EPSC Abstracts
Vol. 6, EPSC-DPS2011-1598, 2011
EPSC-DPS Joint Meeting 2011

The Problem of Cometary Fading is Not a Problem

P. R. Weissman (1)
(1) Jet Propulsion Laboratory, Pasadena, CA United States (paul.r.weissman@jpl.nasa.gov)

Abstract

It has been recognized since Oort's classic paper in 1950 [1] that the number of returning long-period comets, i.e., those with original inverse semi-major axes, $1/a_o > 10^{-4}$ AU^{-1} (where a_o is the semi-major axis of the comet's orbit before it entered the planetary system and referenced to the barycenter of the solar system) is less than would be predicted from the observed flux of dynamically new comets, i.e., those with $1/a_o < 10^{-4}$ AU^{-1}. To explain this, researchers have commonly assumed a "fading factor," which is usually an exponential or power law decay in the removal probability or lifetimes for returning comets. While mathematically convenient, these functions do not necessarily relate to real physical processes that we know occur in comets, and that may lead to their physical demise. A Monte Carlo model of the evolution of long-period comets from the Oort cloud is presented that incorporates these processes, including random disruption, sublimation of all volatiles, non-volatile crust formation on nucleus surfaces, and planetary impacts [2]. The model is updated based on our current knowledge of cometary dynamics and of each of the physical loss mechanisms. Using this model, it is shown that a reasonably good fit to the observed $1/a_o$ distribution can be achieved for $1/a_o$ values between 0 and 8×10^{-3} AU^{-1} (semi-major axes between 125 AU and infinity). The dominant physical loss mechanism is random disruption of nuclei, which is poorly understood but may be due to spin-up of weakly-bound nuclei from outgassing torques on the irregular nuclei. Thus "fading" is actually a misnomer for describing the major loss mechanism. Formation of non-volatile crusts on nucleus surfaces, thus cutting off all cometary activity, plays a lesser though still important role. Observational selection effects will also be discussed.

Acknowledgements

This work was supported by the NASA Planetary Astronomy Program and was performed at the Jet Propulsion Laboratory under contract with NASA.

References

[1] Oort, J. H.: The structure of the cloud of comets surrounding the Solar System and a hypothesis concerning its origin. Bull. Astron. Inst. Netherlands 11, 91-110, 1950.

[2] Weissman, P. R.: Physical and dynamical evolution of long-period comets. In Dynamics of the Solar System, ed. R. L. Duncombe, D. Reidel, Dordrecht, pp. 277-282, 1979.