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Negative radiation forces and the asymmetry of scattered radiation: spheres in Bessel beams PHILIP L. MARSTON, LIKUN ZHANG, Washington State University — The discovery that acoustical [1] and optical [2,3] radiation forces computed on spheres placed on the axis of acoustical and optical Bessel beams may be opposite the direction of beam propagation makes it appropriate to reexamine the relationship between radiation forces and the asymmetry of the scattered radiation. For all of the previously identified acoustical cases in which the force was negative and the scattering pattern was also computed, it was found that the backscattering was suppressed and the forward scattering relatively enhanced (see e.g. [1]). In the present research the acoustic radiation force on an arbitrary isotropic sphere is related to the asymmetry in the scattering and the extinction introduced by the sphere for the case of a helical Bessel beam of arbitrary order [4]. The analysis confirms that conditions are more favorable for generating negative forces when the asymmetry is such that the backscattering is suppressed relative to the forward scattering. It is also found, however, that absorption of power by the sphere gives rise to a positive force contribution, a term which has been neglected in the corresponding optical analysis [2].
[1] P. L. Marston, J. Acoust. Soc. Am 120, 3518 (2006). [2] J. Chen et al., Nature Photonics (2011). [3] A. Novitsky & C.-W. Qiu, arXiv:1102.5285v1 (2011). [4] L. K. Zhang & P. L. Marston (submitted).

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