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Uniqueness and evolutionary status of MWC 349A

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Abstract. MWC349A, which had remained an ordinary member of the MWC catalog for a few decades, is now known as: (1) the brightest stellar source of radio continuum; (2) the only known high-gain natural maser in hydrogen recombination lines; and (3) the only strictly proven natural high-gain laser (in IR hydrogen recombination lines). These phenomena seem to occur in the circumstellar disk seen almost edge-on. They help us understand the structure and kinematics of the disk. The evolutionary status of MWC 349A is still debated: a young HAeBe star with a pre-planetary disk or an old B[e] star or even a protoplanetary nebula? We discuss new observational data obtained at the Maria Mitchell Observatory and elsewhere which may cast light on this issue.

1. New Observational Facts concerning MWC 349A

1. Apparently chaotic variations in BVRI on time scales from days to years, with amplitudes $0.1^{\rm m} - 0.4^{\rm m}$ and a power spectrum of $\alpha \approx -0.3 \rightarrow -0.5$ (noise, between "white" and "pink").

2. Correlation of the integrated emission in hydrogen mm recombination lines with the optical emission on the year time scale.

3. Possible periodicity of the peak ratio in the double-peaked maser spectrum, with a period of $238 \pm 8^{\rm d}$ and possible periodicity of Hα emission with a close period of $223 \pm 7^{\rm d}$ (Fig. 1) but with unclear phase relations between the two.

4. Possible anti-correlation (at least temporary) of Hα emission with the nearby (645 nm) continuum; some periods of considerable variations of the continuum on the week time scale with almost constant Hα emission.

5. The discovery of a steeper than Keplerian (linear?) velocity gradient in the circumstellar disk (Weintroub *et al.* 2008).

6. The discovery of a few-arcmin hourglass structure at 24 μm around MWC349A (Hora *et al.* 2010), similar in shape and orientation to the sub-arcsec hourglass structures in radio (Tafoya *et al.* 2004). Maps in ^{12}CO and ^{13}CO rotational lines (Strelnitski *et al.* 2010) do not show obvious correlation with the 24 μm structure.

2. Discussion and Conclusions

1. Variability patterns indicate possible complex relationship between the sources of the continuum and emission lines. Accretion from the disk or from a companion of a close binary which had filled its Roche lobe may augment the ordinary hot star/HII region scheme. Periodicity of the maser peak ratio and Hα variations, if confirmed, may indicate a second component, a star or a massive planet, as well as a periodic component in the intrinsic variability of the star.

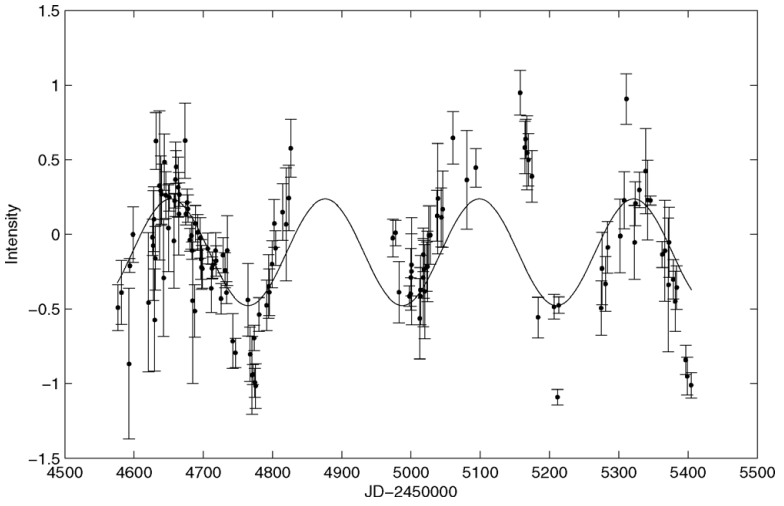

Figure 1. Long-time trend subtracted light curve of Hα emission in MWC349. Observations with the MMO 60 cm telescope and Hα interference filter (Schwarz *et al.*, 2010, BAAS, to be submitted).

2. If the object is young, the observed non-Keplerian (linear) gradient of velocity in the disk can be explained by the spinning up of the inner edge of the disk by magnetic stellar wind from a fast rotating central star. However, if the object is old and its disk is formed from the stellar wind of a fast rotating star, the linear gradient of the disk rotational velocity would be a natural consequence of the angular momentum conservation.

3. The lack of correlation between the 24 μm and CO structures supports the idea that the arc-minute hourglass structure is not shaped by the external clouds but is a result of a recurrent process of mass ejection from the central object, confined into a biconical outflow by a geometrically thick circumstellar disk, as in the prototypical Red Rectangle nebula (Men'shchikov *et al.* 2002).

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