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Rotational Velocities in Galactic Clusters.

HELMUT A. ABT, *Kitt Peak National Observatory*.—Axial rotational velocities of stars in four galactic clusters and associations have been determined from McDonald Observatory coude spectrograms of 18 Å/mm. Those measured were 23 B6-A1 Pleiades stars, 21 B3-A1 α Persei cluster stars, 39 O9.5-B5 I Orion stars, and 26 O9-B3 I Lacerta stars.

The relation between mean rotational velocity and spectral type differs from group to group by statistically significant amounts and from that for field stars. For instance, in agreement with Struve and Smith, we find that the B stars in the Pleiades rotate about 50% faster than field B stars but the A-type Pleiades stars rotate about 50% slower than field stars. The O9.5-B3 stars in I Orion rotate 20% less rapidly than similar field stars (in approximate agreement with McNamara's results) but the B5 stars rotate more rapidly than field B5 stars.

It appears that although the dependence of angular momentum on mass (or spectral type) differs between groups, the total angular momentum per unit mass may be the same for all groups. Also, the apparent dips at B2 and A2 in the rotational velocity dependence on spectral type among field stars may be explained in terms of large admixtures in the sample of stars from certain groups with unusual rotational velocities. There is preliminary evidence of a strong inverse correlation between mean rotational velocity and binary frequency.

Evolution of Gaseous Emission Nebulae.

W. I. AXFORD, *Defence Research Board, D.R.T.E., Shirley Bay, Ottawa, Ontario*.—From a few elementary considerations it is apparent that the emission nebulae surrounding young, hot stars cannot be described as static Strömgren spheres. In fact, these nebulae must be in a state of expansion producing gas motions of the order of 10 km/sec. This leads to an interesting problem in gas dynamics involving the presence of "discontinuities" in the form of shock waves, as well as the ionization front (I.F.) which separates the H I and H II regions. Goldsworthy [*Phil. Trans. Roy. Soc. (London)* **A253**, 277, 1961] has obtained some solutions to this problem which are of the "self-preserving" type, having the property that the flow pattern remains geometrically similar at all times as the nebula expands—this is possible only for a particular initial density distribution of the un-ionized gas. Goldsworthy's solutions have a degree of indeterminacy which can be removed by a study of the I.F. structures [Axford, W. I., *Phil. Trans. Roy. Soc. (London)* **A253**, 301, 1961]. We have

used these results in an attempt to determine the manner in which the flow pattern changes for the more realistic case of a uniform initial density distribution of the un-ionized gas. It is concluded that in the initial stage of evolution of a nebula the I.F. is weak *R* type (Kahn, *Bull. Astron. Inst. Neth.* **12**, 187, 1954) and the flow pattern such that the H I region is undisturbed and a shock occurs in the H II region. Later a second shock emerges ahead of the I.F. which becomes strong *D* type—the flow pattern then contains two shocks as well as the I.F. Eventually the shock in the H II region catches up with the I.F. changing it to weak *D* type, and thereafter the flow pattern does not change character although the I.F. gradually slows down. The H II region would asymptotically approach the Strömgren condition in static equilibrium with its surroundings if the exciting star could live indefinitely.

Hydrodynamic Oscillation of Solar Chromosphere.

J. BAHNG AND M. SCHWARZSCHILD, *Princeton University Observatory*.—Standing compression waves in a plane parallel atmosphere are studied with the aim of accounting for the oscillations recently discovered by Leighton (1960, 4th IAU-IAUTAM Symposium on Cosmical Gas Dynamics) in the solar atmosphere.

An idealized model consisting of three isothermal layers with temperature discontinuities at the interfaces is considered. The bottom layer, representing the photosphere, is assumed to be at 6000°K. Because of its steep density gradient, this layer acts as a reflector and the amplitude of the oscillation in this bottom layer decreases very rapidly with increasing depth. The top layer, with a temperature of the order of 10^5 °K or higher, acts also as a reflector, similar to the action of a free surface. This reflection is however, not perfect, and some energy leaks out in the form of progressive waves traveling upwards. The corresponding energy loss is small enough to fit the observed oscillation decay rate if the top temperature is not substantially below 10^5 °K.

In the middle layer the oscillation has essentially the character of a standing wave. The period of the oscillation is largely determined by the temperature and depth of the middle layer. To explain the observed 5-min period a depth between 1200 and 1700 km is required for a temperature between 8000° and 30 000°K. This depth range is of the right order of magnitude for the depth of the chromosphere.

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