Black holes trigger stars to self-destruct

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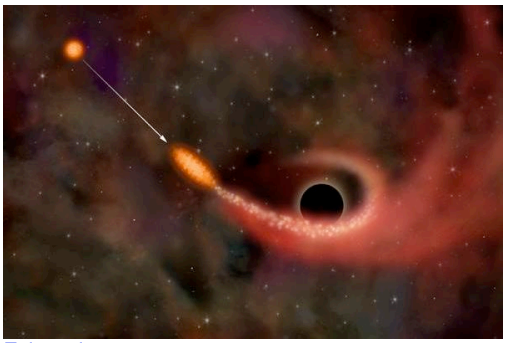
The fate of stars that venture too close to black holes could be even more violent than previously believed. Not only are they pulled apart by the black hole's tremendous gravity, but the process can also trigger a nuclear explosion that tears the star apart from within, a new study says.



Enlarge image
A star is pulled apart by a black hole in this artist's impression (Illustration: NASA/CXC/M Weiss)

Scientists have long understood that supermassive black holes weighing millions or billions of Suns can tear apart stars that come too close.

The black hole's gravity pulls harder on the nearest part of the star, an imbalance that pulls the star apart over a period of minutes or hours, once it gets close enough. Watch an animation of a star getting ripped apart and swallowed by a black hole.

Now, a pair of physicists says this uneven pulling is not the only hazard facing the star. The strain of these unbalanced forces can also trigger a nuclear explosion powerful enough to destroy the star from within.

Matthieu Brassart and Jean-Pierre Luminet of the Observatoire de Paris in Meudon, France, carried out computer simulations of the final moments of such an unfortunate star's life, as it veered towards a supermassive black hole.

Swirling in

When the star gets close enough, the uneven forces flatten it into a pancake shape. Some previous studies had suggested this flattening would increase the density and temperature inside the star enough to trigger intense nuclear reactions that would tear it apart.

But other studies had suggested that the picture would be complicated by shock waves generated during the flattening process and that no nuclear explosion should occur.

The new simulations investigated the effects of shock waves in detail, and found that even when their effects are included, the conditions favour a nuclear explosion.

"There will be an explosion of the star – it will be completely destroyed," Brassart told **New Scientist**. Although the explosion obliterates the star, it saves some of the star's matter from being devoured by the black hole. The explosion is powerful enough to hurl much of the star's matter out of the black hole's reach, he says.

The devouring of stars by black holes may already have been observed, although at a much later stage. It is thought that several months after the event that rips the star apart, its matter – which had been spiralling towards the black hole – starts swirling into the hole itself. It heats up as it does so, releasing ultraviolet light and X-rays.

Stellar fireworks

NASA's GALEX spacecraft may have seen such an event (see *Black hole seen devouring star in best detail yet*). Another event may have been picked up by both NASA's Chandra X-ray Observatory and ESA's XMM-Newton spacecraft (see *Giant black hole caught devouring star*).

If stars disrupted near black holes really do explode, then they could in principle allow these events to be detected at a much earlier stage, says Jules Halpern of Columbia University in New York, US. "It may make it possible to see the disruption of that star immediately if it gets hot enough," he told **New Scientist**.

Brassart agrees. "Perhaps it can be observed in the X-rays and gamma rays, but it's something that needs to be more studied," he says.

Supernova researcher Chris Fryer of the Los Alamos National Laboratory in Los Alamos, New Mexico, US, says the deaths of these stars are difficult to simulate, and he is not sure whether the researchers have proven their case that they explode in the process.

But if these explosions do occur, future observatories, such as the Large Synoptic Survey Telescope (LSST), which will detect large numbers of supernovae, could turn up some explosions of this type. "Then these objects may come into the limelight," he told **New Scientist**.

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Jules Halpern, Columbia University
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