HE 0437−5439: the First Hypervelocity Star from the LMC

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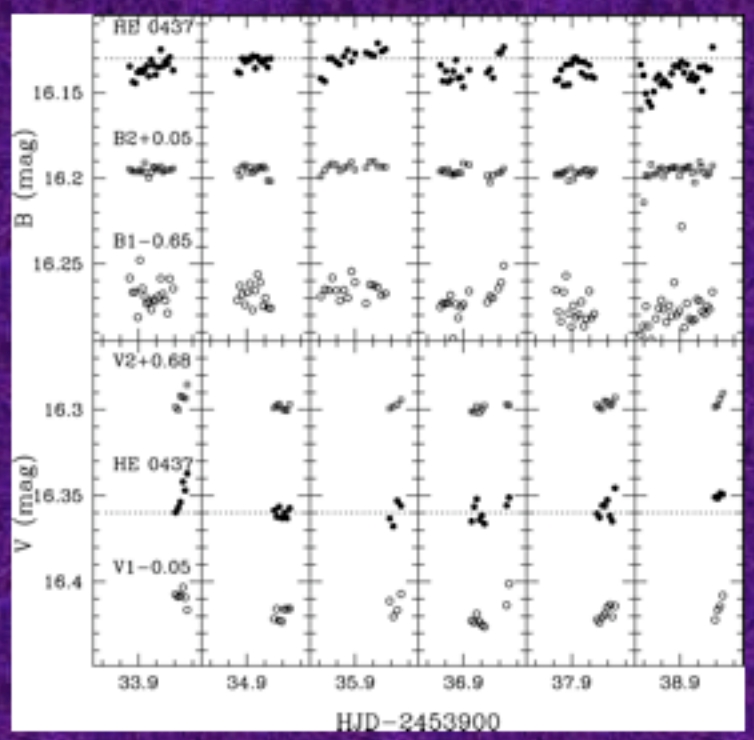
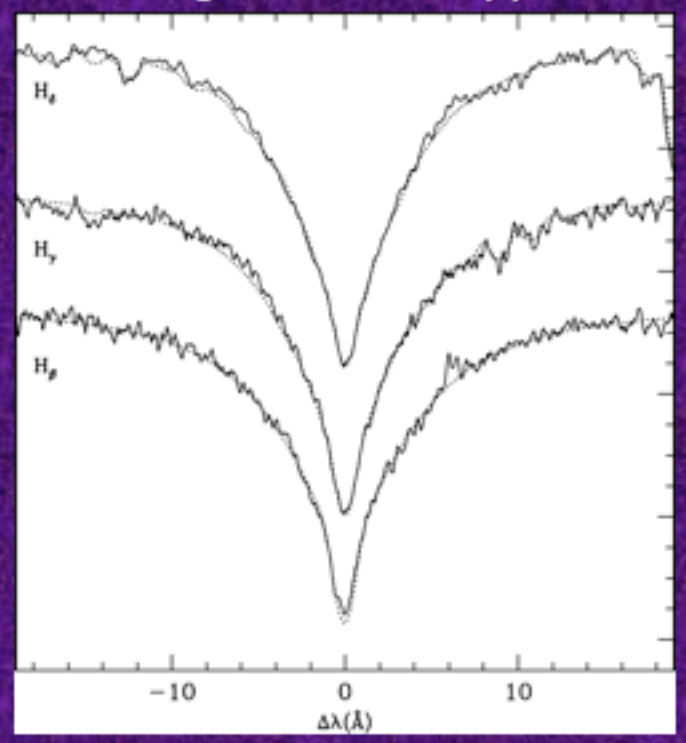
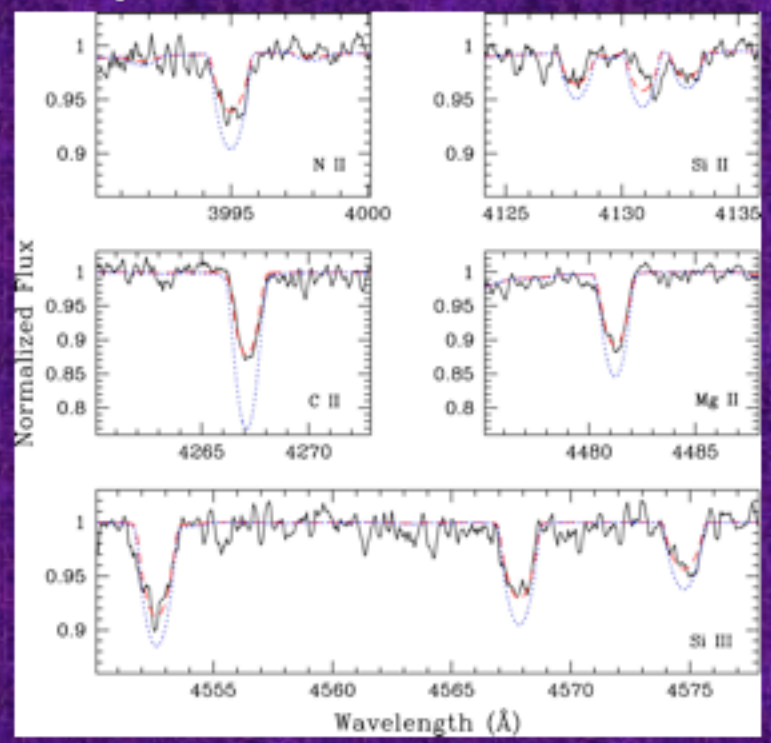


