Erratum: The post-Newtonian gravitomagnetic spin-octupole moment of an oblate rotating body and its effects on an orbiting test particle; are they measurable in the Solar system?

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In Iorio (2019), due to the unfortunate and misleading definition\(^1\) \(J_2 = -\varepsilon^2/5\) of equation (5), the dimensionless quadrupole-type parameter \(J_2\) entering the analytically computed post-Newtonian spin-octupole orbital precessions of equations (6) to (15) differs from the even zonal harmonic \(J_2\) usually determined in standard spacecraft-based geodetic and geophysical data reductions which is, indeed, positive. Moreover, also their magnitudes are different, as can be straightforwardly noted in the case of Jupiter. Indeed, as per the IAU 2015 Resolution B3 on Recommended Nominal Conversion Constants for Selected Solar and Planetary Properties available on the Internet at https://www.iau.org/administration/resolutions/general_assemblies/, the nominal polar and equatorial radii of Jupiter amount to 66,854 km and 71,492 km, respectively, yielding \(-\varepsilon^2/5 = -0.0251\). Its size is larger than the Juno-based positive value \(J_2 = 0.0147\), listed in Table 1, by a factor of 1.7084. Actually, the Juno-based, positive value \(J_2 = 0.0147\) of Table 1 was erroneously used in calculating the gravitomagnetic precessions \(\dot{e}_{gm}, \dot{I}_{gm}, \Omega_{gm}, \dot{\omega}_{gm}\) quoted in Tables 2 to 4 and mentioned throughout the paper, and in producing\(^2\) Figs 1 to 4 and the post-Newtonian spin-octupole curves in the upper-left panels of Figs 5 to 19 instead of \(-\varepsilon^2/5\). As a consequence, there is a minus sign mistake in \(\dot{e}_{gm}, \dot{I}_{gm}, \Omega_{gm}, \dot{\omega}_{gm}\) of Tables 2 to 4, and in the post-Newtonian gravitomagnetic spin-octupole signatures displayed in Figs 1 to 4 and in the upper-left panels of Figs 5 to 19. Moreover, the magnitudes of \(\dot{e}_{gm}, \dot{I}_{gm}, \Omega_{gm}, \dot{\omega}_{gm}\) in Tables 2 to 4, and the amplitudes in Figs 1 to 4 and of both the Newtonian and post-Newtonian curves in the upper-left panels of Figs 5 to 19 are smaller than the correct ones by a factor of 1.7084. As such, all the curves of the post-Newtonian spin-octupole effect in Figs 1 to 4 and in the upper-left panels of Figs 5 to 19 should be flipped, and their sizes, along with those of the Newtonian signatures in the upper-left panels of Figs 5 to 19, rescaled by a factor of 1.7084. Luckily, it strengthens our conclusions since it increases the signal-to-noise ratio of the post-Newtonian spin-octupole effect. The mutual (de)correlations of the post-Newtonian spin-octupole signatures with the classical ones in the upper-left panels of Figs 5 to 19 change accordingly. In the captions of Figs 5 to 19, the values of \(J_2^{\ell = 2, 3, \ldots, 12}\) and \(C_2^{\ell = 2, 3, \ldots, 12}, S_2^{\ell = 2, 3, \ldots, 12}\) associated with the post-Newtonian spin-octupole effects should be rescaled by a factor of 1.7084. All the figures in the second column from the left of Table 5 should be reduced by a factor of 1.7084, which is a fortunate circumstance since it implies smaller improvements in our knowledge of the Jovian Newtonian multipoles to detect the post-Newtonian spin-octupole signatures. Finally, it would likely be more correct to replace \(GS\dot{\Theta}_c e^{-2}\) with, say, \(GSc^2 e^{-2}\) throughout the paper to avoid further misunderstandings; in particular, it would be better to replace \(J_2\) in the analytical precessions of equations (6) to (15) with \(-\varepsilon^2/5\).

The conclusions pertaining the other post-Newtonian effects remain unchanged.

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\(^1\) It comes from equation (27) of Panhans & Soffel (2014) for \(n = 1\). It reproduces incorrectly equation (56) of Klioner (2003) which, in fact, contains \((-1)^{n+1}\) instead of \((-1)^n\) entering equation 27 of Panhans & Soffel (2014). However, it is the post-Newtonian spin-octupole acceleration relying upon \(\phi_{gm}\) of equation (32) of Panhans & Soffel (2014) that matters; it is independent of all such unnecessary definitions.

\(^2\) In case of Fig. 1, it is not relevant since its purpose was just confirming the analytical calculation of equations (6) to (15) with a numerical integration of the equations of motion in the case of a fictitious astronomical scenario: the numerical values actually adopted for the primary’s physical properties are unimportant.