

Re: Short Gamma-Ray Bursts: New Models Shed Light on Enigmatic Explosions (Forwarded)

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From: Aladar (alistolmar_at_3dresearch.com)

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Just two comments: the energy released is predicted to be 2–4 solar masses in the supernovae – gamma ray burst initial event (followed by further decay of super-heavy nuclear layers) (see Daisy-petal graph).

The small – short bursts could be just results of closing of two neutron stars, without merger. It should be detected from the galactic center, hence it is a multitude of neutron stars, moving in a well defined system...

Cheers!

Aladar

<http://stolmarphysics.com>

Andrew Yee <ayee@nova.astro.utoronto.ca> wrote in message news:<[lrP_c.3376\\$Nd6.133229@news20.bellglobal.com](mailto:lrP_c.3376$Nd6.133229@news20.bellglobal.com)>...

> *Max-Planck-Institute for Astrophysics*

> *Garching, Germany*

>

> *September 1st, 2004*

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> *Short Gamma-Ray Bursts*

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> *New Models Shed Light on Enigmatic Explosions*

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> *H.-Thomas Janka, M.A. Aloy, E. Müller*

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> *Researchers at the Max-Planck-Institute for Astrophysics have developed new*

> *relativistic models which allow predictions of so far unknown properties of*

> *short gamma-ray bursts. Their simulations will come under scrutiny by the Swift*

> *Gamma-Ray Burst Explorer, a NASA mission that is scheduled for launch in the*

> *fall of 2004.*

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> *Gamma-ray bursts are among the most energetic and most luminous explosions in*

> *the Universe. They occur roughly once a day, last from a few thousandths of a*

> *second to a few hundred seconds, and come from all different directions of the*

> *sky. Their gamma radiation is more energetic than visible light and can be*

- > measured by satellites orbiting the Earth in space. The energy set free by the
- > bursts in just one second is comparable to the energy production of the Sun
- > during its whole life.
- >
- > The more than 2700 observed bursts are grouped into two distinct classes, one of
- > which are the so-called long bursts that emit gamma radiation for more than two
- > seconds, and the other one are the short bursts with durations up to two seconds.
- >
- > So far only long bursts could be observed in much detail. The detection of
- > associated afterglows in X-rays, visible light and at radio wavelengths allowed
- > the determination of their distances and confirmed their origin from host
- > galaxies at large redshifts, i.e., typically hundreds of millions to billions of
- > light years away. Until recently the source of these bursts was a mystery. But
- > evidence has accumulated that they are death throes that accompany the
- > catastrophic explosions which end the lives of very massive stars. A final
- > confirmation of this conjecture was provided by GRB030329, a gamma-ray burst
- > which was detected on March 29, 2003, by HETE, NASA's High-Energy Transient
- > Explorer satellite. For the first time this burst could unambiguously be
- > identified as linked to a peculiar supernova named SN 2003dh at a distance of
- > about two billion light years.
- >
- > But where does the gigantic energy come from which powers the gamma-ray burst?
- > Scientists have coined the theory that the "engine" is a rapidly spinning black
- > hole which forms when the central core of a dying star becomes unstable and
- > collapses under its own gravity. This newly formed black hole then swallows much
- > of the infalling stellar matter and thereby releases enormous amounts of energy
- > in two "jets". These expand "highly relativistically", i.e. with almost the
- > speed of light, along the rotation axis of the star. Before they break out from
- > the stellar surface, they have to drill their way through thick layers of
- > stellar material, thus getting collimated into very narrow beams with an opening
- > angle of only a few degrees (see Current Research -- March 2000). Indeed,
- > observations not only confirm the origin of long gamma-ray bursts from exploding
- > massive stars, but also provide evidence that the gamma emission comes from
- > narrowly collimated, ultrarelativistic jets with velocities of more than 99.995
- > per cent of the speed of light.
- >
- > Rotating, growing stellar mass black holes are also born in other cosmic events,
- > for example in the violent mergers encountered by binary neutron stars (Fig. 1)
- > or a neutron star and a black hole (Fig. 1) after hundreds of millions of years
- > of inspiral, driven by the emission of gravitational waves. The remnant of such
- > a catastrophe is a stellar-mass black hole sucking matter from a girding, thick
- > torus of gas (Fig. 2). Such events have long been considered as possible sources
- > of gamma-ray bursts, and they are still hot candidates for bursts of the short
- > type, which so far could not be studied by observations in the same way as
- > bursts from dying stars.
- >
- > Researchers at the Max-Planck-Institute for Astrophysics have now developed
- > better computer models that take into account effects due to Einstein's theory
- > of relativity. Their simulations can follow the highly relativistic ejection of
- > matter that is caused by energy release (e.g., due to particle reactions) in the
- > close vicinity of the black hole. The calculations confirm that short bursts

- > *have properties that are distinctively different from those of long bursts.*
- > *Since the black hole -- torus system is not buried inside of many solar masses*
- > *of stellar material as in case of dying stars, the polar jets do not have to*
- > *make their ways through dense stellar layers and quickly reach extremely high*
- > *velocities (Fig. 3). As a consequence, they are strongly collimated by the*
- > *presence of the accretion torus, but their opening angles are somewhat larger*
- > *than those measured for long bursts, typically around 5 to 10 degrees (Fig. 3).*
- > *The models predict that outside of these polar cones gamma emission should*
- > *become very weak (Fig. 4) so that a gamma-ray burst will be observable only from*
- > *one out of hundred mergers when the ultrarelativistic jet is sent towards Earth.*
- > *The models also suggest that short bursts can be nearly as bright as long*
- > *bursts, although their total energy release is 100 times lower.*
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- > *Previous gamma-ray satellites were unable to make precise measurements for short*
- > *bursts, but there is hope that these predictions can be tested soon. The Swift*
- > *Gamma-Ray Burst Explorer, a NASA mission with international participation, is*
- > *scheduled for launch in the fall of 2004. One of its prime goals is to unravel*
- > *the mysteries of the short bursts.*
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- > *Literature:*
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- > *S. Setiawan, M. Ruffert und H.-Th. Janka, Monthly Not. R. Astron. Soc., 352,*
- > *753--758 (2004)*
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- > *M.A. Aloy, H.-Th. Janka und E. Müller (2004), Astron. Astrophys., submitted*
- > *(astro-ph/0408291).*
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- > *[NOTE: Images supporting this release are available at*
- > *http://www.mpa-garching.mpg.de/mpa/research/current_research/hl2004-9/hl2004-9-en.html*
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