Abstract Submitted
for the SES08 Meeting of
The American Physical Society

Mechanics in Early Solar System Formation JUNICHIRO FUKAI, Auburn University — The generally accepted model for the early stage of the evolution of the solar system is the solar nebula, where a protostar, in this case our sun, at the origin is surrounded by a rotating material disk. The material in the disk collides, coalesces, and gradually forms aggregated objects. This coalescence of objects increases the total angular momentum of the resulting aggregate and the aggregating objects consequently experience an effective force of the form A/r^2 (where A is a constant) in the radial direction (Bacon 1959). Taking into account the gravitational force exerted by the sun, the force acting on such an aggregating object is $A/r^2 - B/r^2$, leading to logarithmic spiral orbits with a periodic feature of 2π in the azimuthal angle. This paper treats the interactions of these small spiraling objects with larger protoplanets as perturbations to the Kepler problem of the planets (Gryzinski 1980). When stability conditions are imposed, the periods of the planetary orbits are found to be discrete; $T_n = (34)\exp(0.815n)$ with n = 0, 1, 2, 3, . . . measured in days, which is in good agreement with observations (Graner and Dubrulle 1994).

Reference

Bacon, R.H. 1959. Am. J. Phys., 27, 164.
Graner, E. and Dubrulle, B. 1994. A&A,282,262.
Gryzinski, M. 1980, Phys. Letters, 76A, 28.

Junichiro Fukai
Auburn University

Date submitted: 11 Aug 2008 Electronic form version 1.4