IAU 2006 NFA GLOSSARY

Prepared by the IAU Division I Working Group "Nomenclature for Fundamental Astronomy"

(latest revision: 20 November 2007)

Those definitions corresponding to the IAU 2000 resolutions are given in italic type[1]. The new definitions proposed by the NFA WG (including those formally endorsed by the IAU in 2006 or by the IUGG in 2007) are underlined while superseded definitions are given in a smaller font.[2]

aberration: the apparent angular displacement of the observed position of a celestial object from its geometric position, caused by the finite velocity of light in combination with the motions of the observer and of the observed object. Annual aberration is due to the motion of the Earth around the Sun, while diurnal aberration is due to the Earth's rotation. In star catalogs of the pre-1984.0 era, it was common to include the secular part of stellar aberration (the so-called e-terms) in the published star positions.

apparent place: a geocentric position (e.g. apparent right ascension and declination) in the true equinox and equator of date reference system at a specified date.

apparent right ascension and declination: angular coordinates in the true equator and equinox of date reference system at a specified date. They are geocentric positions differing from the ICRS positions by annual parallax, gravitational light deflection due to the solar system bodies except the Earth, annual aberration, and the time-dependent rotation describing the transformation from the GCRS to the Celestial Intermediate Reference System (they are similar to intermediate positions in the CIO based system but the apparent right ascension origin is at the equinox). Note that apparent declination is identical to intermediate declination.

astrometric place: direction of a solar system body formed by applying the correction for the barycentric motion of this body during the light time to the geometric geocentric position referred to the ICRS. Such a position is then directly comparable with the astrometric position of a star formed by applying the corrections for proper motion and annual parallax to the catalog direction at J2000. The gravitational deflection of light is ignored. For high-accuracy applications, gravitational light deflection effects need to be considered, and the adopted policy declared.

barycentric: centered at the solar system barycenter.

Barycentric Celestial Reference System (BCRS): *a system of barycentric space-time coordinates for the solar system within the framework of General Relativity with metric tensor specified by the IAU 2000 Resolution B1.3. Formally, the metric tensor of the BCRS does not fix the coordinates completely, leaving the final orientation of the spatial axes undefined. However, according to IAU 2006 Resolution B2, for all practical applications, unless otherwise stated, the BCRS is assumed to be oriented according to the ICRS axes.*

Barycentric Coordinate Time (TCB): the coordinate time of the BCRS; it is related to Geocentric Coordinate Time (TCG) and Terrestrial Time (TT) by relativistic transformations that include secular terms.

Barycentric Dynamical Time (TDB): a time scale originally intended to serve as an independent time argument of barycentric ephemerides and equations of motion. In the IAU 1976 resolutions, the difference between TDB and TDT was stipulated to consist of only periodic terms, a condition that cannot be satisfied rigorously. The IAU 1991 resolutions introducing barycentric coordinate time (TCB) noted that TDB is a linear function of TCB, but without explicitly fixing the rate ratio

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[1] Some of the definitions prior to the IAU 2000 resolutions may not be compliant with relativity.

[2] Although the following definitions are provided with capitals this does not mean that they must be used with capitals. The policy adopted throughout this document is to capitalize those terms that are defined in IAU or IUGG resolutions. This includes the words that are represented by the abbreviations BCRS, CIO, CIP, CIRS, ERA, GCRS, GTRS, HCRF, ICRF, ICRS, ITRF, ITRS, TAI, TCB, TCG TDB, TDT, TIO, TIRS, and TT.

and zero point, leading to multiple realizations of TDB. In 2006 TDB was re-defined through the following linear transformation of TCB (IAU 2006 Resolution B3):

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

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.

BCRS: see Barycentric Celestial Reference System.

catalog equinox: the intersection of the hour circle of zero right ascension of a star catalog with the celestial equator.

catalog place: a star catalog position.

