Unusual explosion sparks new insight into the life of stars

National Science Foundation

Scientists in California have discovered a new way that stars explode, in research funded by the National Science Foundation (NSF).

The discovery hinges on an unusual explosion in the galaxy NGC 1821, roughly 160 million light years away, according to astronomer Dovi Poznanski of the Lawrence Berkeley National Laboratory. Poznanski and colleagues report their discovery in a paper published in the journal Science Express.

"Stellar explosions are some of the key processes in the evolution of the universe," said Thomas Statler, an NSF program director in its division of astronomical sciences. "They influence the formation of stars and the growth of galaxies, and they produce nearly all of the metallic elements that form the cores of planets like Earth."

Light from the exploding star reached Earth in 2002 and was recorded by a robotic telescope at Lick Observatory, near San Jose, Calif. At first, the flash was mistakenly classified as an ordinary "Type II" supernova, a catastrophic event in which a massive star destroys itself.

A single supernova releases a hundred times more energy in its first second than the sun will produce in its entire lifetime. The sun is too small to explode this way, but Earth still owes its existence to supernovas. Heavy elements, like iron, gold, and uranium, are made through no other means than a supernova.

When Poznanski and his colleagues re-examined the 2002 data this year, they realized they had something new on their hands. The spectrum—the inventory of the explosion's light across different colors—didn't match typical supernovas. It indicated an abundance of helium and a hint of the metal vanadium.

Poznanski and University of California (UC) Berkeley graduate student Mohan Ganeshalingam analyzed how the object, designated SN 2002bj, had brightened and faded over time. "It was three to four times faster than a standard supernova," said Poznanski, "basically disappearing within 20 days. Its brightness just dropped like a rock."

Christopher Stubbs, chair of the Department of Physics at Harvard University, jokingly dubbed it a ".Ia" (point one A) supernova, because it is one-tenth as bright for one-tenth the time as a Type Ia supernova, and the name stuck.

The researchers realized that these properties matched the description of a new type of explosion proposed in 2007 by a group led by Lars Bildsten of the Kavli Institute for Theoretical Physics at UC Santa Barbara. Bildsten's theoretical work, also supported by NSF, examined what happens when two ultra-dense white dwarf stars are in orbit around each other.

White dwarfs are the ultimate end of stars like the sun, in which the mass of an entire star is packed into a volume roughly the size of Earth. If two white dwarfs are orbiting closely enough, matter can flow from one to the other, building up a thick layer of helium on the second star. In the right circumstances, the helium layer can explode in a thermonuclear blast.

Bildsten and his colleagues calculated that the explosion would look, at first glance, like a regular supernova, but it would appear faster and only about one-tenth as luminous. The explosion would eject huge amounts of helium and vanadium into space.

"We think this may well be a new physical explosion mechanism, not just a minor variation of ones already known," said Alex Filippenko, UC Berkeley professor of astronomy and co-author on the discovery paper. "It whets my appetite for what else we might find."

A by-product of heart transplants

By WANG YUANFU & STEPHANIE LAM
Epoch Times Staff

Legend has it that about 2,500 years ago, during China's Warring State Period, two men went to see a great doctor by the name of Bian Que. Bian cured their sickness very quickly but discovered that they had another problem that had been growing more serious over time. Bian said that they would both get well if they exchanged their hearts, and they agreed to let Bian perform the surgery.

Bian had the two men drink some anesthetics and they lost consciousness for three days, during which Bian opened their chests, exchanged their hearts, and applied medicine. When they regained consciousness, they had already recovered and were as well as before.

But something was wrong: When they returned home, they were both baffled because their wives couldn't recognize them. It turned out that they had both gone to the other person's home and thought that the other person's wife was their wife.

It seems inconceivable that such a surgery could have been performed 2,500 years ago, but this story is unbelievably similar to the situation observed in some modern heart transplant cases.

The U.K.'s Daily Mail reported that, after a heart transplant, Sonny Graham of Georgia fell in love with his donor's wife and married her. Twelve years after their marriage, he committed suicide the same way his donor did.

In another Daily Mail report, a man named William Sheridan received a heart from an artist who died in a car accident, and suddenly he was able to produce beautiful drawings of wildlife and landscapes.

