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Alignment-mediated entanglement of cold polar molecules[1] FELIPE HERRERA, Purdue University, K. BIRGITTA WHALEY, University of California Berkeley, SABRE KAIS, Purdue University — Many-particle entanglement can be found in the ground state of natural solids and strongly interacting atomic and molecular gases, but it is still experimentally challenging to generate highly entangled states between weakly interacting particles in a scalable way. We describe a one-step method to generate rotational entanglement between polar molecules using strong off-resonant laser pulses, in the absence of DC electric fields. The laser pulse induces molecular alignment. For a pair of polar molecules separated by up to several micrometers in optical traps, maximally entangled states can be created using a single aligning pulse with intensity in the range $10^{10} - 10^{12}$ W/cm^2 and duration in the range $10 - 10^2$ ns. We present two methods for entanglement detection. One based on local molecular orientation measurements to establish violations of Bell's inequality, and a second method based on the linear microwave absorption of the molecular ensemble. We analyze the post-pulse entanglement dynamics in noisy optical traps, and discuss applications of the system for infrared photon detection and quantum computing.

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