Celestial Ephemeris Origin (CEO): *the original name for the Celestial Intermediate Origin (CIO) given in the IAU 2000 resolutions.*

Celestial Ephemeris Pole (CEP): used from 1984 to 2003 with the IAU 1980 Theory of Nutation as the reference pole for nutation and polar motion; the axis of figure for the mean surface of a model Earth in which the free motion has zero amplitude. This pole was originally defined as having no nearly-diurnal nutation with respect to a space-fixed or Earth-fixed coordinate system and being realized by the IAU 1980 nutation. It was afterwards determined by using VLBI observations of celestial pole offsets. It is now replaced by the CIP, which is defined by IAU 2000 Resolution B1.7.

Celestial Intermediate Origin (CIO): origin for right ascension on the intermediate equator in the Celestial Intermediate Reference System. It is the non-rotating origin in the GCRS that is recommended by the IAU 2000 Resolution B 1.8, where it was designated the Celestial Ephemeris Origin. The name Celestial Intermediate Origin was adopted by IAU 2006 Resolution B2. The CIO was originally set close to the GCRS meridian and throughout 1900-2100 stays within 0.1 arcseconds of this alignment.

Celestial Intermediate Pole (CIP): *geocentric equatorial pole defined by IAU 2000 Resolution B1.7 as being the intermediate pole, in the transformation from the GCRS to the ITRS, separating nutation from polar motion. It replaced the CEP on 1 January 2003. Its GCRS position results from (i) the part of precession-nutation with periods greater than 2 days, and (ii) the retrograde diurnal part of polar motion (including the free core nutation, FCN) and (iii) the frame bias. Its ITRS position results from (i) the part of polar motion which is outside the retrograde diurnal band in the ITRS and (ii) the motion in the ITRS corresponding to nutations with periods less than 2 days. The motion of the CIP is realized by the IAU precession-nutation plus time-dependent corrections provided by the IERS.*

Celestial Intermediate Reference System (CIRS): geocentric reference system related to the GCRS by a time-dependent rotation taking into account precession-nutation. It is defined by the intermediate equator (of the CIP) and CIO on a specific date (IAU 2006 Resolution B2). It is similar to the system based on the true equator and equinox of date, but the equatorial origin is at the CIO. Since the acronym for this system is close to another acronym (namely ICRS), it is suggested that wherever possible the complete name is used.

celestial pole offsets: time-dependent corrections to the precession-nutation model, determined by observations. The IERS provides the celestial pole offsets in the form of the differences, dX and dY, of the CIP coordinates in the GCRS with respect to the IAU 2000A precession-nutation model (i.e. the CIP is realized by the IAU 2000A precession-nutation plus these celestial pole offsets). In parallel the IERS also provides the offsets, $d\psi$ and $d\varepsilon$, in longitude and obliquity with respect to the IAU 1976/1980 precession/nutation model.

celestial pole offsets at J2000.0: offset of the direction of the mean pole at J2000.0, provided by the current model, with respect to the GCRS. These offsets are part of what is often called frame bias.

CEO: see Celestial Ephemeris Origin.

CEP: see Celestial Ephemeris Pole.

CIO: see Celestial Intermediate Origin.

CIO locator (denoted *s*): the difference between the GCRS right ascension and the intermediate right ascension of the intersection of the GCRS and intermediate equators. The CIO was originally set close to the mean equinox at J2000.0. As a consequence of precession-nutation the CIO moves according to the kinematical property of the non-rotating origin. The CIO is currently located by using the quantity *s*.

CIO right ascension and declination: see intermediate right ascension and declination.

CIP: see Celestial Intermediate Pole.

CIRS: see Celestial Intermediate Reference System.

CTRS: see Conventional Terrestrial Reference System.

Conventional International Origin: the international origin of polar motion adopted for use by the former International Latitude Service (ILS). It was defined in 1967 by an adopted set of astronomical latitudes of the 5 stations of the ILS. It approximately coincided with the mean pole of 1903.0 as determined by the ILS. To avoid ambiguity, this origin should be designated by its full name. This designation should be avoided for the current origin (the ITRF pole) of the polar motion, which no longer coincides with the conventional international origin.

