astroconst

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ONE

ASTROCONST PACKAGE

1.1 Submodules

1.1.1 astroconst.aa module

aa.py: Define astronomical constants from the AA table Selected Astronomical Constants, 2021. Source: http://asa.hmnao.com/SecK/Constants.html

astroconst.aa.**a_e = 6378136.6**

6378136.6 ± 0.1 m (TT)

Type Equatorial radius for Earth

astroconst.aa.**au = 149597870700**

149597870700 m

Type Astronomical unit (unit distance)

astroconst.aa.**c = 299792458**

299792458 m/s

Type Speed of light

astroconst.aa.**depsilon_dt = -46.836769**

-46.836769 ‘’/Julian century (TDB)

Type Rate of change in obliquity

astroconst.aa.**dj_2 = -3e-09**

-3.0E-09 ± 6E-10 per cy

Type Long-term variation in J_2

astroconst.aa.**domega_dt = -0.025754**

-0.025754 ‘’/Julian century (TDB)

Type Precession of the equator in obliquity

astroconst.aa.**dpsi_dt = 5038.481507**

5038.481507 ‘’/Julian century (TDB)

Type Precession of the equator in longitude

astroconst.aa.**dtheta_dut1 = 1.0027378119113546**
1.00273781191135448 revs/UT1-day

Type Rate of advance of ERA

astroconst.aa.**epsilon_j2000 = 23.4392794**
23.4392794 °

Type Mean obliquity of the ecliptic, epsilon_0

astroconst.aa.**g = 6.67428e-11**
6.67428E-11 ± 6.7E-15 m^3/kg/s^2

Type Constant of gravitation

astroconst.aa.**gme = 398600441800000.0**
3.986004418E14 ± 8E05 m^3/s^2 (TCB)

Type Geocentric gravitational constant

astroconst.aa.**gms = 1.32712442099e+20**
1.32712442099E20 ± 1E10 m^3/s^2 (TCB)

Type Solar mass parameter

astroconst.aa.**gms_over_gme = 332946.0487**
332946.0487 ± 7E-04 [-]

Type Mass Ratio

Type Sun to Earth

astroconst.aa.**j_2 = 0.0010826359**
0.0010826359 ± 1E-10 [-]

Type Dynamical form-factor for the Earth

astroconst.aa.**kappa = 20.49551**
20.49551 ''

Type Constant of aberration at epoch J2000.0

astroconst.aa.**l_b = 1.550519768e-08**
1.550519768E-08 [-]

Type 1-d(TDB)/d(TCB)

astroconst.aa.**l_c = 1.48082686741e-08**
1.48082686741E-08 ± 2E-17 [-]

Type Average value of 1-d(TCG)/d(TCB)

astroconst.aa.**l_g = 6.969290134e-10**
6.969290134E-10 [-]

Type 1-d(TT)/d(TCG)

astroconst.aa.**m_ceres_over_m_s = 4.72e-10**
4.72E-10 ± 3E-12 [-]

Type Mass Ratio

Type

(1) Ceres to Sun

astroconst.aa.**m_e = 5.9722e+24**

5.9722E24 ± 6E20 kg

Type Mass of the Earth

astroconst.aa.**m_e_over_m_m = 81.300568**

81.300568 ± 3E-06 [-]

Type Mass Ratio

Type Earth to Moon

astroconst.aa.**m_m_over_m_e = 0.0123000371**

1.23000371E-02 ± 4E-10 [-]

Type Mass Ratio

Type Moon to Earth

astroconst.aa.**m_pallas_over_m_s = 1.03e-10**

1.03E-10 ± 3E-12 [-]

Type Mass Ratio

Type

(2) Pallas to Sun

astroconst.aa.**m_s = 1.9884e+30**

1.9884E30 ± 2E26 kg

Type Mass of the Sun

astroconst.aa.**m_s_over_m_eris = 119100000.0**

1.191E08 ± 1.4E06 [-]

Type Mass Ratio

Type Sun to (136199) Eris

astroconst.aa.**m_s_over_m_j = 1047.348644**

1.047348644E03 ± 1.7E-05 [-]

