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The Quantum World Observed by Electron Waves

Akira Tonomura

Advanced Research Laboratory, Hitachi, Ltd.
Frontier Research System, The Institute of Physical and Chemical Research (RIKEN), Tokyo

We can see objects in this world with our eyes. We can also see smaller objects if we use microscopes. However, as long as we use light, our ability to observe extremely small objects is limited by the wavelength of light waves. If we want to see an even smaller world we must use an electron microscope. Electrons cannot travel in the air, but they can in a vacuum and then they behave as waves. The wavelength of electrons accelerated to 150 Volts is as short as one angstrom, and decreases further as electrons move faster. Therefore, we can observe, at least in principle, very small objects down to the size of atoms and molecules. In fact, we can see viruses and crystal imperfections with electron microscopes that are not visible under optical microscopes.

However, we cannot see some tiny objects even with such powerful microscopes. Examples are “phase objects”, which do not affect the intensity but the phase of electron waves. In order to observe such objects, we have developed bright electron beams similar to a laser beam in optics. We can produce these beams from a field-emission tip.

Thanks to bright electron beams, we can now directly observe such phase objects as quantized vortices in superconductors, and such quantum phenomena as the single-electron build-up of an interference pattern, and the Aharonov-Bohm effect.

Montag, 28. Oktober, 17:30 Uhr
(ab 17:00 Uhr Kaffee)
Großer Hörsaal des Instituts für Experimentalphysik der Universität Wien
Strudlhofgasse 4/1. Stock, A-1090 Wien

Universität Wien ÖPG TU Wien

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