guide these high school students to their projects. Ng came up with his project as a result of analyzing whether rounding off provided adequate approximations for balancing his mother's checkbook. Pine happened upon fungi because her father suggested she do research for a summer job. An interest in model airplanes motivated 11th-place winner Aaron James Passey, 18, of Bothell (Wash.) H.S. to do his engineering project.

Their results may advance the frontiers of science. Egeland, for example, showed that salt does exert subtle effects on daphnia. His results suggest that toxicity studies, which typically last a month, may need to run longer, he says. The 12th-place finalist, Michael Ward Itagaki of Punahou School in Honolulu, synthesized a complicated organic molecule that collaborators at the California Institute of Technology are testing as a synthetic alternative to a natural anticancer drug. *— E. Pennisi*