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Rotational cooling of molecules in a BEC and angulon stability<sup>1</sup> MARTIN WILL, TOBIAS LAUSCH, MICHAEL FLEISCHHAUER, University of Kaiserslautern — We discuss the rotational cooling of diatomic molecules in a Bose-Einstein condensate (BEC) of ultra-cold atoms by emission of phonons with orbital angular momentum. Despite the superfluidity of the BEC there is no frictionless rotation for typical molecules since the dominant cooling occurs via emission of particle-like phonons. Only for macro-dimers, whose size become comparable or larger than the condensate healing length, a Landau-like, critical angular momentum exists below which phononemission is suppressed. We find that the angular momentum relaxation for usually sized molecules is much faster than the cooling of linear motion of impurities in a BEC. This also leads to a finite lifetime of angulons, quasi-particles of rotating molecules coupled to orbital angular-momentum phonons. The lifetimes are however still smaller than typical angulon binding energies. We are analyzing transition rates, between the angular-momentum states of the molecule, including single- and two-phonon scattering and discuss the effect of thermal phonons.

<sup>1</sup>Department of Physics and Research Center OPTIMAS

Martin Will University of Kaiserslautern

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