New explanation for an old nova

In August 1975, an unusually bright and fairly nearby nova – a stellar explosion – occurred in the constellation Cygnus. Compared with the novas astronomers were familiar with, this one yielded data containing many anomalies, and since no one could come up with good explanations, Nova Cygni 1975 faded from attention as it faded in the sky. "No model ever satisfactorily explained the observations," says Peter Stockman of the Space Telescope Science Institute in Baltimore.

Twelve years later, he and two other astronomers took up the case again. Stockman, Gary Schmidt of the University of Chicago and Don Lamb of the University of Arizona in Tucson have worked out a model that explains the anomalies, they say, and will publish it in a future issue of THE ASTROPHYSICAL JOURNAL.

Their main contention and the key to their theory is that Nova Cygni 1975 happened in an AM Herculis system, a binary star in which a cool normal star and a highly magnetized white dwarf star are bound together by gravity. As astronomers are mostly accustomed to novas that happen in unmagnetized systems, the magnetic field – which could be as much as 30 million gauss, or 60 million times earth's – explains many of the anomalies.

According to their theory, the white dwarf's strong gravity pulls matter from the companion star, and this is what causes the nova. On the surface of the dwarf the accreted matter is unstable and eventually reaches a critical mass at which thermonuclear burning starts, and an explosion results. A shell of bright, hot matter flies off the dwarf's surface, engulfs the entire binary system and expands into space. After the explosion the process of accretion begins again, and after some time – anything from 10,000 to 100,000 years – the system can explode again.

Nova Cygni 1975 brightened very rapidly, increasing by a factor of about 40 million in a few days. However, it faded rapidly, too, anomalously fast. Early observers found a cyclic fluctuation in brightness and spectral features with a period of about 3.3 hours. This period was puzzlingly unstable. Astronomers expected that the period would be the same as the binary period. Instead, it decreased in the first year from 0.141 of a day to 0.138 of a day and later stabilized at 0.140. The total difference amounts to about 5 minutes, but theorists had to resort to some very exotic suggestions to explain the changes.

By the 1980s the nova had faded to the point where astronomers could easily see the radiation from the star itself, and Stockman, Schmidt and Lamb observed it with the 2.3-meter telescope of the University of Arizona's Steward Observatory. They found that a significant portion of the star's light was circularly polarized, indicating a strong magnetic field at the source. Stockman told SCIENCE NEWS that they can't calculate a value for the field but they estimate it as strong enough to assign the nova to an AM Herculis system.

In an unmagnetized binary system, matter falling onto the white dwarf forms an accretion disk, a disk of matter slowly spiraling down. This disk gets hot and glows, adding to the overall brightness of the system. In the magnetic case, the disk doesn't form. Instead, accreting matter falls directly on the magnetic poles of the white dwarf. This channeling and concentration of the infalling matter can explain the fast rise in the nova's brightness. If there were no magnetism, a new accretion disk should have begun to form immediately after the explosion. The lack of this accretion disk and its contribution to brightness can explain the swift fall of Nova Cygni 1975.

Stockman, Schmidt and Lamb attribute the observed light variations to a searchlight beam of bright radiation coming from the magnetic pole of the white dwarf, where the explosion started. Thus the fluctuations in its period would reflect fluctuations in the rotation of the white dwarf. However, even an AM Herculis system is still supposed to have its rotations phase-locked and relatively stable – that is, the combination of magnetic and gravitational interaction in this system should make the rotation period of the white dwarf equal to the binary orbital period.

The instabilities come from the dynamic interactions of the system, the astronomers say. As the expanding nova shell increases in size, its spin rate slows. (This is a general dynamic effect and will happen to any expanding body.) This creates a drag on the white dwarf and slows its rotation down a little. Later the red companion star begins to interact with the expanding shell, increasing the shell's rotation to match the orbital period of the binary. The white dwarf increases its spin to match. Finally, as the shell cools, it falls back onto the white dwarf, spinning it faster again and providing the asynchronism still observed today.

The three astronomers intend to continue observing the system. They expect that it will continue to fade over the next decade, and that the white dwarf's spin will slowly resynchronize with the binary orbit. *– D.E. Thomsen*

Neighbors bugged by germ warfare lab

The Army is facing unexpectedly fierce opposition to its plans to build a laboratory in Utah for conducting experiments with deadly germ warfare agents. Recent public hearings held near the Army's Dugway Proving Ground, where the laboratory would be located, and in Salt Lake City, 70 miles away, were attended almost exclusively by citizens and public officials opposed to the proposed biological aerosol facility. The hearings followed the February release of a draft environmental impact statement (EIS) concluding that there is "no cause for concern" that dangerous biological agents might escape from the laboratory (SN: 2/14/87, p.100).

In the past two weeks, Utah Governor Norman H. Bangerter, Sen. Orrin G. Hatch (R-Utah) and several local officials have come out against the plan, stirring rumors that the Army might reconsider its choice of the Utah site. Those rumors, however, are "not correct," according to Army spokesperson John Chapla. "A number of significant operational and safety issues were raised in the public hearing process . . . and we'll address those issues as part of the environmental impact statement process," Chapla told SCIENCE NEWS. "We will work through the EIS process and make a decision based on a full consideration of all the input that we've got."

The input, so far, has been largely negative. Hatch last week called the Army's plan "reckless endangerment," suggesting the facility should be built on Johnston Atoll in the South Pacific, where the Army currently stores outdated chemical weapons. Bangerter says he is "adamantly opposed" to construction of the facility in Utah. And a local television station and a newspaper, both owned by the politically influential Mormon church, have run editorials against the Army's plans.

The controversy has resulted in the scheduling of a House joint hearing in May, according to an aide to Rep. Wayne Owens (D-Utah). At the hearing, the chairmen of the Foreign Affairs, Armed Services and Interior and Insular Affairs Committees will look at the Dugway facility "from both a safety and a national security standpoint."

The Army has argued that the new facility is needed to design defenses to biological weapons being developed in other countries. Although it is designed to accommodate genetically engineered microbes for which no vaccines are currently available, the Army says it has no plans to experiment with such organisms.

The Army's final environmental impact statement is scheduled to be released in August. *– R. Weiss*