Claire Sylvia, the recipient of a heart and a lung in 1988, wrote in her book "A Change of Heart: A Memoir" that after the transplant she started to like beer, fried chicken, and green pepper—all of which she didn't like before but her donor, an 18-year-old boy, liked.

She had a dream in which she kissed a boy she thought to be named Tim L., and inhaled him into her during the kissing. She later found that Tim L. was the name of her donor. She wondered if it was because one of the doctors mentioned the name during her surgery, but was told that the doctors did not know the name of the donor.

In a paper published in the Journal of Near-Death Studies, Dr. Paul Pearsall of the University of Hawaii and Dr. Gary Schwartz and Dr. Linda Russek of the University of Arizona discussed 10 cases of heart or heart-lung transplants in which the recipients were reported to have "changes in food, music, art, sexual, recreational, and career preferences, as well as specific instances of perceptions of names and sensory experiences related to the donors."

In one of the cases that they described, the donor was an African American, so the recipient thought the donor would like rap music and therefore didn't think the transplant was the cause of his new preference for classical music. However, it was found that the donor was a violin player and loved classical music.

This case suggests that changes in organ recipients' preferences occur without the recipients anticipating them. Thus these cases are unlike the placebo effect, in which patients' health conditions change in the direction of their expectations.

In addition, the researchers pointed out that like the above recipients, there might be other recipients who dismiss the idea that they adopted their donors' preferences because of their expectations of the donors, so the number of organ transplant recipients who experienced a personality change similar to that of their donors might be underrepresented.

Pearsall, Schwartz, and Russek concluded that it is unlikely these cases happened out of coincidence, and hypothesized that it is because of cellular memory, meaning that memories and preferences can be stored in cells. However, it is currently unknown whether this form of memory exists.

To see their report, please visit http://www.littleurl.net/ac45f9

Newborns cry differently according to their mother tongues

By HELENA ZHU
Epoch Times Staff

On the first days of their lives, French babies already cry in a different tone from German babies.

In a study published last week, researchers from France and Germany compared recordings of 30 French and 30 German infants aged between two and five days old. The French newborns cried in rising tones, while German infants cried in falling tones.

The researchers believe that the crying tones correspond to the differing intonation patterns of the two languages. These patterns are perceived by the fetus in the mother's uterus during the last trimester of the pregnancy.

"The sense of hearing is the first sensory system that develops. The mother's voice, in particular, is sensed early on," said Dr. Angela Friederici, director of the Neuropsychology department at Leipzig, Germany's Max-Planck-Institute for Human Cognitive and Brain Sciences, in a press release.

Yet the fetus's hearing in the uterus is restricted due to the amniotic fluid.

"What gets through are primarily the melodies and intonation of the respective language," said Friederici.

Especially with the large differences existing between spoken German and French, the crying patterns of the German infants mostly began loud and high and followed a falling curve, while the French infants more often cried with a rising tone.

"In French, a lot of words have stress at the end, so that the intonation rises, while in German, it is mostly the opposite," said Friederici.

The researchers said that this early sensitivity to features of intonation may later help the infants learn their mother tongues.

Other researchers include those from University of Würzburg in Würzburg, Germany; and Ecole Normale Supérieure in Paris, France.

To see the research paper, please visit http://www.littleurl.net/d09cb9

SCIENCE MATTERS

10 NOVEMBER 2009

Vol. 11, No. 45

All life depends on the oceans

By David Suzuki with Faisal Moola

It's often said that we know as much about Mars and the moon as we do about our oceans. Considering that Earth is 71 per cent ocean, this should be cause for concern. At the very least, we should be doing more to protect our oceans from the negative effects of human activities, even if we don't fully understand all that is happening under the seas.

One thing we do know is that oceans are changing – and the changes aren't for the best. For centuries, we've thought of our oceans as stable. But ocean currents, upwellings, oxygen levels, acidity, and temperature are changing in ways we haven't seen before. Assumptions we once held about the seas are no longer valid.

We've always assumed that oceans would provide us with an endless bounty of food. We rely on our oceans for transportation, recreation, and numerous resources. And oceans provide almost half the oxygen we breathe.

