

Antennas for Light: phase matters



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The observation of quantum mechanical effects in biological processes, such as photosynthesis, has opened a lively debate as to the role of coherences in natural systems. Traditionally such coherences are probed by manipulating quantum interference effects with shaped laser pulses. Yet the intrinsic structural inhomogeneity and environmental fluctuations of complex systems at ambient conditions average out most oscillatory spectroscopic features. Only by “single molecule detection” one can hope to catch a glimpse through the disorder.

Here we present coherent control of single molecules, allowing both observation and manipulation of vibrational wave-packet interference and Rabi-oscillations in individual molecules at ambient conditions. The single-molecule approach ensures that the ultimate degree of coherent control can be realized. We have applied our novel method to single light-harvesting complexes and optical nanoantennas. Recent results on ultrafast quantum coherent energy transfer and femtosecond control of nanoscale hotspots will be presented.

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Short bio:

Niek van Hulst, PhD (1986) in Molecular & Laser-physics at University of Nijmegen (NL). After research in non-linear optics, organic materials, integrated optics and waveguides, since 1990, Assistant Professor at the University of Twente, working on near-field optics, AFM, non-linear optics, hyper Rayleigh scattering.

In 1997 he became full Professor in Applied Optics, at the MESA+ Institute for NanoTechnology (Enschede, the Netherlands), with focus on single molecule detection, nanophotonics, photonic structures, scanning probe technology, applications in molecular biology and chemistry.

Since Sep 2005, he is ICREA Professor at ICFO – Institute of Photonic Sciences – Barcelona (Spain), working in NanoPhotonics: nanoantennas, single photon emitters, nanoscale femtosecond dynamics & phase control, quantum coherence.

Recipient of the 2010 *Barcelona Science Award*, 2009 *ERC Advanced Investigator Award*; 2003 *European Science Award* (Körber foundation, Hamburg), 1997 *Shell Research Stimulation Award*.

Since 2007 he coordinates the national Spanish CONSOLIDER program “NanoLight.es – light control on the nanoscale” (2008-2013), on nanophotonics.