Conventional Terrestrial Reference System (CTRS): term used in the 1991 IUGG Resolution 2 for designating the ideal terrestrial system to be defined from a geocentric non-rotating system by a spatial rotation. It is proposed to replace this designation by GTRS, which was endorsed by IUGG 2007 Resolution 2.

date: a reading of a time scale.

day: an interval of 86400 seconds. The day, and related conventional units such as the Julian year and Julian century, may be used with any continuous time scale (TCG, TCB, TT, TDB, ...). In precise work the time scale should be specified (e.g. 1 TT day). This also applies to UT1 when used as a time scale. Note that for UTC, on the days that leap seconds are added, the day can be 86401 (or 86399) seconds.

declination: angular distance north or south of the celestial equator. It is measured along the hour circle passing through the celestial object. Declination is usually given in combination with right ascension or hour angle.

dynamical mean equinox: the ascending node of the ecliptic on the mean equator. The mean equinox of epoch (to which the recent analytical and numerical solutions for the Moon and planets refer) corresponds to the definition of the ecliptic in its "inertial" sense. It differs by 93.66 mas from the "rotational dynamical mean equinox of J2000.0", which was intended to coincide with the FK5 equinox.

Earth Rotation Angle (ERA): *angle measured along the intermediate equator of the Celestial Intermediate Pole (CIP) between the Terrestrial Intermediate Origin (TIO) and the Celestial Intermediate Origin (CIO), positively in the retrograde direction. It is related to UT1 by a conventionally adopted expression in which ERA is a linear function of UT1 (see IAU 2000 Resolution B1.8). Its time derivative is the Earth's angular velocity. Previously, it has been referred to as the stellar angle.*

ecliptic: the plane perpendicular to the mean heliocentric orbital angular momentum vector of the Earth-Moon barycentre in the BCRS (IAU 2006 Resolution B1). In the past, there was no unique interpretation; an ecliptic was defined by means of the angles of the precession theory.

Ephemeris time (ET): the time scale used prior to 1984 as the independent variable in gravitational theories of the solar system, with its unit and origin conventionally defined. It was superseded by TT and TDB.

epoch: a fixed date used to reckon time for expressing time varying quantities. It is often expressed in the system of Julian date, marked by the prefix J (e.g. J2000.0), with the Julian year of

365.25 days as unit. The term is also used to designate the date and time of an observation, e.g. "epoch of observation", which would be better expressed by 'date of observation'.

equation of the equinoxes: the right ascension of the mean equinox referred to the true equator and equinox; alternatively the difference between apparent sidereal time and mean sidereal time (GAST –GMST).

equation of the origins: distance between the CIO and the equinox along the intermediate equator; it is the CIO right ascension of the equinox; alternatively the difference between the Earth Rotation Angle and Greenwich apparent sidereal time (ERA – GAST).

equinox: either of the two points at which the ecliptic intersects the celestial equator; also the time at which the Sun passes through either of these intersection points; i.e., when the apparent longitude of the Sun is 0° or 180°. When required, the equinox can be designated by the ephemeris of the Earth from which it is obtained (e.g. vernal equinox of DE 405). By 2100 the equinox will have moved 1.4° from the ICRS meridian, due to the precession of the equinoxes.

equinox right ascension: right ascension that is measured from the equinox; also simply called right ascension.

ERA: see Earth Rotation Angle.

ET: see Ephemeris time.

FCN: see free core nutation.

fixed ecliptic: The ecliptic of a given ephemeris at an adopted epoch. Such a fixed ecliptic has a specified obliquity and crosses the ICRS equator at a specified offset from the ICRS origin.

frame bias: the three offsets of the mean equator and (dynamical) mean equinox of J2000.0, provided by the current model, with respect to the GCRS; the first two offsets are the mean pole offsets at J2000.0 and the third is the offset in right ascension of the mean dynamical equinox of J2000.0.

free core nutation (FCN): free retrograde diurnal mode in the motion of the Earth's rotation axis with respect to the Earth, due to non-alignment of the rotation axis of the core and of the mantle; it is a long period (of 432 days) free nutation of the CIP in the GCRS.

GAST (GST): see Greenwich sidereal time.

GCRS: see Geocentric Celestial Reference System.

GCRS CIP coordinates: direction cosines *X, Y,* of the CIP in the GCRS; these quantities are often multiplied by 1296000″/2π in order to represent the approximate values in arcseconds of the corresponding angles with respect to the polar axis of the GCRS.

