CONTENTS OF:

PLASMA PHYSICS VIA COMPUTER SIMULATION

by

Charles K. Birdsall University of California, Berkeley, California

and

A. Bruce Langdon Lawrence Livermore Laboratory University of California, Livermore, California

Preface, Commentary, Acknowledgments

PART I PRIMER: ONE DIMENSIONAL ELECTROSTATIC CODE

Chapter 1 Some ideas on why computer simulation using particles makes good physical sense

Chapter 2 Over-all View of a One Dimensional Electrostatic Program

2.01 Introduction

- 2.02 The electrostatic model; general remarks
- 2.03 The computational cycle; general remarks
- 2.04 Integration of the equations of motion
- 2.05 Integration of the field equations
- 2.06 Particle and force weighting; connection between grid and particle quantities
- 2.07 Choice of initial values; general remarks
- 2.08 Choice of diagnostics; general remarks
- 2.09 Is it correct? Tests

Chapter 3 A One Dimensional Electrostatic Program, ES1D2V

- 3.01 Introduction
 - 3.02 General structure of the program, ES1D2V
 - 3.03 Data input
 - 3.04 HISTRY subroutine; plots versus time
 - 3.05 Change of input parameters to computer quantities
 - 3.06 Normalization; computer variables
 - 3.07 CREATR subroutine, calculation of initial charge positions and velocities
 - 3.08 SETRHO, initialization of charge density
 - 3.09 CPFT, RPFT2, RPFT12, fast Fourier transform subroutines
 - 3.10 FIELDS subroutine, solution for the fields from the densities, field energy
 - 3.11 SETV, subroutine for half step in velocity at t=0
 - 3.12 ACCEL, subroutine for advancing the velocity
 - 3.13 Advance time one step
 - 3.14 MOVE, subroutine for advancing the positions
 - 3.15 Listing of entire program

Chapter 4

4.01 Introduction

- 4.C2 Particle mover accuracy; simple harmonic motion test
- 4.03 Lorentz force; 3 dimensional v × B integrator
- 4.04 Implementation of the v×B integrator
- 4.05 Application to one-dimensional programs
- 4.06 Particles as seen by the grid; shape factors S(x), S(k)
- 4.07 A warm plasma of finite-size particles
- 4.08 Interaction force with finite size particles in a grid
- 4.09 Alternatives to the cloud concept
- 4.10 Field solver; accuracy of Poisson solver; other approaches
- 4.11 Particle and field energies

Chapter 5 Cold Plasma Projects

5.01 Introduction

- 5.02 Relations among initial conditions; small amplitude excitation
- 5.03 Plasma (or Langmuir) oscillations; analysis
- 5.04 Plasma oscillations; project
- 5.05 Two-stream instability; linear analysis
- 5.06 Two-stream instability; approximate nonlinear analysis
- 5.07 Two-stream instability; project
- 5.08 Two-stream instability; selected results
- 5.09 Beam-plasma instability; linear analysis
- 5.10 Beam-plasma instability; approximate nonlinear analysis
- 5.11 Beam-plasma instability; project

(More projects lined up, but not written, to include beam cyclotron instability, Dory Guest and Harris instability, etc.)