Re: Mixed Coordinate conversion − ra from long and dec

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Here is an exercise for you and be sure to take your time.

If the Ra\Dec system works using 3 years of 365 days and 1 year of 366 days,actually requires those values to work,can you guess what it means as an accurate reflection of the Earth's orbital motion when you force the stellar background into heliocentric reasoning.

http://www.dur.ac.uk/john.lucey/users/sidereal_day.gif

http://www.bedford.k12.ny.us/flhs/science/geoscience/images/siderealdaysm.jpg

A few years ago ,many would happily play along with your simpleminded celestial sphere system couched in non geometric language but that is then and this is now.When you base the Earth's orbital motion on the calendrical system you get pure junk couched in wonderful math

Bill Owen wrote:

> Dave Blake wrote:
>
> > Can any one help me with a bit of math.
> > I would like to get right ascension given the celestial longitude and declination of an object. Yes, that's right I do mean mixed co−ordinate systems. I know the equations that convert ecliptical to equatorial co−ordinates e.g. celestial long and lat to ra and dec (and vica versa) but I'm darned if I can get the trig re−arranged to give ra as a function of celestial longitude and declination. Not so worried about celestial lat, but it could be part of it.
> >
> > It might sound odd, but I really do need to solve this. Hope this is right place to try.
>
> Yup. In what follows, I'll use (a,d) for (RA,Dec) and (l,b) for ecliptic (lon,lat) and e for the obliquity, just to save keystrokes.

(Note that l and b are really lambda and beta, NOT galactic coordinates!)

Use rectangular coordinates. The conversion from (RA,Dec) to (lon,lat):

cos l cos b = cos a cos d
sin l cos b = cos e sin a cos d + sin e sin d
sin b = −sin e sin a cos d + cos e sin d

Divide the second equation by the first:

sin l cos e sin a cos d + sin e sin d
−−−−− = −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
cos l cos a cos d

This equation contains RA, longitude, declination, and obliquity −− the latitude has been removed. We need to solve it for RA in terms of the others. Cross multiply and gather everything on one side:

sin a (cos e cos d cos l) − cos a (cos d sin l) + sin e sin d cos l = 0

Now −− here's the tricky part −− make the substitution

cos e cos d cos l = m cos M
cos d sin l = m sin M
sin e sin d cos l = C

so the previous equation reduces to

sin a (m cos M) − cos a (m sin M) + C = 0

or

m sin (a−M) = −C

whose solution is

a = M + arcsin (C/m)

where

M = atan2 (sin l, cos e cos l)
m = cos d sqrt (sin^2 l +cos^2 e cos^2 l)

Use the principal value for arcsin (C/m) and the 4−quadrant arctan to get M.

As one would expect, this blows up at the poles. :−)

I'll leave it as an exercise for the reader to prove that |C/m| <=1 for all physically possible combinations of declination and longitude.

−− Bill Owen

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