GMST: see Greenwich mean sidereal time.

geocentric: referring to the center of the Earth.

Geocentric Celestial Reference System (GCRS): *a system of geocentric space-time coordinates within the framework of General Relativity with metric tensor specified by the IAU 2000 Resolution B1.3. The GCRS is defined such that the transformation between BCRS and GCRS spatial coordinates contains no rotation component, so that GCRS is kinematically non-rotating with respect to BCRS. The equations of motion of, for example, an Earth satellite, with respect to the GCRS will contain relativistic Coriolis forces that come mainly from geodesic precession. The spatial orientation of the GCRS is derived from that of the BCRS, that is (c.f. IAU 2006 Resolution B2), unless otherwise stated, by the orientation of the ICRS.*

Geocentric Coordinate Time (TCG): coordinate time of the GCRS based on the SI second. It is related to Terrestrial Time (TT) by a conventional linear transformation provided by IAU 2000 Resolution B1.9.

Geocentric Terrestrial Reference System (GTRS): a system of geocentric space-time coordinates within the framework of General Relativity, co-rotating with the Earth, and related to the GCRS by a spatial rotation which takes into account the Earth orientation parameters. It was adopted by IUGG 2007 Resolution 2. It replaces the previously defined Conventional Terrestrial Reference System.

geodesic precession and nutation: the largest components (in fact the only non-negligible ones) of the relativistic rotation of the GCRS with respect to a dynamically non-rotating geocentric reference system in the framework of General Relativity. Geodesic precession is the secular part of the rotation and geodesic nutation is the periodic part. Geodesic precession and nutation are included in the IAU 2000 precession-nutation model.

Greenwich mean sidereal time (GMST): Greenwich hour angle of the mean equinox defined by a conventional relationship to Earth Rotation Angle or equivalently to UT1.

Greenwich sidereal time (GST): Greenwich apparent sidereal time (GAST), the hour angle of the true equinox from the Terrestrial Intermediate Origin (TIO) meridian (Greenwich or International meridian).

GST (or GAST): see Greenwich sidereal time

GTRS: see Geocentric Terrestrial Reference System

IAU 2000 precession-nutation: *IAU 2000 Resolution B1.6 recommends the IAU 2000A precession-nutation model for those who need a model at 0.2 mas level. It represents the CIP. An abridged model, designated IAU 2000B, is available for those who require a model at the 1 mas level.*

ICRF: see International Celestial Reference Frame.

ICRS: see International Celestial Reference System.

ICRS place: a direction in ICRS coordinates, (e.g. ICRS right ascension, the right ascension measured from the ICRS origin on the ICRS equator, and ICRS declination, the declination measured from the ICRS equator).

intermediate equator: equatorial plane through the center of the Earth and perpendicular to the direction of the Celestial Intermediate Pole (CIP) at some epoch (it is synonymous with the instantaneous equator or true equator of date, or equator of the CIP).

intermediate place: direction of an object in the Celestial Intermediate Reference System (e.g. intermediate right ascension and declination), analogous to an apparent place in the equinox based system, but the origin for intermediate right ascension is at the CIO.

intermediate right ascension and declination: angular coordinates measured in the Celestial Intermediate Reference System at a specified date**.** They specify a geocentric direction that differs from the ICRS direction by annual parallax, gravitational light deflection due to the solar system bodies, except the Earth, annual aberration, and the time-dependent rotation describing the transformation from the GCRS to the Celestial Intermediate Reference System. They are similar to apparent right ascension and declination when referring to the equinox based system. Note that intermediate declination is identical to apparent declination.

International Atomic Time (TAI): a widely used practical realization of TT with a fixed shift from the latter due to historical reasons (see TT); it is a continuous time scale, now calculated at the Bureau International des Poids et Mesures (BIPM), using data from some three hundred atomic clocks in over fifty national laboratories in accordance with the definition of the SI second**.**

International Celestial Reference Frame (ICRF): a set of extragalactic objects whose adopted positions and uncertainties realize the ICRS axes and give the uncertainties of the axes. It is also the name of the radio catalog whose 212 defining sources is currently the most accurate realization

of the ICRS. Note that the orientation of the ICRF catalog was carried over from earlier IERS radio catalogs and was within the errors of the standard stellar and dynamic frames at the time of adoption. Successive revisions of the ICRF are intended to minimize rotation from its original orientation. Other realizations of the ICRS have specific names (e.g. Hipparcos Celestial Reference Frame).