B & V light curves of HE 0437−5439 (filled circles) and two comparison stars. Dotted lines show the derived photometry (V=16.36+/-0.04 mag, B-V=-0.23+/-0.03 mag). The stability of our photometry renders the scenario of a blue straggler contact binary ejected from our Galaxy unlikely.



Balmer lines of HE 0437−5439. The TLUSTY model spectrum (dotted line) for the derived parameters is overplotted, illustrating the good fit to the Balmer wings. Its spectral type is B2 IV-III.



Representative metal lines in HE 0437−5439 (solid line) used to derive abundances. TLUSTY model spectra for half-solar (dashed line) and solar (dotted line) metallicity are overplotted, illustrating that **the metallicity of HE 0437-5439 is half-solar.**

The hypervelocity star HE 0437−5439 was serendipitously discovered by Edelmann et al. (2005). With a radial velocity of +723 km/s, an early-B spectral type and an estimated distance of 60 kpc, its origin remained enigmatic: a main sequence lifetime of 25-35 Myr is much shorter than the 100 Myr required to travel that distance at the measured radial velocity. Edelmann et al. therefore proposed two possible explanations for this paradox: either HE 0437−5439 is a Galactic blue straggler or it originated from the LMC. We measured the chemical abundance of the hypervelocity star from high-resolution spectra obtained with UVES/VLT and found that **HE 0437−5439 has half-solar metallicity, thus establishing its origin in the LMC.**

We can rule out a Galactic origin, because stars in the Galactic center have solar or supersolar metallicities (e.g. Cunha et al. 2007) and an origin from the low-metallicity outskirts of the Galactic disk suffers from the age paradox. Our metallicity result has been confirmed by Przybilla et al. (2008). A noteworthy implication is the existence of a massive black hole in the LMC. According to the simulations of Gualandris & Portegies Zwart (2007), an intermediate mass black hole of mass >1000 Mo is required to eject HE 0437−5439 from the LMC. Further work is necessary to determine the location of the massive black hole in the LMC.

PARAMETERS AND ABUNDANCES FOR HE 0437−5439

Parameter or Element	HE 0437−5439	LMC Abundance	Solar Abundance
$T_{\rm eff}$ (K)	21500 ± 1000	...	...
log g (dex)	3.70 ± 0.2	...	...
ξ (km s^{-1})	2 ± 3	...	...
$v \sin i$ (km s^{-1})	55 ± 1	...	...
C II	7.79 ± 0.13 (1)	7.75	8.39
N II	7.30 ± 0.24 (1)	6.90	7.78
O II	8.44 ± 0.33 (13)	8.35	8.66
Mg II	7.10 ± 0.18 (1)	7.05	7.53
Si II	7.17 ± 0.21 (2)	7.20	7.51
Si III	7.18 ± 0.34 (3)	7.20	7.51

SUMMARY

- We measure half-solar metallicity for the hyper-velocity star HE 0437−5439.
- Based on its metallicity and distance, HE 0437−5439 must have originated in the LMC.
- According to the simulations of Gualandris & Portegies Zwart (2007), an LMC origin for this star implies the existence of a massive black hole (>1000 Mo) somewhere in the LMC.

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References:

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