

Highly Reliable Rotational Decay Experiments *

J. K. FREMERY

Institute of Physical Chemistry, University Bonn, Germany

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A brief report is given of some recent experiments which have been conducted in order to prove the existence of a gravitational radiation effect proposed by Keith (1963).

The investigation of the rotational decay of freely spinning rotors has largely developed since the invention of the axial magnetic suspension by HOLMES¹. A lot of experimental improvements have been made by several authors in order to minimize the drag of high-speed rotors. At pressures down to 10^{-7} Torr the drag may essentially be ascribed to gas friction². In ultra-high vacuum, the residual drag^{3,4} is mainly due to energy dissipation associated with eddy current phenomena. A complete theory of eddy current losses within a magnetically suspended rotating sphere has been developed by KEITH⁵. This theory fairly agrees with earlier experiments, showing that such losses are caused by the earth rotation and by asymmetries of the suspension field⁶. Recent experiments with a new cavity type permanent magnet suspension system^{7,8} excellently confirm the above theory, so that the rotor drag which is caused by the "interior" (inside the rotor) eddy currents can now be quantitatively eliminated by evaluation. Also the "exterior" eddy current losses, which are generated in conducting parts of the suspension system due to the rotating component of the rotor magnetization^{9,4}, can now be quantitatively accounted for. This is accomplished by means of a new "multiple-branch"

method of recording drag-versus-speed measurements⁷. This method also helps to avoid errors due to relaxation processes associated with spin axis displacements and plastic flow of the rotor material at high speeds⁴. In a continuous long-term experiment we have recorded about eighty primary values (each measurement requires a whole day of observation) of the decay ratio $-\dot{\omega}/\omega$ of a freely spinning 2.5 mm diam ball bearing sphere as a function of its angular velocity ω ⁷. The measured (uncorrected) residual drag at high rotor speeds ($\omega/2\pi = 50 \dots 90$ kHz) was of the order 10^{-9} sec^{-1} at a reliability in the $10^{-12} \text{ sec}^{-1}$ range. After correction of the primary results for both exterior and interior eddy current losses, there remains a significant drag of the order $10^{-11} \text{ sec}^{-1}$, which increases markedly with the rotor frequency. A lot of phenomena, such as gas friction, electrodynamic, vibrational, and elasticity¹⁰ effects, have been discussed without finding an explanation of the small overhanging drag. It seems interesting, however, that this drag coincides quite well with a gravitational radiation effect proposed by KEITH^{11,12}. Although we originally had the intention of verifying the Keith effect, as other workers have also attempted in the past¹³, we cannot do so at the moment on the basis of our present results. It is impossible to state categorically whether the observed effect is due to gravitational interactions or to some different cause, and this question cannot be resolved until our results have been checked under modified experimental conditions. It seems worthwhile at this time to prove the validity of Keith's predictions also from a theoretical point of view. A first comment has been given very recently by REINHARDT and ROSENBLUM¹⁴.

Reprint requests to Dr. J. K. FREMERY, Institut für Physikal. Chemie, Universität Bonn, D-5300 Bonn.

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