

LMC origin of the hyper-velocity star HE0437-5439. Beyond the supermassive black hole paradigm

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Context: Hyper-velocity stars move so fast that only a supermassive black hole (SMBH) seems to be capable to accelerate them. Hence the Galactic centre (GC) is their only suggested place of origin. Edelmann et al. (2005) found the early B-type star HE0437-5439 to be too short-lived to have reached its current position in the Galactic halo if ejected from the GC, except if being a blue straggler star. Its proximity to the Large Magellanic Cloud (LMC) suggested an origin from this galaxy.

Aims: The chemical signatures of stars at the GC are significantly different from those in the LMC. Hence, an accurate measurement of the abundance pattern of HE0437-5439 will yield a new tight constraint on the place of birth of this hyper-velocity star.

Methods: High-resolution spectra obtained with UVES on the VLT are analysed using state-of-the-art non-LTE modelling techniques.

Results: We measured abundances of individual elements to very high accuracy in HE0437-5439 as well as in two reference stars, from the LMC and the solar neighbourhood, respectively. The abundance pattern is not consistent at all with that observed in stars near the GC, ruling out an origin from the GC. However, there is a high degree of consistency with the LMC abundance pattern. Our abundance results cannot rule out an origin in the outskirts of the Galactic disk. However, we find the life time of HE0437-5439 to be more than three times shorter than the time of flight to the edge of the disk, rendering a Galactic origin unlikely.

Conclusions: Only one SMBH is known to be present in Galaxy and none in the LMC. Hence the exclusion of an GC origin challenges the SMBH paradigm. We conclude that there must be other mechanism(s) to accelerate stars to hyper-velocity speed than the SMBH. We draw attention to dynamical ejection from dense massive clusters, that has recently been proposed by Gvaramadze et al. (2008).

Reference: Astronomy & Astrophysics

Status: Manuscript has been accepted

Weblink: <http://www.sternwarte.uni-erlangen.de/~ai32/hvs.pdf>

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