FSM4S_11986

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Inverse Magnus Force in Free Molecular Flow

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A particle interaction model is introduced for calculating the sidewise force on spinning projectiles in a rarefied gas. The simple method reproduces the result obtained recently by Borg, Söderholm and Essén for a sphere using probabilistic calculation, and can be extended to other shapes and also to flows with shear. For high Knudsen number uniform flows, the sidewise force on spinning and translating objects is in the opposite direction to the classical Magnus force in continuum flows. This inverse Magnus force is calculated for cylinders and right parallelepipeds of various section. For a sphere, a cylinder, and parallelepipeds of regular polygon section with even number of sides, the force is steady and proportional to one-half of the mass of gas displaced by the body. We hypothesize that this is a universal property of a class of planar objects having convex section with two perpendicular axes of reflectional symmetry.

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