COMMENTS ON THE SYMMETRY PROPERTIES OF PLANETARY MAGNETIC FIELDS;

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FORMAT. This paper provides a comparative study of the geometrical structures of the magnetic fields of Earth, Jupiter, Saturn and Uranus starting from the traditional multipolar representations of these fields up to the order 3. That means that the centered dipole, quadrupole and octupole contributions are included. The magnetic fields are analyzed by decomposing them into those portions which have simple symmetry properties with respect to the rotation axis and the equatorial plane. Simultaneously, some basic ideas concerning planetary dynamo models are presented. The implications of the results of these analyses for dynamo models are discussed. There are a great number of common features of the magnetic fields of Earth and Jupiter, which suggest a strong similarity of the flow patterns of the electrically conducting material in the interior of these planets. Compared to Earth and Jupiter, the Saturnian field exhibits both a high degree of symmetry about the rotation axis, by now rather well known, but also a high degree of antisymmetry about the equatorial plane. The Uranian field shows strong deviations from both such symmetries. Nevertheless, there remain features common to all four of these magnetized planets which suggests certain similarities of the flow patterns in the interiors and pose constraints for the construction of more detailed dynamo models. With a view to Cowling's theorem, the symmetry of the fields is not only investigated with respect to the rotation axis but also to other axes intersecting the planetary center. Surprisingly, the high degree of asymmetry of the Uranian field that is observed with respect to the rotation axis reduces considerably to being comparable to that for Earth or Jupiter when the appropriate axis is employed.