Meetings

Solar and Stellar Magnetism

Various aspects of the astronomical universe were discussed at a symposium of the International Astronomical Union, held in Rottach-Egern (near Munich), Germany (3–10 September). More than 100 scientists from 20 countries participated.

The astronomical universe is composed mainly of plasma, that is, fully or partially ionized gas moving under the constraints of gravity, magnetic fields, and hydrodynamic forces. On a cosmic scale, problems such as containment, boundaries, and high vacuum, which plague the laboratory physicist, do not disappear but take on different dimensions. Astronomers have been aware of such problems through the appearance of magnetic fields in the sun (both in sunspots and in the elusive general field), in stars (many of which have general fields above 10,000 gauss), in interstellar space, and in cosmic radio sources. Many of the pioneers in magnetohydrodynamics, such as Alfvén, Biermann, Lüst, Schlüter, Cowling, and Severny, noted how some of the first applications of magnetohydrodynamics have been in astronomy. The laboratory physicists working on the magnetic stability and containment problems connected with thermonuclear fusion may be assured that nature, at least on the astronomical scale, can and often does produce very high energy particles in moving, magnetized plasmas.

The meeting was approximately evenly divided between discussions of observational data and theoretical interpretation. Topics included the description of stellar magnetic fields, the large solar field (which may or may not be changing polarity at present), the localized solar fields responsible for the hot spots in the chromosphere, the sunspot fields and their changes as related to solar flares. The theorists covered instability in plasma physics (Schlüter), the effect of fields on the internal and sunspot convection, the cooling of sunspots, solar flares (Sweet), and the alternative interpretations of the variation of stellar magnetic fields (Cowling).

Recent observational results include studies of the small-scale magnetic fields in solar plages, the reticulated structure of the solar chromosphere, and the velocity fields observed by Leighton. Above the granulation level of the solar photosphere, the gas motion and field pattern transfers into a larger-scale pattern in the chromosphere at a level in which at least some energy dissipation and heating occur. An extraordinarily complete mapping of magnetic fields near sunspots has been carried out by Severny who used both longitudinal and transverse Zeeman effects. The field lines so deduced can in general be modeled by simple subsurface fields. After a solar flare, Severny finds a rearrangement and simplification of the field lines, as if energy has been transferred from the field to matter in motion and possibly to high-energy particles. The solar flare observations by Zirin and motion picture films by Moreton showed the complex pattern of these extraordinary, energetic events which have such profound effects in interplanetary space and on geophysical phenomena. In stellar magnetic phenomena, perhaps the greatest emphasis was placed on the changes in the apparent surface composition of the stars that have large magnetic fields (Sargent, Greenstein, Burbidge). The abundances of many elements are affected, for example, O, Si, P, Mn, Eu, and the rare earths, and in one star He^3. It is probable that the reshuffling of the elemental abundances is caused by nuclear reactions induced by high-energy particles. The question of how deep this contamination goes is an interesting one, and the consensus of belief is that it is a shallow phenomenon.

One disconcerting result of the theoretical discussion is that it is not yet possible to ascertain the magnitude and pattern of the magnetic field inside a star from observations of its surface field. Unless a priori assumptions such as equipartition are made, it is possible for a stellar field to be squeezed largely into layers near the surface, or alternatively even to be largely trapped beneath the surface with few lines of force emerging. Another difficult theoretical question concerns models for sunspot fields beneath the surface and for the complex surface fields in which solar flares occur. The fundamental physics of the instability of plasma flow was touched on from many astronomical aspects. The hope is that the origin of stellar magnetic fields and of the interstellar fields may soon be understood. One important impression resulting from the symposium was how widespread and important these fields are in the energy balance of the universe.

The local arrangements were handled by scientists from the various branches of the Max Planck Institute in Munich. One day of the meeting was spent at the new centers of plasma physics, magnetohydrodynamics, and space science at the Institute. The proceedings will be published in full detail as a book.

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Electron Microscopy

An almost equal balance between biological and nonbiological topics existed at the 21st annual meeting of the Electron Microscope Society of America, held in Denver, Colorado, 28–31 August. About 700 researchers from a wide variety of fields attended.

Since the design of commercially available electron microscopes has now advanced to the stage where the amount of information obtained from a specimen is frequently dependent on a detailed knowledge of the operation of the instrument and the quantitative determination of the performance by the research worker, a symposium on optimum use of modern electron microscopes was held. This symposium, arranged by W. C. Bigelow, featured lectures by well-known experts in the