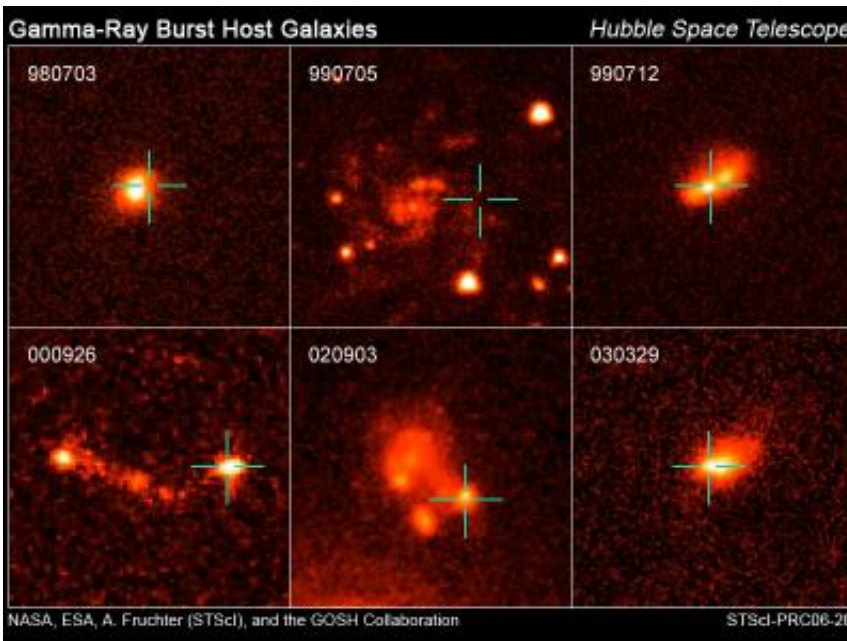


Earth is safe from gamma-ray bursts, Hubble finds

May 10 2006



This is a sampling of the host galaxies of long-duration gamma-ray bursts taken by NASA's Hubble Space Telescope. Credit: NASA, ESA, Andrew Fruchter (STScI), and the GRB Optical Studies with HST (GOSH) collaboration.

A gamma-ray burst (GRB) occurring in our own galaxy could decimate life on Earth, destroying the ozone layer, triggering climate change and drastically altering life's evolution. However, the good news is that results published online today in the journal *Nature* show that the likelihood of a natural disaster due to a GRB is much lower than previously thought.

Long-duration GRBs are powerful flashes of high-energy radiation that arise from some of the biggest explosions of extremely massive stars. Astronomers have analysed a total of 42 long duration GRBs – those lasting more than two seconds – in several Hubble Space Telescope (HST) surveys.

They have found that the galaxies from which they originate are typically small, faint and misshapen (irregular) galaxies, while only one was spotted from a large spiral galaxy similar to the Milky Way. In contrast, supernovae (also the result of collapsing massive stars) were found to lie in spiral galaxies roughly half of the time.

These results, published in the May 10 online edition of the journal *Nature*, indicate that GRBs form only in very specific environments, which are different from those found in the Milky Way.

Andrew Fruchter, at the Space Telescope Science Institute, the lead author of the paper said, “Their occurrence in small irregulars implies that only stars that lack heavy chemical elements (elements heavier than hydrogen and helium) tend to produce long-duration GRBs.”

This means that long bursts happened more often in the past when galaxies did not have a large supply of heavy elements. Galaxies build up a stockpile of heavier chemical elements through the ongoing evolution of successive generations of stars. Early generation stars formed before heavier elements were abundant in the universe.

The authors also found that the locations of GRBs differed from the locations of supernovae (which are a much more common variety of exploding star). GRBs were far more concentrated on the brightest regions of their host galaxies, where the most massive stars reside. Supernovae, on the other hand, occur throughout their host galaxies.

"The discovery that long-duration GRBs lie in the brightest regions of their host galaxies suggests that they come from the most massive stars – perhaps 20 or more times as massive as our Sun," said Andrew Levan of the University of Hertfordshire, a co-author of the study.

However, massive stars abundant in heavy elements are unlikely to trigger GRBs because they may lose too much material through stellar "winds" off their surfaces before they collapse and explode. When this happens, the stars don't have enough mass left to produce a black hole, a necessary condition to trigger GRBs. The energy from the collapse escapes along a narrow jet, like a stream of water from a hose. The formation of directed jets, that concentrate energy along a narrow beam, would explain why GRBs are so powerful.

If a star loses too much mass, it may only leave behind a neutron star that cannot trigger a GRB. On the other hand, if the star loses too little mass, the jet cannot burn its way through the star. This means that extremely high-mass stars that puff away too much material may not be candidates for long bursts. Likewise, neither are the stars that give up too little material.

"It's a Goldilocks scenario," said Fruchter. "Only supernovae whose progenitor stars have lost some, but not too much mass, appear to be candidates for the formation of GRBs".

"People have, in the past, suggested that it might be possible to use GRBs to follow the locations of star formation. This obviously doesn't work in the universe as we see it now, but, when the universe was young, GRBs may well have been more common, and we may yet be able to use them to see the very first stars to form after the Big Bang," added Levan.

Source: Royal Astronomical Society

Citation: Earth is safe from gamma-ray bursts, Hubble finds (2006, May 10) retrieved 10 April 2024 from <https://phys.org/news/2006-05-earth-safe-gamma-ray-hubble.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.