Stellar shockwaves shaped our solar system

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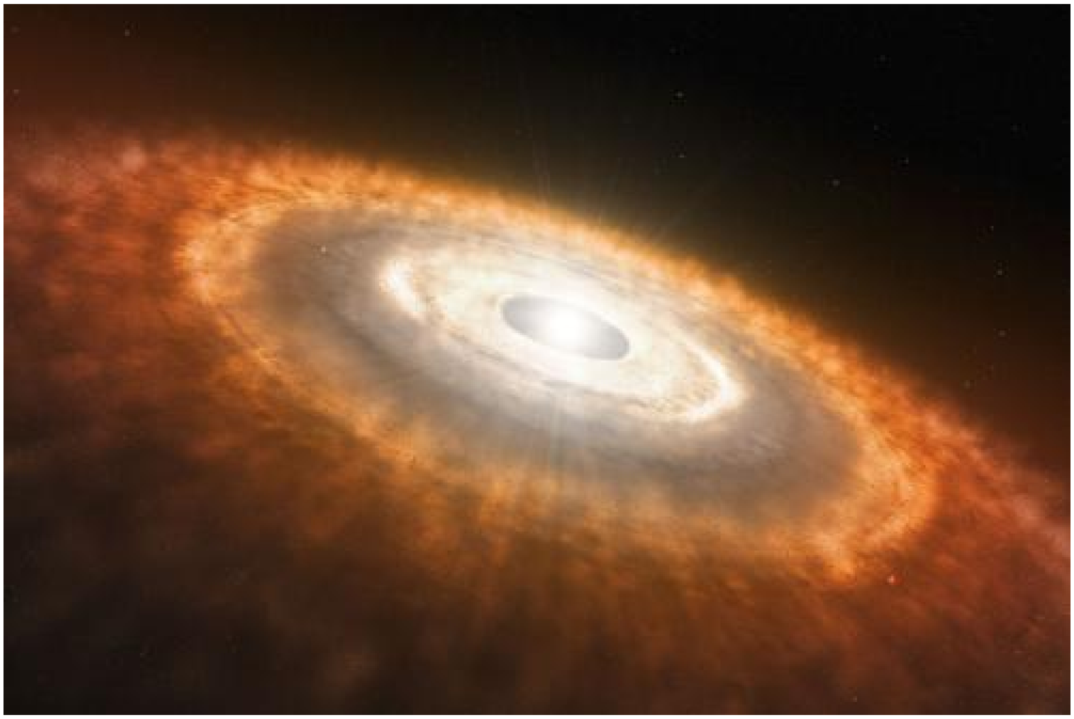
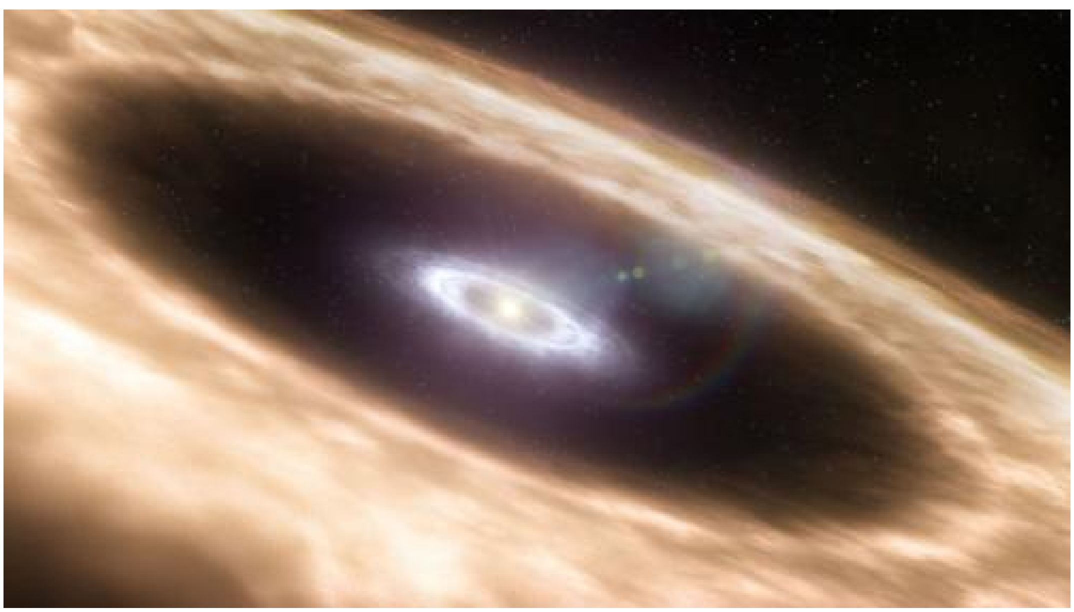


