Evolution of Planetesimal Velocities[1]

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Abstract

A self-consistent set of equations for the velocity evolution of a general planetesimal population is presented. The equations are given in a form convenient for calculations of the early stages of planetary accumulation, when it is necessary to model the planetesimal swarm by the methods of gas dynamics, rather than follow the orbital evolution of individual bodies. To illustrate the relative importance of the various terms of these equations, steady state velocities of a simple planetesimal population, consisting of two different sizes of bodies, are calculated. Dynamical friction is found to be an important mechanism for transferring kinetic energy from the larger planetesimals to the smaller ones, providing an energy source for the small planetesimals that is comparable to that provided by the viscous stirring process. When small planetesimals are relatively abundant, gas drag and inelastic collisions among the smaller bodies are of comparable importance for dissipating energy from the population.

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[1]This research was sponsored by the National Science Foundation under grants AST-82-04256 and MCS-83-04459 and by NASA under grants NSG-7437, NAGW-398, and NAGW-929.