Science publishes new results on light communication in nano-emitters at the groups led by Prof. Niek van Hulst and Prof. Romain Quidant.

Nanoantenna fed by
a quantum dotICFO PhD Students Alberto G. Curto, Giorgio Volpe and Tim H. Taminiau, ICFO Research Fellow Dr. Mark P. Kreuzer, and ICFO Group Leaders and ICREA Prof. Romain Quidant and Prof. Niek van Hulst describe in Science a method to get unidirectional emission from single transmitters. Their results offer new possibilities to communicate energy to, from and between nano-emitters.

Nanoscale quantum emitters are key elements in quantum optics and constitute the ultimate limit in sensing. However, efficient optical excitation and detection of such emitters involves large solid angles because their interaction with freely-propagating light is omnidirectional. So far the control of directionality has mainly been pursued by photonic crystal structures and surface-plasmon-based devices.

In this paper, Curto and his collaborators demonstrate unidirectional emission of a single emitter by coupling to a nanofabricated Yagi-Uda antenna. A quantum dot is placed in the near field of the antenna, so that it drives the resonant feed element. Control of the directivity of the quantum dot emission is achieved by tuning the antenna dimensions. The antenna transforms the non-directional quantum-dot luminescence into a directed light source which can be efficiently collected, simply with a low numerical aperture. Further, the authors anticipate that the

antennas work both in emission and absorption. The near-field coupling to the antenna plasmon resonance enhances radiative transition rates, increasing the emission efficiency. Most remarkably, all this control over photon emission is obtained from an antenna that is only a single wavelength long.

The authors conclude that unidirectional optical antennas provide a new route to effectively communicate light to, from, and between nano-emitters, for example in directed, bright single-photon sources for quantum optical technologies, planar biochemical sensors, and light-harvesting and emission devices.