



Institute for
Nanoscale Physics and Chemistry



**INPAC Lectures on Modern Trends in Nanoscience
and
Colloquium Natuurkunde en Sterrenkunde**

***The Quantum World Observed Using
Electron Waves***

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Coffee at 15:45

Celestijnenlaan 200D, room 05:11

Abstract

Quantum mechanics was first born as a law governing the behavior of electrons inside atoms. Recently, however, thanks to the development of advanced technologies, phenomena peculiar to quantum mechanics have been observed in more macroscopic regions.

We have successively developed brighter field-emission electron beams over 30 years [1] and applied them to directly observe quantum phenomena by using the wave nature of electrons. Every time we developed a brighter electron beam, new applications opened up. We can now carry out fundamental experiments in quantum mechanics that were once regarded as thought experiments. Examples include a single-electron build-up of an interference pattern and conclusive experiments on the Aharonov-Bohm effect. In addition, visualizing magnetic lines of force in h/e flux units by interference microscopy and visualizing quantized vortices in superconductors by Lorentz microscopy have become possible. This method is expected to become a useful tool for investigating quantum phenomena that have begun to be observed in more macroscopic regions.

[1] A. Tonomura, Proc. Natl. Acad. Sci. 102 No. 42, 14952, (2005).

http://www.hqrd.hitachi.co.jp/global/fellow_tonomura.cfm