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.

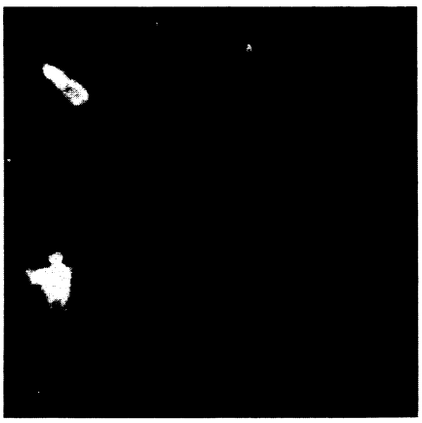
James M. Cordes and Scott C. Lundgren of Cornell University and Roger W. Romani of Stanford University describe their discovery in the March 11 NATURE.

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