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Special Topics : Gamma-ray Bursts : Joshua Bloom Interview - Special Topic of Gamma-ray Bursts

AUTHOR COMMENTARIES - From Special Topics

Gamma-ray Bursts - June 2009

Interview Date: August 2009



Joshua Bloom

From the Special Topic of [Gamma-ray Bursts](#)

In our Special Topic on gamma-ray burst (GRB) research over the past decade, Dr. Joshua Bloom's work ranks at #10 by total cites, based on 85 papers cited a total of 3,639 times. Five of these papers are on the lists of the 20 most-cited papers over the past decade and over the past two years.

Dr. Bloom's record in [Essential Science IndicatorsSM](#) from *Thomson Reuters* includes 114 papers cited a total of 4,344 times between January 1, 1999 and April 30, 2009.

Dr. Bloom is an Associate Professor in the Astronomy Department at the University of California, Berkeley. He is also the Principal Investigator for both the Peters Automated Infrared Imaging Telescope (PAIRITEL) Project and the Synoptic All-Sky IR Imaging (SASIR) Survey, as well as the Chair of both the GRB Science Working Group for EXIST and the Keck Observatory Time-Domain Working Group.

Below, he talks with ScienceWatch.com about his highly cited GRB research.

SW: Would you tell us a bit about your educational background and research experiences?

In the summer of 1994, I went to work with Ed Fenimore at Los Alamos National Laboratory for my first research project. With astronomy, and with Dr. Fenimore in particular, it's very easy for a young person to catch the research bug: it's a wonderfully vast physical science that we know so little about, and Ed made the challenge of forefront research accessible and riveting.

As an undergraduate at Harvard, I then worked with Josh Grindlay and won a prize for my senior thesis research on gamma-ray bursts and X-ray binaries (that paid for my backpacking in Europe that summer!). On a Herschel Smith Fellowship from Harvard, I spent one year in Cambridge, England, doing a research M.Phil. (like a Master's) degree with [Prof. Martin Rees](#), Ralph Wijers, and Nial Tanvir. In 1997, I started as a graduate at Caltech and began the gamma-ray burst program with Prof. Shri Kulkarni. Those were rather heady days as the revolutions in the gamma-ray burst field seemed to come with unflinching rapidity.

After getting my Ph.D. in 2002, I took a position in the Society of Fellows at Harvard until 2005, when I started in a junior faculty position at UC Berkeley. At Berkeley, I've grown my own small group of students and postdocs working on gamma-ray bursts and related fields. In 2008, I was named associate professor with tenure and in 2009 I was named winner of the Newton Lacy Pierce Prize by the American Astronomical Society.

SW: What first drew your interest to gamma-ray bursts?

When I first started thinking about GRBs, we knew very little about where they came from, what made them, and what would be their importance for the totality of astrophysics. I was drawn to the sheer mystery of the events (how far away were they? how much energy did they release?) and, by extension, the detective work that would need to be applied to unravel those mysteries. It became easy to stay hooked on the events as the mystery unraveled and new questions came up; indeed, just as the GRB field seems to stagnate, a series of discoveries and insights always seem to come along to re-energize the field—this doesn't happen with most fields in astronomy.

SW: One of your most-cited papers in our analysis is the 1999 *Nature* paper, "The unusual afterglow of the gamma-ray burst of 26 March 1998 as evidence for a supernova connection." Would you tell us about this paper, and why you think it's so highly cited?

Prof. Kulkarni and I went to the Keck telescopes in late 1998 intending to get some better images of the host galaxy of that event. At the time we thought that the host had been imaged by us and others about one month after the event. So it came as a shock that we didn't detect the host in those late times (galaxies don't disappear after all!). We immediately knew that those month-after images and spectra were something unseen previously. We surmised it was evidence for a supernova (SN) but needed to do some careful reanalysis of all the data to be able to make the best sense of what had happened.

I presented the first results of this in March 1999 in a conference in Santa Barbara in the form of a poster. Many of the big names in GRBs were there and I was very despondent when our claim wasn't at all well received. Indeed a few were openly against the idea of this being evidence for a SN concurrent with a GRB (at the time, most believed that GRBs wouldn't be due to the death of massive stars—as was the implication of my work—but instead due to mergers of neutron stars).

We had a long referee process for that paper in the spring of 1999 but after the paper came out, the case was more solid than it had been at the conference in Santa Barbara. While GRB 980425 at very low redshift had an obvious SN counterpart (1998bw), 980326 became accepted as the first GRB at "cosmological" distances associated with a GRB. Many events since then have had much better evidence for a SN association (the best with spectroscopy showing this unambiguously), but our paper helped to start the community on the right track for these events.

SW: This year, you were the first author on the January *Astrophysical Journal* paper, "Observations of the naked-eye GRB 080319B: Implications of nature's brightest explosion." Could you tell our readers something about this paper?

