New tools for electron microscopy

Electron microscopes have developed into extremely powerful and versatile tools for research in physics, chemistry, biology, and material science. Although around since 1931 and very well developed by now, efforts to extend the usability even further are still fierce and fast-progressing. Examples are the development of ultrafast electron microscopy, which allows the study of dynamical processes on a very short timescale, combining EELS (electron energy loss spectroscopy) with electron microscopy in order to image material composition, and extending phase-contrast (Zernike) microscopy to the electron domain, which enables the imaging of non-absorbing objects.

In this talk, I will discuss novel devices for electron microscopy based on microwave cavities as well as the ponderomotive interaction with pulsed laser beams. Microwave cavities allow extensive phase space manipulation of electron beams, with applications in ultrafast and in EELS microscopy. Using the ponderomotive interaction, the actual phase of the quantum mechanical electron wavefunction can be manipulated. The latter has a direct application as an (immaterial) phase plate for Zernike phase contrast microscopy, but also opens a wider range of options in diffractive and interferometric optics with electrons.

The Eindhoven CQT group (headed by Prof. Jom Luiten) collaborates with Prof. Nahid Talebi in the ponderomotive project.