Resonant Nanophotonics group (AMOLF)
Group leader: Femius Koenderink
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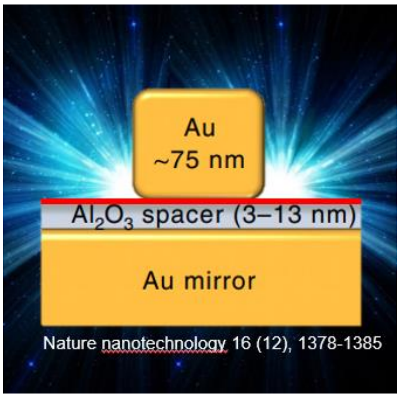
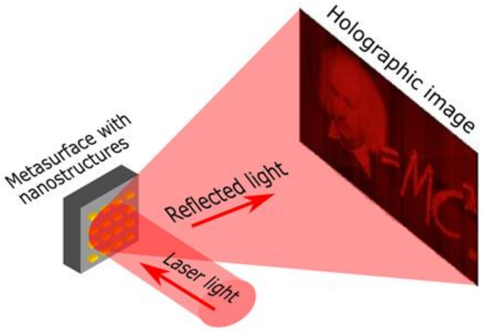
The Resonant Nanophotonics team studies subwavelength resonators to control the emission, absorption, amplification and detection of light, on levels down to single photons and single molecules. We turn concepts from the field of plasmonic antennas and metasurfaces into nanolasers, LEDs, quantum light 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. Strong nonlinear light from single atomic layers
Supervisors: Falco Bijloo and Femius Koenderink
In this project, you explore nonlinear optical signal generated from flat atomically thin layers of material that convert red femtosecond pulses into blue light. Nonlinear generation is usually an extremely weak optical phenomenon, unless you manage to reach extreme nanophotonic near-field enhancement for the pump light. We will place atomically thin layers in a very small gap between a metallic nano-antenna and a mirror. On one hand, we want to use the nonlinear signal as a means to measure the magnitude of the field enhancement in this unique geometry, while on the other hand we are interested in making efficient nonlinear light sources. The activities of the project are tunable to your preference and consist of nanofabrication, measuring the nonlinear signal with a femtosecond laser, and simulating optical responses.



2. Metasurface inverse design with holography
Supervisors: Nick Feldman and Femius Koenderink
A metasurface hologram is a nanostructured lattice of subwavelength building blocks that are individually engineered in size and positioning to project a desired image upon laser illumination. How to design a metasurface for a given image is approximately known, but can you solve the inverse problem? Can you figure out the geometry of a metasurface when you measure a particular hologram that it scatters? This question has direct applications in, e.g, microscopy or metrology, where with optical measurements your goal is to reconstruct the shape parameters of an object or device. You will have the opportunity to construct an optical setup that is able to record holograms, and fabricate metasurfaces in our cleanroom facilities that realize holograms that you design. Next, you will explore advanced algorithms to tackle the inverse problem: retrieving metasurface geometries from measured holograms.



Nature nanotechnology, 2015, 10.4: 308-312.

3. Making a new circularly polarized honeycomb nanolaser
Supervisors: Nelson de Gaay Fortman and Femius Koenderink
Would you like to help us build and understand a new 2D nanolaser? In the cleanroom we are able fabricate arrays of metallic nanoparticles that interact strongly with light. We propose a special honeycomb 2D periodic design that we coin `plasmonic graphene', where differently sized nanoparticles (see Figure) allow to mimic topological bandstructure physics, but with plasmons instead of electrons. You will make these systems lase. We expect the topology to appear in polarization handedness of the laser output. This has interesting application perspectives in light-based data processing in future chip technology. You can choose flexibly to focus on fabrication, simulations or doing experiments in our advanced optical setups.