



Tobias Brandes (Ed.)

Low-Dimensional Systems

Interactions and Transport Properties

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Experimental progress over the past few years has made it possible to test a number of fundamental physical concepts related to the motion of electrons in low dimensions. The production and experimental control of novel structures with typical sizes in the sub-micrometer regime has now become possible. In particular, semiconductors are widely used in order to confine the motion of electrons in two-dimensional heterostructures. The quantum Hall effect was one of the first highlights of the new physics that is revealed by this confinement. In a further step of the technological development in semiconductor-heterostructures, other artificial devices such as quasi one-dimensional 'quantum wires' and 'quantum dots' (artificial atoms) have also been produced. These structures again differ very markedly from three- and two-dimensional systems, especially in relation to the transport of electrons and the interaction with light. Although the technological advances and the experimental skills connected with these new structures are progressing extremely fast, our theoretical understanding of the physical effects (such as the quantum Hall effect) is still at a very rudimentary level. In low-dimensional structures, the interaction of electrons with one another and with other degrees of freedoms such as lattice vibrations or light gives rise to new phenomena that are very different from those familiar in the bulk material. The theoretical formulation of the electronic transport properties of small devices may be considered well-established, provided interaction processes are neglected.

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