Nonlinear and relativistic effects in plasma

V. I. Petviashvili

Usp. Fiz. Nauk **162**, 189–190 (October 1992)

Nonlinear and Relativistic Effects in Plasmas (Research Trends in Physics), **Ed. V. Stefan**, AIP, New York, 1992, 764 p.

This book is a collection of reports presented at the eponymous conference held in San Diego in 1990. The conference set an ambitious goal: to gather the most outstanding American specialists on the practical problems of nonlinear and relativistic effects in plasma. The areas of application are extremely varied, and areas were selected by the organizing committee acording to their timeliness. The selected areas were beam, laser, and magnetic fusion, magnetohydrodynamic turbulence and transport in plasma systems, beams of relativistic particles, acceleration of particles by a coherent electromagnetic wave, charged plasma, the physics of the upper atmosphere, cosmic and stellar plasmas, and the interaction of waves with particles and waves. The chairman of the conference was V. Stefan. The organizing committee, which consisted of such prominent specialists as D. Baldwin, R. Davidson, A. Hasegava, M. Rosenbluth, T. Stix, and others, proposed that this variety would have a cross pollinating effect: the methods developed in one area could find an application in other areas. A subject of pure theory, for example, the interaction of waves with particles, is now used in the heating of plasma, the generation of a current in tokamaks, in plasma diagnostics, in particle acceleration, and in the stabilization of plasma instabilities.

In the section on beam fusion, reports were given on terawatt ion diodes, and on the compression of plasma by beams of heavy ions (K. Brueckner) and by light ions. In the section on laser plasma it was noted that the powerful Nova laser makes it possible to compress fuel to a density greater than 40 g/cm^3, and an explanation of plasma physics was given in which electrons oscillate in an electromagnetic field with relativistic speeds. An overview was given of the instabilities of plasma compressed by radiation.

The report of N. Fisch discussed the radiation of moderately relativistic electrons in a tokamak. In the section on magnetohydrodynamic turbulence, B. Carreras described the properties of turbulence in the boundary layer plasma of a tokamak and discussed nonlinear drift waves (turbulence, computer modeling, transport). A theory of turbulence in tokamaks was presented separately by R. Waltz.

Various instabilities of relativistic beams were examined and the possibility of creating free-electron lasers was discussed by C. Pellegrini.

The acceleration of particles by a coherent wave has revealed new opportunities to increase the energy and density of accelerated particles. The generation of a coherent electromagnetic wave by a free-electron laser was discussed. Eddies and other coherent structures in electron plasma were examined. It was noted by T. O'Neil that when ion plasma is cooled a liquid or crystal may be formed.

The section on near-Earth and cosmic plasmas discussed various structures in the magnetosphere, turbulence and dynamo affects in accretion disks, Alfvén turbulence, the heating of the ionosphere by radio waves, and the interaction of negative ions with ozone.

The issues of bifurcation in wave theory, strong Langmuir turbulence, soliton turbulence, and other subjects were also discussed.

The materials from the conference demonstrate the practical value of many theoretical ideas. The goal set by the conference organizers, the creation of a contact between experienced and young specialists, was obviously met. This collection is undoubtedly of interest to scientists of all ages and skills.

Translated by C. Gallant

 0038-5670/92/100902-01$03.00