

REMARKS ON THE ENERGY OF THE NON-THERMAL RADIO-FREQUENCY EMISSION

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It is proposed to discuss the role of the radio-frequency emission in the whole set of the non-thermal emissions of the sun, which originate in the solar corona and the uppermost regions of the chromosphere. Of these, the radiative emissions give probably an amount of between 10^4 and 10^5 ergs/cm.² sec., to which the radio-frequency region contributes only very little (even during an intense outburst, when the total radiative emission is much larger, not more than 10^0 – 10^2 ergs/cm.² sec.); the contribution of the lower chromosphere, however, is not yet well known. The corpuscular emissions under normal conditions seem to require $\approx 10^5$ ergs/cm.² sec. (but again much more in active, e.g. 'M', regions), and to constitute a normal feature of the outer solar corona. These emissions, we propose, are maintained by the same supply of mechanical energy which secures the thermal and radiative equilibrium of the inner corona. That is to say, some part of the flux of acoustic energy originating in the hydrogen convection zone and, according to this theory, heating the upper chromosphere and the inner corona, is believed always to reach the outer corona, where the radiative loss is smaller, and this part is then at least comparable with that dissipated in the inner corona.*

It is evident that the travelling waves transmitting this energy outwards, and the mass motions constituting the corpuscular emission, are greatly affected by the solar magnetic fields. If one assumes 1 gauss as an estimate for the large-scale magnetic field intensity on the sun, the magnetic stress becomes comparable with the ordinary gas pressure just in the transition region from the chromosphere to the corona. The magnetic field will cause the acoustic energy to flow along the magnetic lines of force rather than at right angles to it. These questions have been discussed in some detail by

* For a more detailed discussion, with a somewhat different emphasis, and for references, see the contribution of one of us [1] to the Joint Discussion on Turbulence in Stellar Atmosphere, I.A.U. General Assembly in Dublin, 1955.

one of us [2]. The mechanism by which the mechanical energy, after heating the regions considered, causes the acceleration of the outer regions of the corona, will be considered in the communication by Arnulf Schlüter.

From this point of view, the radio-frequency radiation of the chromosphere and the corona ultimately is of completely non-thermal origin, although the emission mechanism of the normal radiation, and probably also that of the slowly varying component, is microscopic. The coherent oscillations causing the more violent types of radiation are considered as produced in the processes mentioned before, for instance directly by the pressure gradients connected with the shock waves, or in the boundary regions of the corpuscular streams. These streams, however, should not necessarily be regarded as something physically different from the outer corona.

REFERENCES

- [1] Biermann, L. *Trans. I.A.U.*, **9**, p. 750, 1957.
- [2] Lüst, R. *Z. Naturf.* **10a**, 125, 1955; see also *Z. Ap.* **37**, 67, 1955.