Issue 5
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Swift Newsletter

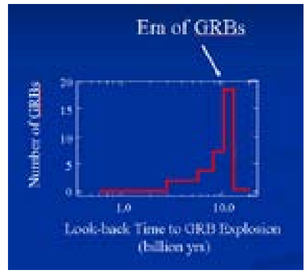
Welcome Message from PI Neil Gehrels

Welcome to the summer 2006 issue of the Swift newsletter. It's been an eventful season!

We had a wonderful gathering of the GRB community this summer in Venice organized by the Swift Italian lead, Guido Chincarini and colleagues. On the secluded island of San Servolo we spent a week looking at and discussing the GRB results from Swift and other observatories. Up to now we have studied individual bursts, but we now have enough data from Swift to start drawing conclusions about the ensemble of GRBs — and we got a surprise.

When the distances to the 150 GRBs Swift has detected in the past 1.5 years are plotted (as shown in the accompanying plot by Jay Norris), the surprising result is how far away they are: on average, their light has been traveling to us for 10.8 billion light years. To put that in perspective, the big bang is thought to have occurred 13.7 billion years ago, so the typical Swift GRB was produced in the early epochs of the universe. Previous, less sensitive, GRB missions had put the average light travel time at 8.5 billion light years.

Plot by Jay Norris - click to enlarge



Why are the bursts so far away on average? One reason is that long-duration GRBs are produced by the explosions of massive stars where their cores collapse to black holes. Such stars are spread throughout the universe, and therefore have a naturally large average distance.

But there may be more to it: GRBs are very rare among stellar explosions, and it is beginning to appear that a key requirement to make a GRB is a low amount of heavy elements (heavier than helium) in the exploding star when compared to the Sun. We expect this of early stars in the universe, before heavier elements were created in other stellar explosions. The heavy element abundance affects many characteristics of the star, and can play a large role in whether it explodes as a GRB or not. We are very excited to see how this plays out as more GRBs are detected by Swift and more theoretical study given to the results.

Swift Guest Investigator Program Opens Up for Non-GRB Science

By: Padi Boyd, GSFC

The deadline for science proposals for Swift's third year of guest investigations was July 28. New for Cycle 3, scientists can now propose to point the Swift telescopes at non-GRB cosmic sources in the sky. This is called a "target of opportunity" (TOO) observation: when an object does something interesting (like explodes, or has an outburst), then Swift will take the opportunity to point at it. Such events include new supernovae, outbursts of known sources, new black hole and neutron star transients in our own Galaxy, and flares seen in distant active galaxies---just the type of fleeting events for which Swift's rapid response and multi-wavelength capabilities are perfect!

NASA received 87 proposals for Swift Cycle 3, and 33 of these are for TOOs. The ideas presented in the proposal run the gamut from the relatively nearby novae in our galaxy to distant blazars far beyond the Milky Way. In between, scientists want to use Swift's instruments to look at pulsars in binary star systems, the X-ray binary Cyg X-1 (the black hole poster child of our Galaxy), study whether supernovae are standard candles (that is, can be used to measure distances) in the ultraviolet, and support observations of newly detected transients seen by other orbiting spacecraft such as INTEGRAL, RXTE, and the soon-to-be-launched GLAST.

In October, an international panel of scientists will meet to discuss the merits of all proposals submitted and choose among them. This will shape the science program for Swift's third year. We wish all proposers the best of luck, and we look forward to a bright future. Guest Investigators will make sure Swift continues to make important contributions to many areas of astrophysics and work with other satellites to provide multiwavelength views that would not be possible otherwise.

Swift in the News

by Lynn Cominsky, SSU E/PO

3/31/06 - Exploding "star within a star"

X-ray observations by Swift of the outburst from RS Ophiuchi were reported at the National Astronomy Meeting in the UK. RS Oph is a binary system containing a white dwarf orbiting around a red giant star. For more information see newsletter article or the UK Swift site (*http://www.swift.ac.uk/RSOph.shtml*).

4/4/06 - An unusual burst in distant Universe.

Swift detected a burst on August 1, 2005 that made the news at the National Astronomy Meeting in the UK. GRB 050801 was unusual in that Swift observed a bright afterglow with steady emission both in X-ray and optical wavelengths that lasted for 250 seconds after the end of the prompt gamma-ray emission, and occurred before the afterglow began its typical decline in brightness. Scientists have suggested that the end product of this GRB could have been a magnetar, rather than a black hole.

