J. Timothy Londergan John P. Carini David P. Murdock

Binding and Scattering in Two-Dimensional Systems

Applications to Quantum Wires, Waveguides and Photonic Crystals



Contents

1.	Intr 1.1 1.2	The Purpose of This Book An Overview of the Text	1 1 3	
2.	Bot	and States in Low-Dimensional Systems	7	
	2.1	Localized Modes in Constrained Two-Dimensional Systems	9	
		2.1.1 Bulges and Bound States in Tubes2.1.2 Existence of Bound States	11	
		in Curved Tubes of Constant Width	15	
		2.1.3 Bound States in Curved Tubes of Arbitrary Shape	18	
		2.1.4 Transfer-Matrix Formalism for Curved Tubes	23	
		2.1.5 Example: One-Dimensional Reduction		
		Applied to the L-Shaped Tube	31	
	2.2	Bound States in Three-Dimensional Tubes	33	
3.	Tra	nsmission and Conductance in Tubes	37	
	3.1	Transmission and Reflection in a Long Tube	37	
		3.1.1 Example: Transmission in the L-Shaped Tube	40	
	3.2	Transmission and Quantum Probability Flow	47	
	3.3	Behavior of Electrons in Quantum Heterostructures	54	
	3.4	Electron Conductance in Quantum Wires	58	
		3.4.1 Conductance for a Many-Channel System	61	
	3.5	Electron Conductance Through a Straight 2-D Channel	64	
		3.5.1 Qualitative Features of Conductance in a 2-D Channel	66	
4.	Waveguide Measurements of the Properties			
	of (Curved Tubes	71	
	4.1	EM Fields in Thin Resonating Cavities	72	
	4.2	Mapping EM Energy Densities in Waveguide Cavities	73	
	4.3	Microwave Measurements with Curved Waveguides	75	
		4.3.1 Confined Mode Studies in Waveguides	76	
		4.3.2 Waveguide Experiments		
		Above the Lowest Cutoff Frequency	78	

5.	Bine	ding and Transmission in Wires and Waveguides 81			
	5.1	Tube with a Circular Bend			
		5.1.1 Bound States in the Limit of Small Curvature 84			
		5.1.2 Bound State Properties for a Circular Bend 86			
		5.1.3 Transmission in a System with a Circular Bend 91			
	5.2	Tube with a Single Sharp Bend			
		5.2.1 Bound States for Structures with a Sharp Bend 98			
		5.2.2 Sub-Cutoff Confined Modes in Curved Waveguides 99			
	5.3	A Tube with a "T-Stub"			
		5.3.1 Transmission in Structures with T-Stubs			
	5.4	Structures with Two Coupled Cells			
		5.4.1 Bound States in Systems with Two Coupled Cells 114			
		5.4.2 Transmission Through a System with Two Coupled Cells 123			
		5.4.3 Electron Conductance in Double-Bend Quantum Wires 126			
6.	Two	o-Dimensional Systems with Finite Periodic Structure . 145			
	6.1	Bound States in Periodic 2-D Systems			
	6.2	Origin of Band Structure in Periodic Systems			
	6.3	Transmission and Conductance in Periodic 2-D Systems 157			
		6.3.1 Transmission in a "Staircase" System 157			
		6.3.2 Transmission in the "Quantum Dot Superlattice" 163			
	6.4	Defects in Quantum Wire "Crystals"			
		6.4.1 Trapped Modes in Band Gaps			
7.	Loc	alized Modes in Photonic Crystals 181			
	7.1	Maxwell's Equations in a Dielectric Medium			
		7.1.1 Band Structure in a Photonic Crystal			
	7.2	"Waveguides" in Photonic Crystals			
	7.3	"Bound States" in Photonic Crystal Waveguides 189			
		7.3.1 Bound States in Local Constrictions			
		7.3.2 Bound States			
		in Curved Photonic Band Gap Waveguides 193			
8.	Epi	logue			
A		100			
Α.	A.1	mparison of Various Approximate Quantum Wells 199 Effects of a Diffuse Surface 200			
	A.1 A.2	Potentials of Finite Depth			
	A.2 A.3	Effect of Sharp Boundaries on Transmission			
	A.3	Effect of Sharp boundaries on Transmission 202			
в.	Con	nducting Sphere on a Grounded Surface 203			
References					
\mathbf{Ind}	Index				