

Astrowatch

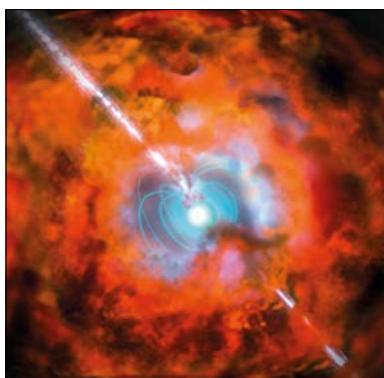
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Do magnetars power hour-long gamma-ray bursts?

Based on optical observations, a team of astronomers has, for the first time, demonstrated a link between a very long-lasting gamma-ray burst (GRB) and an unusually bright supernova explosion. The results show that the supernova was not driven by radioactive decay, as expected, but most likely by the spin down of a magnetar, a neutron star with an extremely strong magnetic field.

GRBs have intrigued astronomers since their discovery nearly 50 years ago by US military satellites intended to detect nuclear test explosions conducted by the Soviet Union. Mysterious gamma-ray flashes were detected, not from Earth, but from random directions in the sky. It was only some 30 years later that the detection of their precise locations and the measurement of their redshifts by follow-up observations proved them to be very luminous events from remote galaxies. The further evidence that some of them are associated with supernova explosions settled the issue of their true nature as being a manifestation of the core collapse of a massive star (*CERN Courier* September 2003 p13).

Astronomers usually distinguish two main classes of GRBs: the short ones that flare up for less than about 2 s and the longer ones. Among the latter, there are a few outstanding bursts lasting more than 10,000 s, which have been proposed to originate in the explosion of giant stars with much larger radii (*CERN Courier* June 2013 p12). A team led by Jochen Greiner of the Max-Planck-Institut für extraterrestrische Physik in Garching,



Artist's impression of a supernova and associated gamma-ray burst driven by a magnetar, a rapidly spinning neutron star with a very strong magnetic field. (Image credit: ESO.)

Germany, has now shown that a supernova explosion is associated with one of these rare ultra-long-duration GRBs, namely GRB 111209A. The supernova's presence has been derived from observations of the afterglow emission by two telescopes of the European Southern Observatory in Chile: the GROND instrument on the 2.2 m telescope at La Silla and the X-shooter instrument on the Very Large Telescope at Paranal.

The supernova's spectral and timing properties are both very peculiar. Its luminosity is intermediate between the supernovas usually associated with

GRBs and a new class of super-luminous supernovas discovered in 2011. The exceptional luminosity of the latter would be due to energy injection from a rapidly rotating magnetar – a neutron star with a huge magnetic field of up to about 10^{10} T. The same process could be at play in the supernova of GRB 111209A. Indeed, the huge amount of nickel needed to explain the observed light curve by radioactive decay of ^{56}Ni is not compatible with the rather featureless spectral shape, which suggests a star of low metallicity. While Greiner and colleagues cannot prove that a magnetar is at the origin of the ultra-long GRB of 9 December 2011, nor the source of the luminous and peculiar supernova they observed, they can rule out alternative possibilities, leaving this as the most likely one.

Magnetars have already been invoked to explain the long-lasting afterglow emission of some GRBs (*CERN Courier* May 2007 p11). Now they seem to be needed to account for powering the prompt emission of some of these powerful flashes of gamma rays. Their advantage is that they would provide a continuous power supply, from hours to months, by losing rotational energy through magnetic-dipole radiation. The flexibility of the magnetar model fits peculiar GRBs and supernovas well, but what about the more standard GRBs? Could they also be powered by a new-born magnetar rather than by a black hole?

● **Further reading**
J Greiner *et al.* 2015 *Nature* **523** 189.

Picture of the month

Welcome to Pluto! Thanks to NASA's New Horizon mission, astronomers and the general public alike now know what the dwarf planet Pluto looks like. Even with the eye of the Hubble Space Telescope, Pluto can only be seen as a little patchy marble. A journey of more than nine years was needed from Earth to this previously outermost planet – now called a dwarf planet – to take this snapshot. Unlike ESA's Rosetta spacecraft, which orbits the comet 67P/Churyumov–Gerasimenko (*CERN Courier* October 2014 p17), New Horizon was not planned to go into orbit around Pluto, but just flew by on 14 July. This high-resolution true-colour image was assembled from four images taken by the Long Range Reconnaissance Imager (LORRI). It shows a bright region in the shape of a heart contrasting with darker areas harbouring mountains rising more than 3000 m above the surface. The brightest area is an intriguing craterless, frozen plain, which is possibly still being shaped by geologic processes. (Image credit: NASA/JHUAPL/SwRI.)



More than a White Rabbit



Chamber placement at the laboratory.

Creotech Instruments SA is a company that was founded by three Polish scientists who met while working at CERN. Initially, the company was engaged in research projects carried out by Polish and European universities. Today, Creotech is the biggest Polish player in the space industry, as well as manufacturer and supplier of highly regarded precision measuring instruments for research institutes around the world.

