The use of extreme ultraviolet (XUV) radiation for nano-scale imaging has distinctive advantages: it is label-free, affords high contrast, allows material identification and penetrates opaque matter. Recent advances in the laser-based generation of high-flux XUV radiation render this imaging modality accessible to a growing number of users. At the same time, unique properties such as ultrafast temporal resolution attract the interest of more and more scientists. On the other hand, there are challenges: Laser-based XUV radiation usually has broad spectra while XUV imaging regularly calls for monochromatic radiation. In addition, cross-sectional imaging is a challenge.

Both challenges can be overcome by coherence tomography. In the visible spectral range, optical coherence tomography (OCT) has found widespread applications since its invention in 1990. For example, OCT is a standard diagnostic technique at ophthalmologists’ offices to date. Being a variant of white-light interferometers, the resolution of OCT scales with the square of the wavelength and the inverse of the bandwidth. This suggests that XUV coherence tomography can achieve nanometer resolution.

We report on the first demonstration of XUV coherence tomography (XCT) with a broadband high-harmonic source and show that XCT with nanometer depth resolution is indeed feasible. Moreover, XCT turns out to be highly sensitive and thus represents a very competitive non-invasive cross-sectional nano-scale imaging method that efficiently exploits broadband XUV radiation. A three-step phase retrieval algorithm allows using simple schemes while eliminating artifacts.