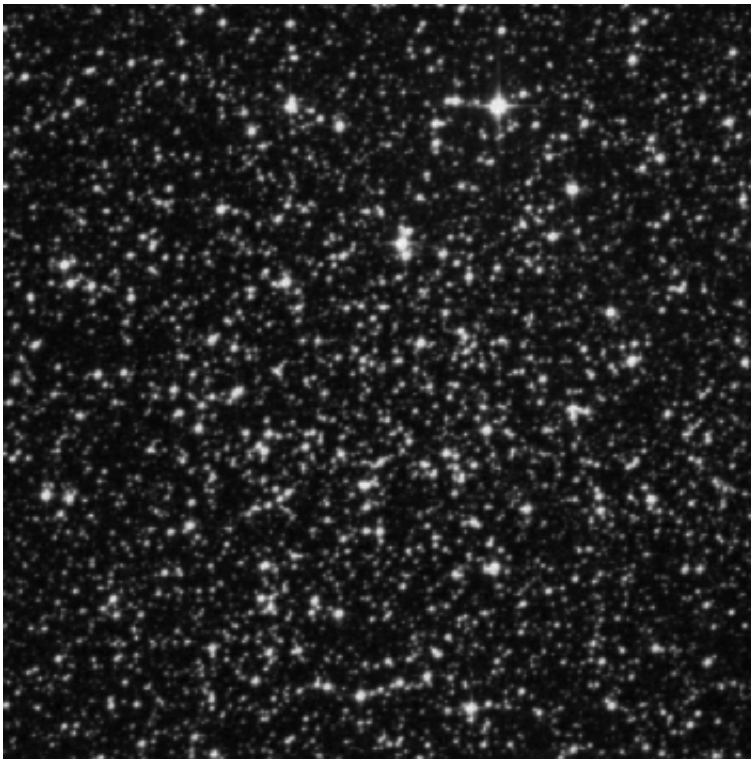


# Astronomers discover two new giant lithium-rich stars in an old open cluster

May 10 2016, by Tomasz Nowakowski

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An image of the open cluster Trumpler 20. Credit: University of Vienna

(Phys.org)—An international team of astronomers, led by Rodolfo Smiljanic of the Nicolaus Copernicus Astronomical Center in Toruń, Poland, has detected two new giant lithium-abundant stars in an old open cluster named Trumpler 20. The discovery could yield new important information regarding the phenomenon of omnipresence of lithium-rich

stars in different environments throughout the universe. The results were published online on May 6 in the arXiv journal.

The newly found [stars](#) were designated MG 340 and MG 591. They were detected during an analysis of a sample of 40 giant stars of the 1.66 billion-year-old Trumpler 20 cluster, for which high-resolution spectra were obtained by the Ultraviolet and Visual Echelle Spectrograph (UVES) on the Very Large Telescope (VLT) in Chile. The observations were carried out under the Gaia-ESO Public Spectroscopic Survey, which utilizes VLT and ESA's Gaia spacecraft to study Milky Way's bulge, thick and thin discs and halo components, as well as [open star clusters](#). One of the goals of this survey is to provide the first homogeneous overview of the distributions of kinematics and elemental abundances in our galaxy.

Thanks to the data collected by UVES, Smiljanic and his colleagues derived atmospheric parameters and lithium abundances of MG 340 and MG 591. Moreover, they estimated the mass of these newly detected stars to be between 1.5 and 3.6 solar masses.

Lithium-rich giants have been observed in different environments: open clusters, globular clusters, metal-rich and metal-poor field stars, the Galactic bulge, as well as in dwarf galaxies. In previous studies, it was found that some of these host planets and thus the surface lithium enrichment could be caused by planet engulfment. This process could activate internal production of lithium and induce its mixing to the surface. According to the research team, the new discovery supports a different theory.

"The properties of many lithium-rich giants discovered within the Gaia-ESO Survey seem to be consistent with those of giants that engulfed close-in giant planets before evolving up the red giant branch. However, a small fraction of cases still require alternative explanations. Here, we

report the discovery of two lithium-rich giants that could be examples of such an alternative formation channel in the open cluster Trumpler 20," the researchers wrote in a paper.

One explanation offered by the scientists is that suppressed all instances of extra-mixing processes, so the surface abundance of lithium in these stars remained at the level predicted by standard stellar evolution models.

"We argue that the fraction of Li-rich giants found in our sample is consistent with these giants being evolved counterparts of magnetic Ap-type dwarfs. In this case, the extra-mixing processes could have been inhibited by the action of magnetic fields," the paper reads.

If the authors are right, this scenario would likely apply to many, if not all, lithium-rich giants with similar masses and abundances of this element. According to them, these stars would not have experienced fresh lithium production, but would instead have preserved part of their original abundance. The team calls for additional observations that could help in providing extra support to their suggested scenario, or they could help to disprove it. The researchers concluded that other hypotheses seem less likely, although they cannot be fully excluded.

**More information:** The Gaia-ESO Survey: Inhibited extra mixing in two giants of the open cluster Trumpler 20?, arXiv:1605.01945 [astro-ph.SR] [arxiv.org/abs/1605.01945](https://arxiv.org/abs/1605.01945)

## **Abstract**

We report the discovery of two Li-rich giants, with  $A(\text{Li}) \sim 1.50$ , in an analysis of a sample of 40 giants of the open cluster Trumpler 20 (with turnoff mass  $\sim 1.8 M_{\text{sun}}$ ). The cluster was observed in the context of the Gaia-ESO Survey. The atmospheric parameters and Li abundances were derived using high-resolution UVES spectra. The Li abundances were

corrected for nonlocal thermodynamical equilibrium (non-LTE) effects. Only upper limits of the Li abundance could be determined for the majority of the sample. Two giants with detected Li turned out to be Li rich: star MG 340 has  $A(\text{Li})_{\text{non-LTE}} = 1.54 \pm 0.21$  dex and star MG 591 has  $A(\text{Li})_{\text{non-LTE}} = 1.60 \pm 0.21$  dex. Star MG 340 is on average  $\sim 0.30$  dex more rich in Li than stars of similar temperature, while for star MG 591 this difference is on average  $\sim 0.80$  dex. Carbon and nitrogen abundances indicate that all stars in the sample have completed the first dredge-up. The Li abundances in this unique sample of 40 giants in one open cluster clearly show that extra mixing is the norm in this mass range. Giants with Li abundances in agreement with the predictions of standard models are the exception. To explain the two Li-rich giants, we suggest that all events of extra mixing have been inhibited. This includes rotation-induced mixing during the main sequence and the extra mixing at the red giant branch luminosity bump. Such inhibition has been suggested in the literature to occur because of fossil magnetic fields in red giants that are descendants of main-sequence Ap-type stars.

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