Stars

Stellar X-ray physics

Almost every star shows phenomena due to the influence of the magnetic field, collectively called *magnetic activity*, the most evident being a strong X -ray emission. As X-rays are absorbed by the terrestrial atmosphere, the study of stellar magnetic activity has been strongly boosted by observations from space telescopes, such as *Einstein* (launched in 1978), *ROSAT* (1990), *Chandra* and *XMM-Newton*, the latter two having been in orbit since 1999.

According to the most reliable theory, contributed also by OAPa researchers, the magnetic field in low/medium mass stars is generated by a complex mechanism known as stellar dynamo, which turns a part of the kinetic energy of the stellar convective and rotational motions into magnetic energy.

The magnetic field allows the existence of the coronae which, like the solar one, are made up of million-degree plasma, visible in the X band.

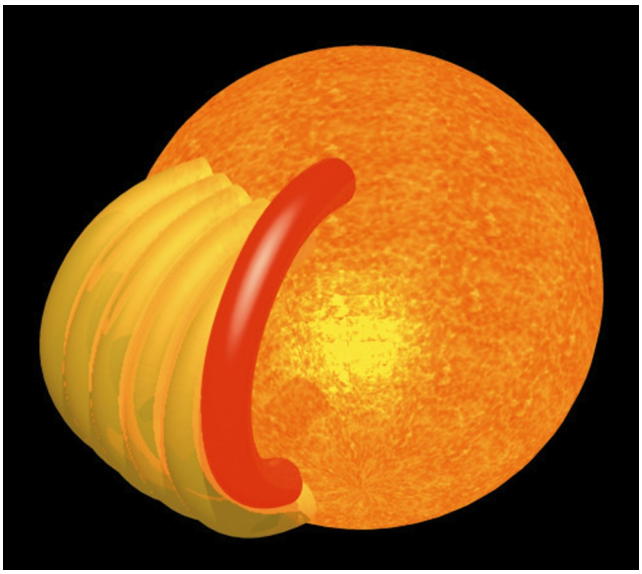
Pulled by the convective motions taking place in the underlying area, the magnetic field may undergo sudden configuration changes, which cause violent energy releases. During these explosions, known as flares, the involved structures of the corona may exceed the brightness of the whole corona up to ten times and temperatures may rise up to tens of million degrees.

'Open' magnetic structures allow the ejection of plasma, generating a strong stellar wind. This wind, conveying angular momentum, slows the star rotation, reducing the efficiency of the dynamo and causing some magnetic activity decrease over billions of years.

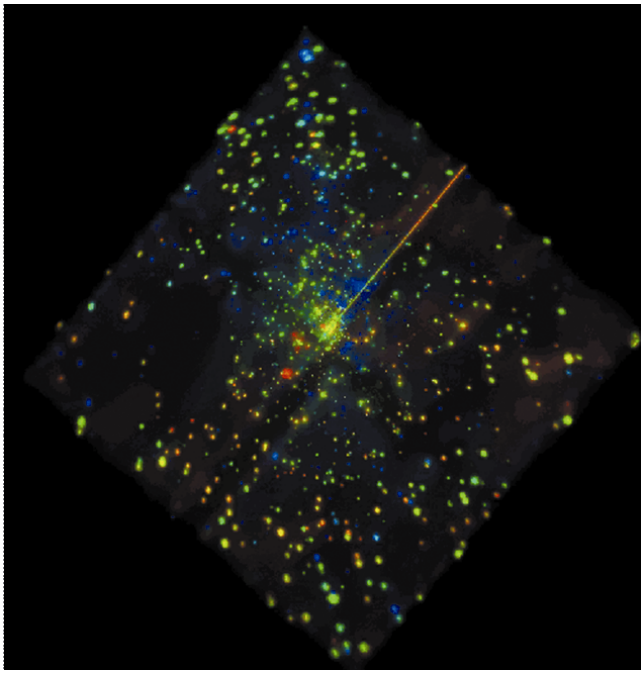
Young stars

Young stars are particularly active and this bears important consequences for the surrounding environment. In the first million years after their formation, following the gravitational collapse of a cloud of gas and dust, stars are surrounded by dense plasma disks, responsible also for the formation of planets. X-ray emissions from the star, as well as its matter ejections due to winds and explosive events, notably influence the physical conditions of the disks, the planets and the residual material cloud which will give rise to other stars. Therefore the study of high-energy phenomena is fundamental to understanding star and planets formation.

OAPa scientist have been actively engaged in searching for the origin of magnetic activity and its effects on the environment surrounding the star. They take part in or lead several large international projects based on observations made with the most powerful space- and ground-based instruments (e. g. *Chandra* and *XMM-Newton*).



A possible scenario for a coronal arch system on Proxima Centauri during a flare observed with the XMM-Newton satellite.



X-ray image of the young stellar cluster Orione, observed with Chandra. The data obtained have allowed over 1600 young stars to be studied.