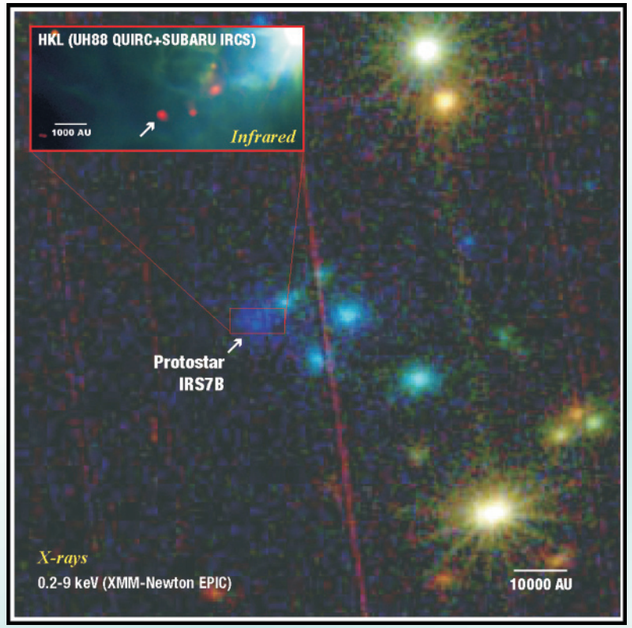
XMM-Newton Highlights

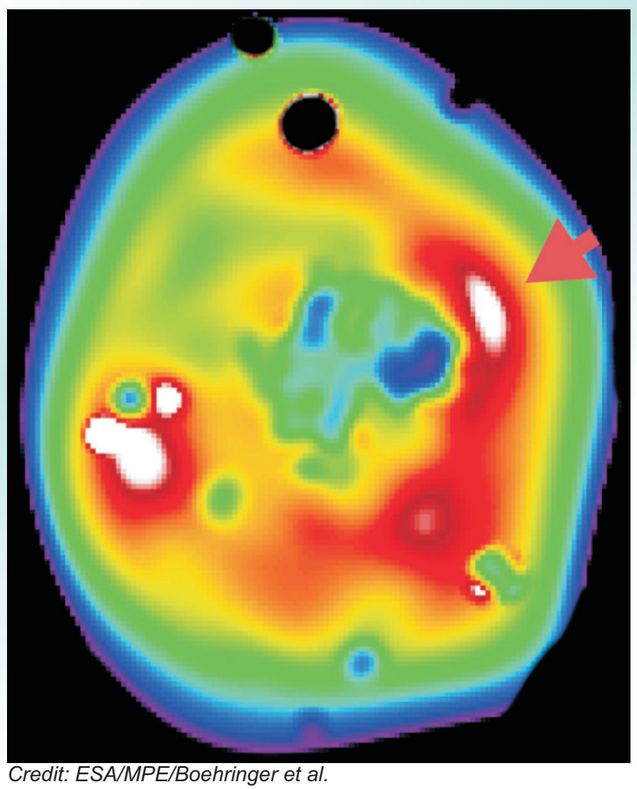
Newly Seen Force May Help Gravity in Star Formation

XMM-Newton pierced through a dusty stellar nursery to capture the earliest and most detailed view of a collapsing gas cloud turning into a star, analogous to a baby's first ultrasound.

The surprise detection of X-rays from such a cold object reveals that matter is falling toward the protostar core ten times faster than expected from gravity alone. The results suggest that some unrealized, energetic process—likely related to magnetic fields—is superheating the surface of the cloud core, nudging the cloud ever closer to becoming a star.



Credit: NASA/ESA/Hamaguchi et al.



Credit: ESA/MPE/Boehringer et al.

XMM-Newton Probes the Formation of Galaxy Clusters

XMM-Newton has, for the first time, allowed scientists to study in detail the formation history of galaxy clusters, not only with single arbitrarily selected objects, but with a complete and representative sample of clusters.

