ON THE UNIQUE STRUCTURE OF THE MAGNETIC FIELDS OF URANUS AND NEPTUNE ; Sh.Sh.Dolginov(IZMIRRAN,142092.Troitsk,Moscow Reg.Russian Federation)

The magnetic fields of Uranus and Neptune, that have comparable dipole, quadrupole and octupole harmonics, are unique in the present-day Solar system but they resemble the geomagnetic field at the epochs of excursions and reversals known from paleomagnetic data.

The precession dynamo model (Dolginov [1]), in which the dominant role in the generation of the planetary magnetic fields is played by external gravitational forces, allows to propose the following scenarios for the formation of the unique topology of the magnetic fields of Uranus and Neptune :

(a) Tidal flows in the "oceans" of these two planets extend down to the depths where the matter has a noticeable electric conductivity and velecity. A hydromagnetic interaction of the mowing conducting fluid with the planetary magnetic field outside the generation region results in the deformation of the field and the deceleration of the motion under the action of the radial magnetic field.

(b) The deformation of the field facilitates drastic changes in cyclonic cells within the generation region causing instabilities that result in a multi-polar field structure, excursions and even inversions (Parker [2]),(Levy [3]).Consider this problem in more detail taking the system Neptune-Triton as an example.

The energy of zonal flows in Neptune's "ocean" is supplied by the planet's rotational energy. A tidal crest invoive the whole gas-fluid structure of the planets. The velocity of the tidal flow is smaller than the tidal crest speed, $v < v1 = \omega R_N =$ 2680 m/s and degreases with depth. (The velocity of the cloud are 600m/s).

The volume per unit area encompassed by the tide is equal to the depth H. The Height of the tidal crest is $h = 3mR_N^4/4Mr^3$ (2) where M and R_N are the mass and radius of Neptune, m and r are the mass and orbit semi-axis of Triton (Goldreich [4]). At the depth H, the tidal crest height is h/H. $H = \omega R_N h/v$ (3) $V = \Omega \sin\alpha\, r/zf$ (4).

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Structure of the Magnetic Fields.

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The depth H at which the linear velocity in the precessing spheroid, (Stuartson and Roberts [5]) reaches v = -0.1 m/s can be determined from eqs. (2) and (3) to be H = 3200 km. At this depth, the conductivity can reach $\sigma = 10^2 om^{-1}m^{-1}$.

The depth of H = 3200 km exceeds the upper boundary of the magnetically active region of Neptune (19150 km [1]) by 2400 km. The magnetic field of the planet is being deformed in this region following the magnetohydrodynamic scenario suggested for Jupiter and Saturn by Kirk and Stevenson [7]. The zonal tidal flows are braked by the radial magnetic field. This magnetic field component has a maximum near the equator where the velocity of zonal flows is less than the rotation velocities in Neptune and Uranus. The width of the region of deceleration is larger in the neptune because the Triton orbit is inclined to the Neptune equator at a larger angle than the satellite system of Uranus.

Tidal deformations lead to differencial rotation and directed mass transport, as studied in laboratory experiments (Bobryakov [6]).

Under a high electric conductivity, such motions result in the generation of toroidal fields and under moderate conductivity, the field is only deformed. The regions of the deformed field are transformed into magnetically active regions and facilitate changes in cyclonic cells and a phase of multi-polar field structure 3. The similarity of the phases and topology of the magnetic fields in the twin planets. Uranus and Neptune, is a manifestation of a property of rotating bodies which have close parameters to synchronisation under arbitrarily weak interactions (Blechman [8]).

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