Astrophysics and extinctions: News about planet-threatening events

October 7 2011

Space is a violent place. If a star explodes or black holes collide anywhere in our part of the Milky Way, they'd give off colossal blasts of lethal gamma-rays, X-rays and cosmic rays and it's perfectly reasonable to expect Earth to be bathed in them. A new study of such events has yielded some new information about the potential effects of what are called "short-hard" interstellar radiation events.

Several studies in the past have demonstrated how longer high-energy radiation bursts, such as those caused by supernovae, and extreme solar flares can deplete stratospheric ozone, allowing the most powerful and damaging forms of ultraviolet radiation to penetrate to the Earth's surface. The probability of an event intense enough to disrupt life on the land or in the oceans becomes large, if considered on geological timescales. So getting a handle on the rates and intensities of such events is important for efforts to connect them to extinctions in the fossil record.

"We find that a kind of gamma ray burst -- a short gamma ray burst -- is probably more significant than a longer gamma ray burst," said astrophysicist Brian Thomas of Washburn University. Improved and accumulated data collected by the SWIFT satellite, which catches gamma ray bursts in action in other galaxies, is providing a better case for the power and threat of the short bursts to life on Earth.

The shorter bursts are really short: less than one second long. They are thought to be caused by the collision of two neutron stars or maybe even

colliding black holes. No one is certain which. What is clear is that they are incredibly powerful events.

"The duration is not as important as the amount of radiation," said Thomas. If such a burst were to happen inside the Milky Way, it its effects would be much longer lasting to Earth's surface and oceans.

"What I focused on was the longer term effects," said Thomas. The first effect is to deplete the ozone layer by knocking free oxygen and nitrogen atoms so they can recombine into ozone-destroying nitrous oxides. These long-lived molecules keep destroying ozone until they rain out. "So we see a big impact on the ozone layer."

Those effects are likely to have been devastating for many forms of life on the surface -- including terrestrial and marine plants which are the foundation of the food web.

Based on what is seen among other galaxies, these short bursts, it seems that they occur in any given galaxy at a rate of about once per 100 million years. If that is correct, then it's very likely that Earth has been exposed to such events scores of times over its history. The question is whether they left a calling card in the sky or Earth's geological record.

Astronomical evidence is not likely, said Thomas, because the galaxy spins and mixes pretty thoroughly every million years, so any remnants of blasts are probably long gone from view. There might, however, be evidence in the ground here on Earth, he said. Some researchers are looking at the isotope iron-60, for instance, which has been argued as a possible proxy for radiation events.

If isotopes like iron-60 can reveal the strata of the events, it then becomes a matter of looking for extinction events that correlate and seeing what died and what survived -- which could shed more light on

the event itself.

"I work with some paleontologists and we try to look for correlations with extinctions, but they are skeptical," said Thomas. "So if you go and give a talk to paleontologists, they are not quite into it. But to astrophysicists, it seems pretty plausible."

Thomas will be presenting his work on Sunday morning 9 October 2011, at the annual meeting of The Geological Society of America in Minneapolis. This work was supported by the NASA Astrobiology: Exobiology and Evolutionary Biology Program.

Provided by Geological Society of America