



29 seconds after supernova  
(above top of frame)

104 seconds

179 seconds

329 seconds

EVONNE MARIETTA

## A Supernova and Its Companion

A Type Ia supernova is the complete thermonuclear explosion of a white dwarf that is closely circled by a companion star. Astronomers have long wondered exactly what happens to the companion so near to such a powerful event. These frames, from a simulation by Evonne Marietta and Adam S. Burrows (University of Arizona) and Bruce A. Fryxell (University of Chicago), show the impact of the rapidly ex-

panding supernova shell (down from top) on a main-sequence companion with one solar mass. Dark blue indicates a gas density of 160 grams per cubic centimeter or more (far denser than lead) and red  $10^{-13}$  (far thinner than air). In the second frame the shell's leading edge has just hit the companion's surface, and by the third the leading edge is converging downstream. The fourth shows a shock wave driven

deep into the companion, a bow shock just upstream, and a narrow, high-velocity tail. Marietta and her coresearchers estimate that main-sequence and subgiant companions lose only 15 percent of their mass as a result of the impact, while red-giant companions are stripped of 96 to 98 percent of their envelopes. The group's findings have been submitted to the *Astrophysical Journal*.

sterdam, the ring is probably the lost outer mantle of one of two stars making up Eta Carinae itself. The material was stripped from the star and flung away by the gravity of its stellar companion. After losing its outer portions the star became unstable, leading to the 1843 eruption. The composition of the nebula, which is relatively rich in nitrogen and poor in carbon and oxygen, is well explained by this model: it's material from part-way into the star's highly evolved interior.

So is Eta Carinae really a binary, as de Koter's model assumes? Other astronomers have concluded that it is. It displays highly unusual changes in its spectrum every 5.5 years with clocklike regularity, suggesting that the changes are regulated by something orbiting (*S&T*: January 1998, page 36, and March 1998, page 19). The latest news comes from Augusto Damineli of the University of São Paulo, Brazil. In *Astrophysical Journal Letters* for January 10, Damineli and his colleagues describe their observations of Eta Carinae made during the latest episode of spectral changes two years ago. They deduce an orbital period of  $5.531 \pm 0.014$  years and an orbital eccentricity of 0.75, meaning the orbit is highly elongated. There are also signs of powerful stellar winds from the two stars colliding to form an X-ray-emitting sheet of gas as hot as 60 million degrees Kelvin.

Eta Carinae is one of only a few luminous blue variables (LBVs) in the Milky Way. These extremely massive stars are racing through their lives and will explode as supernovae soon, astronomically speaking. "This will happen within a few hundred thousand years," says de Koter. "It could happen tomorrow."

## Mapping the Local Interstellar Cloud

For the past quarter-million years, the solar system has basked in a passing biob of neutral atomic hydrogen called the Local Interstellar Cloud (LIC). It appears to be part of an expanding complex of such clouds perched on the edge of a cavity surrounding the enormous Scorpius-Centaurus stellar association, which is centered about 400 light-years away. A collection of hot, young, massive stars forms the heart of Sco-Cen, including most of the brightest naked-eye stars of those two constellations. Their winds, combined with ancient supernova shockwaves, have carved out a 700-light-year-wide abyss. These stellar winds are propelling the LIC as it envelops the solar system.

The roughly egg-shaped LIC isn't visible to optical observers, but it can be mapped, as ultraviolet light from nearby stars is partly absorbed by it. Jeffrey Linsky and Seth Redfield (University of Colorado) are exploring the LIC with instruments on the Hubble Space Telescope, trying to establish the cloud's boundaries. They estimate that it is about 20 light-years long and uniformly dense, has a smooth surface, and is flowing past us at 26 kilometers (16 miles) per second. Their work appears in the January 10th *Astrophysical Journal*.

The solar system and its protective "heliosphere" of solar wind sit very near the trailing edge of this cloud, which means the LIC will leave us behind sometime in the next few thousand years, Linsky says. When this does occur, we will enter a hotter, harsher environment called the interstellar matrix, which could shrink or expand the heliosphere and affect the outermost solar magnetic field. It's also possible that another cloud will engulf the Sun and planets as it rushes away from the maelstrom of the Scorpius-Centaurus Association.