THE STELLAR CONTENT OF THE QUINTUPLET CLUSTER

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Abstract.
The Quintuplet cluster contains over two dozen post main sequence descendants of massive O-stars, including Wolf-Rayet and OBI stars.

The five Quintuplet-proper members (QPMs) may be dusty late-type Wolf-Rayet carbon stars (DWCLs), and the Pistol star may have a very high luminosity, $\approx 10^{6.7 \pm 0.5}$ $L_\odot$. Coupled with its rather cool temperature, $12-23$ kK, the Pistol Star is well in violation of the Humphreys−Davidson limit. We argue that the surrounding "Pistol" nebula was ejected from the star a few thousand years ago.

The cluster stars imply the following approximate cluster properties: $t_{age} \sim 2$ to 7 Myrs, M $\sim 10^4$ $M_\odot$, L $\sim 10^{7.3 \pm 0.2}$ $L_\odot$, and $N_{Ly,c} > 10^{49.9}$ s^{-1}. The "Sickle" (G0.18−0.04) radio feature and the mid-IR ring (seen in MSX images) may naturally be explained by the presence of a young cluster and a nearby molecular cloud.

1. The Quintuplet Cluster

We have used K-band spectra to identify the following cluster stars: 14 OBI, 2 Ofpe/WN9, 4 WN, 4 WC, 1 LBV candidate, 1 red supergiant (RSG), and 5 possible DWCLs (Figer, Morris, & McLean 1996). The ages are between 2 to 7 Myrs according to recent stellar evolution models (Meynet 1995); the low (high) end of the range applies to the OBI stars (RSG). The mass
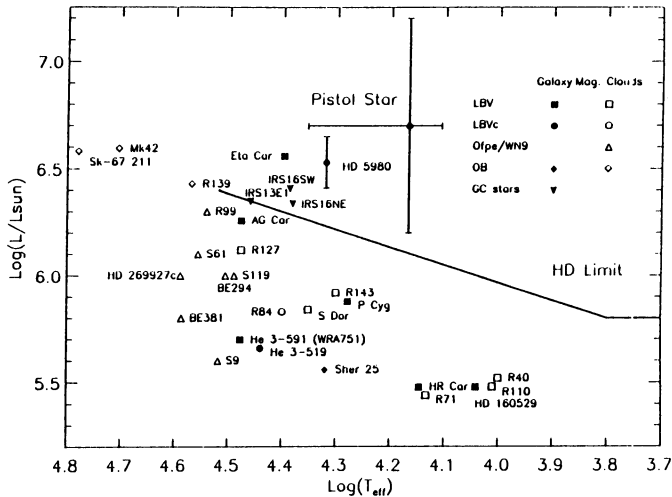
Figure 1. HR Diagram for the Pistol Star and other luminous stars.

of the cluster can be estimated by integrating a power-law IMF and assuming 30 stars having $M_{initial} > 20$ $M_{\odot}$. We estimate $\sim 10^{4\pm0.3}$ $M_{\odot}$ ($\alpha = -2.35$); a similar mass is found by demanding that the cluster is stable against tidal disruption. The Lyman-continuum flux is estimated to be $> 10^{49.9}$ s^{-1} by summing contributions from individual stars; Timmermann et al. (1996) estimate ~ 2.5 times more ionizing flux by integrating the radio emission over the region surrounding the cluster. The total luminosity from the cluster is estimated by adding the individual luminosities of the identified stars. We find L $\sim 10^{7.3\pm0.2}$ L$_{\odot}$, where the uncertainty is set by assuming an error of ±0.5 in BC$_K$ for all the stars. If we exclude the two most luminous stars, then the cluster luminosity is reduced by $\sim$ 0.3 dex. The Pistol Star, plotted on an HR diagram in Figure 1, may be the most luminous known, and it is quite cool. The line-of-sight velocity ι the cluster is $\sim$ 130 km s^{-1}, similar to that of the Pistol nebula. We fin $I_{(2.06\,\mu m,\ HeI)}/I_{(Br\gamma)} \sim 1$, suggesting that the Pistol nebula is enhanced in helium. We argue that the Pistol nebula has been ejected by the star (Figer et al. 1995; Figer et al. 1997).

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