The gravitational "Magnus" effect

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ABSTRACT

It is well known that a spinning body moving in a fluid suffers a force orthogonal to its velocity and rotation axis — it is called the Magnus effect. Recent (indirect) theoretical arguments [2] and numerical simulations of spinning black holes [3] have suggested that a somewhat analogous effect may occur for purely gravitational phenomena. The magnitude and precise direction of this "gravitational Magnus effect" is however still the subject of debate. Starting from the rigorous equations of motion for spinning bodies in General Relativity (Mathisson-Papapetrou equations), we show that indeed such an effect takes place, being actually a fundamental part of the spin-curvature force. We compute it explicitly for some astrophysical systems of interest: galactic dark matter haloes, black hole accretion disks, and the cosmological FLRW background. It is seen to lead to secular orbital precessions potentially observable by future astrometric experiments and gravitational-wave detectors.

References

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