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PRESS RELEASE

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The missing link in the evolution of magnetic cataclysmic stars?

Based on the article "Paloma (RXJ0524+42): the missing link in magnetic CV evolution?"
by Schwarz et al.

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An international team of astronomers might have discovered the missing link in the evolution of the so-called magnetic cataclysmic variable stars. They determined the spin and orbital periods of the binary star Paloma. They found that the Paloma system has a weird way of rotating that fills the gap between two classes of magnetic cataclysmic stars. Their results will soon be published in *Astronomy & Astrophysics*.

Cataclysmic variables (CVs) are a class of binary stars made up of a white dwarf [1] and a normal star much like our Sun. Both stars orbit so close to each other that the white dwarf accretes matter from the companion star. In most of the several hundred CVs known, the matter spirals around the white dwarf, forming a disk, before being accreted and incorporated into the star. About 20% of the known CVs include a white dwarf with a strong magnetic field of several million Gauss [2]. They are known as "magnetic CVs". The magnetic field of the white dwarf can be strong enough to disrupt the accretion disk or even to prevent the disc from forming.

Astronomers currently know two classes of magnetic CVs:

- Polars (also known as the prototype star AM Herculis) have a strong enough magnetic field to synchronize the spin period of the stars and the orbital period of the system [3]. A departure from synchronization is observed for four AM Herculis stars, which are thought to be normal AM Herculis systems currently desynchronized by a recent nova explosion. The difference between the spin period and the orbital period, that is, the degree of asynchronism, is less than 2% for these near-synchronous polars.

- Intermediate polars (known as DQ Herculis stars) have a lower magnetic field, and the spin period of the stars is shorter than the orbital period. The majority of the DQ Herculis stars have orbital periods longer than 3 hours and spin periods ranging from 33 seconds to 1 hour.

In a cataclysmic variable system, both stars are so close to each other (the whole system would match the size of our Sun) that astronomers cannot distinguish one star from the other. For studying CVs, they rely on indirect observations: measuring the variation in the brightness of the system, thereby estimating its characteristics (orbit size, period).

Dr. R. Schwarz and his colleagues [4] studied the candidate magnetic CV Paloma (also known as RX J0524+42), which has not yet been characterised. It does not fit either of the known CVs categories. The team presents both long- and short-term monitoring of this stellar system, using several European telescopes (1.2m OHP, 70 cm AIP, 1.23m Calar Alto), over a period ranging from 1995 to 2001. With this monitoring, they built the light curves and estimated the periods of the system. ROSAT observations of the system confirm that it has a strong magnetic field and thus belongs to the magnetic CVs.

From their observations, the team concludes that the faster white dwarf performs 14 spins around its own axis during 13 orbital revolutions. The weird degree of synchronization of the system presents the characteristics that makes Paloma so interesting. This bridges the gap between the two main classes of magnetic CVs: it spins much more slowly than any known intermediate polar, but is too much desynchronized to be an AM Herculis star. Paloma thus revives the old idea that both classes are evolutionarily linked together and that intermediate polars are the ancestors of the older AM Herculis stars. Theoreticians predict that Paloma is in the process of synchronization and should become a spin-locked AM Herculis star over the next 100 million years.

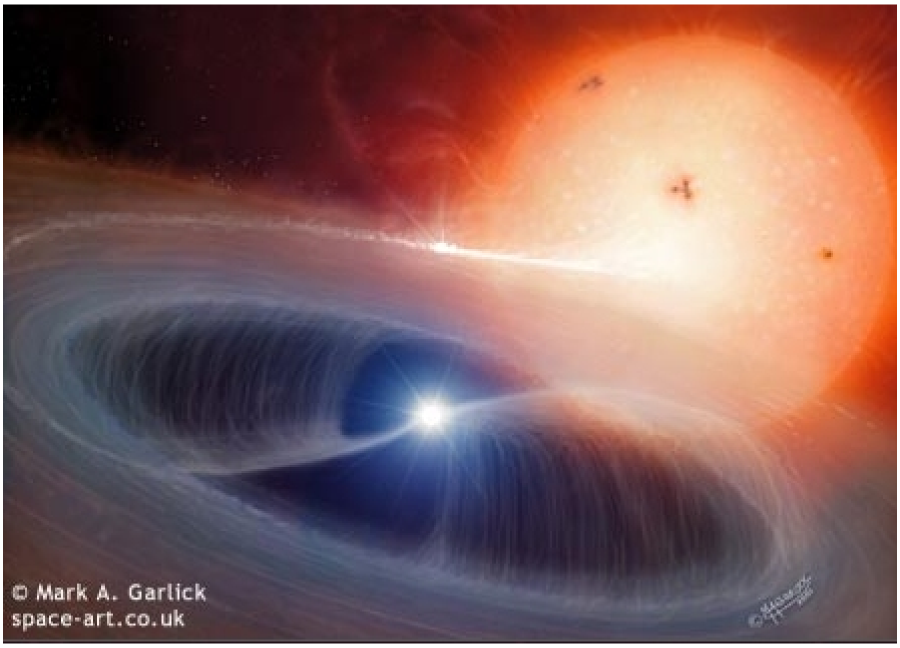

Figure 1. *Artist's illustration of an intermediate polar. Copyright M.A. Garlick.*

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[1] A white dwarf is a dying star that has exhausted most of its nuclear fuel. It is extremely dense (1 ton per cm^3), with about the mass of the Sun and the size of the Earth. Our Sun will become a white dwarf in about 4.5 billion years.

[2] For comparison, the Sun's magnetic field is about 50 Gauss and the magnetic field inside a nuclear medical imaging device is about 10000 Gauss.

[3] The Earth-Moon system illustrates the case for synchronization in astronomy: from the Earth, we always see the same side of the Moon because the spin period of the Moon is the same as its orbital period around the Earth.

[4] The team includes R. Schwarz, A.D. Schwope, A. Staude (Astrophysikalisches Institut Potsdam, Germany), A. Rau (CalTech, USA), G. Hasinger (MPI, Garching, Germany), T. Urrutia (UC Davis, USA), and C. Motch (Observatoire Astronomique, Strasbourg, France).

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