

VLA SCIENTIFIC MEMO 145

The New IAU Precession Procedures

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The changes in precession resolved by the IAU are:

- 1) The new standard coordinate system will be equator and equinox of 2000.
- 2) Newcomb's precession constant is altered by approximately $1.''3/\text{century}$.
- 3) Standard mean coordinates will refer to the beginning of the Julian year (January 1.50 2000) rather than the Besselian year (January 0.72 2000)
- 4) E terms will be removed. That is, positions will be in a coordinate system stationary relative to the solar system barycenter.
- 5) A new Theory of Nutation will be used.

The Besselian day numbers in the Astronomical Almanac will reflect these changes beginning in 1984. It would seem to behoove us to get our house in order by the same date.

The new system is explained in USNO circular 163. An abstract of its procedure for "Conversion of epoch 1950.0 radio source position catalogs" follows.

- "1. Determine the (weighted) mean epoch of observations....
- "2. Compute the mean place of each source at its mean epoch of observations, using... the old (Newcomb) precession formulas....
- "3. For each source, add the following correction to its right ascension at the mean epoch of observations:
$$\Delta\alpha = 0.0775 + 0.0851 T + 0.0002 T^2 \text{ seconds,}$$
where T represents the mean epoch of observations, expressed in Julian centuries from JD 2451545.0 (1.5 Jan 2000)....
- "4. Compute the mean place of each source at JD 2451545.0 (1.5 Jan 2000) using the mean place at the mean epoch of observations, resulting from steps 2 and 3, and the new precession formulas...."

This procedure is incorrect because in constructing radio catalogs, usually one or a few sources were chosen to have a fixed 1950 coordinate. Radio 1950 coordinates have been a little more nearly inertial than the optical, because of this rotation about the 1950 pole to make radio catalogs agree.

Three conversion procedures are needed for going from 1950 to 2000.

First, we need the astrometrists procedure. This ideally replaces step 3 of the USNO procedure by a rotation in α so that the sources used to set right ascensions will end up at some conventional right ascension in 2000 coordinates. This conventional right ascension should, ideally, involve looking at the original optical measurements, which placed the objects on the system of the FK4, assigning them a proper motion appropriate to the change in precession constant (about 1.3" per century), and following the procedure of USNO Circular 163 for converting FK4 based positions to the new system. Alternately, it could be set for agreement with one of the new astrometric catalogs already published in 2000 coordinates.

Second, we need the run-of-the mine observer's procedure for converting his observations from 1950 to 2000. Best for this is to allow an astrometrist to convert the positions of his calibrators. The observer should then precess the positions of his source and his calibrators to the epoch of observation using the Newcomb precession (using the positions he used at observe time), and also precess the 2000 positions of his calibrators back to the epoch of observations using the new IAU precession. He should then adjust the position of his source by the difference in positions of his calibrators precessed back from those precessed forward, and then precess his source position to 2000 using the new IAU precession.

Third, we need a quick and easy procedure useful when highest precision is not needed, eg in converting someone else's map in 1950 coordinates to a 2000 phase tracking center for observing. This could be built into OBSERV, as well as other places. It would simply replace step 3 of the USNO procedure by a constant offset in right ascension (perhaps chosen to maximize conformity between our 1950 calibrator positions and the right ascensions in the new VLBI astrometric catalogs which quote positions in coordinates of 2000).

The things we need to do are:

1. Implement the changes in the on-line programs. It seems impossibly confusing unless we have two conventions: a) The old procedures will be used for precession from 1950 coordinates and the new procedures will be used for precession from 2000 coordinates; and b) The output (map) coordinates will be on the same system as the input coordinates.
2. Develop a calibrator list in 2000 coordinates.

3. Program the easy procedure outlined above and make it so available that observers will actually use it.

A final note must be added on the subject of source names. The IAU, at the last general assembly, declined to answer the question of whether IAU style names should continue to reflect 1950 coordinates of the objects, or whether they should also permit 2000 coordinates. As soon as we have calibrator lists in 2000 coordinates, the problem will come to a head. Personally, I think the only sensible solution is to rename the sources, but I recognize the possibility of dissent. I suspect we shall have to remain schizophrenic on the subject until the IAU resolves it in 1985.

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