International Celestial Reference System (ICRS): the idealized barycentric coordinate system to which celestial positions are referred. It is kinematically non-rotating with respect to the ensemble of distant extragalactic objects. It has no intrinsic orientation but was aligned close to the mean equator and dynamical equinox of J2000.0 for continuity with previous fundamental reference systems. Its orientation is independent of epoch, ecliptic or equator and is realized by a list of adopted coordinates of extragalactic sources.

International Terrestrial Reference Frame (ITRF): a realization of ITRS by a set of instantaneous coordinates (and velocities) of reference points distributed on the topographic surface of the Earth (mainly space geodetic stations and related markers). Currently the ITRF provides a model for estimating, to high accuracy, the instantaneous positions of these points, which is the sum of conventional corrections provided by the IERS Convention center (solid Earth tides, pole tides, ...) and of a "regularized" position. At present, the latter is modeled by a piecewise linear function, the linear part accounting for such effects as tectonic plate motion, post-glacial rebound, and the piecewise aspect representing discontinuities such as seismic displacements. The initial orientation of the ITRF is that of the BIH Terrestrial System at epoch 1984.0.

International Terrestrial Reference System (ITRS): according to IUGG 2007 Resolution 2, the ITRS is the specific GTRS for which the orientation is operationally maintained in continuity with past international agreements (BIH orientation). The co-rotation condition is defined as no residual rotation with regard to the Earth's surface**,** and the geocenter is understood as the center of mass of the whole Earth system, including oceans and atmosphere (IUGG 1991 Resolution 2). For continuity with previous terrestrial reference systems, the first alignment was close to the mean equator of 1900 and the Greenwich meridian. The ITRS was adopted (IUGG 2007 Resolution 2) as the preferred GTRS for scientific and technical applications and is the recommended system to express positions on the Earth.

ITRF: see International Terrestrial Reference Frame.

ITRF zero-meridian: the plane passing through the geocenter, ITRF pole and ITRF *x*-origin.

ITRS: see International Terrestrial Reference System.

ITRS CIP coordinates: direction cosines of the CIP in the ITRS, also called pole coordinates. They are currently expressed in the form of *x* and *y* coordinates, in arcseconds, the values of which represent the corresponding angles with respect to the polar axis of the ITRS. The sign convention is such that *x* is positive towards the *x*-origin of the ITRS and *y* is in the direction 90° to the west of *x*.

J2000.0: defined in the framework of General Relativity by IAU 1994 Resolution C7 as being the event (epoch) at the geocenter and at the date 2000 January 1.5 TT = Julian Date 245 1545.0 TT. Note that this event has different dates in different time scales.

Julian century: a period of 100 Julian years (36525 days). The Julian century as a unit of time may be used with any continuous time scale (TCG, TCB, TT, TDB). In precise work the time scale should be specified (e.g. 1 TT Julian century). Note that this extends the IAU 1994 Resolution C7 where Julian century was defined as 36525 TT days.

Julian date: the interval of time in days and fractions of a day since 4713 B.C. January 1, Greenwich noon, approximately. The Julian date can be used with any time scale (TCG, TCB, TT, TDB). In precise work, the Julian date in TT, TCG and TCB, has its origin fixed according to the

IAU 1991 Resolutions by the condition that on 1977 January 1, $00^h\ 00^m\ 00^s$ TAI at the geocenter, the readings of TT, TCG and TCB are 1977 January 1, $00^h\ 00^m\ 32^s.184$ (JD 244 3144.5003725). The equivalent TDB reading depends on the adopted ephemeris (for example, the same reading for TDB(DE405) is JD 244 3144.5003725 – 65.564518 μs). The Modified Julian date is JD – 240 0000.5.

