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Rotational Doppler effect in third-harmonic generation from spinning molecules ILYA SH. AVERBUKH, Weizmann Institute of Science, Rehovot , Israel, J. ZYSS, Laboratoire de Photonique Quantique et Moléculaire, Ecole Normale Supérieure de Cachan, France, A. MILNER, V. MILNER, Department of Physics and Astronomy, University of British Columbia, Vancouver, Canada, E. PROST, E. HERTZ, F. BILLARD, B. LAVOREL, O. FAUCHER, Laboratoire Interdisciplinaire CARNOT de Bourgogne, UMR 6303 CNRS-Université Bourgogne Franche-Comté , Dijon, France — The angular Doppler effect results from interaction of a rotating body with a circularly-polarized (CP) light. In linear optics, it was first evidenced by observing the frequency shift imparted to a CP light transmitted through a mechanically rotated wave plate [Opt. Commun., **31**, 1 (1979)], and more recently, demonstrated in our experiments with fast spinning molecules [Nat Photon. **7**, 711 (2013); Phys.Rev.Lett. **112**, 113004 (2014); Phys.Rev.Lett. **114**, 103001 (2015)]. We present here the first observation of the nonlinear rotational Doppler shift in the frequency of optical harmonic generated in fast rotating molecules. Conservation of energy and angular momentum in the light-molecule interaction suggests four different kinds of nonlinear shifts depending on the mutual handedness of the circularly polarized fundamental and harmonic fields, as well as the handedness of the molecular rotation. All four types of the frequency shifts were observed in our experiments on third-harmonic generation in a gas of fast spinning O_2 molecules [Phys. Rev. A **94**, 051402(R) (2016)].

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