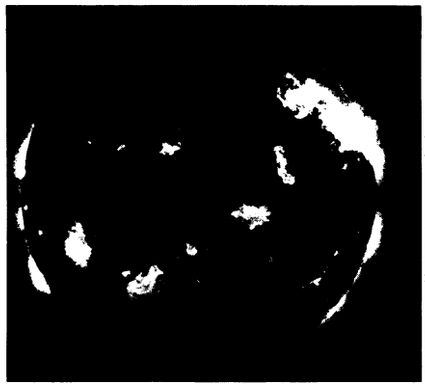
finding provides a reference point that will help scientists "stitch together" the magnetic activity on the sun's surface with that in the solar atmosphere.

Other research teams at Mauna Kea examined solar features with wide-field infrared cameras, capturing the first infrared pictures of the sun during an eclipse. Astronomers had hoped the images would reveal whether a ring of dust or rocky material circles the sun thousands of kilometers above the solar surface. Such a ring might arise from dust shed by comets passing near the sun or from rocky material left over from the solar system's formation, says Eric Tollestrup of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass. The preliminary images show no evidence of a ring, but this doesn't necessarily rule out its existence. The brightness of the corona – the outermost layer of the solar atmosphere – may have obscured the relatively dim glow of sun-warmed rocks or vaporized dust, Tollestrup says. If so, further processing to subtract the coronal background from the images might yet reveal the ring.

The preliminary pictures do show other key features of the solar atmosphere, Tollestrup says. These include bulges in the region surrounding the eclipsed solar disk, which depict long extensions of the corona called streamers; and white areas that indicate solar prominences – elongated gas clouds held intact by magnetic fields.

Some Mauna Kea observers are collaborating with researchers who imaged the sun at the same time from other sites. In one such project, astronomers plan to match visible-light features in the solar atmosphere observed from Hawaii with X-ray images taken simultaneously above White Sands, N.M., where the eclipse had not yet occurred. Comparing the X-ray images of the full solar disk with the eclipse photographs of the corona should help astronomers trace the path of magnetic field lines from the surface of the sun to its outer atmosphere, explains Leon Golub of the Harvard-Smithsonian Center for Astrophysics, who made the White Sands observations with colleagues from IBM in Yorktown Heights, N.Y. The X-ray images themselves, he says, may feature the highest resolution of any such photos of the sun (SN: 9/30/89, p.223). The bright areas of these pictures reveal elongated, magnetically confined regions of hot plasma – structures that did not show up clearly in previous X-ray images, Golub says.

– *R. Cowen*



Smithsonian Astrophysical Observatory/IBM Research

A rocket-borne telescope flying over White Sands, N.M., captured this X-ray image just minutes before the moon passed in front of the sun. The picture may represent the sharpest X-ray image yet of solar-disk features. The moon looms at right.

Wavering radio signals hint at an unseen planet orbiting a pulsar

British astronomers have found tantalizing evidence that a planet-sized object orbits a pulsar some 33,000 light-years from Earth. If their finding proves correct, it will mark the first detection of a planet outside the solar system. A confirmation of this provocative result would also challenge accepted theories about the formation of pulsars.

Previous reports of planets orbiting stars other than the sun have not withstood further scrutiny. But the British team maintains that the long-term consistent nature of their data bolsters their finding.

Early last year, Andrew G. Lyne and his colleagues noticed a peculiar, periodic pattern in the arrival times of radio emissions from PSR1829-10, a Milky Way pulsar they had discovered in 1985. In reexamining earlier data, they discovered that the timing of radio signals from this star, unlike that of the 39 other pulsars they had identified, had fluctuated about every six months since close monitoring of PSR1829-10 began in 1987.

Six weeks ago – after Lyne and his coworkers at the University of Manchester rejected other explanations for the star's variability – they arrived at a startling conclusion: The emission pattern indicates that the pulsar and a much smaller body orbit each other, and that the "companion" object meets the criteria for a planet. The unseen object, perhaps only 10 to 15 times the mass of the Earth, follows a nearly circular path about 105 million kilometers from the pulsar – roughly the distance between Venus and the sun – and each orbit takes six months to complete, the researchers report in the July 25 NATURE.

"If there is a companion, the work ... will challenge some, perhaps several, fundamental aspects of our view of the evolution of stellar and planetary systems," writes David Black, of the Lunar and Planetary Institute in Houston, in an accompanying commentary.

The pulsar and its planetary companion, Lyne says, would orbit around a common center close to the pulsar, as is the case with Earth and the sun. When the pulsar travels on the far side of its orbit, its radio pulses take longer to reach Earth; on the near side, they arrive sooner. This hypothetical scenario, Lyne asserts, would account for the six-month changes in the timing of the signals.

While the discovery of a possible planet outside our solar system seems dramatic in itself, the presence of a planet near a pulsar poses a special puzzle, Lyne says, particularly if the planet predated the pulsar's explosive birth. According to standard theory, the catastrophic events leading to the formation of a pulsar – a rotating neutron star – should destroy a planet or eject it from the star's gravitational grasp.

For example, if the red giant star that likely gave rise to the pulsar suddenly shed more than half its mass to form the new pulsar, the planet could not remain bound. In any case, the ensuing shock wave spewed out by the collapsing red giant would blow the planet apart. But Lyne and his colleagues suggest that the pulsar may have formed more slowly and less violently than the standard theory permits, and that this would enable the planet to remain intact. "If this 'kinder, gentler' process works, the new discovery will have led to a revolution in [pulsar] astrophysics," writes Black.

Lyne and his colleagues have also developed an alternative theory, which assumes that the planet did not predate the pulsar. In this model, which Black calls "more likely and equally intriguing," a neutron star spinning especially rapidly would slow down by forming a disk around its equator, and material in the disk could condense into a planet. Researchers believe the solar system planets arose from a disk that once surrounded the sun. A planet that formed in this way could have several features similar to those of the object inferred by the British team, Black says.

Direct observations of the proposed planet seem unlikely, since the object probably reflects light dimly at all wavelengths, Lyne says. Black says he's reluctant to call the object a planet, because this substellar mass and its environment would bear little, if any, resemblance to known planets.

Lyne says his group will continue monitoring PSR1829-10 to corroborate their findings and to examine whether subtler changes in the radio emissions indicate the presence of a second, more massive planet. The team will also look for periodicity in emissions from other pulsars in the hope of uncovering evidence of other planet-like objects. – *R. Cowen*

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