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国外物理名著系列 16

（注释版）

Introduction to Mesoscopic Physics

(2nd Edition)

介观物理导论

（第二版）

Y. Imry

科学出版社
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《国外物理名著系列》专家委员会名单

（按姓氏笔画排序）

国外物理名著系列序言

对于国内的物理学工作者和青年学生来讲，研读国外优秀的物理学著作是系统掌握物理学知识的一个重要手段。但是，在国内并不能及时、方便地买到国外的图书，且国外图书不菲的价格往往令国内的读者却步，因此，把国外的优秀物理原著引进到国内，让国内的读者能够方便地以较低的价格购买是一项意义深远的工作，将有助于国内物理学工作者和青年学生掌握国际物理学的前沿知识，进而推动我国物理学科研和教学的发展。

为了满足国内读者对国外优秀物理学著作的需求，科学出版社启动了引进国外优秀著作的工作，出版社的这一举措得到了国内物理学界的积极响应和支持，很快成立了专家委员会，开展了选题的推荐和筛选工作，在出版社初选的书单基础上确定了第一批引进的项目，这些图书几乎涉及了近代物理学的所有领域，既有阐述学科基本理论的经典名著，也有反映某一学科专题前沿的专著。在选择图书时，专家委员会遵循了以下原则：基础理论方面的图书强调“经典”，选择了那些经得起时间检验、对物理学的发展产生重要影响、现在还不“过时”的著作（如：狄拉克的《量子力学原理》）。反映物理学某一领域进展的著作强调“前沿”和“热点”，根据国内物理学研究发展的实际情况，选择了能够体现相关学科最新进展，对有关方向的科研人员和研究生有重要参考价值的图书。这些图书都是最新版的，多数图书都是 2000 年以后出版的，还有相当一部分是 2006 年出版的新书。因此，这套丛书具有权威性、前瞻性和应用性强的特点。由于国外出版社的要求，科学出版社对部分图书进行了少量的翻译和注释（主要是目录标题和练习题），但这并不会影响图书“原汁原味”的感觉，可能还会方便国内读者的阅读和理解。

“他山之石，可以攻玉”，希望这套丛书的出版能够为国内物理学工作者和青年学生的工作和学习提供参考，也希望国内更多专家参与到这一工作中来，推荐更多的好书。

杨国桢

中国科学院院士

中国物理学会理事长

To CYLA

前言

Mesoscopic physics is a rather young branch of science. It started about 15 years ago and has already had several exciting and instructive achievements. It enjoys the unique combination of being able to deal with and provide answers to fundamental questions of physics while being relevant for applications in the not-too-distant future. In fact, some of the experimental possibilities in this field have been developed with an eye to reducing the sizes of electronic components. It can be hoped that cross-fertilization between physics and technology will continue and go both ways. We now already understand much more about the realm intermediate between the microscopic and macroscopic. Basic questions about how the quantum rules operate and go over into the classical macroscopic regime have been and are being answered. It is hoped that the whole regime between man-made structures and naturally occurring molecules, with their modifications, will be approached and understood soon. Impressive nanoscale techniques for that future stage are being developed.

This book is written in an attempt to make these interesting issues clear to physicists, chemists, and electronic and optical engineers and technologists. The reader should have a solid background in physics, but not necessarily be conversant with advanced formal theoretical methods. The understanding of the underlying physical ideas and the ability to make quite accurate estimates should be of help to both experimental researchers and technologists. At the same time, the study of this material should be helpful to graduate physics and chemistry students for integrating and solidifying their studies of quantum mechanics, statistical mechanics, electromagnetism, and condensed-matter physics.

The author is indebted to many colleagues for collaborations related to these subjects over the years, from which much was learned and the results obtained from which constitute much of the material covered. These colleagues include: Y. Aharonov, A. Aharony, B. L.Altshuler, N. Argaman, the late A. G. Aronov, M. Ya Azbel, D. J. Bergman, M. Büttiker, G. Deutscher, O. Entin-Wohlman, B. Gavish, Y. Gefen, L. Gunther, C. Hartzstein, I. Kander, R. Landauer, N. Lang, I. Lerner, Y. Levinson, S. Mohlecke, G. Montambaux, M. Murat, Z. Ovadyahu, J. L. Pichard, P. Pincas, S. Pinhas, E. Pytte, A. Shalgi, D. J. Scalapino, A. Schwimmer, N. S. Shiren, N. Shmueli, U. Sivan, U. Smilansky, A. Stern, A. D. Stone, M. Strongin, D. J. Thouless, A. Yacoby, and N. Zanon.

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Preface to the second edition

In this edition chapters 3, 8, and 9 and the references section were modified substantially, including a new short account of some new results in very small quantum dots and recent organic and molecular conductors. The latter systems represent examples of the evolving field of nanoscience, the small-size end of mesoscopics, which offers several exciting directions of research. Many of the errors and typos of the first edition were corrected. The author is indebted to many colleagues for communicating errors and comments.

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符号表

Below are frequently used notations. In some chapters different notations are used to allow easy comparison with the literature.

Vol	Volume (e.g., for a wire, $Vol = A \times L$ where A is the cross section and L the length. For a slab, $Vol = A \times d$, where A is the area and d is the thickness)
T	Temperature or transmission probability (by context)
$\bar{A}$	Vector potential of the electromagnetic field.
n	Average density
$\hat{n}$	Particle-density operator
$\hat{\rho}$	Charge-density operator (note: sometimes ρ denotes the resistivity)
N	$\equiv n \times Vol$
$N(\varepsilon)$	Single-particle density of states (DOS)
$N(0)$	Single-particle density of states at the Fermi energy
$N_\perp$	Number of channels described precisely in chapter 5 section 2
$n(\varepsilon)$	$\equiv N(\varepsilon)/Vol$
$n(0)$	$\equiv N(0)/Vol$
ε_F	Fermi energy
E_c	$\equiv \hbar D/L^2$ (Thouless energy)
V_L	$\equiv \pi E_c$
μ	Chemical potential
Δ	$\equiv 1/N(0)$
Δ_s	Superconducting gap
D	Diffusion coefficient
G	Conductance
g	Dimensionless conductance
$\sigma(\omega)$	Conductivity
σ	$\equiv lim_{\omega \to 0} \mathrm{Re}(\sigma(\omega))$ (d.c. conductivity)
τ_ϕ	Dephasing time
L_ϕ	Dephasing length
I	Current
j	Current density
I_c	Josephson critical current amplitude
Φ	Magnetic flux
Φ_0	$\equiv hc/e$
Φ_s	$\equiv hc/(2e)$
$S_I(\omega)$	Power spectrum of I (often the index I is omitted)
$C_I(t)$	Temporal autocorrelation function of I (often the index I is omitted)

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