1999 - 2009 10 Years of Science with XMM-Newton

Gamma-ray burst afterglow: an X-ray shout echoing through space

Gamma-ray bursts are amongst the most powerful explosions in the Universe. They occur randomly and unpredictably. This image shows the afterglow of a gamma-ray burst (GRB 031203) observed in X-rays by XMM-Newton. As XMM-Newton watched to see how this object changed over time two concentric rings appeared to expand outwards from the burst. These rings are caused by dust lying in XMM-Newton's line-of-sight reflecting the X-rays as they travel out from the explosion.

Planetary nebula: dying Sun-like Stars

A planetary nebula is formed as a dying Sun-like star throws off its outer layers of gas. All that remains of the star's fading core is a white dwarf, visible as a tiny dot in the centre of the nebula. This image of the Saturn Nebula (NGC 7009) combines data taken by XMM-Newton and the Hubble Space Telescope. XMM-Newton located the faint X-ray emission coming from hot gas in the centre of the Nebula, shown in blue. The green and red areas are cooler gas in the nebular shell that can be seen at visible wavelengths.

Colliding galaxies: triggering stellar activity

The Antennae galaxy system is a pair of galaxies undergoing a violent collision triggering a stellar baby boom within their huge gas clouds. The Antennae galaxy system has a high rate of supernova explosions which heats the gas to millions of degrees so that it glows in X-rays. In this image the X-rays with the lowest energy are shown in red and the highest in blue and are overlaid onto an optical image highlighting the antenna-like spiral arms.

Sky surveys: mapping dark and ordinary matter

This is the first map of both the dark and ordinary filamentary matter distributions in the Universe. In this image the X-ray light from ordinary matter, observed by XMM-Newton, is shown in red . Stars and galaxies, whose visible light was observed by the Hubble Space Telescope are shown in grey. Ordinary matter only accounts for a small fraction/one sixth of the total matter in the Universe. The rest is a mysterious component known as 'dark matter' that cannot be seen directly. Gravitational lensing techniques were applied to derive its distribution shown in blue, The map reveals that ordinary matter formed galaxies and clusters of galaxies inside a scaffolding of dark matter.

Star-forming regions: revealing their complexity

NGC 346 is the brightest star forming region in the Small Magellanic Cloud. This spectacular image combines observations of the region taken in different types of light and reveals the coexistence of many different environments: X-rays, depicted as blue were detected by XMM-Newton and show where hot gas lies within the cloud. Infrared emission by cold gas was captured by NASA's Spitzer Space Telescope and is displayed in red. The green areas show excited gas that glows in visible light as seen by the European Southern Observatory's New Technology Telescope.

Starburst galaxies: undergoing violent star formation

XMM-Newton took this image of the X-ray, ultraviolet and visible light of the starburst galaxy M82. Within the image, regions of intense star formation can be seen as bright knots in the plane of the galaxy. Winds from supernovae embedded in these regions make their way through the disk of the galaxy and emerge as plumes of hot gas glowing in X-rays, shown in blue in the image. It is thought that the burst of star formation in M82 was triggered about 100 million years ago during a close encounter with a neighbouring galaxy.

Supernova remnants: the death of massive stars

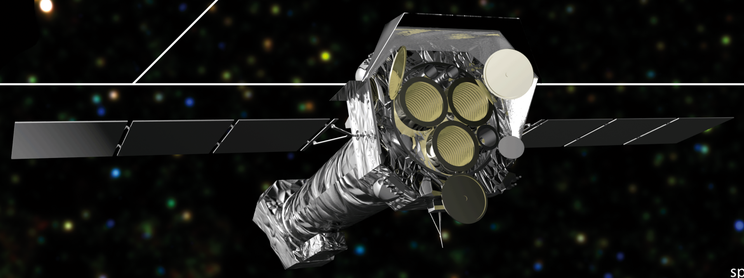
The Tycho supernova remnant is the remains of a massive star that reached the end of its life and exploded, shooting out material into the surrounding space. This image exposes nested knots of hot gas at the heart of the remnant emitting X-rays that were detected by XMM-Newton. In the image the X-rays with the lowest energy are shown in red and the highest in blue. The spectrum of the X-rays emitted reveals the signatures of the different types of elements present in the remnant.

Clusters of galaxies: probing their formation

Galaxy clusters are the largest gravitationally bound objects in the Universe. By detecting the X-rays emitted by hot gas trapped in the clusters XMM-Newton provided the first detailed study of how these clusters formed. A record of how the gas has been heated and cooled over a long period of time, as revealed by XMM-Newton, provides crucial information about how the galaxy cluster evolved. Insight into cluster formation plays a key role in understanding the evolution of the Universe.

Stellar wind shocks in star-forming regions: creating hot gas bubbles

Inside the Orion Nebula, XMM-Newton discovered a huge area of extremely hot gas, shown in blue. This region looks like a cavity in visible and infrared light (from NASA's Spitzer Space Telescope). The origin of the hot gas is explained by a fast stellar wind from the most massive star, heated as it slams into the dense surrounding gas. If a single massive star is so efficient, such processes might create a network of channels and bubbles of hot gas interweaved with the cooler interstellar medium in the Milky Way.



ESA's XMM-Newton was launched on 10 December 1999 on a mission to peer into the most energetic phenomena in the Universe. For 10 years XMM-Newton has simultaneously collected X-rays, visible and ultraviolet light and consistently demonstrated its role as one of the most important astronomical observatories of the time. XMM-Newton will continue to keep watch the ever-changing X-ray sky and to make exciting discoveries to further our understanding of the unknown Universe. This poster features a small selection of areas to which XMM-Newton has made an important contribution. All images, unless otherwise specified, are from XMM-Newton instruments. The background image is the XMM-LSS survey mosaic.

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