CEN 34 – High-Mass YSO in M 17 or Background Post-AGB Star ?

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Introduction

The formation process of massive stars is still not understood well. The detection of high-mass YSOs is rare because of their extremely short PMS evolutionary phase; in addition, they are deeply embedded and, hence, difficult to find. The search for and the identification of high-mass YSOs is hampered by confusion with much more evolved objects, showing similar or even identical observational signatures in SED shape and spectral lines. CEN 34 was so far considered as a high-mass YSO candidate due to its high IR luminosity and IR excess. We verified its classification with the new X-Shooter spectrum.

High-mass YSOs in M 17

As one of the brightest H II regions in the Galaxy, M 17 shows evidence for multiple epochs of massive star formation. The bright H II region is ionized by a couple of OB-type stars located in the cluster center. This active star forming region harbors several high-mass YSO candidates, which display rising SEDs towards IR wavelengths but still await confirmation of their preliminary classification. Some of them have been confirmed to be high-mass young stars with circumstellar disks. CEN 34 is one of the most interesting high-mass YSO candidates.

Fig. 1. Projection of CEN 34 (red cross) on the sky overlaid on the JHK_s pseudo-color image of M 17. The major ionizing sources of the H II region –the O4-type binary, and the hypercompact H II region–M 17-UC1 are marked also.

X-Shooter spectrum and classification

The appearance of Ca II triplet, Fe I, Ti I, Paschen lines and CO bandheads within this range indicates a rough temperature class of early-/mid-G. The absolute strengths of these absorption lines are greater than those of giants (III), suggesting a luminosity class II (bright giant) or I (supergiant). Furthermore, with the assumptions of solar metallicity and a rotation velocity of 10 km/s, fitting line profiles of the Ca II triplet and the Paschen line at 8598 Å (P14) to the library of synthetic spectra published by Munari et al. (2005) yields an effective temperature and a surface gravity for CEN 34, which are 5250 ± 250 K and 2.0 ± 0.3, respectively.

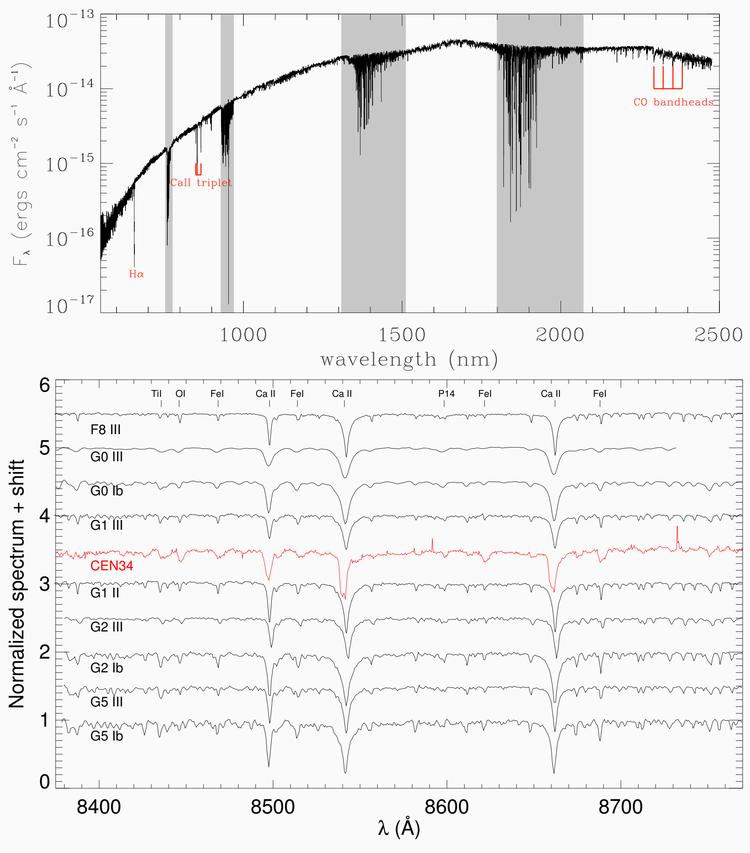

Fig. 2. Top: Flux calibrated spectrum of CEN 34. Grey shaded regions mark the major telluric absorption features. Bottom: Normalized spectrum of CEN 34, highlighted in red. The two features seen in emission are artifacts. The reference spectra have nearly identical spectral resolution.

