Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Interactions of polar molecules dressed by far-off-resonant light: Entangled dipoles up- or down-holding each other MIKHAIL LEMESHKO, ITAMP, Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts 02138, USA, BRETISLAV FRIEDRICH, Fritz Haber Institute of the Max Planck Society, Faradayweg 4-6, D-14195 Berlin, Germany, FRIEDRICH TEAM — We show that the electric dipole-dipole interaction between a pair of polar molecules undergoes an all-out transformation when superimposed by a far-off resonant optical field. The combined interaction potential becomes tunable by variation of wavelength, polarization and intensity of the optical field and its dependence on the intermolecular separation exhibits a crossover from an inverse-power to an oscillating behavior. The ability thereby offered to control molecular interactions opens up avenues toward the creation and manipulation of novel phases of ultracold polar gases among whose characteristics is a long-range entanglement of the dipoles' mutual orientation. We devised an accurate analytic model of such optical-field-dressed dipole-dipole interaction potentials, which enables a straightforward access to the optical-field parameters required for the design of intermolecular interactions in the laboratory.

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Date submitted: 28 Nov 2011 Electronic form version 1.4