Julian year: a period of 365.25 days. The Julian year as a unit of time may be used with any continuous time scale (TCG, TCB, TT, TDB). In precise work the time scale should be specified (e.g. 1 TT Julian year).

mean equator: equator associated with a celestial pole whose direction is determined only by the precession portion of the precession-nutation transformation**.**

mean equinox: equinox associated with the mean equator.

mean place: position of an object on the celestial sphere referred to the mean equator and equinox at a standard epoch.

non-rotating origin: in the context of the GCRS or the ITRS, the point on the intermediate equator such that its instantaneous motion with respect to the system (GCRS or ITRS as appropriate) has no component along the intermediate equator (i.e. its instantaneous motion is perpendicular to the intermediate equator). It is called the CIO and TIO in the GCRS and ITRS, respectively.

nutation: forced periodic part of the motion of the pole of rotation of a freely rotating body that is undergoing torque from external gravitational forces.

observed place: a topocentric place that includes the effect of refraction**.**

offset in right ascension: expression used to describe the equatorial offset at J2000 of the GCRS right ascension of the inertial dynamical mean equinox (see frame bias).

parallax: the difference in apparent direction of an object as seen from two different locations; annual parallax refers to the difference in directions as seen from the barycenter and the geocenter, while diurnal parallax refers to the component of parallax due to the observer's separation from the geocenter.

polar motion: the motion of the Earth's pole with respect to the ITRS. The main components are the Chandlerian free motion with a period of approximately 430 days, and an annual motion. It also includes sub-daily variations caused by ocean tides and periodic motions driven by gravitational torques with periods less than two days. Sub-daily variations are not included in the values distributed by the IERS, and are therefore to be added, after interpolation to the date of interest, using a model provided by the IERS Conventions.

pole coordinates: angular coordinates of the pole with respect to the terrestrial system (see ITRS CIP coordinates).

precession of the ecliptic: the secular part of the motion of the ecliptic with respect to the fixed ecliptic.

precession of the equator (and CIP): the uniformly progressing motion of the pole of rotation of a freely rotating body, undergoing torque from external gravitational forces. In the case of the Earth, the precession of the equator is caused by solar system objects acting on the Earth's equatorial bulge making the pole of rotation describe a 26000-year orbit around the ecliptic pole.

precession of the equinox: results from both the precession of the equator and the precession of the ecliptic.

precession-nutation: the ensemble of effects of external torques on the motion in space of the rotation axis of a freely rotating body (see the separate entries for precession and nutation below), or alternatively, the forced motion of the pole of rotation due to those external torques. In the case

of the Earth, a practical definition consistent with the IAU 2000 resolutions is that precession-nutation is the motion of the CIP in the GCRS, including FCN and other corrections to the standard models: precession is the secular part of this motion plus the term of 26000-year period and nutation is that part of the CIP motion not classed as precession.

proper place: direction of an object in the GCRS (e.g. right ascension and declination); geocentric place that is corrected for light-time, light deflection, annual parallax and annual aberration**.**

reference frame: practical realization of a reference system, usually as a catalog of positions and motions of a certain number of fiducial points. For instance, the ICRF is the realization of the ICRS, where the ICRF points have no proper motions.

reference system: theoretical concept of a system of coordinates, including time and standards necessary to specify the bases used to define the position and motion of objects in time and space.

refraction: the bending of a ray of light as it passed through the Earth's atmosphere. Most commonly calculated using pressure, temperature, humidity and wavelength.

right ascension: angular distance measured eastward along the celestial equator from the CIO, or equinox, to the hour circle passing through the celestial object. Right ascension is given either in arc or time units. It is essential that the origin, CIO or equinox, of the right ascension be specified.

stellar angle: the original term used for the Earth Rotation Angle (ERA) in the first definition of the non-rotating origin.

sidereal time: the measure of the angle defined by the apparent diurnal motion of the equinox; hence, a measure of the rotation of the Earth with respect to the celestial reference frame rather than the Sun. It is often expressed in hours, minutes, and seconds, one hour being equal to 15º.

TAI: see International Atomic Time**.**

TCB: see Barycentric Coordinate Time.

TCG: see Geocentric Coordinate Time.

TDB: see Barycentric Dynamical Time.

TDT: see Terrestrial Dynamical Time.

