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**Measurement of higher-order moments of a rotational wave packet dynamics and alignment** KLAUS HARTINGER, RANDY BARTELS, Colorado State University — Field free molecular alignment, attributed to the revivals of a rotational wave packet, has been an area of very active research recently, with numerable potential applications<sup>1</sup>. While there is very rich structure and temporal dynamics in the quantum rotational wave packet, so far, measurements have been restricted to just the first moment of the wave packet, i.e., a measurement of  $\langle\langle\cos^2\theta\rangle\rangle$ . This measure probes the transient alignment of the molecules, but does not reveal the complete dynamics of the quantum wave packet. A measurement of the rotational wave packet dynamics with a linear optical technique depends only on  $\langle\langle\cos^2\theta\rangle\rangle$  and does not provide information on higher order moments of the alignment. Third-order nonlinear interactions provide information on the  $\langle\langle\cos^4\theta\rangle\rangle$  moment and provide additional information about rotational wave packet dynamics. We present third harmonic generation experiments measuring the transient THG susceptibility, which includes the  $\langle\langle\cos^4\theta\rangle\rangle$  dynamics.

<sup>1</sup>T. Seideman, Adv. in At., Mol. and Opt. Phys., 52 (2006)

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