

NEW HERBIG-HARO OBJECTS RELATED TO COMETARY NEBULAE.

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In the course of the continuing search of new HH objects in Byurakan observatory we present the results of optical studies of the fields of several cometary nebulae (CN): MacC H12, MacC sH15, Pars 17. Observations were carried out in the prime focus of the 2.6m telescope of Byurakan observatory during 1998-2002. The images were taken through [SII] and H α interference filters and, for the continuum, an I-band filter was used. All objects were found to be the sources of HH-outflows, some of which include more than one HH knot. However, morphology of all these CN cannot be represented as the simple fan; they have unusual structure with not easily determined axes. Below we describe them in more detail.

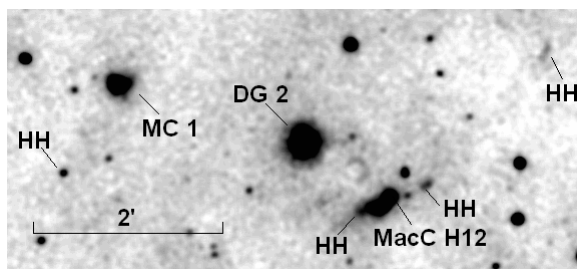


Figure 1: H α image of MacC H12 and the HH objects. MC 1 and DG 2 are nearby nebulous objects

MacC H12. This nebula, firstly described by MacConnell (1968), is also known as GN 00.04.4 or PP1 (see Magakian, 2003). It is illuminated by HAeBe star HBC 1 and is located in the association Cep IV and molecular cloud [YMD97]CO112, with probable distance 850pc. As is obvious from Fig.1, this star is the source of bipolar outflow with at least three HH condensations, one of which is actually embedded in the nebula itself. We also found yet another compact, near stellar-like emission object in this area (to the southeast from MC1 star). Its origin and nature are not so clear.

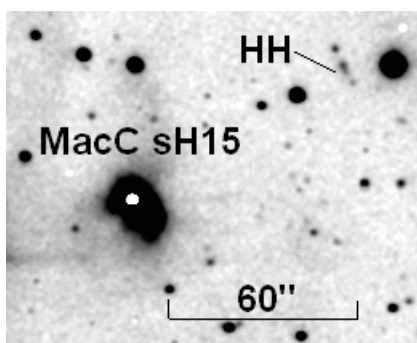


Figure 2: [SII] image of MacC sH15 and its HH object

MacC sH15. This nebula also belongs to the Cep IV association. It is illuminated by the CTT-type star (Cohen and Kuhl, 1979) and is associated with IRAS 00098+6516 and the source of CO emission (Kerton and Brunt, 2003). As is shown in Fig.2, MacC sH15 also is the probable source of HH object.

Pars 17. This well-known object (see Neckel and Staude, 1984) is located in the dark cloud LDN 1653 on a distance of about 1 kpc (Kim et al., 2004). This unusual nebula and its illuminating star were the subject of several studies, but no HH objects in its vicinity were found so far. However, as is shown in Fig.3, several HH knots, very probably related to Pars 17, can be seen in our images.

Using the photometric data from the 2MASS survey, we also plotted the central stars of these nebulae in two-color diagram. They fall in the loci of HAeBe and T Tauri stars.

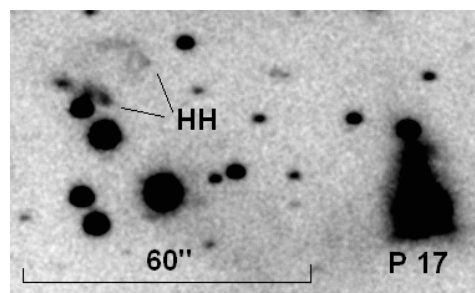


Figure 3: [SII] image of Pars 17 nebula. Several HH knots are arrowed

The unusual feature of all three nebulae is their shape, which has little relation to classic cones, produced by the extinction and the scattering of the stellar light with circumstellar disks. The structure of these nebulae becomes even more unclear, if we will take into account that the directed outflows usually coincide with the nebular axes of symmetry. One possible explanation can be that the visible shapes of these relatively distant objects are distorted by interstellar dust obscuration; other reasons, as unusual geometry, also cannot be excluded.

References

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