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Quantum Interference in Multiwall Carbon Nanotubes

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Recent low temperature conductance measurements on multiwall carbon nanotubes in perpendicular and parallel magnetic field are reported. An efficient gating technique allows for a considerable tuning of the nanotube doping level. This enables us to study extensively the signature of nanotube bandstructure in electron quantum interference effects like weak localization, universal conductance fluctuations and the Aharonov-Bohm effect. We show that the weak localization is strongly suppressed at peaks at certain gate voltages which can be linked with the bottoms of one-dimensional electronic subbands. This assignment allows a detailed comparison of theoretical calculations with the experimental data. In agreement with the theory, we find clear indications for a pronounced energy dependence of the elastic mean free with a strong enhancement close to the charge neutrality point. In large parallel magnetic field, we observe a superposition of h/2e-periodic Altshuler-Aronov-Spivak oscillations and an additional h/e-periodic contribution. The latter contribution shows a diamond-like pattern in the B/V_{gate}-plane, which reflects the magnetic field dependence of the density of states of the outermost shell of the nanotube.