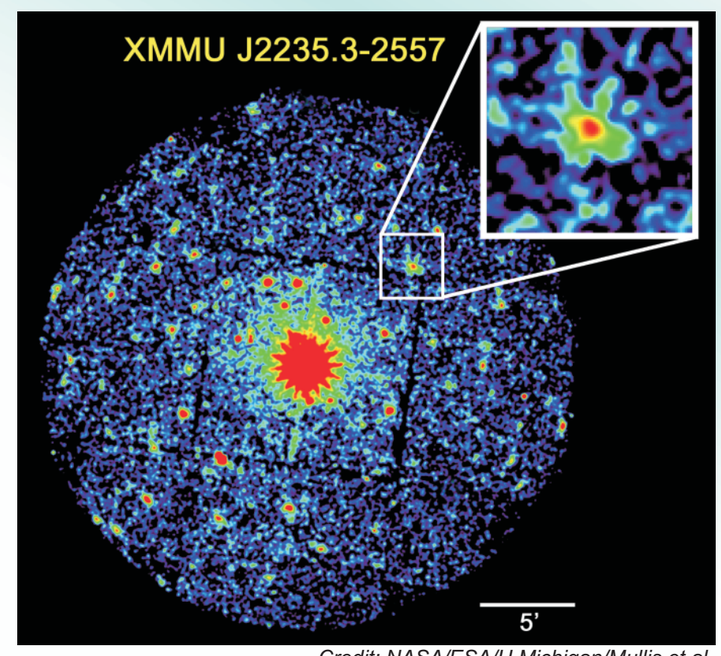
The entropy image shows structure in the cluster RXCJ0658.5-5556, which is a measure of effects from collisions at high speed. The dark blue region near the center is the core of a sub-cluster flying through the main cluster body at supersonic speed, as indicated by a Mach cone in front of this region. In front of the bow shock region we see a dramatic entropy enhancement, marked by an arrow, which is the cluster gas heated by the shock front caused by the fast flying sub-cluster 'bullet'. This is the first direct X-ray evidence of shock heating in merging clusters.

Background

XMM-Newton (X-ray Multi-Mirror Mission) is an orbiting X-ray observatory built by the European Space Agency. It consists of three coaligned high throughput X-ray telescopes with 6 arc second (FWHM) angular resolution. The X-ray telescopes provide images over a 30 arc minute field of view with moderate spectral resolution using the European Photon Imaging Camera (EPIC), which consists of one PN and two MOS CCD arrays. High-resolution spectral information is provided by the Reflection Grating Spectrometer (RGS) that deflects half of the beam on two of the X-ray telescopes. The observatory also has a coaligned 30 cm optical/UV telescope called the Optical Monitor (OM). Since its launch on December 10, 1999, XMM-Newton has performed almost 5,000 observations and produced more than 1,000 refereed scientific publications (as of 9/30/05). NASA supported hardware contributions to both the RGS and OM instruments, and the production of project software. Participation by U.S. astronomers is supported by NASA and aided by the Guest Observer Facility at the Goddard Space Flight Center.

