Proposal

Title: Constraining the mass of the possible blackhole at the center of the Large Magellanic Cloud

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Summary

The research follows the work from Erkal et al.(2019) and aims to give a constraint on both the mass of the possible black hole living at the center of the Large Magellanic Cloud, as well as the age of HVS3 when it shot out.
Depending on the age of the star a possible planetary system will be coupled to it such that we will investigate the range of different fates of these possible hypervelocity planets.

Description of the proposed work

Based on the trajectory of HVS3, what is the mass constraint of the possible black hole submerged within the Large Magellanic Cloud?

In order to achieve this investigation, we need to retrace the trajectory of HVS3 back to the center of the LMC with the help of gravitational dynamics as well as use GR codes to properly model the field acting on HVS3 when it is at a close enough proximity to the black hole which we will base off from theoretical values provided by research and obtain ejection velocity as well as the radius of binary disruption, provided by Brown 2015. By calculating the radius of binary disruption we can better constrain the mass of the binary star and therefore the blackhole as well. Further research will have to be instigated to choose the best modules.

Furthermore, the use of stellar evolution codes which will also be chosen based on information provided in *Astrophysical Recipes; The art of AMUSE* to infer the semi-major axis which is needed to infer the mass of the black hole from the formula derived by Hills in 1988, and given enough time allows to derive the population age such that we can to achieve the secondary goal of the research project.

Initial conditions for HV3 according to Gaia Dr2;

Name	R.A.	Dec.	Proper motion $\mu_a \cos \delta \ (mas \ yr^{-1})$	$\mu_\delta (mas \ yr^{-1})$	Correlation	Radial velocity $v_{rad} \ (km \ s^{-1})$	Spectrophotometric distances $D_{hel}(kpc)$
HVS3	04:38:12.8	-54:33:12	0.851 ± 0.110	1.936 ± 0.162	0.1899	723 ± 3	61 ± 10

The project will incorporate observations taken by Gaia Dr2 and follow the theory developed by Hills with a Brown 2015 as the main reference point.

The Large Magellanic Cloud has not been confirmed whether it has a black hole or not, this project, with the main aim looking at HVS3 looks at the possibility of a blackhole existing within the irregular galaxy whilst providing a mass constraint on which future research can be built upon. Furthermore, with hypervelocity stars being a recent development within the astrophysical field, and HVS3 being one of the few seeming to originate elsewhere than the center of the Milky Way any research provides key insight for researchers to look at.

In the chance that the project becomes too difficult and not enough time to complete, many assumptions can be made on the properties of the binary system and the potential of the galaxy.

Resources

For tracing the system backwards we can use our own computer as it won't be resource intensive. Once we develop the binary system we will use the ALICE supercomputer as this requires more cores to work with.

Literature references

- Erkal et al.(2019). A hypervelocity star with a Magellanic origin. , 483(2):2007–2013, February 2019. doi: 10.1093/mnras/sty2674
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- Warren R. Brown. Hypervelocity Stars. , 53:15–49, August 2015.doi: 10.1146/annurev-astro-082214-122230.