Type Mass Ratio

Type Sun to Jupiter

astroconst.aa.**m_s_over_m_ma = 3098703.59**

3.09870359E06 ± 2E-02 [-]

Type Mass Ratio

Type Sun to Mars

astroconst.aa.**m_s_over_m_me = 6023600.0**

6.0236E06 ± 3E02 [-]

Type Mass Ratio

Type Sun to Mercury

astroconst.aa.**m_s_over_m_n = 19412.26**
1.941226E04 ± 3E-02 [-]

Type Mass Ratio

Type Sun to Neptune

astroconst.aa.**m_s_over_m_p = 136566000.0**
1.36566E08 ± 2.8E04 [-]

Type Mass Ratio

Type Sun to (134340) Pluto

astroconst.aa.**m_s_over_m_sa = 3497.9018**
3.4979018E03 ± 1E-04 [-]

Type Mass Ratio

Type Sun to Saturn

astroconst.aa.**m_s_over_m_u = 22902.98**
2.290298E04 ± 3E-02 [-]

Type Mass Ratio

Type Sun to Uranus

astroconst.aa.**m_s_over_m_ve = 408523.719**
4.08523719E05 ± 8E-03 [-]

Type Mass Ratio

Type Sun to Venus

astroconst.aa.**m_sun_over_m_earthmoon = 328900.5596**
328900.5596 ± 7E-04 [-]

Type Mass Ratio

Type Sun to Earth + Moon

astroconst.aa.**m_vesta_over_m_s = 1.35e-10**
1.35E-10 ± 3E-12 [-]

Type Mass Ratio

Type

(4) Vesta to Sun

astroconst.aa.**msat_over_mpl_ariel = 1.49e-05**
1.49E-05 [-]

Type Mass of Ariel over planet mass

astroconst.aa.**msat_over_mpl_callisto = 5.667e-05**
5.667E-05 [-]

Type Mass of Callisto over planet mass

astroconst.aa.**msat_over_mpl_europa = 2.528e-05**
2.528E-05 [-]

Type Mass of Europa over planet mass

astroconst.aa.**msat_over_mpl_ganymede = 7.805e-05**
7.805E-05 [-]

Type Mass of Ganymede over planet mass

astroconst.aa.**msat_over_mpl_io = 4.705e-05**
4.705E-05 [-]

Type Mass of Io over planet mass

astroconst.aa.**msat_over_mpl_oberon = 3.32e-05**
3.32E-05 [-]

Type Mass of Oberon over planet mass

astroconst.aa.**msat_over_mpl_titan = 0.0002367**
2.367E-04 [-]

Type Mass of Titan over planet mass

astroconst.aa.**msat_over_mpl_titania = 3.94e-05**
3.94E-05 [-]

Type Mass of Titania over planet mass

astroconst.aa.**msat_over_mpl_triton = 0.0002089**
2.089E-04 [-]

Type Mass of Triton over planet mass

astroconst.aa.**msat_over_mpl_umbriel = 1.41e-05**
1.41E-05 [-]

Type Mass of Umbriel over planet mass

astroconst.aa.**n = 9.2052331**
9.2052331 ‘’

Type Constant of nutation at epoch J2000.0

astroconst.aa.**omega = 7.292115e-05**
7.292115E-05 rad/s (TT)

Type Nominal mean angular vel.of Earth rotatio

astroconst.aa.**one_over_f = 298.25642**
298.25642 ± 1E-05 [-]

Type Earth, reciprocal of flattening IERS 2010

astroconst.aa.**one_over_tau_a = 173.144632674**
173.144632674 au/d

astroconst.aa.**p_a = 5028.796195**
5028.796195 ''/Julian century (TDB)

Type General precession in longitude

astroconst.aa.**pi_sun = 8.794143**
8.794143 ''