The collapse of Canada's Atlantic cod stocks was just one of many warnings we should have heeded. Many West Coast salmon stocks have also disappeared and many are returning in increasingly lower numbers. Even the survival of the very base of the marine food chain, plankton, is being threatened.

Some threats to our oceans are easier to pinpoint than others. Swirling masses of plastic garbage in the oceans – one of them in the North Pacific estimated to be bigger than Quebec – are obvious artifacts of our disposable societies. "Dead zones" are showing up in our oceans around the globe. These are areas where oceans are starved of oxygen because of a nitrogen overdose from agricultural runoff.

Many fish stocks are dwindling, in part because of our appetite for seafood. This is spurring more development in aquaculture – but most fish-farming practices are putting added pressure on oceans and wild fish.

On top of the many direct threats to ocean health we also have climate change to contend with. We know that global warming is causing the oceans to become more acidic. This is a worrisome trend.

As with our atmosphere, too much carbon is resulting in dangerous effects. Carbon dioxide is necessary for photosynthesis, which is how plants grow and develop. But when we burn fossil fuels or clear-cut forests, we release too much carbon dioxide into the atmosphere, upsetting the balance. This creates a heat-trapping blanket around the Earth, which contributes to global warming.

The oceans absorb carbon dioxide, keeping some of it from the atmosphere. But while oceans help slow the pace of global warming, they too are absorbing too much carbon dioxide, resulting in disruption of the ocean's pH balance. This increasing acidity causes calcium carbonate to dissolve, affecting life forms including corals, shellfish, and several species of plankton that rely on calcium for their very structure.

Science is confirming that our old assumptions are no longer valid, and we find ourselves in a situation of escalating risk. As a result, we need to look at our oceans in an entirely new way. We can't continue to exploit ocean resources on false assumptions. We need to know more about what's going on. That means investing in science that will help explain the interactions between changing ocean conditions and the species that depend on the seas.

We need a new way to manage our oceans in the face of uncertainty and elevated risk facing marine life. A comprehensive marine-planning initiative that considers new and evolving science and the evidence of what is actually happening to marine ecosystems would be a good start. This process must be based on a precautionary approach that recognizes increased uncertainty and the fact that our oceans will continue to change as global warming and other human-induced factors continue to affect them.

We can't rely on governments alone to protect the health of our oceans. Industry, nongovernmental organizations, First Nations, coastal communities, and governments at all levels must come together to plan and monitor conservation efforts based on science and local community knowledge.

After all, one thing we've learned about Mars and the moon is that we can't move there if we destroy our home on this beautiful and generous planet – in part because they don't have oceans. Neglecting the health of our oceans, where all known life began, is a risk we cannot afford to take.

Learn more at www.davidsuzuki.org.

Dr. David Suzuki is a scientist, broadcaster, author, and chair of the David Suzuki Foundation and Dr. Faisal Moola is the Director of Science at the David Suzuki Foundation.

Take David Suzuki's Nature Challenge and learn more at www.davidsuzuki.org.

Airborne Nitrogen Affects Aquatic Ecosystem in Alpine Lakes

National Science Foundation

The impact of airborne nitrogen released from the burning of fossil fuels and widespread use of fertilizers in agriculture is much greater than previously recognized, according to research results published in the journal Science.

It extends even to remote alpine lakes.

Examining nitrogen deposition in alpine and subalpine lakes in Colorado, Sweden, and Norway, James Elser, a limnologist at Arizona State University (ASU), and colleagues found that, on average, nitrogen levels in the lakes were high, even in those lakes far from urban and agricultural centers.

The paper, "Shifts in lake N:P stoichiometry and nutrient limitation driven by atmospheric nitrogen deposition," presents experimental data from more than 90 lakes.