Artist's impression of a baby star still surrounded by a protoplanetary disc in which planets are forming. Using ESO's very successful HARPS spectrograph, a team of astronomers has found that Sun-like stars which host planets have destroyed their lithium much more efficiently than planet-free stars. This finding does not only shed light on the low levels of this chemical element in the Sun, solving a long-standing mystery, but also provides astronomers with a very efficient way to pick out the stars most likely to host planets. It is not clear what causes the lithium to be destroyed. The general idea is that the planets or the presence of the protoplanetary disc disturb the interior of the star, bringing the lithium deeper down into the star than usual, into regions where the temperature is so hot that it is destroyed. Credit: ESO/L. Calçada

The early years of our Solar System were a turbulent time, and questions remain about its development. Dr Tagir Abdylmyanov, Associate Professor from Kazan State Power Engineering University, has been researching shockwaves emitted from our very young Sun, and has discovered that these would have caused the planets in our Solar System to form at different times. Abdylmyanov presented his work at the European Planetary Science Congress in Madrid on Thursday September 27.

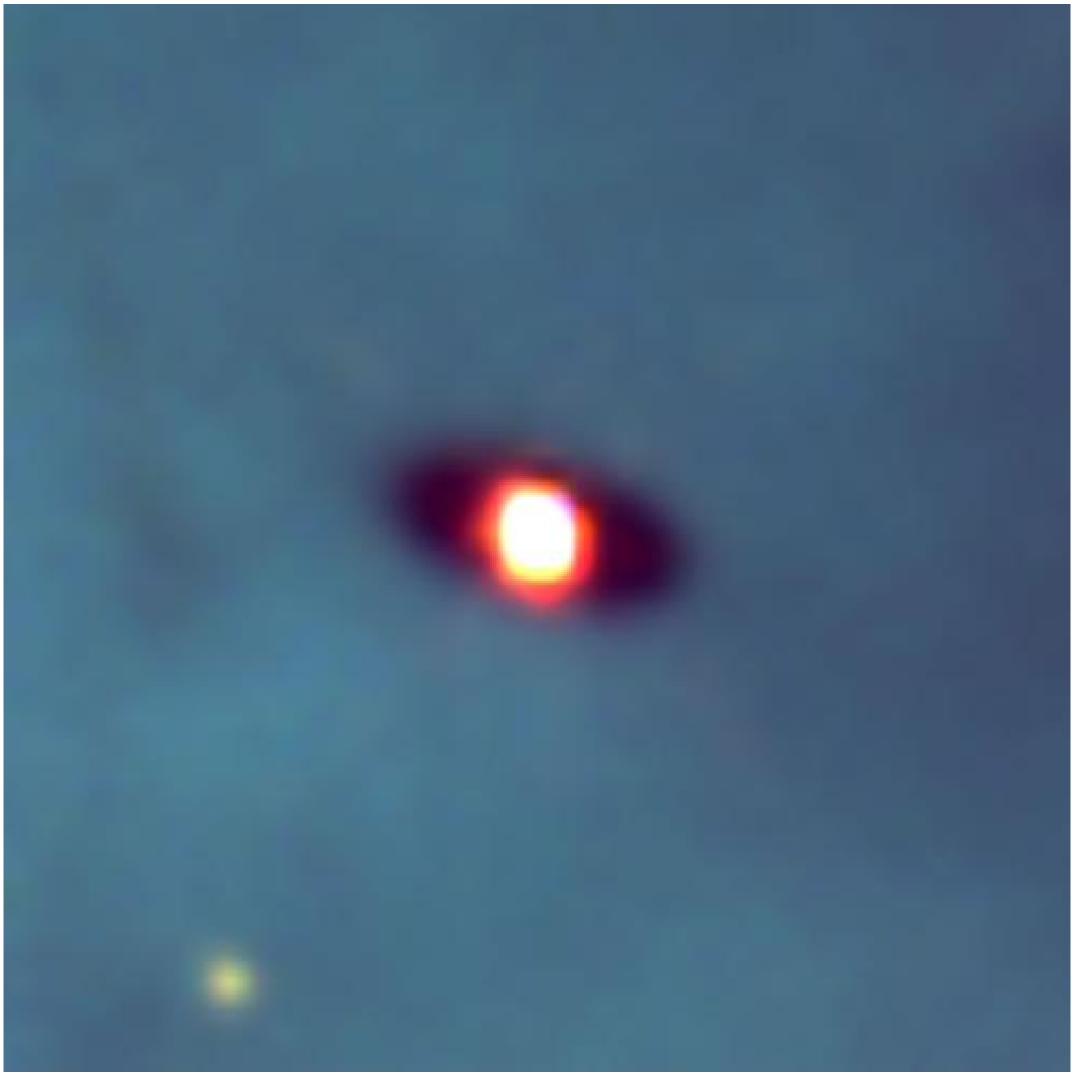
Abdylmyanov has modelled the movements of particles in fluids and gases in the gas cloud from which our Sun accreted. His work suggests our new-born Sun emitted a series of shockwaves that rippled out into the remaining material. This created a series of debris rings around the Sun that accreted over millions of years into planets.



