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Probing Multiplicity in Young and Embedded Massive Galactic Star Clusters with NACO/VLT

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The formation of stellar multiples is a frequent occurrence during the formation and evolution of massive stars. The characterisation of stellar multiplicity rates, separations, and mass ratios is a crucial input for star formation theories, and for investigating how the natal clusters influence the process. However, the multiplicity of young, massive stars remains poorly understood because of the challenges in observing them and the complexity of the dense cluster environments they are found in, especially during the first few million years of their formation. In this work, we focus on investigating close multiplicity (separations < 2000 AU) of young massive stars in embedded clusters at distances of 1.3 –1.75 kpc and ages of 1 –2 .75 Myr, aiming to fill the gap in our understanding of their multiplicity. We use 28′′ × 28′′ NACO/VLT near-infrared K-band images mapping multiple fields of four Galactic massive star clusters at Z ~ Z⊠, called DBS 113, DBS 121, Hourglass, and RCW 108, to determine their multiplicity fractions (MF) and companion fractions (CF). We identify stars down to K ≈ 18 around cluster members previously identified through JHK colour-colour analysis using VVV data. We then assess the true companionship of stars around the cluster members by statistical means using chance alignment probabilities. This is achieved by estimating stellar density for each cluster using the Besancon stellar population synthesis model. We trace back the parenthood of the companions using a tree-based clustering algorithm called dendrogram. We see that both MF and CF increase with probed separations, while we do not notice a strong correlation with cluster age. This suggests that the cluster environment and its properties—such as the gas and dust environment, and initial mass function—might play a more pronounced role in influencing multiplicity at such early stages of evolution.

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