Stellar Rotation
Proceedings IAU Symposium No. 215, © 2003 IAU
André Maeder & Philippe Eenens, eds.

Stellar Rotation in the Young Cluster M17

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Abstract. We constructed line profile models for young OB stars in M17 using TLUSTY and SYNSPEC, including the effects of rotational flattening and gravitational darkening. The values of $v \sin i$ for 8 member stars (with spectral classifications O4.5 V to O9 V) range from 7 km s^{-1} to 168 km s^{-1} . The mean value of $v \sin i$ (102 km s^{-1}) is lower than expected for very young clusters.

1. Introduction and Observations

M17 is one of the most massive molecular clouds and most luminous HII regions in the Galaxy, and its member stars are in their formation stage (Hanson, Conti, & Rieke 1996). Major investigations on M17 have been done only in radio and IR due to the large extinction caused by the thick surrounding medium (Bumgardner 1992; Hanson, Howarth, & Conti 1997, hereafter HHC). However, there are some regions that do have relatively low opacities so that YSOs can be studied at optical wavelengths. Fifteen very young OB stars have recently been identified in M17 (HHC). Some of these show evidence of circumstellar disks, while others appear to have cleared out their surroundings. We can determine the spectral type and projected rotational velocity of these young stars using spectrum synthesis techniques.

We observed the M17 stars during a single observing run (2000 July 11-16) using the WIYN 3.5-m/Hydra multi-object spectrograph with the 860@30.9 grating in second order for a resolving power $R = 5700$. We obtained spectra in the red (5000-5900Å) because the targets are significantly brighter in V than B. We obtained spectra of 15 young OB stars, six of which have a known disk morphology (HHC).

2. Projected Rotational Velocities

Using TLUSTY and SYNSPEC (Hubeny & Lanz 1995), we built a grid of intensity line profiles parameterized by $T_{\rm eff}$, $\log g$ and μ (in this paper, we assume solar abundances for simplicity) with non-LTE treatments. The synthesis of line

profiles for a rotating star is based on this grid. We investigated several spectral lines in the observed waveband, but found that only He II λ5411 gave reliable measurements of $v \sin i$ for 8 member stars. The results are listed in Table 1. Interestingly, all the stars with disk morphology in our investigation (except B289) have no measurable lines in their red spectra.

Table 1. Spectral Classifications and Projected Rotational Velocities

Name	Sp. Type (HHC)	Sp. Type (W_λ(He II λ5411))	$v \sin i$ (km s^{-1})	Notes
OI345	O6 V	O6.5 V	106	SB1
B098	O9 V	O8.5 V	79	
B111	O5 V	O4.5 V	168	
B164	O7-O8 V	O6 V	59	SB2?
B189	O5 V	O5 V	143	
B260	O7-O8 V	O7.5 V	114	
B289	O9.5 V	O9 V	139	Disk
B311	...	O8.5 V	7	

The mean value of $v \sin i$ (102 km s^{-1}) is lower than the expected for OB stars in very young clusters (150-200 km s^{-1}; Howarth et al. 1997). Although our sample of 8 member stars is small, we doubt that this low mean can be explained by systematically low inclination angles. There may be some efficient braking mechanism that has slowed the rotation of these stars. It is possible that the angular momentum of the natal cloud was preferentially deposited in an enhanced population of binaries in M17. However, our one-week observing run is not long enough to find binary systems with medium and long periods, and additional observations will be required to determine the actual incidence of binaries.

References

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https://doi.org/10.1017/S0074180900195233 Published online by Cambridge University Press