Surprise Discovery of Highly Developed Structure in the Young Universe

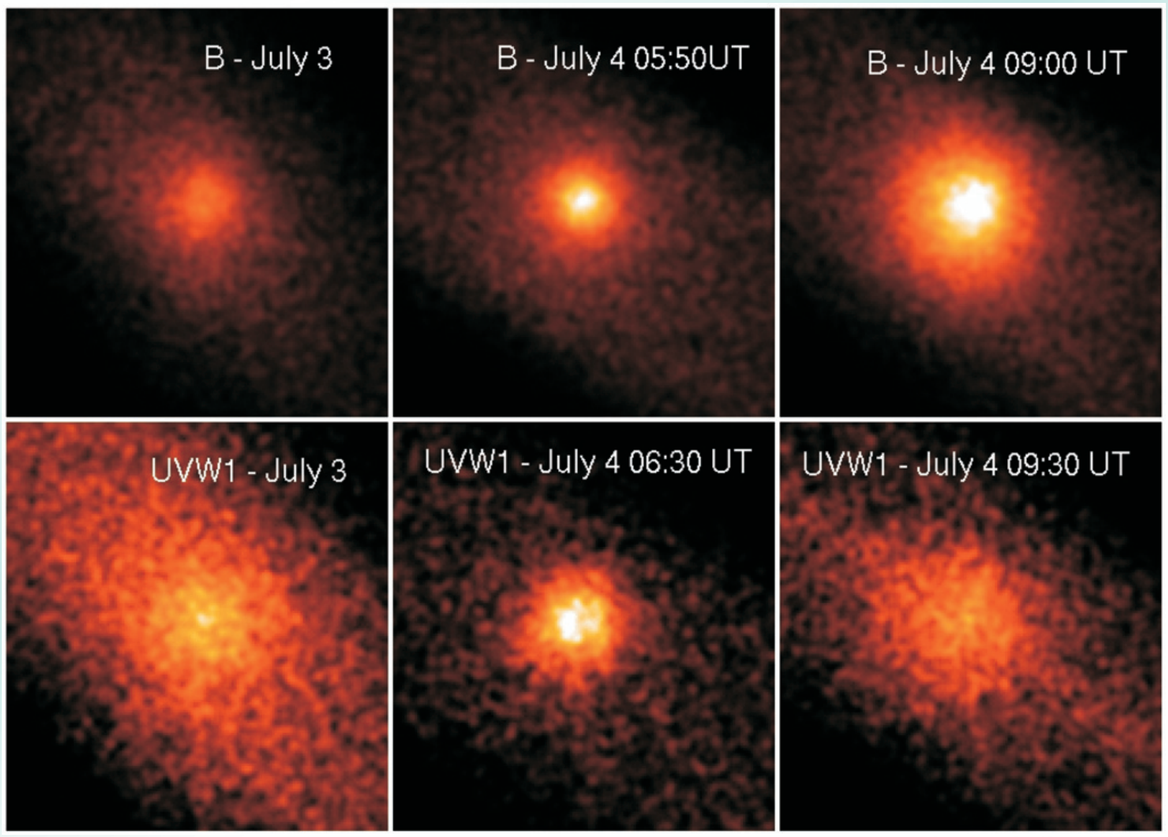
Combining XMM-Newton observations with data from ESO's Very Large Telescope, astronomers have discovered the most distant, massive structure in the Universe known to date. It is a remote cluster of galaxies with a mass of several thousand galaxies like our own Milky Way. The newly discovered cluster, called XMMU J2235.3-2557 (shown in the insert in the X-ray image), is 9 billion light years away and at least 500 million years older than any other cluster known so far. Since the Universe is about 13.7 billion years old, we see this cluster as it looked when the Universe was only 5 billion years old, or about one third of its present age.



Credit: NASA/ESA/U Michigan/Mullis et al.