Type Solar parallax, pi_odot

astroconst.aa.**r_earth = 6378.1366**
6378.1366 ± 0.0001 km

Type Equatorial radius of Earth

astroconst.aa.**r_jupiter = 71492**
71492 ± 4 km

Type Equatorial radius of Jupiter

astroconst.aa.**r_mars = 3396.19**
3396.19 ± 0.1 km

Type Equatorial radius of Mars

astroconst.aa.**r_mercury = 2440.53**
2440.53 ± 0.04 km

Type Equatorial radius of Mercury

astroconst.aa.**r_moon = 1737.4**
1737.4 ± 1 km

Type Equatorial radius of Moon (mean)

astroconst.aa.**r_neptune = 24764**
24764 ± 15 km

Type Equatorial radius of Neptune

astroconst.aa.**r_pluto = 1188.3**
1188.3 ± 1.6 km

Type Equatorial radius of Pluto (134340)

astroconst.aa.**r_saturn = 60268**
60268 ± 4 km

Type Equatorial radius of Saturn

astroconst.aa.**r_sun = 696000**
696000 km

Type Equatorial radius of Sun

astroconst.aa.**r_uranus = 25559**
25559 ± 4 km

Type Equatorial radius of Uranus

astroconst.aa.**r_venus = 6051.8**
6051.8 ± 1.0 km

Type Equatorial radius of Venus

astroconst.aa.**tau_a = 499.00478384**
499.00478384 s

Type Light-time for unit distance

astroconst.aa.**tdb_0 = -6.55e-05**
-6.55E-05 s

Type TDB-TCB at T_0 = 2443144.5003725 (TCB)

astroconst.aa.**theta_0 = 0.779057273264**
0.7790572732640 revolutions

Type Earth rotation angle (ERA) at J2000.0 UT1

astroconst.aa.**w_0 = 62636853.4**
6.26368534E07 ± 0.5 m^2/s^2

Type Potential of the geoid

1.2 Module contents

AstroConst package

A Python package that provides astronomical constants. The code is being developed by Marc van der Sluys of the department of Astrophysics at the Radboud University Nijmegen, the Institute of Nuclear and High-Energy Physics (Nikhef), and the Institute for Gravitational and Subatomic Physics (GRASP) at Utrecht University, all in The Netherlands. The AstroConst package can be used under the conditions of the EUPL 1.2 licence. These pages contain the API documentation. For more information on the Python package, licence and source code, see the AstroConst GitHub page.

astroconst.**a_rad = 7.56572310579377e-16**
Radiation (density) constant, 7.56591e-16 J m^-3 K^-4

astroconst.**am2r = 0.0002908882086657216**
Factor to convert arcminutes to radians

astroconst.**amu = 1.66053904e-27**
Atomic mass unit; (mass of C12 atom)/12, 1.6605402e-27 kg

astroconst.**as2r = 4.84813681109536e-06**
Factor to convert arcseconds to radians.

astroconst.**au = 149597870700**
Astronomical unit

astroconst.**c = 299792458**
Speed of light in vacuo

astroconst.**c2k = 273.15**
Degrees Celcius to Kelvin (shift)

astroconst.**cm = 0.01**

Centimeter in SI (m)

astroconst.**d2h = 0.06666666666666667**

Factor to convert degrees to hours

astroconst.**d2r = 0.017453292519943295**

Factor to convert degrees to radians.

astroconst.**day = 86400.0**

Default day == solar day = 86400 s

astroconst.**day_sid = 0.997269663**

Siderial day in days

astroconst.**day_sol = 86400.0**

Solar day = 86400 s

astroconst.**dec_gp_2000 = 0.4734773**

27.12825° in rad

Type Dec of the Galactic pole for J2000

astroconst.**dow_en = array(['Sunday', 'Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday'], dtype='<U9')**

Capitalised day-of-week names in English.

astroconst.**dow_en_abr = array(['Sun', 'Mon', 'Tue', 'Wed', 'Thu', 'Fri', 'Sat'], dtype='<U3')**

Capitalised three-letter day-of-week abbreviations in English.

astroconst.**dow_en_abr2 = array(['Su', 'Mo', 'Tu', 'We', 'Th', 'Fr', 'Sa'], dtype='<U2')**

Capitalised two-letter day-of-week abbreviations in English.