5/12/06 - X-rays Fly as Cracking Comet Streaks Across the Sky.

Scientists using NASA's Swift satellite have detected X-rays from a comet that is now passing the Earth and rapidly disintegrating on what could be its final orbit around the sun. The press release (*http://swift.gsfc.nasa.gov/docs/swift/news/2006/06-35.html*) is on the NASA Goddard Space Flight Center website, and the image is on the NASA site *(http://www.nasa.gov/mission_pages/swift/main/index.html).*

For links to all of these press releases and images, see:

http://swift.gsfc.nasa.gov/docs/swift/news/

Swift Sees a Different Kind of Explosion

By: Kim Page and Michael Bode, University of Leicester

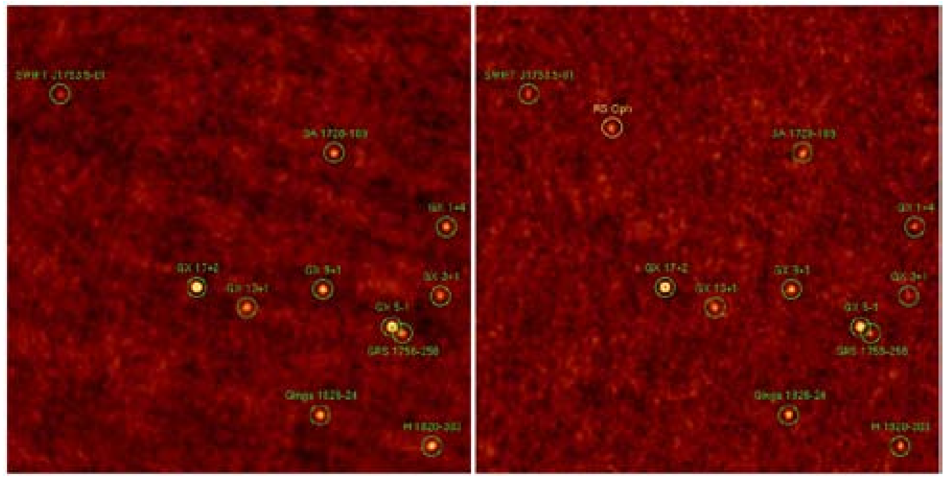
On 12th February 2006, the recurrent nova RS Ophiuchi went into outburst for the first time in 21 years. It is one of only a few novae which erupt every few decades, rather than on timescales of thousands of years as do classical novae. The RS Oph system consists of a white dwarf (thought to be near the upper mass limit for such a star) and a red giant, in a 456-day orbit around each other—such a system is called a binary. The white dwarf accretes matter from the outer layers of the red giant until there is sufficient hydrogen on its surface to explode like a runaway nuclear bomb.

Thanks to the rapid turnaround of the Swift Target of Opportunity system, we obtained X-ray observations of RS Oph far more rapidly and frequently than has ever been the case for previous outbursts of such systems: observations started after only three days and have continued ever since. All three instruments onboard Swift have observed (and detected) RS Oph. For the UVOT, the grisms had to be used - the source was far too bright for the filters! In addition, when the BAT data were examined, we found that the source was detected during the outburst itself (see figure) - the first time this has been accomplished for any nova.

For the first few days, the X-ray emission brightened rapidly, then began to fade.

This emission is thought to be from shock waves generated as ejecta from the nova, traveling at several thousand km per second, slam into the stellar wind from the red giant at a large distance from the stars themselves. A paper is now in press with the Astrophysical Journal about this aspect of the nova, where RS Oph acts like a dramatically sped-up supernova remnant. About a month after the outburst the character of the emission changed dramatically and seemed to be coming from the central binary itself. Work is now in progress to fully understand this new phase.

Swift is ideal for following such an event, since we could obtain X-ray and UV/optical data simultaneously, and, at peak brightness, we were observing RS Oph during every orbit of the day! Observations are planned until the end of October at least; RS Oph will then not be visible to Swift until early next year.



Swift's Burst Alert Telescope's X-ray view of the region around RS Oph about two days before (left) and two days after (right) the outburst. The nova is clearly visible in the later image.

