

JD6

# Interactions between Planets and Small Bodies

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## INTERACTIONS BETWEEN PLANETS AND SMALL BODIES:

### INTRODUCTION

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The exploration of our Solar System is rapidly growing in importance as a scientific discipline. During the last decades, great progress has been achieved as the result of space missions to planets and small bodies and improved remote-sensing methods, as well as due to refined techniques of laboratory measurements and a rapid progress in theoretical studies, involving the development of various astrophysical and geophysical evolutionary models, based in particular on the approach of comparative planetology. In the crossroads of astronomy and geophysics, recent years have seen a growing understanding of the importance of impact phenomena throughout the history of the Solar System and, therefore, the necessity to get more insight into the problem of interactions of planets and small bodies. This importance is clearly manifested by the observed cratering records of planetary surfaces and such dramatic events as the explosions of the comet P/Shoemaker-Levy 9 fragments in Jupiter's atmosphere in 1994, that of the Tunguska object over Siberia in 1908, and the Chicxulub event dating back to the end of the Cretaceous.

The significance of impact processes in planetary evolution is demonstrated not only by the obvious fact that small bodies scar the planetary surfaces, but also by the progressively collected evidence that they shape the evolution of the atmosphere and hydrosphere of the Earth and atmospheres of other planets. Indeed, deposition of cometary-like volatiles through impact processes is considered to be mainly responsible for the origin of secondary atmospheres on the inner planets. These impacts, at later times, probably have repeatedly interfered with the Earth's biological evolution and may once have been essential for starting this evolution. Currently part of the NEO ('Near-Earth Objects') population, closely approaching the Earth's orbit, represents a potential threat to our civilization. At the same time, the asteroidal and cometary populations have been continuously shaped by planetary gravity, resulting in a preferential flux of meteorites originating in resonant zones of the main belt, and, further out in the Solar System, the formation of dynamical structure in the recently discovered Kuiper belt. In addition, comets are known to be continually tossed around by close encounters with the planets, and an understanding of their dynamics is necessary in order to assess the cometary inventory of the Solar System and its slow "evaporation" into interstellar space. Indeed, comets provide the link of our Solar System with the Galaxy in several respects, e.g., by probing the material of the presolar cloud. Thus the various processes accompanying their interactions with the planets offer an opportunity to understand better both the nature of these primitive small bodies and their role in planetary cosmogony and Galactic evolution.

The explosive growth of knowledge in the field of Solar System exploration and the interdisciplinary character of the subject of impacts, bringing together planetary and galactic astronomers as well as specialists in geophysics, dynamics, and cosmochemistry, made the subject of this Joint Discussion very timely. The topic and program of the meeting brought interest of astronomers

dealing with both observations and theory and allowed to give an outlook to the formation and evolution of planetary systems in general, being also relevant to the problem of Galactic evolution. Specific attention was given to near-Earth objects (NEO) with the involvement of historical retrospectives, NEO survey simulation and orbital element distribution, as well as an assessments of potential hazards for the Earth and improved facilities (either ground-based or space-born) to detect these objects most reliably and cost-efficiently.

Nineteen papers, including twelve invited and seven contributed, were presented at the three sessions, entitled "Impacts and Solar System Evolution", "Origin and Dynamics of Planet-Crossing Bodies", and "Observations of Impacts and Impactors". Forty-one posters covering a wider range of topics relevant to the title of JD 6 were selected and displayed during the poster session. The discussions benefitted from the broad participation of scientists from Japan as the hosting country where active research in most aspects of the topic are carried since a long time. For instance, five years earlier prof. S. Yabushita of Kyoto University organized an international workshop on "Dynamics and Evolution of Minor Bodies with Galactic and Geological Implications", which was very successful and had a clear impact on the development of international contacts and collaborations. The IAU XXIIIrd GA offered an invaluable opportunity to gather an even wider community for free and open-minded discussions, since the Pacific region including Australia houses an important part of the relevant research programmes.

Unfortunately, because of the strict time limit some authors were reluctant to prepare a paper for the IAU Proceedings. In addition, a limited page budget allowed to publish only short versions of the original presentations. But in order to cover all main topics discussed at JD 6 and hence to make the proceedings as comprehensive as possible, we decided as editors to complement the original papers and/or extended abstracts submitted for publication with an overview of other presented papers and posters. This overview comes after the papers and includes several sections where topically relevant papers are reviewed. We in no way attempted to modify the authors' original concepts or to use this review to promote our own ideas. Essentially the overview is based on the abstracts already published in the IAU GA abstract book, applying only minor editing.