Ultrafast switching of semiconductor microcavities

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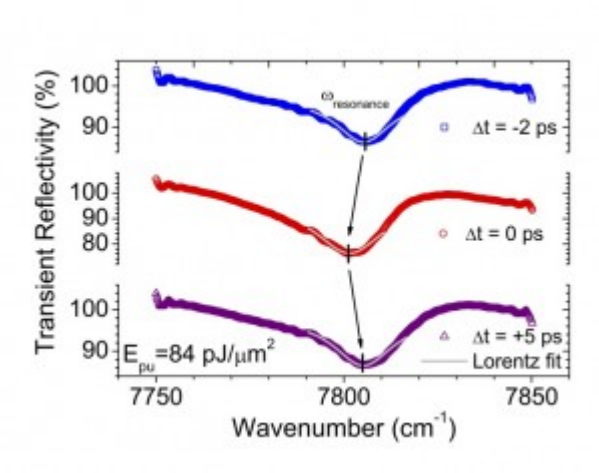

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ABSTRACT:
The interest in all-optical switching of photonic nanostructures is rapidly increasing due to the inherent speed of the process. Achieving ultrafast all-optical switching promises both new developments in information technology and a novel control of fundamental cavity quantum electrodynamics (QED). Switching photonic nanostructures is achieved by changing the refractive index of the constituent materials. To date, the switching speed has been limited by material properties but not by optical considerations. We explore the ultimate fast switching of the cavity resonance in GaAs/AlAs in the telecom range. We exploit the instantaneously fast electronic Kerr effect by the judicious tuning of the pump and probe frequencies relative to the semiconductor bandgap, resulting in a shift of the cavity resonance by nearly one linewidth. The speed of the switching – both on and off – is only limited by the dynamics of the light in our cavity [1].
We explore the not-adiabatic regime of tuning of light in a single-resonance cavity. We observe that the frequency of probe light is changed to a value different from the cavity resonance. The light accumulates a phase shift while it is trapped in the cavity due to a fast change in the refractive index, induced by an earlier pump pulse. Consequently, all light trapped in the cavity obtains a frequency different from the cavity resonance. To our knowledge, such photonic not-adiabatic tuning has not been observed before [2].
[1] G. Ctistis, E. Yüce, A. Hartsuiker, J. Claudon, M. Bazin, J.-M.Gérard, and W. L. Vos, , Appl. Phys. Lett. 98, 161114 (2011).
[2] P.J. Harding, H.J. Bakker, A. Hartsuiker, J. Claudon, A.P. Mosk, J.-M. Gérard, and W.L. Vos, J. Opt. Soc. Am. B 29, A1 (2012).