Title : will be set by the publisher
Editors : will be set by the publisher
EAS Publications Series, Vol. ?, 2002

THE ARCHES MASS FUNCTION

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Abstract. VLTI observations of individual, massive objects in dense star forming regions limited by crowding in conventional astronomy, can have impacts on the determination of the stellar mass spectrum, and test classical methods to derive the mass function.

1 Introduction

The mass function in massive star forming regions may give us clues on the physical processes involved in star and cluster formation. It determines the efficiency to form high- vs. low-mass stars, and thus allows conclusions on the accretion efficiency within a star forming (SF) environment. A mass function (MF) with a flat slope hints at a strong high-mass population, while a steep MF contains relatively more low-mass objects. The MF may be defined as $\mathrm{d}\log N/\mathrm{d}\log M = M^{\Gamma}$, where Γ is the slope of the MF. The value determined by Salpeter (1955), $\Gamma = -1.35$, is frequently quoted as the standard value for star forming regions (see e.g., Massey et al. 1995). Fluctuations around this value are interpreted as statistical scatter. Star formation models, however, predict the formation of massive stars to occur mainly in dense environments, such as the centers of massive star clusters. Thus, in a very dense environment, one might expect a bias towards massive stars, leading to a flatter MF.

2 The Arches Cluster

The Arches cluster is with a mass of a few $10^4\,M_\odot$ and a central density of $\sim 3\cdot 10^5\,M_\odot\,pc^{-3}$ one of the densest and most massive young star clusters in the Milky Way. It forms in the extreme Galactic Center environment. Arches hosts about 100 O-type stars. Fig. 1 shows the dense cluster center obtained with the University of Hawai'i adaptive optics (AO) system Hokupa'a at the Gemini North telescope. Supporting massive SF models, Arches displays an integrated MF with

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DOI: (will be inserted later)

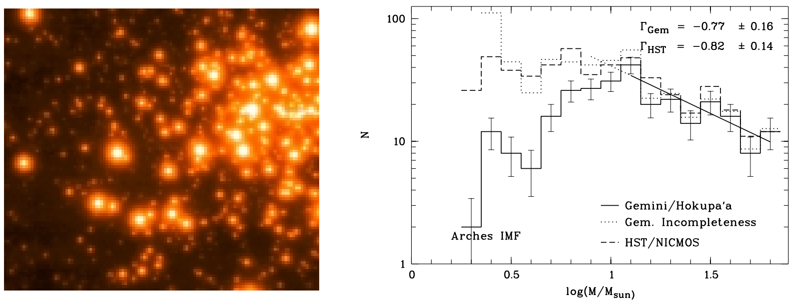

Fig. 1. Left: AO K-band image of the Arches cluster. Right: Arches mass function.

a slope of $\Gamma = -0.8$ (Stolte et al. 2002, Figer et al. 1999), flatter than the Salpeter MF. In the cluster center itself, Γ seems to be nearly zero, showing a strong bias to high-mass stars. However, even with high-resolution AO instruments, the densest cluster regions are hard to resolve. At the moment, we cannot exclude that several of the very massive stars with $M > 50\,M_\odot$ are multiple systems. With the aid of VLTI, the spatial extent and structure of the most massive objects found in Arches and other dense star forming regions may be analysed.

3 VLTI and Mass Functions

Measuring visibility curves of several massive objects found massive SF regions will aid a reliable determination of mass functions. Structures on size scales of a few mas may be resolved, allowing conclusions on the existence of double or multiple systems. This constrains the upper mass limit in a cluster, and yields insight into the frequency of interactions between individual stars. Low-mass companions captured by or formed near high-mass stars can be traced as a perturbance in the radial symmetry of the system. Resolving a few of the very bright sources seen in the AO image into a single star or the components of a very tight multiple system allows to verify the mass function - or tells us to handle it with care. When with time a larger number of observations becomes available, the frequency of multiple systems and the merger rate, suspected to play a significant role in the formation of very massive stars, may be estimated. VLTI observations in massive SF regions will lead to a more complete understanding of the formation processes of low- as well as high-mass stars.

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