

# Gold on Earth formed in collision of exotic stars

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*There's gold in them thar neutron stars! That's right, astronomers claim Earth's gold, the stuff of wedding bands and pricey speaker wires, originated in cataclysmic collisions of exotic stars.*



(Photo: Dana Berry)

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The gold glinting on your wedding band was likely born in a cataclysmic merger of two exceedingly exotic stars, astronomers report Wednesday.

Dying stars billions of years ago cooked up most of the lighter elements in the universe, the oxygen in the air and calcium of our bones, and blasted it across the cosmos in their final explosive moments. We are stardust, as the singer Joni Mitchell put it.

But some of the heaviest atoms, including gold, defied this explanation, requiring an even more exotic origin.

A team led by Harvard astronomer Edo Berger now reports that gold is likely created as an aftereffect of the collision of two "neutron" stars. Neutron stars are themselves the collapsed remains of imploded stars, incredibly dense stellar objects that weigh at least 1.4 times as much as the sun but which are thought to be less than 10 miles wide.

While ordinary stars explode about once every century in our galaxy, Berger says, explosive collisions of two neutron stars happen only about once every 10,000 years. And it appears they spew out gold and other heavy elements in the week after their merger.

"Call it the golden glow," Berger says. "In this case, we were able to observe it for the first time and see how the merger seems to be producing (the) heavy elements."

The team bases its finding on observations of a high-energy flash of gamma rays, a "gamma ray burst" called GRB 130603B that was detected in June by NASA's Swift X-ray telescope satellite. The burst is seen as a signature of the explosive union of two neutron stars, in this case ones some 3.9 billion light-years away (one light year is about 5.9 trillion miles) the team reports in an *Astrophysical Journal Letters* report.

Observation of the cloudy aftereffects of the burst suggest that each merger of two neutron stars produces several moons worth of gold by weight. "At today's prices, that amount of gold would be worth 10 octillion dollars," says Berger. (That's \$10,000 trillion-trillion or \$10,000,000,000,000,000,000,000,000,000,000, for anyone counting.)

Overall about 1% of the mass of the two neutron stars was likely converted into exotic minerals by the merger, only a small part of it gold. In the collision, sub-atomic particles blasted out of the neutron stars fuse together to form heavy elements, escaping a black hole that forms afterward from the merger. Such are the likely origins for the gold that accumulated in Earth's crust some 4.54 billion years ago, swept up from space at the birth of the solar system, and now seen in jewelry store windows.

"This means (that) the Harvard team might have discovered the 'smoking gun' for unraveling the long-standing mystery which objects in the universe are responsible for the production of gold and platinum and other heavy elements," says astrophysicist Hans-Thomas Janka of Germany's Max-Planck Institute for Astrophysics. "One gets even more platinum in the same events, so even more material for mankind's jewelry!"

Janka cautioned that the gamma ray burst result represents only one observation and that astronomers will need to observe more such blasts in coming years to feel fully confident about the finding.

"It really seems that the gold in jewelry that people are wearing is the result of one of the most violent explosions in the universe: a gamma-ray burst that is produced when two neutron stars merge with each other," says astrophysicist Stephen Rosswog of Germany's Jacobs University Bremen, who first suggested the golden glow effect in 1999. "These are very difficult observations, but if this turns out to be true, this would be truly very exciting news."

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