parallel slab geometries for the line-forming region. For each geometry we self-consistently derive the Compton temperature, $T_C$, as a function of the electron column density, $N_e$. We discuss the effect of altering the angle at which the superstrong magnetic field intersects the plane-parallel slab, which is critical if we are to discern the effects of neutron star rotation in the observed line bursts. We also describe improvements in our treatment of polarization, and consider its effect on the cyclotron resonance scattering line profiles, particularly at higher harmonics.

4.06

The Transient Gamma-Ray Spectrometer: A New High Resolution Detector For Gamma-Ray Burst Spectroscopy


The Transient Gamma-Ray Spectrometer (TGRS) to be flown aboard the WIND spacecraft is primarily designed to perform high resolution spectroscopy of transient gamma-ray events, such as cosmic ray bursts and solar flares, over the energy range 20 keV to 10 MeV with an expected spectroscopic resolution of $E/\Delta E = 500$. The detector itself consists of a 215 cm$^3$ high purity n-type Ge crystal kept at cryogenic temperatures by a passive radiative cooler. The geometric field of view defined by the cooler is 170$^\circ$. To avoid continuous triggers caused by soft solar events, a thin BiCu sunshield around the sides of the cooler has been provided. A passive Mo/Pb occulter, which modulates signals from within $\pm 5^\circ$ of the ecliptic plane on the spacecraft spin frequency, is used to identify and study solar flares, as well as emission from the galactic plane and center. Thus, in addition to transient event measurements, the instrument will allow the search for possible diffuse background lines and monitor the 51 keV positron annihilation radiation from the galactic center. In order to handle the typically large burst count rates which can be in excess of 100 kHz, burst data are stored directly in an on-board 2.75 Mbit burst memory with an absolute timing accuracy of $\pm 5$ ns after ground processing. This capacity is sufficient to store the entire spectral data set of all but the largest bursts. The experiment is scheduled to be launched on a Delta II launch vehicle from Cape Canaveral in the fall of 1993.

5.02

On the Dynamics of Emerging Toroidal Magnetic Flux Tubes


We study the dynamic evolution of emerging toroidal magnetic flux rings in the solar convective envelope by carrying out 3D numerical simulations based on the thin flux tube approximation of Spruit. We find: 1) For an axisymmetric magnetic flux ring, the aerodynamic drag force experienced by the ring when moving with respect to the ambient fluid transfers no angular momentum to the ring. Therefore in both cases, with or without the drag force, the ring moves nearly parallel to the rotational axis of the sun and emerges at a latitude significantly poleward of subsurface zonal zones, as pointed out by Choudhuri and Gilman. However, for a non-axisymmetric flux ring (i.e. with wave-like undulations along its circumference), the aerodynamic drag force can transfer angular momentum to the flux ring, and therefore reduces the latitude of flux emergence to within the observed subsurface latitudes. 2) As each apex of a flux loop rises due to the magnetic buoyancy force, gas inside the flux tube tends to diverge from the apex. In the meantime, however, the Coriolis force drives a flow within the flux tube opposite to the direction of rotation. Thus the point of maximum divergence in the flow within the tube is shifted from the apex into the leading side (in the direction of rotation) of the emerging loop. The evacuation of plasma from the leading side of the loop results in a much lower internal gas pressure there as compared to that in the following side at the same depth. Therefore, the magnetic field strength is stronger on the leading side. The numerical simulations show that the field strength in the leading side of the loop can be twice as large as that of the following side at the same depth. This result offers a simple explanation for the observed fact that the leading polarity of an active region is more compact, forms sunspots more easily, and has a longer life time than does the following polarity.

5.03

Bouyant Flux Concentrations and Energy Transfer in Gravitationally Stratified Atmospheres

A. B. Hassam and David Devine (Dept. of Physics, U. Maryland)

The problem of the self-consistent generation of magnetic flux from Rayleigh-Benard convection and the concomitant tendency of buoyant flux escape from the zone of convection is addressed. The efficiency of buoyant escape as a function of the size of the gravitational scale height $H$ is examined. Since for small $H$ some magnetic configurations are stable, the self-consistent vertically distributed profile of magnetic flux is investigated, using both analytic and numerical approaches. The possibility of overshoot of strongly buoyant flux is considered; the deposition of such rapidly rising flux into the upper, colder layers of the atmosphere may contribute to heating the upper atmosphere. Flux transfer, dissipation, and heating rates are assessed and applied to heating of the lower solar corona.

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5.04

Evolution of Large-Scale Coronal Arcades

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Previous simulations (Mikić, Barnes, and Schnack 1988; Biskamp and Welter 1989) have shown that coronal arcades can become unstable when sheared sufficiently by photospheric flows. The application of these results to the solar corona were limited by the assumptions of these models. They had artificial lateral boundaries which may have affected the behavior of the magnetic fields. We have developed a model in spherical geometry which eliminates the presence of artificial lateral boundaries. Our spherical model will be used to model the corona between 1 and approximately 8 solar radii. We will investigate the properties of large-scale arcade fields which are subjected to