astroconst.**dow_nl = array(['zondag', 'maandag', 'dinsdag', 'woensdag', 'donderdag', 'vrijdag', 'zaterdag'], dtype='<U9')**

Lower-case day-of-week names in Dutch.

astroconst.**dow_nl_abr = array(['zo', 'ma', 'di', 'wo', 'do', 'vr', 'za'], dtype='<U2')**

Lower-case two-letter day-of-week abbreviations in Dutch.

astroconst.**dow_nl_abr4 = array(['zon', 'maa', 'din', 'woe', 'don', 'vrij', 'zat'], dtype='<U4')**

Lower-case four-letter day-of-week abbreviations in Dutch.

astroconst.**dst_en = array(['standard time', 'daylight-savings time'], dtype='<U21')**

English DST timezone names.

astroconst.**dst_nl = array(['wintertijd', 'zomertijd'], dtype='<U10')**

Dutch DST timezone names.

astroconst.**eV = 1.6021766208e-19**

1.6021766e-19 J

Type Elementary (electron) charge in Coulomb; ElectronVolt

astroconst.**ec = 1.6021766208e-19**

1.6021766e-19 J

Type Elementary (electron) charge in Coulomb; ElectronVolt

astroconst.**enGrChar = array(['alpha', 'beta', 'gamma', 'delta', 'epsilon', 'zeta', 'eta', 'theta', 'iota', 'kappa', 'lambda', 'mu', 'nu', 'xi', 'omicron', 'pi', 'rho', 'sigma', 'tau', 'upsilon', 'phi', 'chi', 'psi', 'omega'], dtype='<U7')**

Lower-case English names for Greek characters.

astroconst.**eps0 = 0.409092599824881**

Obliquity of the ecliptic in J2000.0, degrees -> radians

astroconst.**eps2000 = 0.409092804**

Obliquity of the ecliptic at J2000.0 (radians)

astroconst.**g = 6.67428e-11**

Newton's gravitational constant

astroconst.**glon_se_2000 = 0.5747704**

32.93192° in rad

Type Galactic longitude of the Spring equinox for J2000

astroconst.**gr = 9.80665**

Mean gravitational acceleration at the Earth's surface, m s^-2

astroconst.**h2d = 15.0**

Factor to convert hours to degrees

astroconst.**h2r = 0.2617993877991494**

Factor to convert hours to radians.

astroconst.**h_bar = 1.0545718001391127e-34**

Reduced Planck constant, J s

astroconst.**h_p = 6.62607004e-34**

Planck's constant, 6.6260755e-34 J s

astroconst.**htmlGrChar = array(['α', 'β', 'γ', 'δ', 'ε', 'ζ', 'η', 'θ', 'ι', 'κ', 'λ', 'μ', 'ν', 'ξ', 'ο', 'π', 'ρ', 'σ', 'τ', 'υ', 'φ', 'χ', 'ψ', 'ω'], dtype='<U9')**

HTML codes for lower-case Greek characters.

astroconst.**jd1820 = 2385801**

JD in 1820 (when T=0)

astroconst.**jd1875 = 2405890**

JD at J1875.0 (when constellation boundaries were defined)

astroconst.**jd1900 = 2415021**
JD at J1900.0

astroconst.**jd1950 = 2433283**
JD at J1950.0

astroconst.**jd2000 = 2451545**
00 UT)

Type JD at J2000.0 (2000-01-01 12

astroconst.**k_b = 1.38064852e-23**
Boltzmann constant, 1.380658e-23 J/K

astroconst.**km = 1000.0**
Kilometer in SI (m)

astroconst.**l_sun = 3.85e+26**
Solar luminosity in SI (W)

astroconst.**m_h = 1.673532757988e-27**
Mass of a hydrogen atom

astroconst.**m_sun = 1.9891e+30**
Solar mass in SI (kg)

astroconst.**mas2r = 4.84813681109536e-09**
Factor to convert milliarcseconds to radians.

astroconst.**mlen = array([31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31])**
Length of the months (for non-leap year).

astroconst.**mm = 0.001**
Millimeter in SI (m)

astroconst.**month = 2629748.16**
Default month == Gregorian month in seconds.

astroconst.**month_ano = 2380713.1094592**
apside to apside, for J2000.0.

