Rare earth and DNA nanophotonics

Dirk Bouwmeester[1,2], Donny de Bruin[1], Maria Gotz[1], and Dorris Heinrich[1]

[1]*Huygens Laboratory, Department of Physics, Leiden University, NilesBohrweg 2, Leiden, Netherlands*

[2]*University of California, Santa Barbara, Department of Physics, US*

We present two nanophotonic systems. The first system concerns rare earth ions embedded in an amorphous Silicon Nitride optical micro-resonator. We show how photon echo measurements reveal the role of two-level systems in glass in determining the quantum decoherence properties of the rare earth ions. The second nanophotonic systems is based on 5 to 20 silver atoms forming a nanocluster on DNA. The DNA base sequence determines the size and shape of the clusters which act as single photon emitters. This in turn determines the optical properties, such as the wavelength, the intensity and even the polarization. The optical properties of Ag:DNA are so sensitive that also a change in environmental conditions can be detected by analyzing the fluorescence. The binding strength of the silver atoms to the DNA also varies with the DNA host and some DNA constructs "leak out" silver inside cells while other constructs are stable. Since silver atoms in general interfere destructively with the functionality of RNA this can leads to tunable toxicity. There are a wide range of potential applications in medicine and biology.