Abstracts of Papers to Appear in Future Issues

COLLISIONAL EFFECTS IN PLASMAS MODELLED BY A SIMPLIFIED FOKKER–PLANCK EQUATION. L. R. T. Gardner and G. A. Gardner. *School of Mathematics, University of Wales, UCNW, Bangor, Gwynedd LL57 1UT, United Kingdom*; S. I. Zaki. *Department of Mathematics, Suez Canal University, Ismailia, Egypt.*

A computer code has been developed to simulate collisional effects in plasmas for the regime where plasma instabilities are dominant but are modified by weak collisions. The numerical method developed for the code is composed of a Galerkin method embedded within a locally one-dimensional approach. This algorithm is used to solve, over the (x, v) phase plane, a simplified Fokker–Planck equation with a one-dimensional Fokker–Planck operator, including a velocity dependent collision frequency. A stability analysis for the numerical scheme is given. The effects of small angle collisions on the Landau damping of plasma waves and the two-stream instability are examined. Results confirm and extend earlier numerical observations.

ENERGY-BOUNDED FLOW APPROXIMATION ON A CARTESIAN-PRODUCT GRID OVER ROUGH TERRAIN. Don K. Purnell and Michael J. Revell. *Atmospheric Division, National Institute of Water & Atmospheric Research Ltd., Wellington, New Zealand.*

We construct a method for modelling of three-dimensional, time dependent, compressible fluid flow in a gravitational field on a rotating cartesian-product grid with a spatially rough metric that bounds solutions by the total initial physical energy. Specifically: (1) the total physical energy is an l_2 norm on the model state and (2) this total energy cannot increase provided the timestep does not exceed CFL limits. In particular, the first property means that our measure of the energy is always positive unless the mass, momentum, and internal energy are all everywhere zero. These conditions guarantee that no error can grow unchecked. This is thought to be a desirable property, although only in the case of linear systems is it sufficient for convergence of a consistent approximation to the true solution. The great merit of this choice of norm is that the method is applicable to a wide variety of real physical problems because, even in complex circumstances, the total physical energy is conserved and each component of this energy is in limited supply. We first note that conservation of energy is equivalent to antisymmetry of a particular tendency operator. Energy-bounded approximations of fluid flow are then constructed either from antisymmetric finite difference operators, or from antisymmetric Galerkin operators. The method may be particularly useful when reliability in difficult conditions is needed. For example, when the viscosity must be small in order to simulate flow separation or turbulence, a model of viscous dissipation may be chosen purely from physical considerations, uncompromised by any requirements of numerical stability. We demonstrate this for an "internal hydraulic jump" flow over a bell-shaped mountain, simulating an internal wave as it steepens and breaks to form a turbulent jump.

ON THE DISCRETE-ORDINATES METHOD VIA CASE'S SOLUTION. K. Ganguly, E. J. Allen, E. Coskun, and S. Nielsen. *Institute of Numerical Transport Theory, Texas Tech University, Lubbock, Texas 79409-1042, U.S.A.*

In this paper, we have used Case's analysis of the neutron transport equation to obtain a new set of quadrature coefficients for the discrete-ordinates method. We perform the transport calculations by this set of quadratures, dependent on the medium. We also use the orthogonality relations in the discrete case to derive the full-range formulation of the half-range problem. This solution can, indeed, be profitably used in the new discrete-ordinates method.

PARTICLE LOADING FOR A PLASMA SHEAR LAYER IN A MAGNETIC FIELD. D. Cai, L. R. O. Storey, and T. Neubert. *STAR Laboratory, Stanford University, Stanford, California 94305-4055, U.S.A.*

Some new particle loading methods have been developed for use in simulating a plasma shear layer with nonuniform density and temperature in the presence of a magnetic field, especially with a large effective ion gyroradius. The numerical approach to the shear instability with strong velocity shear consists of starting a simulation from a state of equilibrium, perturbing this equilibrium in some way, then observing the linear growth of the perturbation and its ultimate saturation. With the usual particle loading method, it is difficult to reproduce the equilibrium state if the ion gyroradius is not small on the scale of the shear. The reason is that, with nonuniform velocity shear, i.e., with the nonuniform E-field, a particle may have more than one guiding-center, the particle distribution cannot be obtained analytically, and it may need to be evaluated numerically. If an equilibrium state is not achieved in the particle loading, the shear may relax by means of an "artificial instability" in the course of the simulation, obscuring the physics of interest. With the particle loading method here presented, we simulate a shear layer in a state close to equilibrium without having to solve the Vlasov–Boltzmann equation.

AN EXPLICIT SYMPLECTIC INTEGRATION SCHEME FOR PLASMA SIMULATIONS. J. R. Cary and I. Doxas. *Astrophysical Planetary and Atmospheric Sciences Department, University of Colorado, Boulder, Colorado 80309-0391, U.S.A.*

An explicit symplectic integration scheme which describes the self-consistent wave particle interaction is developed. The integrator does not split the hamiltonian trivially into a kinetic and potential part. The integrator yields accurate growth rates for the gentle-bump instability even when the timestep is of the order of the inverse plasma frequency. This represents up to a tenfold reduction in computation compared to conventional schemes. The integrator is generalizable to arbitrary order without increase in storage requirements, but tests show that when the accuracy requirements are of the order of a few percent, the second-order method is the most efficient.

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