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Radiation force on spheres in acoustic beams and related aspects of scattering

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The close connection between the acoustic radiation force on objects in fluids and the angular distribution of the farfield scattering is especially useful in cases where dissipative effects are weak in the surrounding fluid. This connection also applies to objects illuminated by acoustic beams and has been used to extend the analysis of scattering by spheres in Bessel beams [P. L. Marston, J. Acoust. Soc. Am. 121, 753-757 (2007); 122, 247-252 (2007)] to the evaluation of the radiation force on spheres [P. L. Marston, J. Acoust. Soc. Am. 120, 3518-3524 (2006); 122, 3162-3165 (2007)]. The quantitative predictions (which include situations of negative radiation force) have been verified by nearfield analysis of the radiation force using the finite element method. We have also examined the radiation force on a sphere for a special case of co-propagating Bessel beams having unequal beam parameters. The scattering of a higher order Bessel beam by a sphere placed on the axis has also been analyzed. The backscattering in that case vanishes in agreement with prior predictions [B. T. Hefner and P. L. Marston, J. Acoust. Soc. Am. 106, 3313-3316 (1999)] for a general class of helicoidal acoustic beams. [Supported by NASA and ONR.]