XXVIth General Assembly

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XXVIe Assemblée Générale

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Resolution 1

Adoption of the Po3 Precession Theory and Definition of the Ecliptic

The XXVIth International Astronomical Union General Assembly,

Noting

1. the need for a precession theory consistent with dynamical theory,
2. that, while the precession portion of the IAU 2000A precession-nutation model, recommended for use beginning on 1 January 2003 by resolution B1.6 of the XXIVth IAU General Assembly, is based on improved precession rates with respect to the IAU 1976 precession, it is not consistent with dynamical theory, and
3. that resolution B1.6 of the XXIVth General Assembly also encourages the development of new expressions for precession consistent with the IAU 2000A precession-nutation model, and

Recognizing

1. that the gravitational attraction of the planets make a significant contribution to the motion of the Earth's equator, making the terms lunisolar precession and planetary precession misleading,
2. the need for a definition of the ecliptic for both astronomical and civil purposes, and
3. that in the past, the ecliptic has been defined both with respect to an observer situated in inertial space (inertial definition) and an observer comoving with the ecliptic (rotating definition),

Accepts

the conclusions of the IAU Division I Working Group on Precession and the Ecliptic published in Hilton et al. (2006, *Celest. Mech.* 94, 351), and

Recommends

1. that the terms lunisolar precession and planetary precession be replaced by precession of the equator and precession of the ecliptic, respectively,
2. that, beginning on 1 January 2009, the precession component of the IAU 2000A precession-nutation model be replaced by the P03 precession theory, of Capitaine et al. (2003, *A&A*, 412, 567-586) for the precession of the equator (Eqs. 37) and the precession of the ecliptic (Eqs. 38); the same paper provides the polynomial developments for the P03 primary angles and a number of derived quantities for use in both the equinox based and CIO based paradigms,
3. that the choice of precession parameters be left to the user, and
4. that the ecliptic pole should be explicitly defined by the mean orbital angular momentum vector of the Earth-Moon barycenter in the Barycentric Celestial Reference System (BCRS), and this definition should be explicitly stated to avoid confusion with other, older definitions.

Notes

1. Formulas for constructing the precession matrix using various parameterizations are given in Eqs. 1, 6, 7, 11, 12 and 22 of Hilton et al. (2006). The recommended polynomial developments for the various parameters are given in Table 1 of the same paper, including the P03 expressions set out in expressions (37) to (41) of Capitaine et al. (2003) and Tables 3-5 of Capitaine et al. (2005).
2. The time rate of change in the dynamical form factor in P03 is

   $dJ_2/dt = 0.3001 \times 10^{-9}$ century^{-1}

References

Capitaine, N., Wallace, P.T., & Chapront, J. 2003, *A&A*, 412, 567

Capitaine, N., Wallace, P.T., & Chapront, J. 2005, *A&A*, 432, 355

Hilton, J.L., Capitaine, N., Chapront, J., Ferrandiz, J.M., Fienga, A., Fukushima, T., Getino, J., Mathews, P., Simon, J.-L., Soffel, M., Vondrak, J., Wallace, P., & Williams, J. 2006, *Celest. Mech.*, 94, 351

Actions to be taken by the General Secretary upon adoption of the Resolution:

Adoption of the P03 Precession Theory and Definition of the Ecliptic

The following institutions should receive formal notification of the action:

Her Majesty's Nautical Almanac Office, Institute de mécanique céleste et de calcul des éphémérides, Institute of Applied Astronomy of the Russian Academy of Sciences, International Association of Geodesy, (IAG), International Earth Rotation and Reference Systems Service (IERS), International Union of Geodesy and Geophysics (IUGG), International VLBI Service for Geodesy and Astrometry (IVS), Japan Coast Guard (JCG), National Astronomical Observatory of Japan (NAOJ), Nautical Almanac Office of the United States Naval Observatory.

