DOWNLOAD PDF DYNAMICS AND STRUCTURE OF QUIESCENT SOLAR PROMINENCES (ASTROPHYSICS AND SPACE SCIENCE LIBRARY)

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Return to the top of this Newsletter? Return to the Newsletter Index? Leighton Bob Leighton died on March 9, after gracefully enduring a gradual degeneration of his mental abilities for the past decade. He then switched to physics, and went on to obtain MS and PhD degrees from Caltech in and , respectively. Bob remained at Caltech as a member of the faculty until when he retired as the William L. During World War II, Bob worked with a group headed by Carl Anderson to develop and test solid propellant rockets to be mounted under the wings of aircraft. Another assignment was to design the burning surface of a solid propellant charge in such a way that gas generated by combustion would provide a nearly constant thrust to the projectile as it flowed through the exhaust nozzle. Bob was a key figure in both the calculations involved and in the static tied down testing in Eaton Canyon in the foothills north of Pasadena, as well as the dynamic free flight testing at Inyokern, in the Mojave Desert. Not only did Bob switch from electrical engineering to physics, but also he switched from field to field within physics; in each new endeavor, everything he touched seemed to turn to gold. Then in the late s, Bob began the solar work that is now legendary. As Mount Wilson Observatory management pondered the future of its solar program, Bob obtained permission to use the early morning hours of good seeing at the 60 foot solar tower. His study of solar granulation was the definitive work up to that time. He added a beam-splitter and polarizers to the Mount Wilson spectroheliograph and obtained photospheric magnetograms of unprecedented spatial resolution. These observations showed that strong magnetic fields exist outside sunspots and coincide with the network of intense chromospheric emission. He modified the instrument so that it could be used to obtain Doppler images of the Sun, and, in one glorious month in , discovered both the 5-minute oscillation and the supergranulation. Thus were born the fields of helioseismology and solar magnetoconvection, which are now, 37 years later, major areas of solar research. While preparing a talk on supergranules and magnetic fields, Bob recognized that the random changes of these convection cells would lead to an effective diffusion of flux on the solar surface - a concept we now call "Leighton diffusion" - and he later included it in a dynamo model of the solar cycle. Hal Zirin was the first to hold this position and joined Bob and his colleagues in a solar site survey that ultimately led to the creation of the Big Bear Solar Observatory. Bob pursued this solar work actively from the late s to the mid s when other projects began to take up his time. His development of photographic equipment during the mids had allowed him to obtain the best pictures of the planets ever attained anywhere to that time, from the 60 and inch telescopes, and led to his work as team leader of the photographic experiments on the Mariner 4, 6, and 7 Mars Probes. These experiments revealed not only that there were no canals on Mars, but also that the polar caps contained frozen carbon-dioxide rather than water ice. These concepts remain the starting point for all subsequent work. Bob was very active in undergraduate teaching at Caltech. Each year he taught a three-term physics course for senior physics majors which resulted in his classic textbook, "Principles of Modern Physics" published in Also, in the early s, he directed a program to revise the freshman and sophomore physics courses and was co-author of another classic text, the "Feynman Lectures on Physics", published in Around , he developed frictionless air troughs for demonstrating the conservation of momentum and energy in laboratory collisions, and received the American Physics Teachers Prize for the best physics experiment of that year. As a result of this work, he became an expert on precision air bearings, and built a frictionless rotating table for spin casting infrared mirrors. While his graduate students carried on the solar observations, Bob worked in his office across the hall spinning an epoxy-based paraboloid of revolution that would be coated with aluminum and used to make the first survey of the infrared sky. This began a new area of infrared astronomy. Then he applied his telescope-making skills to design and build even bigger dishes for the millimeter wave region, opening up still another field of astrophysical research. Most of them have also made careers in solar physics. Bob Leighton had a profound influence in several areas of physics, and solar physics is lucky to have been one of them. Memorial services are being planned by his son Ralph fot lafn. Contributions to this article were made by:

Chapter 2 : Science - Astrophysics & Space Sciences: People: Paulett C. Liewer

astrophysics and space science library a series of books on the recent developments of space science and of general geophysics and astrophysics.