Astronomers have been able to study planet-forming discs around young Sun-like stars in unsurpassed detail, using ESO's Very Large Telescope. The studied discs were known to have gaps in the dusty discs (represented by the brownish color in the image) but the astronomers found that gas is still present inside these gaps (represented by the white color in the image). This can either mean that the dust has clumped together to form planetary embryos, or that a planet has already formed and is in the process of clearing the gas in the disc. Credit: ESO

The research indicates that the first series of shockwaves during short but very rapid changes in solar activity would have created the proto-planetary rings for Uranus, Neptune, and dwarf planet Pluto. Jupiter, Saturn, and the asteroid belt would have come next during a series of less powerful shockwaves. Mercury, Venus, Earth, and Mars would have formed last, when the Sun was far calmer. This means that our own planet is one of the youngest in the Solar System.

"The planets formed in intervals – not altogether, as was previously thought," Abdylmyanov explains. "It is difficult to say exactly how much time would have separated these groups, but the proto-planetary rings for Uranus, Neptune and Pluto would have likely formed very close to the Sun's birth. 3 million years later and we would see the debris ring destined to form Saturn. Half a million years after this we would see something similar but for Jupiter. The asteroid belt would have begun to form about a million years after that, and another half a million years on we would see the very early stages of Mercury, Venus, Earth and Mars."



Disks around young stars (also known as circumstellar or protoplanetary disks) are thought to be made up of 99% gas and 1% dust. Even that small amount of dust is enough to make the disks opaque and dark at visible wavelengths. The dark disk is seen in this image because they are silhouetted against the bright backdrop of the hot gas of the Orion nebula. Credit: Mark McCaughrean (Max-Planck-Institute for Astronomy), C. Robert O'Dell (Rice University), and NASA/ESA

Abdylmayanov hopes that this research will help us understand the development of planets around distant stars. "Studying the brightness of stars that are in the process of forming could give indications as to the intensity of stellar shockwaves. In this way we may be able to predict the location of planets around far-flung stars millions of years before they have formed."

Provided by European Planetary Science Congress