Resolution 2
Supplement to the IAU 2000 Resolutions on reference systems

RECOMMENDATION 1. Harmonizing the name of the pole and origin to "intermediate"

The XXVIth International Astronomical Union General Assembly,

Noting

1. the adoption of resolutions IAU B1.1 through B1.9 by the IAU General Assembly of 2000,
2. that the International Earth Rotation and Reference Systems Service (IERS) and the Standards Of Fundamental Astronomy (SOFA) activity have made available the models, procedures, data and software to implement these resolutions operationally, and that the Almanac Offices have begun to implement them beginning with their 2006 editions, and
3. the recommendations of the IAU Working Group on "Nomenclature for Fundamental Astronomy" (IAU Transactions XXVIA, 2005), and

Recognizing

1. that using the designation "intermediate" to refer to both the pole and the origin of the new systems linked to the Celestial Intermediate Pole and the Celestial or Terrestrial Ephemeris origins, defined in Resolutions B1.7 and B1.8, respectively would improve the consistency of the nomenclature, and
2. that the name "Conventional International Origin" with the potentially conflicting acronym CIO is no longer commonly used to refer to the reference pole for measuring polar motion as it was in the past by the International Latitude Service,

Recommends

1. that, the designation "intermediate" be used to describe the moving celestial and terrestrial reference systems defined in the 2000 IAU Resolutions and the various related entities, and
2. that the terminology "Celestial Intermediate Origin" (CIO) and "Terrestrial Intermediate Origin" (TIO) be used in place of the previously introduced "Celestial Ephemeris Origin" (CEO) and "Terrestrial Ephemeris Origin" (TEO), and
3. that authors carefully define acronyms used to designate entities of astronomical reference systems to avoid possible confusion.

RECOMMENDATION 2. Default orientation of the Barycentric Celestial Reference System (BCRS) and Geocentric Celestial Reference System (GCRS)

The XXVIth International Astronomical Union General Assembly,

Noting

1. the adoption of resolutions IAU B1.1 through B1.9 by the IAU General Assembly of 2000,
2. that the International Earth Rotation and Reference Systems Service (IERS) and the Standards Of Fundamental Astronomy (SOFA) activity have made available the models, procedures, data and software to implement these resolutions operationally, and that the Almanac Offices have begun to implement them beginning with their 2006 editions,
3. that, in particular, the systems of space-time coordinates defined by IAU 2000 Resolution B1.3 for (a) the solar system (called the Barycentric Celestial Reference System, BCRS) and (b) the Earth (called the Geocentric Celestial Reference System, GCRS) have begun to come into use,
4. the recommendations of the IAU Working Group on "Nomenclature for Fundamental Astronomy" (IAU Transactions XXVIA, 2005), and
5. a recommendation from the IAU Working Group on "Relativity in Celestial Mechanics, Astrometry and Metrology",

Recognizing

1. that the BCRS definition does not determine the orientation of the spatial coordinates,
2. that the natural choice of orientation for typical applications is that of the ICRS, and
3. that the GCRS is defined such that its spatial coordinates are kinematically non-rotating with respect to those of the BCRS,

Recommends

that the BCRS definition is completed with the following: "For all practical applications, unless otherwise stated, the BCRS is assumed to be oriented according to the ICRS axes. The orientation of the GCRS is derived from the ICRS-oriented BCRS."

Note on Resolution 2:

Resolution 2, adopted by the 26th IAU General Assembly states in its "Noting" 2, that the International Earth Rotation and Reference Systems Service (IERS) and the Standards Of Fundamental Astronomy (SOFA) activity have made available the models, procedures, data and software to implement the IAU 2000 resolutions operationally, and that the almanac offices have begun to implement them beginning with their 2006 editions.

2006 is the year of the edition for which most of the worldwide-accessible almanacs have implemented the IAU 2000 resolutions. However, it should be noted that the Polish Almanac of the Institute of Geodesy and Cartography (Warsaw, Poland), began implementing the IAU 2000 resolutions in their 2004 edition. We are pleased to acknowledge the efforts that our Polish colleagues made to implement the changes with so little delay.

