SFB/TRR 21 - Colloquium

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### Sisyphus Cooling of Polyatomic Molecules


Interest in ultracold polar molecules has experienced tremendous growth in recent years, with potential applications reaching beyond those of ultracold atoms due to additional internal degrees of freedom and long-range dipole-dipole interactions. Developing methods to prepare the required ensembles of ultracold molecules has been a formidable challenge. To this end, we have now achieved results with opto-electrical cooling [1-3], a general Sisyphus-type cooling scheme for polar molecules. Molecules are cooled by more than an order of magnitude with an increase in phase space density by a factor of 30. The scheme proceeds in an electric trap, and requires only a single infrared laser with additional RF and microwave fields. The cooling cycle depends on generic properties of polar molecules and can thus be extended to a wide range of molecule species. Ongoing improvements will allow cooling to sub-mK temperatures and beyond, opening wide-ranging opportunities for fundamental studies with polyatomic molecules at ultracold temperatures.



[1] M. Zeppenfeld et. al., Phys. Rev. A 80, 041401 (2009) [2] B.G.U. Englert et. al., Phys. Rev. Lett 107, 263003 (2011) [3] M. Zeppenfeld et. al., Nature 491, 570-573 (2012)


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