Spectroscopy in the vacuum-ultraviolet

To the Editor — The recently presented results in *Nature Photonics* on Fourier transform spectroscopy (FTS) in the vacuum-ultraviolet (VUV) range are truly impressive¹. With a resolution much greater than what can be attained using grating spectrometers and the innate advantages of simultaneous wavelength accuracy and broad tunability, this technological development is of great importance and it will certainly open up new fields of research. However, the implemented design is limited to operation at wavelengths longer than 40 nm, owing to miniscule reflectivities at large glancing angles of incidence for the beamsplitter. To extend FTS to even shorter wavelengths, reflection at grazing incidence is necessary. The experimental challenge is therefore to manufacture and use appropriate wavefront-dividing grazing-incidence beamsplitters. De Oliveria *et al.*¹ state that FTS using amplitude-dividing beamsplitters has so far been limited to wavelengths of larger than 140 nm, and that attempts to use wavefront-dividing beamsplitters in a Mach–Zehnder-type design² have been unsuccessful.

Here we would like to point out that a modified Mach–Zehnder Fourier transform spectrometer³, similar in conceptual design to the one described in ref. 2, has been built and tested with He I and He II radiation⁴, and was also shown to be capable of reaching wavelengths as short as 22.5 nm (55 eV; Fig. 1). Although this spectrometer is indeed based on wavefront-dividing beamsplitters as suggested in ref. 2, the scanning length is much shorter than in ref. 1 and hence it cannot yet compete in terms of energy resolution. Wavefront-dividing beamsplitters based on the microstructuring of silicon nitride membranes were recently developed⁵, which may extend the FTS technique to even shorter wavelengths.

It should be noted that large-aperture wavefront-dividing beamsplitters⁴ make it possible to use the FTS technique not only for absorption studies (as in ref. 1), but also for the analysis of secondary photons. This will not only increase the number of applications of this technique but will also facilitate resonant inelastic soft-X-ray/VUV inelastic scattering (RIXS) experiments with unprecedented energy resolution. In this energy range, the behaviour of double excitations of the helium atom

Figure 1 | Fast Fourier transform spectra of interferograms measured with a modified grazing-incidence Mach–Zehnder interferometer at the NIM beamline I3 at MAX-lab, Lund, Sweden. The interferometer probes the monochromatic beam to test the system's ability to perform FTS at various VUV energies. The energy scale was set using a 650 nm diode laser running parallel to the VUV beam through the interferometer.

(the prototype two-electron system) continues to challenge state-of-the-art atomic physics theory. Moreover, the inner shells of transition metal M-edges come within reach at such energies, allowing for RIXS investigations of the fundamental excitations in correlated compounds⁶, including most high-temperature superconductors. The ability to achieve high energy resolution is essential for such studies. We are looking forward to further developments in this exciting new field. □

References

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