TEO: see Terrestrial Ephemeris Origin.

Teph: the independent time argument of the JPL and MIT/CfA solar-system ephemerides (Standish, 1998). The linear drift between Teph and TCB is such that the rates of Teph and TT are as close as possible for the time span covered by the particular ephemeris. Each ephemeris defines its own version of Teph; the Teph of the JPL ephemeris DE405 is for practical purposes the same as TDB defined above.

Terrestrial Dynamical Time (TDT): time scale for apparent geocentric ephemerides defined by a 1979 IAU resolution and in 1991 was replaced by Terrestrial Time (TT).

Terrestrial Ephemeris Origin (TEO): *the original name for the Terrestrial Intermediate Origin (TIO) given in the IAU 2000 resolutions.*

Terrestrial Intermediate Origin (TIO): origin of longitude in the Intermediate Terrestrial Reference System. It is the non-rotating origin in the ITRS that is recommended by the IAU 2000 Resolution B1.8, where it was designated Terrestrial Ephemeris Origin. The name Terrestrial Intermediate Origin was adopted by IAU 2006 Resolution B2. The TIO was originally set at the ITRF origin of longitude and throughout 1900-2100 stays within 0.1 mas of the ITRF zero-meridian.

Terrestrial Intermediate Reference System (TIRS): a geocentric reference system defined by the intermediate equator of the CIP and the TIO (IAU 2006 Resolution B2). It is related to the ITRS by polar motion and *s*' (see TIO locator). It is related to the Celestial Intermediate Reference

System by a rotation of ERA around the CIP, which defines the common z-axis of the two systems. Since the acronym for this system is close to another acronym (namely ITRS), it is suggested that wherever possible the complete name be used.

Terrestrial Time (TT): a coordinate time whose mean rate is close to the mean rate of the proper time of an observer located on the rotating geoid. At 1977 January 1.0 TAI exactly, the value of TT was 1977 January 1.0003725 exactly. It is related to the Geocentric Coordinate Time (TCG) by a conventional linear transformation provided by IAU 2000 Resolution B1.9. TT may be used as the independent time argument for geocentric ephemerides. An accurate realization of TT is TT (TAI) = TAI + $32^{s}.184$. In the past TT was called Terrestrial Dynamical Time (TDT).

TIO: see Terrestrial Intermediate Origin.

TIO locator (denoted *s′*): the difference between the ITRS longitude and the instantaneous longitude of the intersection of the ITRS and intermediate equators. The TIO was originally set at the ITRF origin of longitude. As a consequence of polar motion the TIO moves according to the kinematical property of the non-rotating origin. The TIO is currently located using the quantity s′, the rate of which is of the order of 50 μas/cy and is due to the current polar motion.

TIO meridian: moving plane passing through the geocenter, the CIP and the TIO.

TIRS: see Terrestrial Intermediate Reference System.

topocentric: a place that is centered at the surface of the Earth and dependent on the geographic location.

true equator of date: see celestial intermediate equator.

true equinox of date: intersection of the ecliptic with the intermediate (true) equator and designated by the ephemeris of the Earth from which it is obtained (e.g. true equinox of DE 405).

TT: see Terrestrial Time.

Universal Time (UT): a measure of time that conforms, within a close approximation, to the mean diurnal motion of the Sun and serves as the basis of all civil timekeeping. The term "UT" is used to designate a member of the family of Universal Time scales (e.g. UTC, UT1).

Universal Time (UT1): angle of the Earth's rotation about the CIP axis defined by its conventional linear relation to the Earth Rotation Angle (ERA). It is related to Greenwich apparent sidereal time through the ERA (see equation of the origins). It is determined by observations (currently from VLBI observations of the diurnal motions of distant radio sources). UT1 can be regarded as a time determined by the rotation of the Earth. It can be obtained from the uniform time scale UTC by using the quantity *UT1–UTC*, which is provided by the IERS.

UT1 – UTC: difference between the UT1 parameter derived from observation and the uniform time scale UTC, the latter being currently defined as: $UTC = TAI + n$, where n is an integer number of seconds, such that $|UT1 - UTC| < 0^{s}.9$.

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