D. JOINT DISCUSSION

ON

AERODYNAMIC PHENOMENA IN STELLAR ATMOSPHERES

Wednesday 2 September 1964 at $9^h\ 00^m$

ORGANIZING COMMITTEE: K. H. Böhm (Chairman), C. de Jager, R. Michard.
SECRETARY: E. P. J. van den Heuvel.

PROGRAMME

1. *K. H. Böhm:* Purpose of the Joint Discussion D.
2. *R. Michard:* Observational Knowledge of Motions in the Solar Atmosphere.
3. *E. A. Spiegel:* The Solar Hydrogen Convection Zone and its Direct Influence on the Photosphere.
4. *E. Schatzman*:* Oscillatory and Wave Motion in Stellar Atmospheres.
5. *E. Böhm-Vitense:* Outer Convection Zones in Stars of Different Spectral Types and Luminosities.
6. *F. Roddier:* Microturbulence above the Hydrogen Convection Zone.
7. *W. Unno:* Generation of Acoustic Noise in Convective Zones.
8. *F. D. Kahn:* Trapped Waves in the Solar Atmosphere.
9. *H. U. Schmidt* and *F. Meyer:* Generation and Propagation of Oscillatory Motions in the Solar Atmosphere.
10. *P. A. Sturrock:* Wave Motion and the Structure of the Solar Chromosphere.
11. *P. Mein:* Déformation du Profil des Raies liées aux Ondes Sonores dans le Cas Solaires.
12. *M. Kuperus:* The Heating of the Solar Corona by Photospheric Waves.

1. PURPOSE OF THE JOINT DISCUSSION D

K. H. Böhm
(University of Heidelberg)

The discovery of oscillatory motion in the solar photosphere and of the 'super-granulation' in the chromosphere has changed our ideas about the hydrodynamics of the solar atmosphere considerably. In this Joint Discussion we shall mainly consider the theoretical implications of this change. As the ultimate aim is an understanding of the hydrodynamics in all stellar atmospheres—not only in the Sun, some discussion of other stellar atmospheres will be included.

* Unfortunately Dr Schatzman was unable to attend the Joint Discussion. His paper was given by Dr Spiegel using Dr Schatzman's manuscript. The abstract published here is due to Dr Schatzman.

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From a theoretical point of view we have to face the following problems:

1. The old problem of understanding the basic hydrodynamics of the outer stellar convection zones (which, as we believe, are also at least the energy sources of the observed oscillations and other photospheric phenomena) is still very far from being solved, despite large computational efforts in the last three years.

2. A fundamental problem is related to the transition from essentially convective modes in deeper layers to oscillatory or wave modes in higher layers of the photosphere. Some tentative calculations indicate a strong overshooting of purely convective modes into the higher layers of the solar atmosphere. Earlier estimates of acoustic noise generated in the convection zone lead to fairly small amplitudes in the upper photospheric layers. Why do we then observe mainly oscillatory motion in the upper photosphere?

3. Why do the observed oscillations have such a fairly narrow frequency spectrum? How does the spectrum change with height in the photosphere?

4. Can we understand the fact that the super-granulation is observed essentially only in the chromosphere if it is an overshooting phenomenon of purely convective modes?

5. If the existence of waves and oscillations in the solar atmosphere is taken for granted, how do these waves propagate in a stratified atmosphere with a temperature minimum?

6. Under which circumstances can these waves propagate into the corona?

It is hoped that this Joint Discussion will lead to the suggestion of some new approaches to these difficult and urgent problems.

2. OBSERVATIONAL KNOWLEDGE OF MOTIONS IN THE SOLAR ATMOSPHERE

R. Michard

(Observatoire de Paris, Meudon)

Motions in the normal solar atmosphere can be studied first by their effects on average strengths and profiles of Fraunhofer lines ('astrophysical turbulence'). Sufficiently thick velocity elements, if larger than about 1″, can be detected individually and their properties described as a function of time and space. Further, a moving atmosphere cannot be homogeneous and conversely an atmosphere with local fluctuations of T and p cannot be at rest: the study of purely photometric fluctuations, such as the photospheric granulation, is thus intimately connected to the study of the mechanics of the solar atmosphere.

Astrophysical Turbulence in the Solar Atmosphere

The existence of 'astrophysical turbulence' in the solar atmosphere can be derived first by the same methods which apply in the case of stars:

1. The study of line-strengths by the curve of growth shows that the 'micro-turbulence' is about $\xi = 1{\cdot}2$ km/sec.

2. The study of Fraunhofer line profiles has been made for lines of different strengths, by many workers using various methods of analysis. Of great importance is the extension of this type of work to the chromosphere, started by Redman and Suemoto from spectra of the 1952 eclipse, with further progresses made by Suemoto from material obtained at the 1958 eclipse.

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