XMM-Newton Detects Water on Tempel 1 during Deep Impact

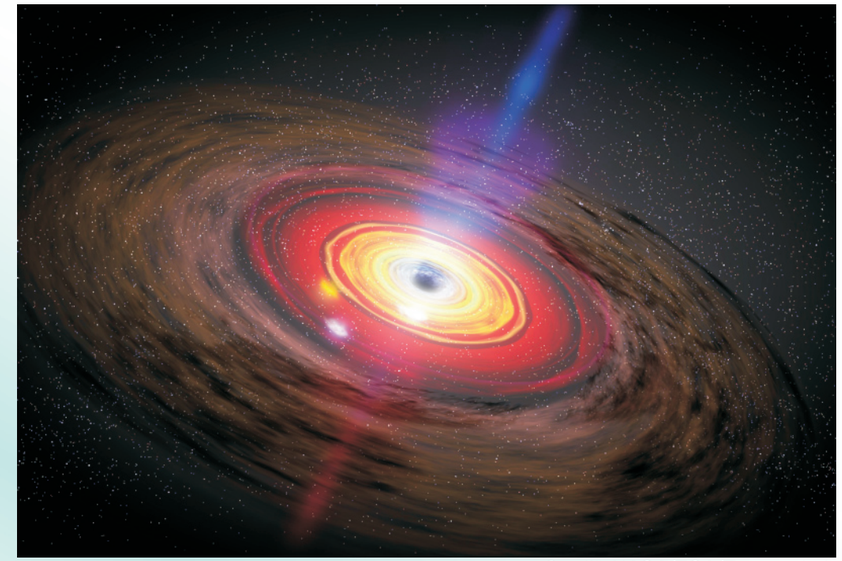
XMM-Newton joined the fleet of satellites and ground-based observatories in observing NASA's "Deep Impact" probe that smashed into the comet Tempel 1 on July 4, 2005. Images taken by the Optical Monitor on board XMM-Newton on July 3 and 4, 2005, show a comparison between the states of the comet before (left) and just after impact. These ultraviolet images were taken in blue (top) and ultraviolet light (bottom). The ultraviolet images show the emission of hydroxyl ions, a direct decay product of water. About 1.5 hours after the impact (middle), the brightness of hydroxyl has increased by a factor of about five. Later, about 4.5 hours after the impact (right), the ultraviolet emission has decreased again which indicates that the peak has passed. XMM-Newton observations of Tempel 1 also revealed that the comet is a weak X-ray source. The X-rays are either produced by charge exchange between neutral particles present in the comet's coma and ionized particles carried by the solar wind, or are solar X-rays scattered by the dust present in the coma.



Credit: ESA/Schulz et al.

XMM-Newton sees matter speed-racing around a black hole

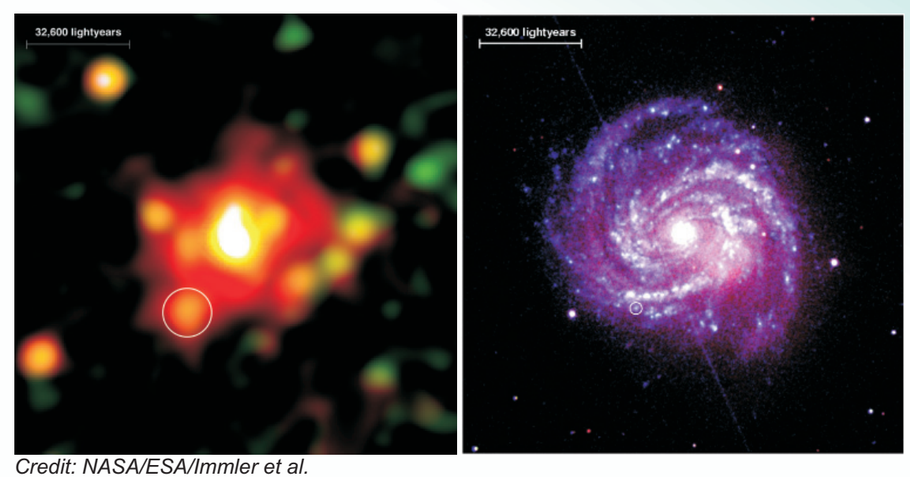
Using a 'radar-gun' technique, scientists have clocked three separate clumps of hot iron gas whipping around a black hole at 30,000 kilometers per second, about a tenth of the speed of light. The observation marks the first time scientists could trace individual blobs of shredded matter on a complete journey around a black hole. This provides a crucial measurement that has long been missing from black hole studies: an orbital period. Knowing this, scientists can measure black hole mass and other characteristics with a precision that has long eluded them.



Credit: NASA/ESA/Turner et al.

The Supernova that just won't fade away

A supernova that exploded in 1979 is as bright today in X-ray light as it was when it was discovered years ago, a surprising result because such objects usually fade significantly after only a few months. The scientists can document a unique history of the star, both before and after the explosion, by studying rings of light left over from the blast, similar to counting rings in a tree trunk. Among the many unique finds is the history of the star's stellar wind dating back 16,000 years before the explosion. Also, scientists were able to measure the density of the material around the star and captured a rare glimpse of the ultraviolet radiation from the supernova and its host galaxy M100 (right) using the XMM-Newton Optical Monitor.



Credit: NASA/ESA/Immler et al.