The MTCA technology components and devices for time synchronization, compliant with the White Rabbit standard and produced by Creotech are, among others, used by CERN, the GSI Helmholtz Centre for Heavy Ion Research and the German Electron Synchrotron DESY in Hamburg.

Located in close proximity to the Polish capital, Creotech Instruments SA is increasing employment and the range of operation. While a few years ago the company employed 10 people, today a team of more than 50 specialists is employed at Creotech. The employees work in a modern sterile assembly room, meeting the highest standards and requirements of the European Space Agency (ISO 8 and ISO 6-7). In the corridors of Creotech can be met not only the staff involved in current projects, but also students from technical universities worldwide, who participate in workshops and internships. The most talented young Polish scientists join the Creotech Instruments team, often before they graduate.

The production of advanced measurement and control solutions for science is, beside activities in the space sector, the most important part of Creotech Instruments business. Before the creation of the company, the founders had worked in the laboratories at CERN, and so they understand the specific needs that scientists engaged in the study of elementary particles and high-energy physics have.

The users of the measuring instruments manufactured by Creotech Instruments appreciate them for their reliability and quality, and the competitive price of the components supplied by the Polish company is also not without significance. The relatively low labour costs allow the Polish market to manufacture at far less cost than Western Europe, the US or Japan. High quality in combination with the relatively low price is one of the biggest competitive advantages of Creotech Instruments. The Open Hardware philosophy is an important feature of Creotech Instruments' products, and is in accordance with the CERN Open Hardware Licence (CERN OHL). This guarantees a high-quality product and full possibility of

modification by the user, along with additional support for the user community.

White Rabbit – in defence of Einstein

Facing the challenge of synchronizing the powerful detectors and other elements of the Large Hadron Collider, The European Agency for Nuclear Research, CERN, started an initiative of creating a new standard for the time synchronization of devices. The standard was named "White Rabbit", and devices produced in accordance with the standard guarantee time synchronization to one nanosecond. The design and manufacture would be as Open Hardware.

Creotech Instruments was one of the first to become involved with the project and to implement the White Rabbit standard successfully. Since the delivery of the first series of White Rabbit standard measuring cards to CERN, the components produced by Creotech have reached and been utilized by research institutions in France, Germany, the Netherlands, the UK, Spain, Russia and the US. Creotech has expanded the range of White Rabbit supporting products with modules complying with MTCA – the AFC and AFCK cards. The company has also worked with the leading MTCA equipment suppliers to expand the standard support for White Rabbit.

White Rabbit modules:

FMC carriers: AFCK, AFC, SPEC, SVEC

Example configuration: White Rabbit Switch + SPEC + FMC ADC 100M 14B 4CH – remote, multichannel digital oscilloscope

MicroTCA applications – flexibility and modularity

Measurement and control applications produced by Creotech Instruments are based on the MicroTCA modular platform. The company produces RTM, RTU, ADC, DAC and TDC measurement cards, FPGA technology AMC base modules, IO cards and other functional units. Currently, the Creotech Instruments offer includes more than 20 different types of components, allowing for the creation of around 90% of applications for measuring and testing systems, for example EGSE for the space sector or the beam-trajectory measurement system in the Proton Synchrotron.

Modular control systems based on the MicroTCA platform are characterized by their fast-data-transfer ability (up to 40 Gbit/s) and include an integrated, high-performance computer and data concentrator, as well as solutions for the integration of multiple MTCA devices in

complete systems. The modular design provides great flexibility and allows for the use of a variety of interfaces. Creotech is the only commercial supplier of AMC modules supporting the White Rabbit protocol and in compliance with the CERN OHL.

Creotech Instruments' measurement applications based on MTCA are utilized by scientific institutions, elementary particle accelerators and experimental reactors. The modularity and flexibility of the components developed by Creotech also allows for commercial use of the technology by industrial companies, the space sector and aerospace industries.

MTCA modules

Example configuration: 16-channel Software Defined Radio mounted on an antenna mast. Another application is the Position Beam Pickup for 4 electromagnetic pickup units.

- Dual AMC box
- 2 x AFCK
- 4 x FMC 16B 4CH ADC 250M
- 4 x 10 Gbit Ethernet over SFP +
- GPS receiver, optionally White Rabbit (SFP module) as time source.

The system provides signal acquisition, DSP processing, and interface transfer of 40 Gbit/s to the PC. Alternatively, the configuration uses dual PCIe x4 port via fibre-optic cable (QSFP connector and PCIe-QSFP interface card).



Creotech DUAL BOX AMC, RTM and without.

Thanks to highly qualified and dedicated staff, Creotech Instruments SA provides also services of electronic assembly in compliance with the most demanding standards (eg. most restrictive ESA norms). With the experience gained in the production of equipment working in space, Creotech ensures quality and reliability at the highest level.

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