GRB 080319B was the brightest GRB ever recorded in visible light and the most distant object that could have been visible to the unaided ("naked") eye. The event blinded ("saturated"), for several minutes, the detectors of our 1.3-meter robotic telescope that had started observing the field 52 seconds after the event. This had to be the most fun I ever had writing a paper because I got to work with so many of my group so closely and so intensely.

Three days after GRB, my group and I had been planning on a ski trip to the Lake Tahoe area. Instead of canceling, we decided to go. But instead of skiing we sat around the cabin writing the paper together! We submitted the 42-page paper just five days after the event and we largely preceded the same conclusions of many others who wrote papers afterwards.

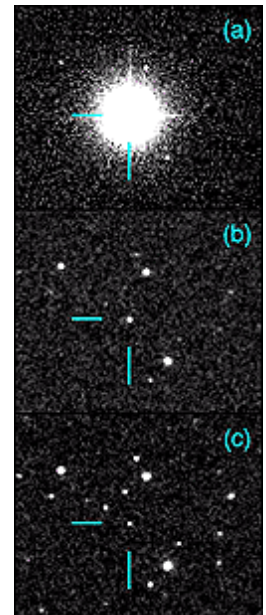
Still, our take on the event was a bit different than some of the other groups. We went through the traditional analysis of the afterglow and the GRB itself, but we focused on comparing the event to all the

Figure 1 [+]
details



Artist's illustration of a gamma-ray burst occurring in a... →

Figure 2 [+]
details



In the seconds after it first pointed at GRB 080319B... →

Figure 3 [+]
details



After the Swift satellite recorded a gamma-ray burst near this galaxy.. →

others with rapid follow-up to see just how special it was. It turns out that while it was the brightest (intrinsically, not just as observed) event at visible light, within about 30 minutes or so it faded to a level consistent with the average of other events. This has important implications for the study of GRBs at very high redshift (large distance from us, where very little is known about the state of the universe then) because it means that many (if not most) of the observed GRBs at moderate redshifts could be seen to large distances with small to mid-sized telescopes. Perhaps the moral is that being small and nimble can be a great asset not just for these relatively nearby events but also for the more distant ones too.

SW: How has our knowledge of gamma-ray bursts changed over the past decade?

In 1999 we knew of just a few GRBs and their (large) distances from us. We now have distances and great data on hundreds of events. In some ways, the basic picture was confirmed—that GRBs are the brightest events in the universe and that most of them come from the death of massive stars. While the basic ideas of the geometry of the explosions seemed to be confirmed five years ago, I think it's safe to say that Swift has, with an avalanche of great data, vastly complicated an otherwise tidy theoretical picture. At best, our understanding of the geometry of the explosions and the actual mechanisms that produce the light we see is rudimentary.

"Nature, it seems, loves to make bursts of gamma rays from a large menu of recipes."

We've also begun learning of the great diversity of the "progenitors" of GRBs. It appears that a minority fraction are, after all, produced in the violent merger of compact objects like **black holes** and neutron stars, and it also appears that neutron stars themselves can make GRBs. There's likely even more mechanisms out there. Nature, it seems, loves to make bursts of gamma rays from a large menu of recipes.

SW: Where would you like to take your research on gamma-ray bursts in the next decade?

We're hoping to start abstracting from the study of the events themselves (and what makes them) and start using GRBs as a probe of the universe. They are bright lighthouses which provide a "core sample" through the universe: much of the study of afterglows is likely to make use of this in new ways. Exploiting GRBs to study the "dark ages" (redshifts higher than about 7 or ages in the universe less than ~800 Million years after the Big Bang) is not a new idea but it's only just now becoming possible on a technical level. The EXIST mission, which should fly at the end of this decade, will be a major boon to the discovery and follow-up of these distant events. We hope to be part of that last frontier in observational cosmology. Last, the events that create some GRBs are also likely the creators of gravitational waves—we hope to observe both the GRBs and the gravity wave events to better understand both phenomena.

SW: What would you tell people looking to understand the value of gamma-ray bursts?

GRBs are great laboratories for the study of motion and light from the fastest-moving material we know about in the universe. The event likely heralds the birth of a black hole, and so there may be clues in GRBs to understanding the basic physics in and around black holes. GRBs are also bright signposts to interesting places in the universe, such as where the first massive stars are born and die and regions of space heavily obscured from view. As such, they are the key to understanding not just the life cycles of the most extreme stars in the universe but important figures in the study of the universe—its past and its fate—itsself. 📌

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Joshua Bloom's current most-cited paper in *Essential Science Indicators*, with 227 cites:

Kulkarni SR, *et al.*, "The afterglow, redshift and extreme energetics of the gamma-ray burst of 23 January 1999," *Nature* 398(6726): 389-94, 1 April 1999. Source: *Essential Science Indicators* from Thomson Reuters.

KEYWORDS: GAMMA-RAY BURSTS, AFTERGLOW, GRB ENERGENETICS, REDSHIFTS, SUPERNOVA, GRB 980425, GRB 080319B, PROGENITORS, OBSERVATIONAL COSMOLOGY.



