Carlo Bradac

University of Technology, Sydney

Cooperatively-enhanced atomic dipole forces in optically trapped nanodiamond containing NV centres in liquid

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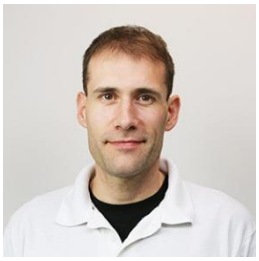
Sala Wataghin, Istituto di Fisica, via P. Giuria 1, Torino

contatto: Paolo Olivero (olivero@to.infn.it)

Abstract

We report on a new regime for optical trapping of diamond nanoparticles in liquid. While holding a nanodiamond (~150 nm) containing many NV centres (~10^3) at the focus of classical optical tweezers, we use a second laser slightly detuned from the dipole transition of the NVs. We measure a change in trap stiffness of ~10%. Remarkably, we show that our results must include collective effects – "superradiance" – between colour centres, which has never been reported before for solid-state systems at room temperature of the type Dicke proposed in 1954. We discuss how these resonant forces depend on (and can be enhanced by) the type, number, dipole strength and spectral linewidth of the centres.

The speaker



Carlo Bradac is a Research Fellow at the University of Technology, Sydney. He studied physics and engineering at the Polytechnic of Milan (Italy) where he achieved his bachelor (2004) and master degree (2006) in Engineering for Physics and Mathematics. He received his PhD in Physics at Macquarie University in 2012. He worked as an Engineer at National Instruments (2006-2007) and at Maire Tecnimont (2007-2008), and as a Research Fellow at Sydney University (2012-2013) and Macquarie University (2013-2017). He is currently at the University of Technology, Sydney. His research focuses on quantum materials and their applications. He is also a co-founder of the start-up company LuciGem (www.lucigem.com.au), producing diamond nanoparticles for quantum and bio-applications.