Type Anomalistic month in seconds

astroconst.**month_drac = 2351135.8785888**
node to node, for J2000.0.

Type Draconic month in seconds

astroconst.**month_greg = 2629748.16**
average calendar month length of 4800 months over 400 years.

Type Gregorian month in seconds

astroconst.**month_sid = 2360591.5576608**
fixed star to fixed star, for J2000.0.

Type Sidereal month in seconds

astroconst.**month_syn = 2551442.8768992**

phase to phase, for J2000.0.

Type Synodic month in seconds

astroconst.**month_trop = 2360584.7056224**

equinox to equinox, influenced by precession, for J2000.0.

Type Tropical month in seconds

astroconst.**months_en = array(['', 'January', 'February', 'March', 'April', 'May', 'June', 'July', 'August', 'September', 'October', 'November', 'December'], dtype='<U9')**

Capitalised month names in English.

astroconst.**months_en_abr = array(['', 'Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug', 'Sep', 'Oct', 'Nov', 'Dec'], dtype='<U3')**

Capitalised month abbreviations in English.

astroconst.**months_en_abr_lc = array(['', 'jan', 'feb', 'mar', 'apr', 'may', 'jun', 'jul', 'aug', 'sep', 'oct', 'nov', 'dec'], dtype='<U3')**

Lower-case month abbreviations in English.

astroconst.**months_en_lc = array(['', 'january', 'february', 'march', 'april', 'may', 'june', 'july', 'august', 'september', 'october', 'november', 'december'], dtype='<U9')**

Lower-case month names in English.

astroconst.**months_nl = array(['', 'januari', 'februari', 'maart', 'april', 'mei', 'juni', 'juli', 'augustus', 'september', 'oktober', 'november', 'december'], dtype='<U9')**

Lower-case month names in Dutch.

astroconst.**months_nl_abr = array(['', 'jan', 'feb', 'mrt', 'apr', 'mei', 'jun', 'jul', 'aug', 'sep', 'okt', 'nov', 'dec'], dtype='<U3')**

Lower-case month abbreviations in Dutch.

astroconst.**months_nl_abr_cap = array(['', 'Jan', 'Feb', 'Mrt', 'Apr', 'Mei', 'Jun', 'Jul', 'Aug', 'Sep', 'Okt', 'Nov', 'Dec'], dtype='<U3')**

Capitalised month abbreviations in Dutch.

astroconst.**months_nl_cap = array(['', 'Januari', 'Februari', 'Maart', 'April', 'Mei', 'Juni', 'Juli', 'Augustus', 'September', 'Oktober', 'November', 'December'], dtype='<U9')**

Capitalised month names in Dutch.

astroconst.**moonphase_en = array(['New Moon', 'First Quarter', 'Full Moon', 'Last Quarter'], dtype='<U13')**

English names of Lunar phases.

astroconst.**moonphase_nl = array(['Nieuwe Maan', 'Eerste Kwartier', 'Volle Maan', 'Laatste Kwartier'], dtype='<U16')**

Dutch names of Lunar phases.

astroconst.**mum = 1e-06**

Micrometer in SI (m)

astroconst.**nm = 1e-09**

Nanometer in SI (m)

astroconst.**pi = 3.141592653589793**

astroconst.**pi2 = 6.283185307179586**

2

astroconst.**pio2 = 1.5707963267948966**

/2

astroconst.**pio4 = 0.7853981633974483**

/4

astroconst.**pl_a = array([3.84400000e+08, 5.79093357e+10, 1.08204140e+11, 1.49597871e+11, 2.27942276e+11, 7.78327802e+11, 1.42698417e+12, 2.87093274e+12, 4.49706159e+12, 5.91345423e+12])**

Planet semi-major axes (m); [0]=Moon

astroconst.**pl_d = array([3.47620600e+06, 4.87940000e+06, 1.21980000e+07, 1.27562732e+07, 6.79240000e+06, 1.42984000e+08, 1.20536000e+08, 5.11180000e+07, 4.95280000e+07, 2.39000000e+06])**

Equatorial planet diameters (m); [0]=Moon; Venus = 12103.6km + clouds?

astroconst.**pl_p = array([2.36045800e+06, 7.60035920e+06, 1.94137573e+07, 3.15569252e+07, 5.93528960e+07, 3.74328247e+08, 9.29575501e+08, 2.65142863e+09, 5.20058127e+09, 7.82422403e+09])**

//en.wikipedia.org/wiki/Orbital_period); [0]=Moon.

