New evidence for planets orbiting a pulsar

After 2 years of additional study, a radioastronomer reports "irrefutable" evidence confirming the existence of two planets orbiting a dense Milky Way star. Estimated at about three times the mass of Earth, these planets would be the first identified outside the solar system.

Alexander Wolszczan of Pennsylvania State University in University Park reported his initial planetary finding in 1992, after studying radio emissions from a compact star some 1,300 light-years from Earth. Now dubbed PSR B1257+12, this dense resident of the Virgo constellation is a millisecond pulsar — a neutron star that rotates like clockwork hundreds of times a second. A millisecond pulsar acts like a lighthouse beacon, aiming radio waves toward Earth at precise intervals.

But in studying the pulsar with the 305-meter radio telescope at Arecibo Observatory in Puerto Rico, Wolszczan detected small fluctuations in the arrival time of the star's radio signals. Some of the waves arrived about three-thousandths of a second sooner than predicted, while others arrived about three-thousandths of a second later.

The variations suggested that the pulsar wobbles, moving closer to and farther from Earth in a quasiperiodic fashion. Wolszczan and a colleague concluded that the best explanation for the wobbling would be the gravitational tug supplied by two or possibly three unseen planets orbiting the pulsar (SN: 1/11/92, p.20).

Because it's unlikely that current telescopes could detect the dim, faraway planets directly, Wolszczan searched for other ways of verifying his finding. In the Jan. 23, 1992 NATURE, a team of astronomers, including Frederic A. Rasio, now at the Institute for Advanced Study in Princeton, N.J., suggested a strategy. Given the special relationship between the orbital periods of two of the proposed planets, their mutual gravitational tug should produce a tiny additional wavering of the pulsar's radio signals. This wavering, produced by an extra wobble in the pulsar's motion as the two planets alter each other's orbit, should be detectable within a few years, the astronomers noted.

At a January meeting in Aspen, Colo., Wolszczan announced that after analyzing 3 years of emissions from the pulsar, he had found the predicted wavering, a variation of a few millionths of a second in the arrival time of radio signals detected between 1990 and 1993. Astrophysicist Stephen E. Thorsett of the California Institute of Technology in Pasadena describes Wolszczan's work in the Feb. 24 NATURE.

"To me the evidence is now irrefutable," says Rasio. "It's the first time we've known for sure that there is a planetary system other than our own." He adds that noise in the data or the motion of the pulsar across the sky could not create the pattern of radio-wave emissions observed.

Wolszczan says the additional data confirm his 1992 report that at least two planets orbit the pulsar. One planet, he says, lies about one-third of an astronomical unit (AU) — the mean distance between Earth and the sun, nearly 93 million miles — from the dense star and has an orbital period of 66.6 Earth-days. The other lies about half an AU from the star and takes 98.2 Earth-days to orbit it. The data also reveal another orbiting body, which has a mass similar to our moon, and hint that other planets of unknown mass lie at least 5 AU from the star.

Although the known masses and orbits of the pulsar planets resemble that of Earth, their composition is likely to be quite different, Wolszczan notes. Astronomers theorize that planets arise from a disk of gas and dust encircling a star. Because a millisecond pulsar is elderly and most likely formed planets much later in life than the infant sun, its planets probably contain far more iron and other heavy elements typical of older stars, he says. *— R. Cowen*

Crop-weed offspring show hardy streak

Genetically engineered crops have yet to hit grocery stores. But companies have inserted foreign genes into many plants to make them tastier and more insect-resistant, for example. In fact, a genetically altered tomato awaits Food and Drug Administration approval for large-scale field trials.

These advances worry some scientists. They fear that pollen containing new genetic material, or transgenes, will fertilize nearby wild, weedy relatives. This could result in a hardier weed. Crops will mate with their wild siblings, even if these plants grow a kilometer or more away, write Terrie Klinger and Norman C. Ellstrand of the University of California, Riverside, in the February ECOLOGY APPLICATIONS.

But for the transgene to spread, the crop-weed hybrids must reproduce. Some scientists argue that the engineered traits would hinder a plant's survival in the wild; others say these hybrids are often robust, Klinger and Ellstrand write. But little research has looked at how crop-weed hybrids reproduce.

Ellstrand and Klinger compared the fitness of wild radishes with that of hybrids of wild and crop radishes. They decided against using genetically engineered plants, in part because they feared the transgene might spread into other species. However, genetically engineered plants would act in ways similar to nonengineered crops, Ellstrand predicts.

The weed-crop hybrids produced about 15 percent more fruit and seeds than their wild siblings, they found.

"These results suggest that, in at least this system, neutral or advantageous transgenes introduced into natural populations will tend to persist," they write. The fitness of the hybrids will depend on the transgene used and on what sort of competition the plants face, they say.

This is "quite an important result," says Johanna Schmitt, an ecologist at Brown University in Providence, R.I., who works with Calgene, the Davis, Calif.-based company that developed the genetically altered Flavr Saver tomato (SN: 11/28/92 p.376). The findings indicate that no "intrinsic barrier" prevents a transgene from moving beyond a farmer's fields, she says.

"It confirms something we in industry have assumed we'd have to deal with," says Ron Meeusen, director of biotechnology for Northrup King Co. in Stanton, Minn. But in some cases, the domesticated crops and their wild relatives live too far apart to breed.

Ellstrand

When crop radishes mate with their wild relatives, a hardy hybrid results.

Klinger and Ellstrand note that the "hybridization of crops and weeds already has played an important role in the evolution of several weed species [such as johnsongrass] and has been implicated in the extinction" of the wild relatives of date, chili pepper, and hemp plants.

In a separate study, Schmitt and her colleagues recently found that seeds from a hybrid of a genetically altered canola plant and a wild mustard plant grew as well as the seeds from the hybrid made without the transgene. Neither her nor Ellstrand's study examined how well the crop-weed hybrids fare when they face competition from other wild plants, the authors acknowledge. *— T. Adler*