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Magnetic fields slow down stars

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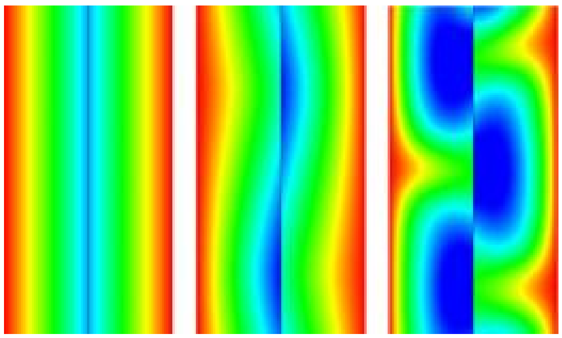

Numerical Simulations show a strong disturbation of the magnetic fields inside a star for higher than critical magnetic field values (Credits:AIP).

Scientists have proved the existence of a magnetic effect that could explain why solar-like stars spin very slowly at the end of their lifetime.

Researchers from the Leibniz-Institut für Astrophysik Potsdam (AIP) made simulations of the magnetic fields of stars and compared the results with measurements from a laboratory experiment done at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR). The aim and result of this experiment was to detect, for the first time, a magnetic instability that had been theoretically predicted but never directly observed in a star. This magnetic effect would enhance the viscosity of hot plasma inside a star, leading to a strong deceleration of its core.

"We have known for years that the Tayler instability is an effective mechanism to explain the deceleration of stars, but until now there was no proof of its existence," says Günther Rüdiger, the principal investigator at AIP. "This experiment confirms our numerical predictions very well," adds Marcus Gellert, who conducted computer simulations to prepare the experiment.

In order to correlate with the low rotation rates observed in white dwarfs, or neutron stars, which are stars at the end of their life cycle, the core rotation rate of a solar-like star would have to drop by ninety percent. A permanently active magnetic instability could decelerate the core of a star very effectively and would explain observations in a simple and elegant way. The extent to which these laboratory results can be transferred to a real star has to be shown via new simulations and comparisons with observations in the near future. The confirmation of the Tayler instability underlines the importance of magnetic fields in stars and could be an important step towards creating more consistent models of stellar evolution.

The GATE experiment is a successor to the award-winning "PROMISE" experiment which, in 2010, proved the existence of so-called magnetorotational instability (MRI), demonstrating a second successful partnership between astronomers from AIP and scientists at HZDR in shedding more light on stars in the lab.

More information: Publications:

Rüdiger G., Gellert M., Schultz M., Strassmeier K.G., Stefani F., Gundrum Th., Seilmayer M., Gerbeth G.: Critical fields and growth rates of the Tayler instability as probed by a columnar gallium experiment (*ApJ*, preprint arxiv.org/abs/1201.2318)
Martin Seilmayer, Frank Stefani u.a.: Evidence for transient Tayler instability in a liquid metal experiment, in: *Physical Review Letters* prl.aps.org/abstract/PRL/v108/i24/e244501

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