The Puzzling Pulsar That Wasn't There

A one-shot observation of supernova 1987A last year revealed a pulsar that seemed too bizarre to be real—and it wasn't

AFTER TANTALIZING THEORISTS and frustrating observers for more than a year, the mysterious pulsar signal from Supernova 1987A will trouble astronomers no more: the observers who saw it during its one and only appearance in January 1989 have now concluded that the signal was spurious, the result of interference between their detector and other electronics in the telescope.

"I'm a little bit let down and a little bit disgusted," says astronomer John Middleditch of Los Alamos National Laboratory, one of the principals in the discovery group* and until now one of the most articulate defenders of the data. "We regret this. But what can I say?"

Not much, except perhaps to express relief that he and his colleagues caught the error themselves—about a week before their review article on the pulsar signal was to go to press in *Science*.

In fairness, however, neither Middleditch nor his colleagues were alone in their enthusiasm. Not only did the observation seem to offer astronomers a once-in-a-lifetime chance to study a pulsar at virtually the moment of its creation, but *this* pulsar was so bizarre that it might have rewritten the physics texts. Says another leading supernova observer, Robert Kirshner of the Harvard-Smithsonian Center for Astrophysics, "It's too bad [it wasn't real]. It was such a weird pulsar."

There was nothing weird about finding a pulsar per se, of course. People had been watching for it practically from the first minute the supernova went off. The explosion itself had presumably been triggered as the ultradense core of a very massive star collapsed inward under its own weight; the formation of a pulsar—the remnant of the core once gravity had compressed it into a furiously rotating ball of solid neutrons—was therefore almost inevitable. All the astronomers had to do was wait until the supernova's expanding shell of debris had thinned out enough to let the pulsar shine through. And on the night of 18 January 1989, that moment seemed to have arrived.

Working at the Cerro Tololo observatory in Chile, Middleditch, and his colleagues detected a very faint, very rapid, but very definite flickering in the light from supernova 1987A. Extracting the signal required massive amounts of computer analysis. But when that was done, the signal was clearly present for the whole 7-hour period that the supernova had been under observation. Moreover, the signal disappeared just the way it should have when the astronomers turned their telescope away from the supernova and checked it against another source, a nearby globular cluster.

The discovery caused a sensation in the astronomical community. The pulsar seemed to be rotating so much faster than any other known pulsar—1968.629 times per second—that it should have been on the ragged edge of breaking apart. Could it be that the physicists' theories of pulsar structure were wrong, that nuclear matter is actually much tougher than it seemed? Theorists quickly rushed in with whole new sets of equations that said Yes, it was. Or could it be that the pulsar was not rotating at all, but vibrating like a bell that has somehow been given a sharp blow? Other theorists explained exactly how this would work.

And then there was the intriguing fact that the time between the pulsar's flickers varied over the 7-hour interval in a smooth sinusoid, just as if it were being tugged back and forth by an orbiting companion with roughly the mass of Jupiter. Could it be that the pulsar was rotating so fast that it *had* broken apart and sent a fragment into orbit?

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No one could say—which is why everyone waited eagerly for confirming observations. And yet those observations never came, despite the best efforts of observers all over the world. Middleditch and company checked and rechecked their equipment. They analyzed and reanalyzed the 18 January data for internal consistency. They took refuge in the hope that the expanding supernova shell was turbulent and patchy—that the pulsar had just happened to shine through a thin spot on 18 January and would one day shine again. Their one night of data looked unassailable. But the pulsar remained hidden.

The awful truth began to dawn only in January of this year, when the group was making yet another attempt to find the pulsar from the Las Campanas observatory in Chile. They saw a clear signal at 7874 cycles per second—far too fast for any conceivable pulsar, and worse, precisely four times the frequency they had seen a year earlier. The situation reeked of electrical interference. If that were the case, moreover, there was only one piece of electronics in the telescope that could be responsible: a television camera used to transmit an image of what the telescope was seeing to the observatory control room. And most disturbing of all, this camera was the same type as the one used at nearby Cerro Tololo, where the group had made their original observation.

The researchers' worst suspicions were confirmed after they went back to Cerro Tololo for further observations on the night of 5–6 February. When Middleditch completed the computer analysis on the evening of Sunday, 11 February, he knew: the data showed precisely the same kind of signal they had seen a year earlier, with precisely the same frequency and much the same kind of slow variation—except that this time, the telescope had been looking not at supernova 1987A, but at the well-known (and very different) pulsar in the Crab nebula.

So—what happened? Why didn't the camera's interference show up in any of the group's other observations during the past year, or in any of their many calibration tests? No one knows, says Middleditch. Perhaps the effect is temperature-related, since January is a summer month in Chile.

But, he says, it's all too easy to see in retrospect why the signal went away on 18 January when the researchers moved the telescope from the supernova to the globular cluster. That observation was made as dawn was beginning to light the sky. And the cameras, which are extremely sensitive, were turned off to protect them from damage. "It was good observing practice," says Middleditch, "but bad scientific method."

Embarrassing? Of course. And yet Kirshner, for one, is not unsympathetic. "You don't want to be too hard on these guys," he says."A lot of people are going to say 'Har, Har, I knew it all the time!' But I don't know—their data looked very nice." And it had a lot of astronomers convinced.

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*J. Kristian, *et al.*, "Submillisecond pulsar in supernova 1987A," *Nature* **338**, 234 (1989).