POSTER CONTRIBUTIONS (ABSTRACTS)

ABOUT FORMATION OF HERBIG-HARO OBJECTS

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It is well known, that HH-objects have been discovered mainly in the regions of star formation. These objects compose the groups of objects, there are also singular objects. The groups of HH-objects have Trapezium-like or chain-like configuration in which the distances between the members are of the same order (Ambartsumian 1954). Irrespective of configuration formed by these objects, there is no doubt about the instability of these systems.

It was suggested in Gyulbudaghian (1977) on the basis of investigation of known observational data, that the HH-objects have been expelled from the bodies, situated in dark nebulae (perhaps from the stars or the bodies, consisting of superdense matter). In the same paper it was told that at least in some of the HH-objects the large radial velocities are due to real motions of HH-objects (other authors supposed that the radial velocity was wholly due to the outflow of matter). The recent papers of Herbig and Jones (1981, 1982), have confirmed the hypothesis of expulsion of HH-objects. They have found that the tangential velocities of some HH-objects were of the order of 50-200 km s^{-1} (what is comparable with the values of radial velocities).

In this report we are interested with the tangential velocities of condensations, the groups of which compose the objects HH 1, HH 2, and HH 39. The tangential velocities of the condensations, the groups of which compose a definite HH-object, have different values, but there is not any explanation to this phenomenon in Herbig and Jones (1981) or Jones and Herbig (1982).

It seems to us that as the different values of the condensation velocities in the groups, as well as the different directions of these velocities can be explained as follows. Let us suppose, that the HH-objects are formed during the division of a more massive body, and this division can take place as a single act (then we are able to expect an origin of a group of objects, diverging in different sides), and as a sequence of successive expulsions (then we have a chain-like group). As was told previously, there are Trapezium-like systems, as well as chain-like systems amid the known groups of HH-groups.

Now let us consider the objects HH 1, HH 1 and HH 39 separately (each of these objects consists of a group of condensations). The distribution of condensations forming HH 1 is given in Herbig and Jones (1981). If we accept that the masses of condensations A, C, D and F are equal to each other (because their luminosities are of the same order) it is possible to obtain the velocity of the body, the division of which has given the present group of condensations. We ought to find the arithmetic mean value of the velocities of condensations (the law of the conservation of impulse has been used). We have obtained as the mean value 240 km s^{-1} and position angle 326°. Now we are able to obtain the values of velocities of condensations A, C, D and F in the centre-of-mass system: for A 90 km s^{-1}, 127°; for C, 38 km s^{-1}, 168°; for D, 10 km s^{-1}, 353°; for F, 115 km s^{-1} , 314°.

These velocities indicate that the group of condensations forming HH 1 is expanding.

Let us now consider the object HH 2. In this object it is possible to distinguish a chain (C, B, G, E) and a Trapezium-like system (A, D, H, I). We propose, that we deal with two successive decays. At first, the initial body has disintegrated into two objects, afterwards one of these objects has formed the chain, and the second -the Trapezium-like system. For the velocity of the second body (before its division) we have obtained 175 km s^{-1}, 162°. For the internal velocities of condensations, forming the Trapezium-like system, we have: for A, 30 km s^{-1}, 20°; for D, 110 km s^{-1}, 319°; for H, 79 km s^{-1}, 123°; for I, 64 km s^{-1}, 173°.

These velocities indicate that in the centre-of-mass system the group of condensations composing HH 2 is again expanding.

Let us consider now the object HH 39 in the north of R Monocerotis. It consists of the condensations A, B, C, D, E and F. The tangential velocities of

A, C, D and E are given in Jones and Herbig (1982). For the mean velocity of these condensations we have obtained 218 km s^{-1}, 349°. The direction of this velocity is very close to the direction to the star R Mon (350°5). After subtraction of this mean velocity from the velocity of each condensation, we have obtained: for A, 57 km s^{-1}, 347°; for C, 139 km s^{-1}, 50°; for D, 168 km s^{-1}, 179°; for E, 99 km s^{-1}, 284°.

These velocities indicate that the condensations A and D are diverging in the centre-of-mass system while that is not the case for E and C. It is possible to suppose that there is a condensation to the east of E, which forms a pair of diverging condensations with E, and there is a condensation to the west of C, forming a pair of diverging condensations with C. There is indeed a condensation (F) to the east of E, but there is not any condensation to the west of C. It is possible that such a condensation exists, but it is very faint and therefore is invisible on the plates. The formation of condensations, forming HH 39, we can imagine as follows. The body, expelled from R Mon, has decayed in the very vicinity of the present place of HH 39, giving three bodies, each of which in its turn has formed two diverging condensations (respectively F and E, A and D, C and invisible condensation).

We can conclude, that the groups of HH-condensations HH 1, HH 2 and HH 39 are diverging in their centre-of-mass system.

A following reasoning can be given in favor of the division hypothesis. The dimensions of groups of condensations, forming HH-objects HH 1, HH 2 and HH 39, are several times less than the distance of these groups from the supposed places of their origin (HH 1 and HH 2 from the star C-S, HH 39 -from the star R Mon). The internal velocities of condensations within the same group are rather large and therefore each group should have been expanded to dimensions, comparable with the distance from present place of the group to the parent star. But this is not the case. Therefore it is natural to suppose that the group of condensations has been formed from one more massive body in the very vicinity of the present place of the group. But since such bodies have not been yet observed, it is more probable to suppose that the formation of a group took place owing to division of a massive body. For a lifetime of a group of condensations we have obtained values of the order of several hundred years.

BULLETS. INTERSTELLAR PLOPS AND PLUNKS

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A new model is proposed for the generation of "bullets" in interstellar space. We have investigated in detail the phenomena that occurs as a strong shock overtakes a high density condensation. During this process the shock bends behind the cloud and eventually becomes a converging conical shock. In incompressible fluid flows this is analogous to the entry of solids into liquids. Here a cavity also forms behind the obstacle, and when collapsing generates a "plop" or a "plunk" sound depending on the missile speed. In compressible fluid flows, when the angle α, between the incident shock and the axis of symmetry of the cone is smaller than 40°, the matter overtaken by the conical shock acquires preferential physical conditions compared to the gas overtaken elsewhere by the shock. The pressure and temperature will be about four times larger and the motion about 2 or 3 times faster. Furthermore, the gas will move along the axis of symmetry of the cone. These properties have been calculated for different values of α assuming a regular or a stationary Mach reflection of an oblique shock against a rigid wall (a reasonable approximation for a conical shock).

If allowances for cooling are made and the shock speed is 100 km s^{-1} (typical of a T Tauri star) a large degree of compression is reached and the material overtaken by the conical shock condenses into a fast (2-3 times the shock velocity) moving bullet. The propagation of such a supersonic bullet when confined by ram pressure of the surrounding gas would generate a bow shock capable of explaining the hard spectrum of HH-objects.

Our model uses the preferential physical conditions acquired upon conical shock reflection and predicts the detachment of HH-objects from the molecular outflows, moving with a velocity at least 2 or 3 times larger. Further details and two dimensional calculations are due to appear in *Astronomy and Astrophysics*.