## Photonic Forces group (AMOLF)

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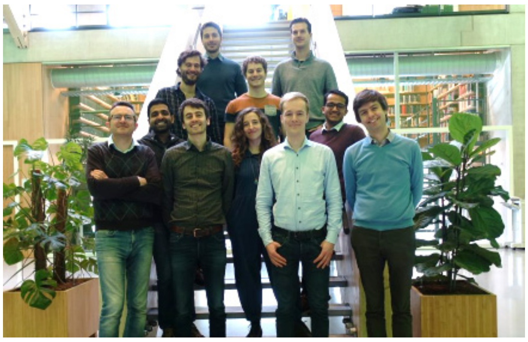
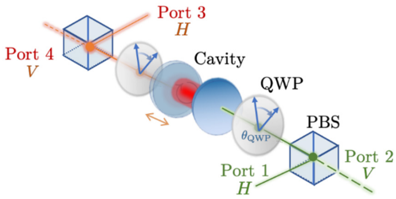


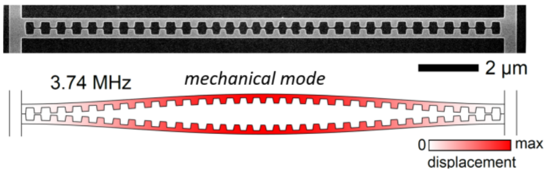
**Research theme** The *Photonic Forces* group studies light-matter interactions at the nanoscale, and in particular the coupling between light and mechanical vibrations in nano-optomechanical systems, as it can occur through radiation pressure. We use this to develop new ways to control light and sound on a chip, and study the behavior of nanomechanical resonators down to the quantum regime.

**Project 1. Optomechanical Faraday effect**
*Supervisors*: Roel Burgwal and Ewold Verhagen



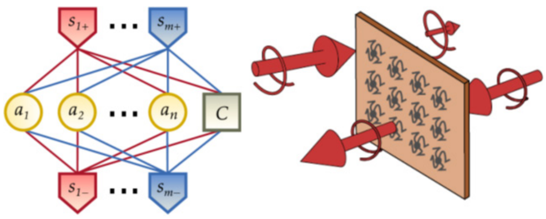

By placing a crystalline slab between two mirrors, light bouncing between the mirrors can couple to standing mechanical waves in the crystal through the process of electrostriction. The excited mechanical waves occur at GHz frequencies, as there the light and sound wavelengths are matched. We have recently predicted that using this photon-phonon interaction, the polarization of laser light reflected from the cavity can be controlled by a second laser. In this project, you will perform optical experiments that seek to demonstrate this effect. You will build a new setup to look for an optomechanical analogue of the Faraday effect: Breaking the two-way symmetry of light propagation similar to the way that a magnetic field in an optical isolator creates one-way optical transmission.

**Project 2. Ultra-coherent nano-optomechanical resonators**
*Supervisors*: Pascal Neveu and Ewold Verhagen




By measuring a mechanical resonator's oscillating position with extreme precision – at femtometer level – one could resolve mechanical quantum fluctuations and gain control over the quantum state of the resonator. In this project, you will develop new photonic crystal cavities that confine light at subwavelength scale to sensitively read out the motion of suspended nanomechanical strings. By making these strings out of silicon nitride, we aim to reduce mechanical damping to very low levels. This would boost the mechanical decoherence time such that characterization and preparation of quantum states of the string come in reach. You will design the systems, fabricate them in the cleanroom at AMOLF, and characterize their performance in high-precision optical measurement.

**Project 3. Predicting metasurface diffraction with artificial intelligence**
*Supervisor*: Ewold Verhagen (collaboration with MPL, Germany)




In (nano-)optics, it is very important to accurately predict the way light scatters from complex nanostructures. These are often periodic, like diffraction gratings, light capturing structures on solar cells, metamaterials, and photonic crystals. Design of such devices requires time-consuming full-field simulations. In this theory/computational project, you will use machine learning algorithms to accurately predict the far-field optical response of nanophotonic structures, in only a fraction of the time of conventional methods. You will combine neural networks with our recent understanding of how diffraction can be predicted from the eigenmodes of a system. This project is carried out in collaboration with the Max Planck Institute for the Science of Light (MPL) in Erlangen, Germany.