Thesis Description

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September 2024

1 Thesis Project Description

The goal of this thesis is to research High- mass X-Ray binaries (HMXBs). These HMXBs contain a compact x-ray stellar object and a massive star companion. The compact x-ray was originally the most massive star in the binary system until it exploded into a supernova and became the compact object. At this stage the secondary star now becomes the most massive star in the binary system, now becoming an O-type star. The system remains bound together when the supernova loses less than half of the total mass, creating a runaway scenario. This is when the binary moves across the galactic plane with high space velocity $\geq$ 30km/s [Gies(1987)]. The HMXB can be ejected from its parent cluster and travel above or below the galactic plane, [Blaauw(1961)] [Gies(1987)] Using GAIA data release 3 (DR3) We can reconstruct the travel path of the HMXB. With this reconstruction, it is possible to identify the parent cluster, age of the compact object and the evolutionary history. GAIA DR3 allows us to precisely calculate the space velocity of the HMXB using the massive star's proper motion.

2 Timeline

My own deadline is to finish my thesis by end of July 2025, including the presentation for the masters Symposium and working 35-40 hours a week. For the first two months (September-October) I would like to work reading background material, learning how to use GAIA DR3 and writing theory. From end of October-December I can begin data collection by searching for HMXBs as runaways and plotting their position and proper motion in the galactic plane. [Blaauw(1961)] and [Gies & Bolton(1986)] have already created a framework to calculate a star's space velocity from proper motion so implementing it with GAIA should be possible. Ideally at this time I can start on my goals by reconstructing the path of a star and setting constraints on the age of the compact object. After the Christmas break I can continue my analysis and ideally the discussion section I hope to complete my discussion by May. This leaves June and July to edit my thesis to make it read more like a story rather than a jumble of facts. This also allows me time to create the symposium presentation and finalize my thesis with my supervisors and examiner. Right now there are a lot

of options for my project which I wish to hone down and focus on one topic by the end of October. Throughout the year I will have weekly meetings with my supervisor and be a part of his research group meetings on Fridays, which I believe will give me a great deal of support.

3 Interruptions

I am taking two courses during the academic year. The first is Professional Skills - Data management and visualization an 1.5 EC course during period two. It is 42 hour course most of which is self-study. I suspect this will minimally interrupt my thesis work over the two months, I believe I can make up the time I'm missing on weekends or longer weekdays. The second course is Computational Optical Imaging, a 3 EC course in period 3. I suspect this course will be more time consuming compared to data management. I plan to work 10-12hours/week for this course depending on how difficult the course seems. As it is only for one month, My thesis timeline should not be interrupted significantly. Again I can make up the missing time on weekends or longer weekdays.

4 Focus of Thesis

After introduction meetings with my supervisor I have two options for the topic of my thesis I can either find multiple HMXBs and reconstruct their paths or find one and conduct all the analysis about the age and evolutionary history of the cluster.Ideally I would like to do a mix of both options since both greatly pique my interests, by the end of October I can specify a topic and focus on it.

References

[Blaauw(1961)] Blaauw, A. 1961, , 15, 265

[Gies(1987)] Gies, D. R. 1987, The Astrophysical Journal Supplement Series, 64, 545, doi: http://doi.org/10.1086/19120810.1086/191208

[Gies & Bolton(1986)] Gies, D. R., & Bolton, C. T. 1986, The Astrophysical Journal Supplement Series, 61, 419, doi: http://doi.org/10.1086/19111810.1086/191118