Binary Formation in the Orion Nebula Cluster: Investigating the Low-mass Stellar and Sub-Stellar Population

Matthew De Furio¹, Michael R. Meyer², Megan Reiter³, Trent Dupuy⁴, Christopher Liu¹, John Monnier¹

¹University of Michigan; ²Rice University; ³University of Texas - Austin; ⁴University of Edinburgh

Motivation:
Multiplicity is a common aspect of star formation, whose properties depend on birth environment and primary mass. Studies in star-forming regions and the Galactic field show a trend in the mass ratio distribution based on primary mass [8, 11], while low-density associations contain an excess of stellar multiple systems relative to the Galactic field [7]. We investigate the multiplicity of the Orion Nebula Cluster (ONC), a high-density star-forming region, across primary masses 0.012 – 0.7 M⊙ and place constraints on the companion population.

Method:
We developed a double point-spread function (PSF) fitting routine using empirical PSFs [2,3] to identify companions to clusters members [4, 6,9,12,14,15] within archival Hubble Space Telescope (HST) data on the Advanced Camera for Surveys (ACS) [13] in the ONC.

Results:
Example binary detections in the F555W filter of HST/ACS. Combined sensitivity to companions for the low-mass stellar sample in the ONC. Over-plotted are lines of the shared sensitivity to companions over the samples in De Furio et al. (2019, 2022).

Conclusions:
1) Our technique is sensitive to companions down to 0.025″ (~ 0.5 λ/D).
2) We find an excess of wide (> 20 au) brown dwarf binaries in the ONC relative to the field (12+6/-3 % vs. 1+/-0.6%), with binding energies low enough for future dynamical disruption in the ONC.
3) We find no difference between the low-mass stellar companion frequency of the ONC and that of the field, but a significant difference relative to Taurus and Upper Sco (low-density associations) [7].
4) We find a power-law fit to the mass ratio distribution biased to higher mass ratios (α = 2) for low-mass stellar primaries in the ONC, consistent with low-mass primaries (< 0.3 M⊙) and inconsistent with higher mass primaries in the field.

Acknowledgments
We would like to thank Jay Anderson for many productive discussions on PSF modeling, as well as Megan Kiminki for contributions to the construction of our code. Megan Reiter received funding from the European Unions Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 665593 awarded to the Science and Technology Facilities Council. This work is based on observations made with the NASA/ESA Hubble Space Telescope, obtained from the data archive at the Space Telescope Science Institute. STScI is operated by the Association of Universities for Research in Astronomy, Inc. under NASA contract NAS 5-26555.

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