Abstract Submitted
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Direct observation, study and control of molecular super rotors ALEKSEY KOROBENKO, ALEXANDER MILNER, Department of Physics and Astronomy, University of British Columbia, JOHN HEPBURN, Department of Chemistry, University of British Columbia, VALERY MILNER, Department of Physics and Astronomy, University of British Columbia, VALERY MILNER TEAM — Extremely fast rotating molecules whose rotational energy is comparable with or exceeds the molecular bond strength are known as "super rotors". It has been speculated that super rotors may exhibit a number of unique properties, yet only indirect evidence of these molecular objects has been reported to date. We demonstrate the first direct observation of molecular super rotors by detecting coherent unidirectional molecular rotation with extreme frequencies exceeding 10 THz. The technique of an "optical centrifuge" is used to control the degree of rotational excitation in an ultra-broad range of rotational quantum numbers, reaching as high as N = 95 in oxygen and N = 60 in nitrogen. State-resolved detection enables us to determine the shape of the excited rotational wave packet and quantify the effect of centrifugal distortion on the rotational spectrum. Femtosecond time resolution reveals coherent rotational dynamics with increasing coherence times at higher angular momentum. We demonstrate that molecular super rotors can be created and observed in dense samples under normal conditions where the effects of ultrafast rotation on many-body interactions, inter-molecular collisions and chemical reactions can be readily explored.

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