Resonant Nanophotonics group (AMOLF)

Group leader: Femius Koenderink

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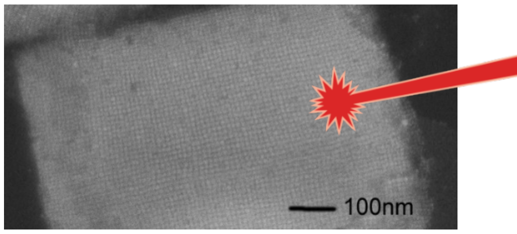
Research theme: The Resonant Nanophotonics team studies subwavelength resonators to control the emission, absorption, amplification and detection of light, on levels down to single photons and single molecules. We turn concepts from the field of plasmonic antennas and metasurfaces into nanolasers, LEDs, quantum light sources, and tools for spectroscopy and microscopy. Projects typically involve the realization of your new nanophotonic designs in the Amsterdam NanoLab cleanroom, optical microscopy, interferometry, ultrafast methods and time-resolved single-photon counting.

1/ Lasing perovskite Mie-resonant microcubes and spheres

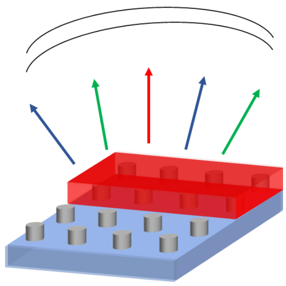
Supervisors: Nelson de Gaay Fortman and Femius Koenderink



We want to make a special quantum dot microcube laser! Together with the team of Peter Schall at UvA you will make microspheres and cubes made of densely arranged perovskite quantum dots -a material with very good light amplification properties . We will pump the particle with a powerful femtosecond pulsed green laser. We will design the size of this particle such that it efficiently absorbs green light, and store it for a long periods of time, thanks to special electric and magnetic Mie-resonances. You will investigate this particle’s scattering behavior, lasing and optical gain. You’ll do this both experimentally, in different optical setups, and/or theoretically, with models and simulation software. Our first aim is to understand how single microparticle lase. This is a first step towards how ensembles of high-gain particles can be an experimental platform for non-Hermitian photonics.

2/ Solid-State lighting for bright efficient white LEDs

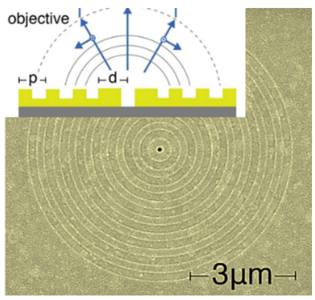
Supervisors: Debapriya Pal and Femius Koenderink



We are all experiencing a revolution in illumination: the development of white LEDs based on the conversion of bright blue LEDs and luminescent phosphors that convert blue light to white. In this project, you join our work with Lumileds, developing highly efficient and ultra-high brightness white nano-LEDs that could ultimately be deployed as pixels in displays. We envision reaching this goal by resonant interaction of designed nanostructured surfaces, known as metasurfaces, with extremely densely packed phosphor materials based on quantum dots. In this regime, new physics appears due to collective emission effects, like superradiance and strong coupling of light and matter. During the project, you will acquire training in nanofabrication, advanced optical characterization experiments and understand the rich nanophotonic theory.

3/ A highly directional single photon source

Supervisors: Ilan Shlesinger and Marko Kamp



The ability to emit single photons in a controlled way is a fundamental requisite for quantum technologies. DBT molecules are excellent single photon emitters when used at a low temperature of 4K. In this project you will design and fabricate a plasmonic nanostructure in the shape of a bullseye to be used as a directional antenna for the single photons emitted by the DBT. You will build a cryogenic Fourier microscopy setup to characterize the purity and directionality of the source.