17.07.03 Sunspots as force-free dynamos. S. P. Sreenivasan, University of California, Canada. - Following the suggestion of Frazier (Phil. Trans. R. Soc. Lond., 221, 295) and Stenflo (Proc. IAU Symp. Basic Mechanisms of Solar Activity, 1976, 135) that there is some very effective equilibrium process in the convection zone that maintains each and every flux tube in the quiet photosphere at the same field strength of about 2000 G, and that these fields are force-free down to the bottom of the photosphere, it is demonstrated that solar magnetic fields are a consequence of steady force-free dynamos operating in a resistive medium. The amplification of magnetic energy that results is shown to imply an automatic depletion of the overall mechanical and thermal energies of the fluid in the region. This offers a natural and direct explanation of the relative coolness of and the reduced velocities observed in sunspots. The missing energy of the fluid resides in the magnetic field in the region. This formalism further permits one to demonstrate that force-free magnetic fields represent a new type of elastic equilibrium of the hydromagnetic fluid. In terms of standard theory (Landau and Lifshitz: Theory of Elasticity, 1970, Pergamon, London) the physical nature of this equilibrium as well as the time-development of these regions can be studied. This leads to a natural interpretation of solar flares as consequences of the breakdown of this hydromagnetic elastic equilibrium. Whence the stored energy in the magnetic field is transferred to the fluid in the form of radiation and particle kinetic energy. The magnetic field is not force-free when the elastic equilibrium breaks down.

17.08.03 Formation of the He II and He II Lines in the Solar Atmosphere. R. H. A. Navenet & J. E. Vernazza, Center for Astrophysics, & J. L. Linsey, JILA, University of Colorado. - We have shown in a recent paper (Ap. J. Letters, 207, L199) that helium is ionized in the chromosphere by coronal line radiation but that the He II λ304 resonance line is formed in the chromosphere-corona transition region by collisional excitation and resonance scattering. That analysis is extended to include the λ584, λ357, and λ522 resonance lines and a 10830 subline of line of He II and the λ584, λ357, λ522 resonance lines and a 10830 subline of λ584. We describe the principal line-forming mechanisms in each case, for both quiet-sun and coronal-hole models.

17.09.03 Models of Solar Chromosphere Structures Implied by Lyman-α Rocket Spectra. G. Basri and J. L. Linsey, JILA, University of Colorado. - We construct semi-empirical model chromospheres for a range of activity on the Sun, including network, cells, average quiet Sun, and plage regions. These models are based on high spatial and spectral resolution rocket profiles of hydrogen Ly-α (cf. Basri et al., 1976 BAAS 8, 331). Models are computed with a partial redistribution linearization code in the core of the line and a partial coherent scattering approximation in the wings. The models differ from previous models in the middle chromosphere. We compute profiles of other photospheric lines to test the self-consistency of the models. Evidence pertaining to the 20,000° plateau and the usefulness of one-component models is discussed briefly. This work is supported by NASA grants to JILA and the University of Colorado.

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17.10.03 The Electron Energy Distribution in the Solar Chromosphere - Transition Region. W. C. Shoub, U.S. of Colo and NRA. - A fundamental assumption made in the theoretical interpretation of spectroscopic data from the outer solar atmosphere is that the free electron energy distribution, and in particular the high energy tail of the distribution, is a local Maxwellian. Steep temperature and density gradients, together with low collision frequencies, render this assumption suspect, however. We investigate its validity by numerically solving a spatially-dependent Fokker-Planck equation subject to the constraint that the electron density and temperature are prescribed functions of height, chosen in accord with current models of the solar chromosphere and transition region. Preliminary results indicate that the tail of the distribution may in fact differ appreciably from a Maxwellian. We discuss the implications of this result for spectroscopic diagnostics and the accuracy of present models of the chromosphere and transition region. This work is supported by a NASA grant to the University of Colorado.

17.11.03 Expansion and Broadening of Coronal Loop Transients. T. C. Mousovias and A. L. Poland, High Altitude Observatory. - As observed by the white-light coronograph on Skylab, typical coronal transients appear as loops with their feet anchored on the solar surface. The radius of curvature of the leading edge is approximately equal to 1 R_s, while the cross-sectional diameter h of the loop is approximately equal to 0.2 R_s. The leading edge of the loop moves outward at an almost constant or slightly increasing speed. We argue that magnetic rather than thermal-pressure forces are responsible for the expansion of coronal loop transients within the field of view (2.0 - 6.0 R_s) of the coronograph. As a consequence, the width h of the leading edge of the loop should increase with distance R from the sun's center. We estimate h(R) and compare it with the results of measurements performed on two typical transients. This comparison supports our theoretical deduction that magnetic forces are responsible for the transient's expansion.