Let us start from the continuity equation 9. With allowance for the definition of the plasma mass density 9. However this is not a general case. Somov, Plasma Astrophysics, Part I: On summing over all kinds of particles, we obtain the following equation: They satisfy the macroscopic Maxwell equations. In astrophysical plasma, the magnetic permeability and the electric permittivity can almost always be replaced by their vacuum values. For this reason, the macroscopic Maxwell equations have the same structure as 1. Since elastic collisions do not change the total momentum, we haveX k h F. The last term in If we accept condition The momentum conservation law in the form The assumption that the astrophysical plasma behaves as a continuum medium, which is essential if these forms of the momentum conservation law are to be applied, is excellent in the cases in which we are often interested: On the other hand, going from the multi-fluid description to a single-fluid model is a serious damage because we loose an information not only on the small-scale dynamics of the electrons and ions but also on the high-frequency processes in plasma. The single-fluid equations describe well the low-frequency large-scale behaviour of plasma in astrophysical conditions. We sum the general equation 9. On rearrangement, the following divergent form of the energy conservation law cf. Recall that we consider general case By contrast, the total heat release under elastic collisions between particles of different kinds see definition 9. In this limit, there is not any term which contains the collisional integral. Elastic collisions have done a good job. Inelastic collisions are still important in radiative cooling and heating. In optically thin plasma in the thermodynamical equilibrium state, with collisional excitations of ions, the power of radiation from a unit volume of plasma is proportional to the square of plasma density n. It depends strongly on the temperature T as illustrated by Fig. The radiative energy losses in astrophysical plasma often create the thermal non-equilibrium processes which govern the plasma evolution. From Somov et al. Radiation can become dominant as the energy loss mechanism and lead to rapid cooling and compression of plasma by different modes of thermal instability Field ; see also Somov and Syrovatskii a. This instability results in the formation of cold dense loops in the corona. The threads are the principal contributors to the total mass of solar prominences, whereas the blob contribution is small. Note in conclusion that, in the frame of our simplified treatment of the second-order moments Sect. This is not unexpected, of course, but inherent at the method of the moments as discussed in Sect. In order to be correct we have to find these transfer coefficients by using the procedure similar to that described in Sect. Once these conditions are satisfied, we can close the set of transfer equations, as has been discussed in Sect. Thus departures from the Maxwellian distribution are small. Moreover the electrons and ions should have comparable temperatures, ideally, the same temperature T being the temperature of the plasma as a whole. Second, we neglect the electron inertia in comparison with that of the ions. Recall that the gyro-frequency of ions! The isotropic conductivity is see formula Under the conditions listed above, we use the general hydrodynamic-type equations which are the conservation laws for mass The general hydrodynamic-type equations have a much wider area of applicability in astrophysics than the equations of ordinary magnetohydrodynamics MHD derived below. The latter will be much simpler than the equations derived in Sect. Therefore additional simplifying assumptions are necessary. Let us introduce them. Thus we suppose that! The conductivity of astrophysical plasma, which is often treated in the MHD approximation, is very high e. This is the reason why condition Thus the problem is reduced to finding the interaction of the magnetic field B and the hydrodynamic velocity field v. The corresponding equation of plasma motion is obtained by substitution of formulae Formulae for these coefficients as well as for the viscous force should be derived from the moment equation for the pressure tensor, which we were not inclined to write down in Sect. To make certain that this is true, evaluate the electric force using In a great number of astrophysical applications of MHD, the plasma velocities fall far short of the speed of light. The Sun is a good case in point. In a simplified picture of an aligned rotator, the charges in the a fully charge- separated plasma flowing parallel to the poloidal magnetic field, generate a poloidal convective current and, therefore, a toroidal magnetic field. On the right-hand side of It plays the same role in The Poynting vector appearing as a part in expression How should we find formula In this way, we could derive the equations for the anisotropic part of the pressure tensor and for the flux of heat due to random motions of particles Shkarofsky et al. We restrict ourself just by recalling the expressions for the viscous stress tensor A key goal of such studies is to deduce how energy of magnetic fields is stored and then suddenly released to drive these phenomena. However, because most MHD models use a relatively simple energy