All eyes on Eta Carinae: A new spectacle?

One of the most massive, luminous, and unstable stars in the heavens, Eta Carinae has been a showstopper since the 1840s, when astronomers watched this behemoth undergo a giant explosion. A new study suggests that in January the star could put on another stellar light show.

Astronomers are gearing up for what could be the largest campaign of ground-based and space observations ever devoted to a single star. The chances are slim that next month's predicted spectacle will reprise Eta Carinae's bravura performance of 150 years ago, when it hurled into space a pair of ballooning, mirror-image gas clouds. Nevertheless, by taking multiwavelength portraits of Eta Carinae at a time when its X-ray output—and perhaps other emissions—are likely to be at a peak, observers hope to answer such basic questions as whether this hour-glass-shaped object is actually two stars locked in a gravitational embrace.

The data take on added significance because Eta Carinae is one of the most likely stars in our galaxy to explode as a supernova, notes Michael F. Corcoran of NASA's Goddard Space Flight Center in Greenbelt, Md. "When you're studying Eta Carinae, you're studying a star just before it becomes so unstable that it blows itself to bits," he says.

Since early 1996, Corcoran and his colleagues have used a NASA craft, the Rossi X-ray Timing Explorer, to monitor Eta Carinae weekly. They report in the Dec. 11 NATURE that radiation from the star exhibits two previously unsuspected patterns. Every 85 days, Eta Carinae undergoes small-scale outbursts at X-ray energies. This activity is superimposed on another, more intriguing trend: an increase in the intensity of high-energy emissions, 3,000 to 10,000 electronvolts, which has accelerated since last January. That increase is expected to peak next month.

Earlier work hinted that the rise in high-energy X rays is periodic, peaking every 5.5 years—exactly in synch with a previously detected minimum in the intensity of near-infrared emissions from helium atoms in Eta Carinae. These periodicities suggest that Eta Carinae may in fact be two stars that orbit each other every 5.5 years. The two members of this stellar system would make their closest approach in January.

In this scenario, the X rays emitted by Eta Carinae are generated when fierce winds from the two stars collide. As the stars approach each other, the radiation should intensify.

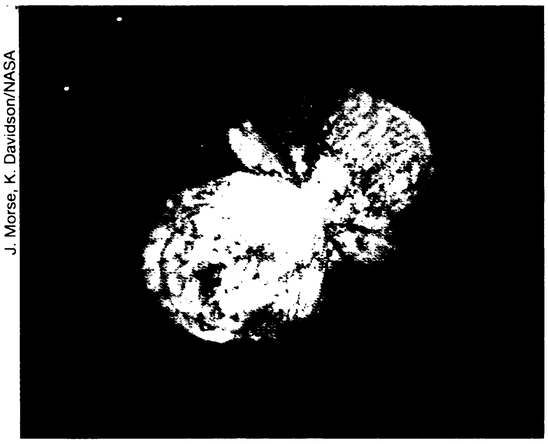
Mario Livio of the Space Telescope Science Institute in Baltimore suggests another test of the two-star model. Ultraviolet emissions should sharply decline as one star blocks the other just before their closest approach. Other forms of radiation may also vary.

Even if Eta Carinae is a single star, the X-ray peak may provide a field day for the four X-ray telescopes now in space, says Livio. There remains an outside chance, he and other astronomers note, that the rise in X-ray emissions may trigger a giant explosion. The 1840 outburst, notes Corcoran, coincided with what would have been a peak in X rays.

If there are fireworks, a slew of telescopes will be poised to record them.

—*R. Cowen*

J. Morse, K. Davidson/NASA



False-color, composite image of Eta Carinae. Red denotes emissions from ionized hydrogen and nitrogen.

California shakes most often in September

Seismologists have discovered a potential link between earthquakes and the weather—a connection that researchers had dismissed for decades.

A study of earthquakes in California and neighboring states indicates that fault activity in the last 5 years has followed a yearly pattern. The predominantly tiny quakes have occurred most frequently in September and least often in April, report Shang Xing Gao and Paul G. Silver of the Carnegie Institution of Washington (D.C.). After examining many potential causes of the cycle, Gao and Silver found that atmospheric pressure appears to be the controlling factor, they reported in San Francisco this week at a meeting of the American Geophysical Union.

When air pressure remains low, as it does during the warmth of summer, it lessens the weight of the atmosphere pressing on the ground, explains Gao. "This reduces the friction on rocks, so earthquakes can occur more easily," he says.

Some Californians have long asserted that earthquakes tend to follow certain weather patterns, but seismologists had been unable to find reliable connections, says Thomas V. McEvilly, a seismologist at the University of California, Berkeley.

Gao and Silver examined all earthquakes that occurred in more than a decade within 1,000 kilometers of Parkfield, Calif., a tiny town on the San Andreas fault. They found no obvious annual pattern in records before 1992. The yearly cycle first appeared in the data following June 28, 1992, when a magnitude 7.3 earthquake struck the Mojave Desert near Landers, Calif.

The Landers tremor may have sensitized certain faults across the western United States, enabling them to respond more readily to changes in atmospheric pressure, the researchers suggest.

"That makes sense," comments Don L. Anderson, a seismologist at the California Institute of Technology in Pasadena. The Landers earthquake, he notes, surprised seismologists by triggering aftershocks across a wide swath of the western United States, much farther than researchers had previously witnessed. Faults in northern California, Nevada, and even Yellowstone National Park in Wyoming awoke in the hours after the Landers quake.

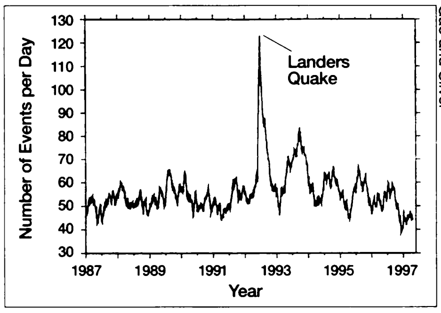
Landers' far-flung aftershocks occurred mostly in volcanic regions, where magma and heated groundwater lie near Earth's surface. These may be weak areas of the crust that are unusually susceptible to changes in atmospheric stress, suggest Gao and Silver. If so, the sensitivity of these faults is waning; the seasonal variation in quake numbers has diminished over the last 5 years.

Other areas, such as the San Andreas fault, showed no heightened sensitivity following the Landers quake.

The researchers examined other potential causes of the seismic variations, such as changes in precipitation or seasonal variation in mining companies' blasting. The pattern of atmospheric pressure fluctuations best matched the rise and fall in quake numbers.

The new observations are important because they also offer new insight into the forces needed to generate aftershocks in the wake of a major quake. Seismologists have assumed that faults would not budge unless stresses jumped or dropped by more than 100 millibars, yet the variations in atmospheric pressure are only one-tenth that figure, say Gao and Silver.

—*R. Monastersky*



Gao and Silver

Western U.S. earthquakes have exhibited a yearly cycle since the Landers jolt.