Stellar Winds and Embedded Star Formation in the Galactic Center Quintuplet and Arches Clusters: Multifrequency Radio Observations

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A multi-frequency, multi-configuration study has been made of the compact radio sources in the Galactic Center Quintuplet and Arches stellar clusters using the Very Large Array. Ten radio sources have been detected in the Quintuplet cluster. The majority of these radio sources have rising spectral indices and are positionally coincident with young massive stars that are known to have powerful stellar winds. We conclude that the three most compact of these sources are produced by stellar wind emission; thus, mass-loss rates can be derived and have an average value of 3$\times$10^{-5} M$_{\odot}$~yr^{-1}. The remainder of the sources are likely to be a combination of stellar wind emission and free-free emission from surrounding ionized gas. In three cases, the radio sources have no stellar counterpart and the radio emission is thought to arise from compact or ultra-compact HII regions. If so, these sources would be the first detections of embedded massive stars to be discovered in the Galactic center clusters. The radio nebula associated with the Pistol star resembles the nebula surrounding the LBV star η Carina and may be related to the stellar wind of the Pistol star. Ten compact radio sources are detected in the Arches cluster and are interpreted to be stellar wind sources, consistent with previous findings. Several of the sources show moderate variability (10-30\%) in their flux density, possibly related to a nonthermal component in the wind emission. A number of radio sources in both clusters have X-ray counterparts, which have been interpreted to be the shocked, colliding winds of massive binary systems.

Reference: In press, Astronomical Journal, November 2005
Status: Manuscript has been accepted

Weblink: http://xxx.lanl.gov/abs/astro-ph/0508178

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