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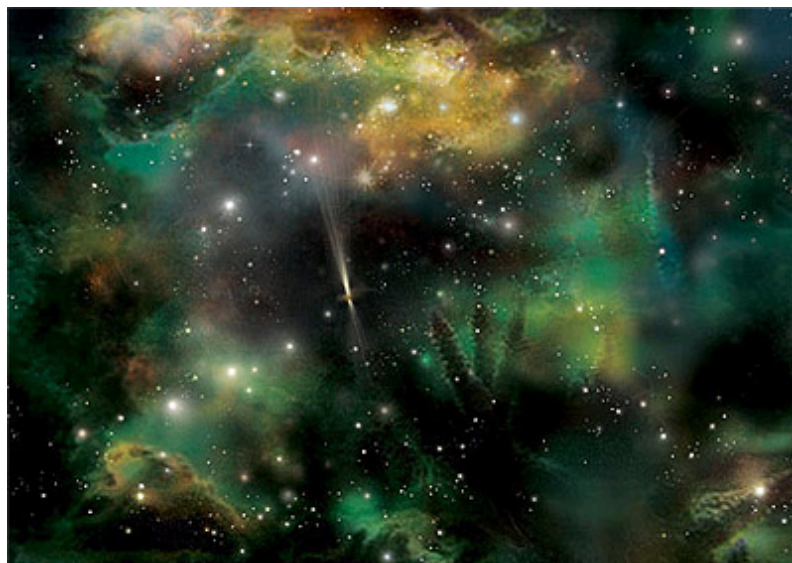


Figure 1: Artist's illustration of a gamma-ray burst occurring in a dusty region of intense star formation. If a dust cloud lies between the burst and Earth, the optical light will be almost entirely absorbed, but the gamma-rays and X-rays will easily penetrate the dust. New evidence suggests that most "dark" gamma-ray bursts — those without optical afterglows — form in similar dusty environments. (Credit: Aurore Simonnet/Sonoma State University, NASA Education & Public Outreach).

Figure 2:

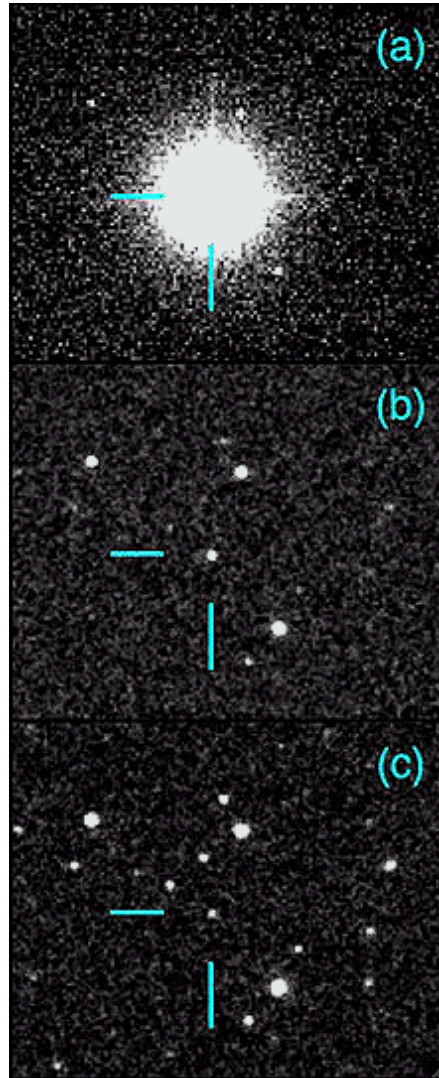


Figure 2: In the seconds after it first pointed at GRB 080319B, the infrared telescope PAIRITEL was blinded by the brilliant explosion (a). As the gamma-ray burst began to fade, PAIRITEL was able to track the light from the explosion for many hours (b and c). (Credit: Joshua Bloom/UC Berkeley).

Figure 3:

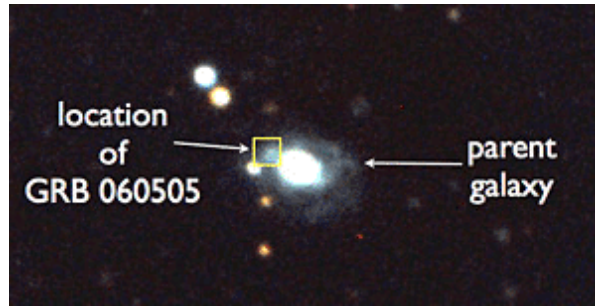



Figure 3: After the Swift satellite recorded a gamma-ray burst near this galaxy on May 5, 2006, UC Berkeley astronomers turned the Keck telescope on the region to look for an expected visible-light signature of a stellar explosion. The lack of supernova light in this and another "long" variety gamma-ray burst now casts doubt on the emerging paradigm that all long bursts accompany supernovae. (Credit: Joshua Bloom & Daniel Perley/UC Berkeley).

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