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Rotational wave packets probed by high harmonic generation<sup>1</sup> BRIAN K. MCFARLAND, Stanford PULSE Center, Stanford University, Stanford, CA 94305, MARKUS GUEHR, Stanford PULSE Center, Stanford University, Stanford, CA 94305 and SLAC, Menlo Park, CA 94025, JOE P. FARRELL, Stanford PULSE Center, Stanford University, Stanford, CA 94305, PHILIP H. BUCKS-BAUM, Stanford PULSE Center, Stanford University, Stanford, CA 94305 and SLAC, Menlo Park, CA 94025 — We prepare an aligned distribution of cold  $N_2$ molecules by the interaction with an intense nonresonant fs laser pulse (pump pulse). The distribution is probed by high harmonic generation (HHG) using a time delayed probe pulse. The high harmonics show an enhancement if the molecules are aligned with the probe pulse polarization and a suppression if the molecules are aligned orthogonal to the polarization. We observe a first alignment 300 fs after the pump pulse. For longer time delays, we observe fractional and full revivals (the later at about 8 ps) of the rotational wave packet. We measure the relative phase of high harmonics from  $N_2$  and Ar at the half revival for  $N_2$ , with a phase jump at the  $23^{rd}$ harmonic. The alignment contrast and phase relation among the high harmonics is discussed in the context of the two center model.

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