Nicole Capitaine, Chair of the IAU Division 1 Working Group on Nomenclature for Fundamental Astronomy (NFA) (2003-2006)

Resolution 3

Re-definition of Barycentric Dynamical Time, TDB

The XXVIth International Astronomical Union General Assembly,

Noting

1. that IAU Recommendation 5 of Commissions 4, 8 and 31 (1976) introduced, as a replacement for Ephemeris Time (ET), a family of dynamical time scales for barycentric ephemerides and a unique time scale for apparent geocentric ephemerides,
2. that IAU Resolution 5 of Commissions 4, 19 and 31 (1979) designated these time scales as Barycentric Dynamical Time (TDB) and Terrestrial Dynamical Time (TDT) respectively, the latter subsequently renamed Terrestrial Time (TT), in IAU Resolution A4, 1991,
3. that the difference between TDB and TDT was stipulated to comprise only periodic terms, and
4. that Recommendations III and V of IAU Resolution A4 (1991) (i) introduced the coordinate time scale Barycentric Coordinate Time (TCB) to supersede TDB, (ii) recognized that TDB was a linear transformation of TCB, and (iii) acknowledged that, where discontinuity with previous work was deemed to be undesirable, TDB could be used, and

Recognizing

1. that TCB is the coordinate time scale for use in the Barycentric Celestial Reference System,
2. the possibility of multiple realizations of TDB as defined currently,
3. the practical utility of an unambiguously defined coordinate time scale that has a linear relationship with TCB chosen so that at the geocenter the difference between this coordinate time scale and Terrestrial Time (TT) remains small for an extended time span,
4. the desirability for consistency with the Teph time scales used in the Jet Propulsion Laboratory (JPL) solar-system ephemerides and existing TDB implementations such as that of Fairhead & Bretagnon (*A&A* **229**, 240, 1990), and
5. the 2006 recommendations of the IAU Working Group on "Nomenclature for Fundamental Astronomy" (IAU Transactions XXVIB, 2006),

Recommends

that, in situations calling for the use of a coordinate time scale that is linearly related to Barycentric Coordinate Time (TCB) and, at the geocenter, remains close to Terrestrial Time (TT) for an extended time span, TDB be defined as the following linear transformation of TCB:

$TDB = TCB\ L_B \times (JD_{TCB}\ T_0) \times 86400 + TDB_0$,

where T_0 = 2443144.5003725, and

$L_B = 1.550519768 \times 10^8$ and $TDB_0 = 6.55 \times 10^5$ s are defining constants.

Notes

1. JD_{TCB} is the TCB Julian date. Its value is T_0 = 2443144.5003725 for the event 1977 January 1 00h 00m 00s TAI at the geocenter, and it increases by one for each 86400s of TCB.
2. The fixed value that this definition assigns to L_B is a current estimate of $L_C + L_G - L_C \times L_G$, where L_G is given in IAU Resolution B1.9 (2000) and L_C has been determined (Irwin & Fukushima, 1999, *A&A* **348**, 642) using the JPL ephemeris DE405. When using the JPL Planetary Ephemeris DE405, the defining L_B value effectively eliminates a linear drift between TDB and TT, evaluated at the geocenter. When realizing TCB using other ephemerides,

the difference between TDB and TT, evaluated at the geocenter, may include some linear drift, not expected to exceed 1 ns per year.

3. The difference between TDB and TT, evaluated at the surface of the Earth, remains under 2 ms for several millennia around the present epoch.
4. The independent time argument of the JPL ephemeris DE405, which is called Teph (Standish, *A&A*, **336**, 381, 1998), is for practical purposes the same as TDB defined in this Resolution.
5. The constant term TDB_0 is chosen to provide reasonable consistency with the widely used TDB TT formula of Fairhead & Bretagnon (1990).
   n.b. The presence of TDB_0 means that TDB is not synchronized with TT, TCG and TCB at 1977 Jan 1.0 TAI at the geocenter.
6. For solar system ephemerides development the use of TCB is encouraged.

