Multiplicity of O-type stars in NGC 2244

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Abstract:
We present the main results from our long-term spectroscopic campaign devoted to the O-type stars in the young open cluster NGC 2244. Previous works by our team on the O-stars multiplicity in other young open clusters (IC 1805 and NGC 6231) showed that the number of binary systems in such clusters was larger than 40%. Until now, only two stars (HD 47129 and HD 48099) in the surroundings of NGC 2244 have been confirmed as spectroscopic binaries (SB) although Garcia & Mermilliod (2001) estimated the O-type binary fraction at 50%. In this context, we revisited the spectral classification, the projected rotational velocity and the multiplicity of O-type stars in NGC 2244.

Rapid Rotators:

• HD 46056: the star shows very broad and shallow line profiles (Fig. 1). They display some variations but cannot easily be associated with a second component. It could be either an effect intrinsic to the stellar atmosphere, or due to pulsations.

• HD 46485: The Temporal Variance Spectrum (TVS; Fullerton et al. 1996) shows variations but does not exhibit the double peak structures, typical of SB (Fig. 2).

Presumably single stars:

• HD 46202: The RV dispersions (Tab. 1) are similar for the stellar and for the interstellar lines during our 2 year spectroscopic campaign.

• HD 46223: No evidence exists that HD 46223 is a variable star. The TVS method failed to detect significant variations (Fig. 3).

Conclusions:
The binary fraction of O-stars in NGC 2244 had been previously estimated at 50% (Garcìa & Mermilliod, 2001). Our investigations (Tab. 2) show that this value has been overestimated and revealed only 1 (maybe 2) long period system. No short period binary and no binary system with similar components (i.e. mass ratio near unity) were detected in NGC 2244. These results imply a minimum binary fraction of 17%.

The proportion of (short period) O+O and O+B binaries (Tab. 3) in NGC 2244 and in IC 1805 is smaller than in other clusters such as NGC 6231. These different results allow us to confirm the hypothesis of a correlation between the density of the cluster and the massive star binary fraction, already proposed by Garcia & Mermilliod (2001).

These 3 different clusters will help constrain theoretical models describing the formation and evolution of early-type stars.

Tab. 1: Mean radial velocities and 1σ dispersion.

<table>
<thead>
<tr>
<th>Name</th>
<th>Spectral Type</th>
<th>v sin i</th>
<th>TVS Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD 46056</td>
<td>O8Vn</td>
<td>365 ± 21</td>
<td>Rapid rotator (minimi var)</td>
</tr>
<tr>
<td>HD 46149</td>
<td>O8V+B1V–2V</td>
<td>78 ± 11′</td>
<td>SB2</td>
</tr>
<tr>
<td>HD 46150</td>
<td>O5V(C)(C)</td>
<td>97 ± 9</td>
<td>Bin?</td>
</tr>
<tr>
<td>HD 46201</td>
<td>O9V</td>
<td>41 ± 9</td>
<td>C</td>
</tr>
<tr>
<td>HD 46223</td>
<td>O7V(M)</td>
<td>100 ± 17</td>
<td>C</td>
</tr>
<tr>
<td>HD 46485</td>
<td>O8Vn</td>
<td>381 ± 25</td>
<td>Rapid rotator (minimi var)</td>
</tr>
</tbody>
</table>

Notes: The reported value for HD 46149 is the projected rotational velocity for the primary.

References:

Tab. 2: Summary of the optical properties of O-type stars in NGC 2244. The last column reports the status of the star: * Bin? * for a potential binary; * C * suggests that the star is single; * SB2 * for a spectroscopic binary where the two components are visible.

References: