Dark Energy

Edwin Hubble famously showed that the Universe is expanding – but we do not know how this expansion will continue. The decisive factor for the future of the Universe is its mass density: if it is above a critical value, about six hydrogen atoms per cubic metre, then the expansion of the Universe will eventually slow down and reverse until the Universe ends in a so-called Big Crunch.

Adding up all the matter known in stars, gas and dust clouds amounts to only about 4% of this critical density. However, from galaxy dynamics and observations of galaxy clusters, astronomers have been able to infer that there exists much more invisible matter, its presence betrayed only by gravitational effects. But even this "dark matter" is not sufficient to halt the expansion of the Universe.

But there is more: In 2000, astronomers realised that the Universe's expansion is accelerating! This discovery was made by combining detailed observations of the fluctuations of the cosmic microwave background, together with accurate estimates of the distance to supernova explosions.

When Einstein developed the General Theory of Relativity in 1916, he introduced an additional "cosmological constant" term in his equations, which counteracted the attractive forces due to the gravitation of matter. Today's measurements of the accelerated expansion indicate that not only does this component exist, but it actually dominates, constituting around 75% of the total energy density of the Universe.

The nature of this energy, which keeps pushing the Universe further apart, remains a mystery – astronomers call it "dark energy". Unravelling this enigma is one of the most fascinating challenges in modern astronomy and physics and could even lead to a fundamental paradigm change.

eROSITA will be the first experiment to measure the parameters of dark energy with high enough precision to differentiate between various theoretical models.

eROSITA is supported by the German Aerospace Centre DLR and the Max Planck Society with BMWi funding. The Max Planck Institute for Extraterrestrial Physics (MPE) is the leading institute for the project, which is carried out in close collaboration with other German research institutes and the IKI in Moscow.

Important academic and industry partners:

Max Planck Institute for Extraterrestrial Physics, Garching, Germany

Max Planck Institute for Astrophysics, Garching, Germany

DLR Space Administration, Bonn, Germany

ROSKOSMOS, Moscow, Russia

Space Research Institute (IKI), Moscow, Russia

Dr. Remeis Observatory Bamberg, University Erlangen-Nürnberg, Germany

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Tecnotron GmbH, Weißensberg, Germany

pnSensor GmbH, Munich, Germany

IABG mbH, Ottobrunn, Germany

Laserjob GmbH, Fürstenfeldbruck, Germany

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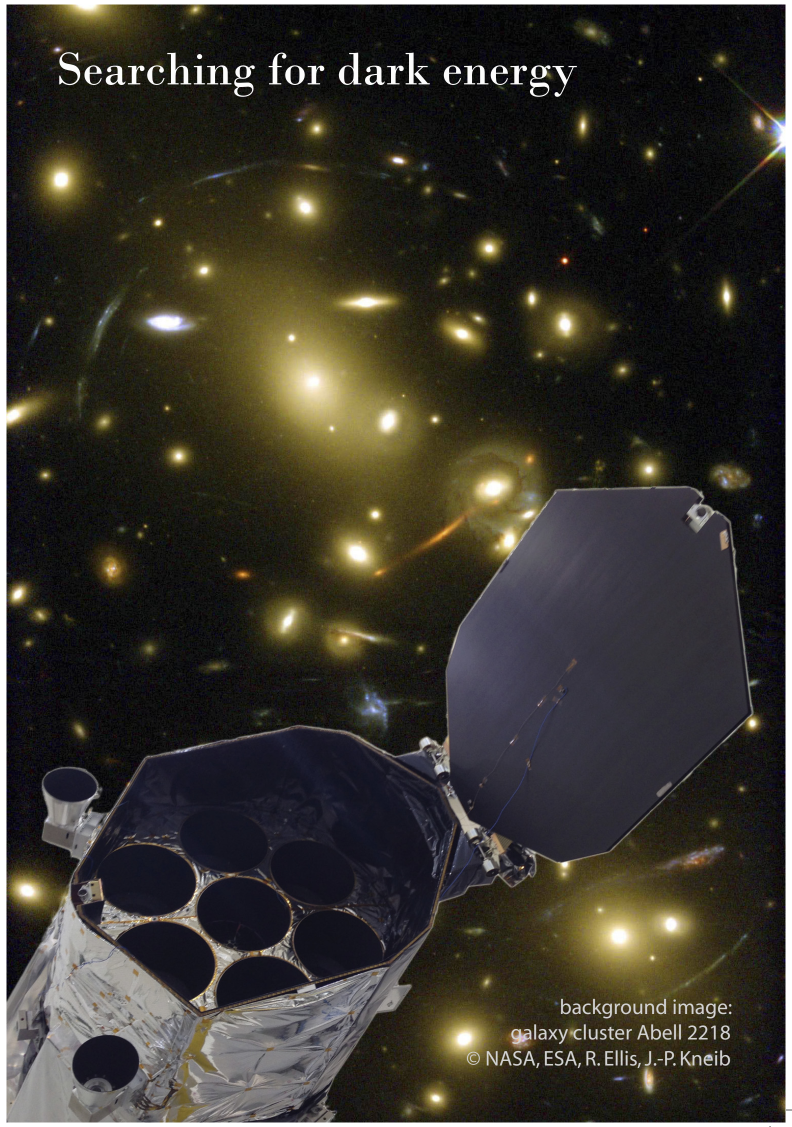
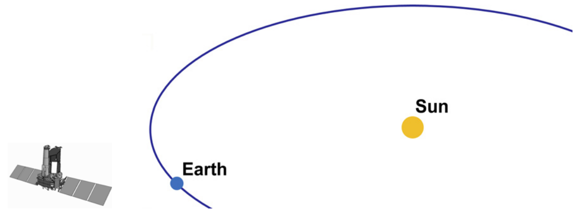
For more information see
http://www.mpe.mpg.de/erosita