Resolution 4
Endorsement of the Washington Charter for Communicating Astronomy with the Public

The Washington Charter was one of the outcomes of the 2nd International Conference on Communicating Astronomy with the Public held in Washington DC in October 2003. Council endorsed the Washington Charter in March 2004. Nineteen other societies, organizations and facilities have endorsed the Charter, including the BAA and PPARC. At the Communicating Astronomy with the Public 2005 meeting in Garching a revised version of the Charter was proposed. This softened the language and also tidied up some of the phraseology. This was endorsed by the attendees and accepted by the IAU Working Group. The revised version is appended.

The IAU General Assembly is requested to confirm endorsement of the Revised Washington Charter.

The Washington Charter for Communicating Astronomy with the Public

As our world grows ever more complex and the pace of scientific discovery and technological change quickens, the global community of professional astronomers needs to communicate more effectively with the public. Astronomy enriches our culture, nourishes a scientific outlook in society, and addresses important questions about humanity's place in the universe. It contributes to areas of immediate practicality, including industry, medicine, and security, and it introduces young people to quantitative reasoning and attracts them to scientific and technical careers. Sharing what we learn about the universe is an investment in our fellow citizens, our institutions, and our future. Individuals and organizations that conduct astronomical research - especially those receiving public funding for this research - have a responsibility to communicate their results and efforts with the public for the benefit of all.

Recommendations

For Funding Agencies:

Encourage and support public outreach and communication in projects and grant programs. Develop infrastructure and linkages to assist with the organization and dissemination of outreach results. Emphasize the importance of such efforts to project and research managers. Recognize public outreach and communication plans and efforts through proposal selection criteria and decisions and annual performance awards. Encourage international collaboration on public outreach and communication activities.

For Professional Astronomical Societies:

Endorse standards for public outreach and communication. Assemble best practices, formats, and tools to aid effective public outreach and communication. Promote professional respect and recognition of public outreach and communication. Make public outreach and communication a visible and integral part of the activities and operations of the respective societies. Encourage greater linkages with successful ongoing efforts of amateur astronomy groups and others.

For Universities, Laboratories, Research Organizations, and Other Institutions:

Acknowledge the importance of public outreach and communication. Recognize public outreach and communication efforts when making decisions on hiring, tenure, compensation and awards. Provide institutional support to enable and assist with public outreach and communication efforts. Collaborate with funding agencies and other organizations to help ensure that public outreach and communication efforts have the greatest possible impact. Make available formal public outreach and communication training for researchers. Offer communication training in academic courses of study for the next generation of researchers.

For Individual Researchers:

Support efforts to communicate the results and benefits of astronomical research to the public, convey the importance of public outreach and communication to team members. Instill this sense of responsibility in the next generation of researchers

Authored by CCAP, Washington DC, October 2003, Revised by CAP 2005, Garching bei München, June 2005

Resolution 5

Definition of a Planet in the Solar System

Contemporary observations are changing our understanding of planetary systems, and it is important that our nomenclature for objects reflect our current understanding. This applies, in particular, to the designation "planets". The word "planet" originally described "wanderers" that were known only as moving lights in the sky. Recent discoveries lead us to create a new definition, which we can make using currently available scientific information.

The IAU therefore resolves that planets and other bodies, except satellites, in our Solar System be defined into three distinct categories in the following way:

1. A planet(1) is a celestial body that
   a. is in orbit around the Sun,
   b. has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and
   c. has cleared the neighbourhood around its orbit.
2. A "dwarf planet" is a celestial body that
   a. is in orbit around the Sun,
   b. has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape(2),
   c. has not cleared the neighbourhood around its orbit, and
   d. is not a satellite.
3. All other objects(3), except satellites, orbiting the Sun shall be referred to collectively as "Small Solar System Bodies".

Footnotes Resolution 5

(1) *The eight planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.*

(2) *An IAU process will be established to assign borderline objects into either dwarf planet and other categories.*

(3) *These currently include most of the Solar System asteroids, most Trans-Neptunian Objects (TNOs), comets, and other small bodies.*

Resolution 6

Pluto

The IAU further resolves:

Pluto is a "dwarf planet" by the above definition and is recognized as the prototype of a new category of Trans-Neptunian Objects(1).

Footnote Resolution 6

(1) *An IAU process will be established to select name for this category.*