equation one or another , the discussion often centers on the over- simplified interpretation or simple comparison of magnetic field structure and evolution in the models with corresponding features observed in emission. Thus we have to develop the MHD models that include radiative losses and other dissipative processes, the energy transport by anisotropic heat conduction in the solar corona and transition region between the corona and chromosphere. Such more accurate representation of energy equation is necessary for example to compute simulated EUV and X-ray emission and to compare it directly with observations. The equation of state In order to do this, we have to make use of Here s is the entropy per unit mass. At the same time, it is convenient to transform the energy conservation law The momentum conservation law The theory of gravitational collapse and models of supernova explo- sions are based on relativistic hydrodynamic models for a star. In most models a key feature is the occurrence of a relativistic shock, for example, to expel the bulk of the star. The effects of deviations from spherical symmetry due to an initial angular momentum and magnetic field require the use of relativistic MHD models. In the theories of galaxy formation, relativistic fluid models have been used, for example, in order to describe the evolution of perturbations of the baryon and radiation components of the cosmic medium. Relativistic hydrodynamics is presumably applied to the so-called quark-gluon plasma, a hot soup of quarks and gluons, which is the primordial state of hadronic matter in the Universe see Sect. When the medium interacts electromagnetically and is highly conducting, the simplest description is in terms of relativistic MHD. From the mathematical viewpoint, the relativistic MHD was mainly treated in the framework of general relativity. Lichnerowicz has made a thorough and deep investiga- tion of the initial value problem. Gravitohydromagnetics describes one of the most fascinating phenomena in the outer space e. In many applications, however, one neglects the gravitational field generated by the conducting medium in comparison with the background gravitational field as well as in many cases one simply uses special relativity. Such relativistic MHD theory is much simpler than the full general relativistic theory. So more detailed results can be obtained Anile ; Novikov and Frolov ; Koide et al. Astrophysical understanding the pulsar electrodynamics comes from using modern observations and relativistic MHD theory to find and follow the flow of energy, mass and momentum. For pulsars, this has been a challenge. Recent successes are nicely reviewed by Arons According to Arons, the unsteady magnetic reconnection in the current layer separating the closed from the open zones of the pulsar magnetosphere is respon- sible for the torque fluctuations observed in some pulsars, as well as for departures of the braking index from the canonical value of 3. The role of reconnection in the transfer of open to closed magnetic flux has begun to be assessed, and is full of promise as a part to a physical theory of pulsars. Let us consider the vector B flux through a surface S moving with the plasma Fig. We are interested to know the time derivative of this flux. Let us clarify the conditions when it is possible to neglect electric resistivity of plasma. The relative role of a dissipation process in the differential equation In a spirit similar to that of Sect. Now we normalize this equation with respect to its left-hand side, i. The magnetic Reynolds number characterizes the ratio of the first term on the right-hand side of Omitting the asterisk, we rewrite So the magnetic Reynolds number is the measure of a relative importance of resistivity. This is just the same as one neglects viscosity effects under large Reynolds numbers in ordinary hydrodynamic equations: In laboratory experiments, for example in devices for studying the processes of current layer formation and rupture during magnetic reconnection e. In this case the electric resistivity has a dominant role, and Joule dissipation is important. This assumption is not universally true either. Sometimes the thermal conductivity due to thermal electrons or radiation is so effective that the astrophysical plasma behavior must be considered as isothermal, rather than adiabatic.

Chapter 3 : Extensive Air Showers : Peter K. F. Grieder :

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Chapter 4 : PDF Download Large Scale Structure Formation Astrophysics And Space Science Library Free

In November a Workshop on the Dynamics and Structure of Solar Prominences was held in Palma Mallorca at the invitation of Jose Luis Ballester with the aim of bringing observers and theorists together and having plenty of time for in-depth discussions of the basic physics of promiÂ- nences.

Chapter 5 : SolarNews: March 14

Prominences are amazing objects of great beauty whose formation, basic structure and eruption represent one of the basic unsolved problems in Solar Physics.

Chapter 6 : Puzzling nature of the fine structure of quiescent prominences and filaments - IOPscience

Abstract Recent observational and theoretical investigations of quiescent solar prominences (QSPs) are reviewed, in greatly expanded versions of lectures presented at the workshop.