The GRB Lottery

By: Phil Plait and Tim Graves, SSU E/PO

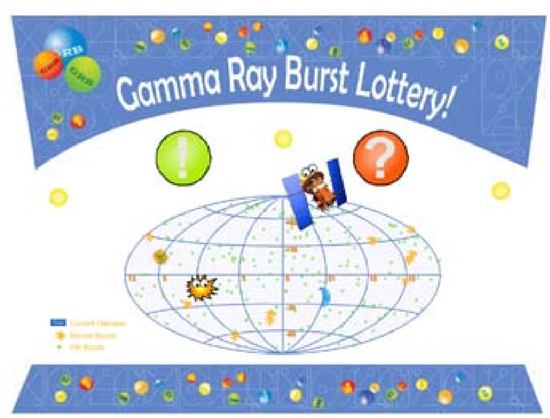
Observing gamma-ray bursts is frustrating. They may only last for a few seconds before fading into obscurity, making them very hard to detect. Worse, they appear in random parts of the sky, meaning they might pop off during local daytime, or below the horizon. It's an astronomer's nightmare.

But it can also be an educator's dream. Why not take the random time and placement of the next GRB and turn it into a game for students? That way, the very thing that makes GRB astronomy difficult for scientist becomes an exciting way to engage students about the highest of high-energy events. That's exactly what the SSU E/PO group did by creating the Gamma-Ray Burst Lottery:

http://swift.sonoma.edu/grb_lotto/

When students enter the game, they pick a spot on the map where they think the next GRB will appear. They can then enter a screen name and a reason why they chose that spot -- creativity is encouraged! When the next GRB is detected, the location is checked against all the students' guesses. The student with the closest guess wins the game! They're notified by email that they have won the GRB lottery, and then they can download a certificate with their name, the name and location of the burst, which satellite saw the burst, and when the burst was detected. As a prize, they can also order an educational product from the SSU group, an ability usually reserved for teachers and scientists.

The Lottery page itself has lots of charming graphics, including an animated Swift that follows your cursor and a GRB that runs away when you try to point to it. The site comes with complete instructions, and also has a tutorial about GRBs which includes a history of how GRBs were first discovered, and the science behind these violent and exciting explosions in deep space.



Amateur Corner

By: Phil Plait, SSU E/PO

GRBs are becoming a favorite target for amateur astronomers who love the thrill of the chase. One such skywatcher is Michael Koppelman, who lives near Minneapolis, Minnesota. By day he's a part owner of Clockwork.net, a company that develops websites and applications – he created an automated skychart plotter for the American Association of Variable Star Observers (AAVSO), for example – but by night he's an avid astronomer.

Koppelman built his Starhouse Observatory on a friend's farm in 2000, after getting tired of lugging around his telescope. He became hooked on digital imaging and it didn't take long before he started looking for GRBs.

"I thought hunting GRBs was a very cool thing for amateurs to do and so I signed up for the [GRB alert] email list. But they always seem to go off when I'm at home or at work."

But persistence pays off. There came a night in April of 2006 when the stars aligned for him. "Finally, the dome was open, I was observing, and the alert came in. The GRB was like 11 degrees above the horizon, literally in the trees, but I was on the thing within about five minutes. I didn't see it at first but later processing brought it out."

He sent the data to the AAVSO, and they issued an email circular about it *(http://gcn.gsfc.nasa.gov/gcn3/4977.gcn3)*: Koppelman had definitely detected GRB 060418A, which turned out to be at whopping distance of more than 9 billion light years away.

He was amazed at this result. "When I first calculated the distance, I did it naively, and I got that it was farther away than possible. Like a kazillion light years away! I had to fold in relatively and cosmology to get the right number."

Koppelman has information about his observatory and the work he does on his website *(http://www.lolife.com/astronomy/starhouse/Home.html)*. He also keeps a blog there, where he wrote about bagging his first

Michael Koppelman standing outside his Starhouse observatory.

GRB. He hopes it isn't his last, though.

"The next time I'm in the right place at the right time I want to capitalize on it better. I'd like to show people a three hour time series of it—no one has anything like that. I'm poised, I'm ready. Every time I go out, I think, come on, let's get a GRB!"

In the meantime, he's working on getting his undergraduate degree in astronomy; he's only one course credit away. And between GRBs, he uses his observatory to observe suspected variable stars. His attitude is one every astronomer—amateur or professional—shares.

"A lot of run-of-the-mill stuff comes up, but a lot of interesting objects show up, too. It's fun to unravel the puzzle of stars."