Radial velocity

Members of the M 17 cluster have $V_{LSR} \sim +25$ km/s. In contrast, based on the analysis of Ca II triplet and CO bandheads, we find for CEN 34 a distinct V_{LSR} of about -60 ± 11 km/s.

Fig. 3. Normalized CO 2-0 first overtone feature of CEN 34 (black solid line), in comparison to that of Arcturus (red and blue dotted line). The red-dotted line presents the rest frame spectrum of Arcturus, while the blue-dotted is the spectrum shifted by the velocity corresponding to CEN 34's V_{LSR}. The rest frame spectrum of Arcturus is shifted along the vertical axis for presentation purposes.

Extinction and luminosity

The observed SED of CEN 34 can be modeled by a star ($T_{\rm eff}$ = 5260 K) with accompanying circumstellar material $\sim 10^{-4}\,M_\odot$. The circumstellar material contributes tiny fraction to the total visual extinction (11 mag) of CEN 34. In light of the foreground extinction of the M 17 region $\sim$ 2 mag, CEN 34 should have a distance not smaller than 2 kpc, which yields a lower limit of luminosity of 1600 $L_\odot$.

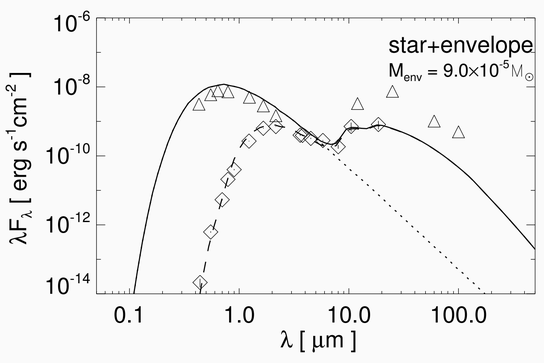

Fig. 4. Observed SED of CEN 34 (diamonds) together with the best-fitting model SED (dashed line). The extinction-corrected model SED (solid line) is compared to the extinction-corrected SED of a reference post-AGB star with a spectral type of G2 Ia (triangles).

Discussion

The position of CEN 34 in HR diagram is compatible with either a high-mass YSO or an evolved star. In the case of a high-mass YSO in M 17, CEN 34 must have been dynamically kicked-out from the M 17 cluster (M 17 distance $\sim$ 2.0 kpc) to explain the observed V_{LSR} discrepancy. Alternatively, CEN 34 might be an evolved background star; comparison to isochrones of post-main sequence evolution then suggests a mass of $5-7\,M_\odot$ and an age of $50-100$ Myr, which are reminiscent of a post-AGB star. Comparison to the reference post-AGB star (see Figure 4) yields a rough distance of 2.0 kpc to 4.5 kpc. For the time being, we prefer the interpretation of a post-AGB star and hope that a future more accurate distance estimate will settle the issue.

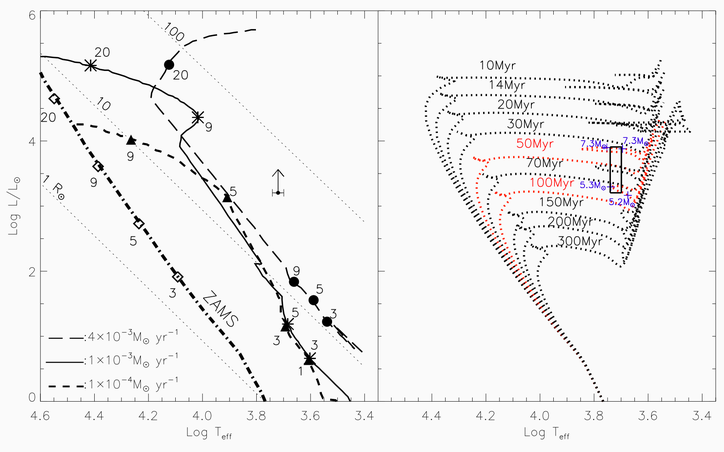

Fig. 5. CEN 34's position in HR diagram is plotted with high-mass YSO evolutionary tracks (left panel) and also the isochrones of post main-sequence evolution (right panel).

References

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