Type Planet orbital periods (s - https

astroconst.**pl_r = array([1738103. , 2439700. , 6099000. , 6378136.6, 3396200. , 71492000. , 60268000. , 25559000. , 24764000. , 1195000.])**

Planet equatorial radii (m) = pland/2.

astroconst.**plname_en = array(['Moon', 'Mercury', 'Venus', 'Sun', 'Mars', 'Jupiter', 'Saturn', 'Uranus', 'Neptune', 'Pluto'], dtype='<U7')**

Capitalised planet names.

astroconst.**plname_en_abr = array(['Moon', 'Mer.', 'Ven.', 'Sun', 'Mars', 'Jup.', 'Sat.', 'Ura.', 'Nep.', 'Plu.'], dtype='<U4')**

Capitalised planet abbreviations.

astroconst.**plname_en_lc = array(['moon', 'mercury', 'venus', 'sun', 'mars', 'jupiter', 'saturn', 'uranus', 'neptune', 'pluto'], dtype='<U7')**

Lower-case planet names.

astroconst.**plname_nl = array(['Maan', 'Mercurius', 'Venus', 'Zon', 'Mars', 'Jupiter', 'Saturnus', 'Uranus', 'Neptunus', 'Pluto'], dtype='<U9')**

Capitalised Dutch planet names.

astroconst.**plname_nl_abr = array(['Maan', 'Mer.', 'Ven.', 'Zon', 'Mars', 'Jup.', 'Sat.', 'Ura.', 'Nep.', 'Plu.'], dtype='<U4')**

Capitalised Dutch planet abbreviations.

astroconst.**plname_nl_lc = array(['maan', 'mercurius', 'venus', 'zon', 'mars', 'jupiter', 'saturnus', 'uranus', 'neptunus', 'pluto'], dtype='<U9')**

Lower-case Dutch planet names.

astroconst.**r2am = 3437.7467707849396**

Factor to convert radians to arcminutes

astroconst.**r2as = 206264.80624709636**

Factor to convert radians to arcseconds.

astroconst.**r2d = 57.29577951308232**

Factor to convert radians to degrees.

astroconst.**r2h = 3.819718634205488**

Factor to convert radians to hours.

astroconst.**r2mas = 206264806.24709636**

Factor to convert radians to milliarcseconds.

astroconst.**r_earth = 6378136.6**

Equatorial radius of the Earth in SI (m), WGS84

astroconst.**r_sun = 695990000.0**

Solar radius in SI (m)

astroconst.**ra_gp_2000 = 3.3660329**

192.85948° in rad

Type RA of the Galactic pole for J2000

astroconst.**sigma = 5.6703668160832706e-08**

Stefan-Boltzmann constant, 5.67051e-8 J m^-2 K^-4 s^-1

astroconst.**sol_const = 1361.5**

Solar constant in W/m^2 (Wikipedia)

astroconst.**year = 31556925.187488**

Default year == tropical year (s), for J2000.0.

astroconst.**year_anom = 31558432.5386496**

apside to apside, for J2000.0

Type Anomalistic year in seconds

astroconst.**year_greg = 31556952.0**

assumes 97 leap years in 400 years, for J2000.0

Type Gregorian year in seconds

astroconst.**year_jul = 31557600.0**

assumes 100 leap years in 400 years, for J2000.0

Type Julian year in seconds

astroconst.**year_sid = 31558149.7676064**

fixed star to fixed star, for J2000.0

Type Siderial year in seconds

astroconst.**year_trop = 31556925.187488**

equinox to equinox, influenced by precession, for J2000.0

Type Tropical year in seconds

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