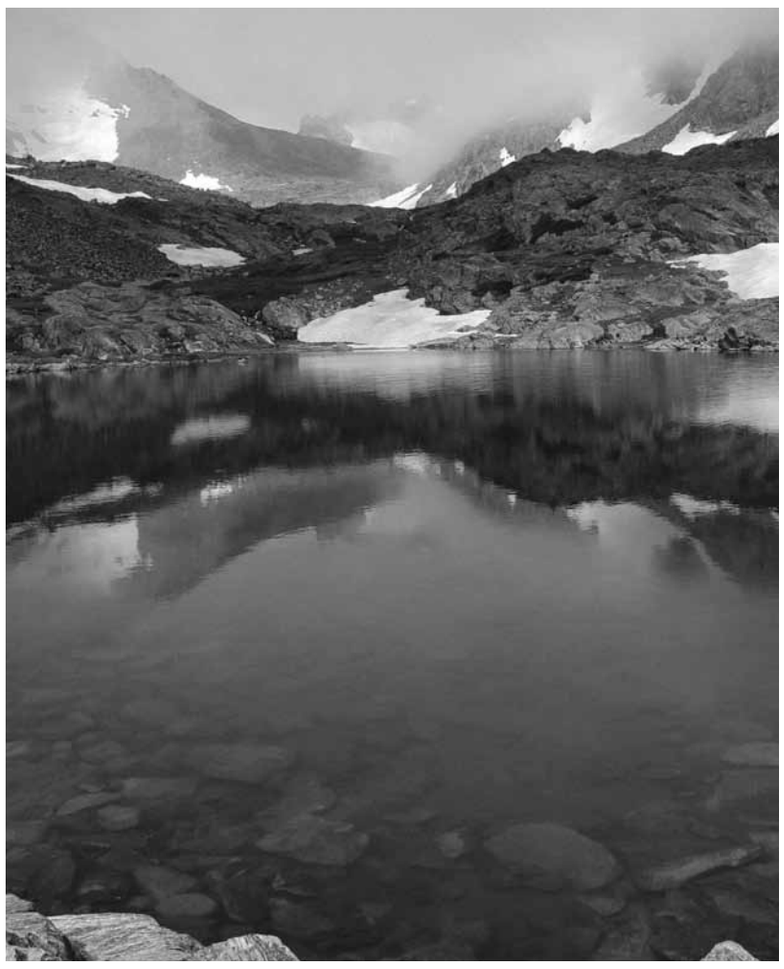
The results also show that nitrogen-rich air pollution has already altered the lakes' fundamental ecology.

"These findings reveal that nitrogen enrichment of the atmosphere, caused by humans, is altering global patterns of lake chemistry and productivity in ways likely to impact the structure and functioning of these ecosystems," says Alan Tessier, program director in the National Science Foundation's (NSF) division of environmental biology, which funded the research.

Plant plankton or phytoplankton, like all plants, need nitrogen and phosphorus for growth. "Inputs from pollution in the atmosphere appear to shift the supplies of nitrogen relative to other elements, like phosphorus," says Elser.

The increase in the availability of nitrogen means that phytoplankton growing in lakes with high nitrogen deposition are now limited by how much phosphorus they can acquire.

"And phosphorus-limited phytoplankton are a poor food source," says Elser. "They're basically 'junk food' for zooplankton, which in turn are food for fish.



HUMAN IMPACT ON ECOSYSTEM: Airborne nitrogen released from the burning of fossil fuels can affect the ecosystem in remote alpine lakes. JAMES ELSER/ ARIZONA STATE UNIVERSITY

"Such a shift could potentially affect biodiversity. However, we don't know the extent because, unlike in land-based ecosystems, the impacts of nitrogen deposition on aquatic systems have not been widely studied."

Elser's collaborators include researchers Tom Andersen and Dag Hessen from the University of Oslo; Jill Baron of the United States Geological Survey and Natural Resource Ecology Laboratory at Colorado State University; Ann-Kristin Bergström and Mats Jansson with Umeå University, Sweden; Koren Nydick of the Mountain Studies Institute in Colorado; and Marcia Kyle and Laura Steger at ASU.

By combining studies from several researchers, Elser says, "we were able to achieve a more global picture of how nitrogen is affecting a range of lakes, and come to firmer conclusions about the effects of its deposition."

Elser and Hessen hope to expand on these findings. In addition, Elser hopes to perform similar studies in China "where atmospheric nitrogen pollution is extremely high," he says, "but is as yet unstudied."