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The Long and Short of It

Astronomers find a new distinction between long and short gamma-ray bursts.

by Vanessa Thomas

Gamma-ray bursts are generally categorized as "short" or "long."
STScI

You'd think the most powerful explosions in the universe would be major events that last days, months, years, or at least hours. But they don't. Despite their commanding presence, gamma-ray bursts are short-lived, elusive characters that appear out of nowhere and vanish within seconds like sly wizards who don't want to be spotted by mortals.

Most gamma-ray bursts linger for about ten seconds, but some of these fleeting flashes of light are much quicker. Astronomers have wondered what the difference is between "short" gamma-ray bursts that last less than two seconds and "long" gamma-ray bursts that hang around for more than two seconds.

Some have proposed that short and long gamma-ray bursts are produced by different kinds of events. An analysis of close to two thousand observed gamma-ray bursts offers more evidence that this is the case.

"We can now say with a high degree of statistical certainty that the two show a different physical behavior," says Lajos Balazs of Konkoly Observatory in Budapest, Hungary. He and colleagues in Budapest, the Czech Republic, and at Pennsylvania State University examined 1,972 gamma-ray bursts recorded between 1991 and 1999 by NASA's former Compton Gamma Ray Observatory.

The group compared the duration of these outbursts to their "fluence," the total energy of all the photons emitted from a source during a gamma-ray event. For both long and short gamma-ray bursts, they saw a correlation in which fluence increased with duration. But the connection was significantly different for the two types of bursts.

NASA's Compton Gamma Ray Observatory studied the high-energy universe from 1991 to 1999. The spacecraft deorbited in 2000.
NASA

The duration of a long burst, the team noticed, is directly proportional to its fluence. According to the team, this hints that energy from the burst is converted to gamma rays at a constant rate. For short bursts, however, the relationship between fluence and duration is not as strong, suggesting the gamma-ray conversion rate declines over time. Sources of short gamma-ray bursts may be less efficient at converting energy.

In a paper to be published by the European journal ***Astronomy & Astrophysics***, the team states that this newfound discrepancy indicates there is an "inherent difference between long and short bursts," probably due to the way they release energy. Like other disparate characteristics previously observed from short and long gamma-ray bursts, this one suggests the sources for the different burst types are physically different. The results add credence to the idea that long bursts come from supernova explosions, while short bursts come from either the merger of neutron stars or black holes, or from supernova that explosively transform into less efficient engines.

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02/25/2003