DIVISIONS I-III / WORKING GROUP
NATURAL PLANETARY SATELLITES

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1. Activities of the Working Group on Natural Planetary Satellites

The main goal of the Working Group was to gather astrometric observations made
during the triennum as well as old observations not yet published in the data base. The
WG encouraged the making of new observations. A Spring School was organized in China
in order to teach the observational techniques of natural satellites to students and young
astronomers. New theoretical models of the motion of the satellites and fit of the current
models to new observations were used in order to make ephemerides of all the planetary
satellites with tools useful for observations such as configurations. These ephemerides
named MULTISAT are available at <www.imcce.fr/sat> or at <lnfm1.sai.msu.ru/
neb/nss/nsssephe.htm>.

Original ephemerides are also available on JPL’s Horizons ephemerides and on MPC
ephemerides for irregular satellites. A workshop has been held in Paris in November
2006 for organizing campaigns of observations. The problem of a standard format for the
astrometric observations of the natural satellites raised and will have to be solved during
the next triennum.

2. Selected works performed during the triennum

2.1. The Martian satellites

The data from MEX and MGS were analysed and information on the tidal dissipation
within Mars were deduced from observation of the shadow of Phobos on Mars (Bills et al.,
J. Geophys. Res., 110, E7, 7004). Numerically integrated orbits for Phobos and Deimos
were produced from fits to all observations including MEX and MGS (Lainey et al.,
A&A, 465, 1075; Jacobson, LPI Contribution 1377). Jacobson’s orbits were produced in
support of the MRO Project and incorporated MRO imaging observations as well.

2.2. The Galilean satellites

Observations of the 1997 mutual events were published (Arlot et al., A&A, 451, 733)
and astrometric data were deduced from these photometric observations (Emelyanov &
Gilbert, *A&A*, 453, 1141). A new theory was published (Lainey *et al.*, *A&A*, 456, 783) and studies have been made on the tidal dissipation in Io (Lainey & Tobie, *Icarus*, 179, 85), on the rotation of Io and Europa (Henrard, *Icarus*, 178, 144; *Cel. M&DA*, 91, 131; 93, 101) and on the free and forced obliquities of the Galileans (Bills, *Icarus*, 175, 233).

2.3. The inner satellites of Jupiter

Several papers were published on Amalthea after the fly-by of Galileo on the gravity field (Weinwurm, *Adv. Sp. Res.*, 38, 2125) and on the density of Amalthea (Anderson *et al.*, *Science*, 308, 1291). Results were obtained from *Cassini* observations (Cooper *et al.*, *Icarus*, 181, 223).

2.4. The outer satellites of Jupiter

Observations were reported (Veiga, *A&A*, 453, 349). New orbits were calculated using all observations (Emelyanov, *A&A*, 435, 1173). The mass of Himalia was determined from perturbations on other satellites using ground-based observations (Emelyanov, *A&A*, 438, L33). Theoretical works were performed on an analytical theoretical model (Beauge’ *et al.*, *AJ*, 131, p. 2299) and the dynamical evolution of this family of satellites (Christou, *Icarus*, 174, 215).

2.5. The main satellites of Saturn

The data of the Cassini probe provide many results on the gravity field, the shape (Jacobson *et al.*, *AJ*, 132, 711; 2520). Star occultations by Titan were reported (Sicardy *et al.*, *JGR*, 111, S91) as astrometric observations by the HST (French *et al.*, *PASP*, 118, 246). A new analysis technique for mutual events data was published (Ramirez *et al.*, *A&A*, 448, 1197) as a new image-processing technique for astrometry (Peng, *MNRAS*, 359, 15, 97).

2.6. The faint inner satellites of Saturn

The hypothetical satellites seen by Cassini led to study of their stability (Mourao *et al.*, *MNRAS*, 372, 1614). New orbits of the inner satellites have been deduced from *Cassini* and old observations (Spitale *et al.*, *AJ*, 132, 692; Jacobson *et al.*, *AJ*, 135, 261). The orbit of the newly discovered satellite Anthe was fit to *Cassini* data (Cooper *et al.*, *Icarus*, 195, 765).

2.7. The outer satellites of Saturn

A new orbit of Phoebe was calculated using all the available observations (Emelyanov, *A&A*, 473, 343). An analysis of albedo was made using Cassini data (Porco *et al.*, *Science*, 307, 1237) as spectrophotometry, useful to characterize the families of satellites and their formation (Buratti *et al.*, *Icarus*, 175, 490).

2.8. The satellites of Uranus

Astrometric observations of the main satellites were performed (Izmailov *et al.*, *Solar System Res.*, 41, 42), of Puck (Veiga & Bourget, *A&A*, 454, 683), mutual events were predicted (Arlot *et al.*, *A&A*, 456, 1173; Christou, *Icarus*, 178, 171)) and observed (Hidas *et al.*, *MNRAS*, 384, 38). Satellites U-12 to 17 have been named (CBET 323, 2005). New ephemerides for the main satellites were produced from fits to all but the mutual event data (Jacobson, *BAAS*, 39(3), 453).

2.9. The satellites of Neptune

Astrometric observations of Triton were performed (Qiao *et al.*, *MNRAS*, 376, 1707) as predictions of eclipses of Nereide (Mallama, *Icarus*, 187, 620). Constraints on the orbital

New ephemerides for Triton, Nereid, and Proteus were produced by fitting all observations through the opposition of 2007 (Jacobson, *BAAS*, 40(2), 296). NOTE: Qiao’s observations contain systematic errors and are unusable.

### 2.10. The satellites of asteroids

These objects are in fact binary or triple objects, the center of mass of the system being not inside the largest object. Nowadays a lot of binary (or triple) systems have been discovered. No data base of astrometric observations is available and no ephemeris is published.

### 2.11. The rings

The rings of the giant planets have been extensively observed by the space probes *Galileo* and *Cassini* and also by the *HST*. The dynamics are studied and the systems ring-moon have also been studied. The ring-moon system of Uranus has been studied (Showalter & Lissauer, *Science*, 311, 973; Gibbard *et al.*, *Icarus*, 174, 253).

### 2.12. Miscellaneous


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