eROSITA

the whole sky in X-rays

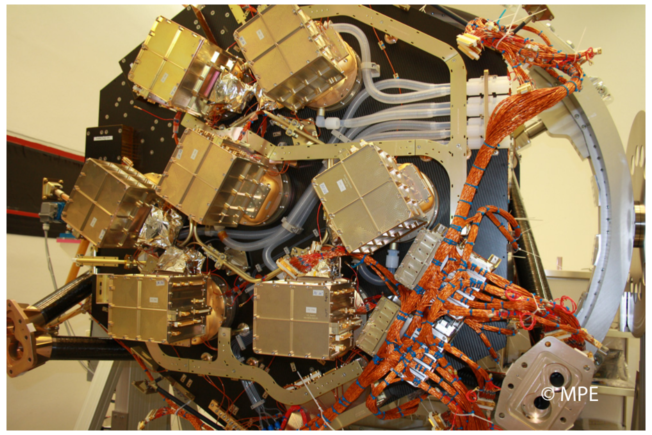


Spectrum-Roentgen-Gamma



Together with the Russian ART-XC telescope, eROSITA will be the main instrument on the Russian space mission Spectrum-Roentgen-Gamma. The launch is scheduled for 2018.

The satellite will be launched with a Proton/Block-DM-03 rocket from the Russian launch site Baikonur in Kazakhstan and then transferred to its orbit around the so-called L2 point, some 1.5 million kilometres from Earth.



eROSITA - the mission

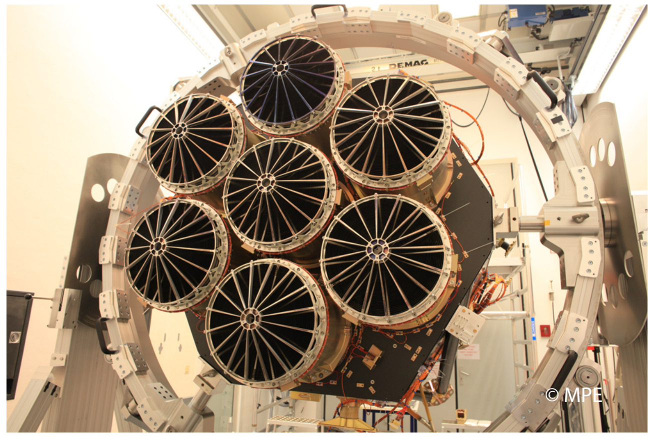
extended ROentgen Survey with an Imaging Telescope Array

Over a four year period eROSITA will survey the entire sky, gathering extensive information about several million cosmic X-ray sources. The eROSITA all-sky survey will be about 25 times more sensitive than the pioneering ROSAT mission of the 1990s.

In its search for clues about **dark energy**, eROSITA will study the distribution of galaxy clusters in the Universe. It is estimated that eROSITA will detect and examine approximately 100,000 galaxy clusters.

Clusters consist of thousands of individual galaxies, and each of these galaxies can contain as many as several hundred billion stars. Clusters are the largest gravitationally bound objects in the Universe. By determining the distribution of galaxy clusters in space, astronomers can not only determine the structure of the Universe today, but also in the past – because of the gigantic distances involved. Dark energy affects how these structures change over time, and so by comparing eROSITA's measurements with cosmological models we can infer the parameters of dark energy.

The eROSITA all-sky survey will detect a multitude of additional X-ray sources, including several million active black holes in the centres of galaxies, and also rare objects like isolated neutron stars. Last, but not least, there is always the hope that new phenomena might be discovered as well.



eROSITA - the telescope

The eROSITA telescope has seven identical X-ray "eyes". Each eye consists of a mirror module with an X-ray sensitive camera placed at its focus.
The X-ray optics are constructed from gold-coated tubular mirrors, with 54 nested mirrors forming one module.

Developed and built at MPE, the cameras contain special X-ray CCDs manufactured from high-purity silicon. For maximum performance, these cameras have to be cooled to -90 °C using a complex heat pipe cooling system.