

Superconducting Quantum Devices

SQUIDs, Qubits and Quantum-limited Amplifiers



Superconducting Quantum Devices



Modul consists of two parts:

WS 22/23

Tutorials

Thu 09:15KIP SR 1.403Thu 14:15KIP SR 1.403

Coordinator/Tutor: Andreas Fleischmann Kirchhoff Institute for Physik (KIP)

room: 0.309, phone 06221/549880 andreas.fleischmann@kip.uni-heidelberg.de

Lecture: Mon and Wed 11:15 – 13:00, KIP H2

Christian Enss

Kirchhoff Institute for Physik (KIP) room: 1.106, phone 06221/549861 email: enss@kip.uni-heidelberg.de Office hour: mondays 14:00 – 15:00, in addition by appointment

Web: https://uebungen.physik.uni-heidelberg.de/vorlesung/20222/1624



Tutorials

Start: 2nd week

WS 22/23

The active participation in the tutorials will be realized by presenting solutions every week. The willingness to present a solution has to be indicated at the beginning of the tutorial by signing up on a list of all participants. To be permitted to the final exam you need to sign up for at least 60 % of all possible problems.

In addition, you may hand in written solutions, but they will not be included in the grading. However, they will be corrected and returned.

Web: https://uebungen.physik.uni-heidelberg.de/vorlesung/20222/1624

Literature





C. Enss, S. Hunklinger Low-Temperature Physics Springer

N.W. Ashcroft, D. N. Mermin Solid State Physics Thomson Press





S. Hunklinger, C. Enss Solid State Physics De Gruyter

> C. Kittel Introduction to Solid State Physics Wiley VCH

EIGHTH EDITION Introduction to Solid State Physics CHARLES KITTEL

Rudolf Gross, Achim Marx FESTKÖRPER-PHYSIK

R. Gross, A. Marx Festkörperphysik De Gruyter

Literature





M. Tinkham Introduction to Superconductivity Dover Publications

> P. Mangin, R. Kahn Superconductivity – An introduction Springer



C.H. Poole Jr., R. Prozorov, H.A. Farach, R.J. Creswick **Superconductivity** Elsevier Insights Superconductivity An introduction

D Springe

P.G. de Gennes, Superconductivity of Metals and Alloys Westview Press

WILEY-VCH Reinhold Kleiner and Werner Buckel Superconductivity An Introduction Thrd Edison



R. Kleiner, W. Buckel Superconductivity – An introduction Wiley-VCH



Literature





R. Gross, A. Marx Lecture notes on applied superconductivity WMI München

> P. Seidel (ed.) **Applied Superconductivity** Wiley-VCH

> > A. Barone, G. Paterno

Wiley-Interscience



DYNA	MICS OF
JOSE	PHSON JUNCTIONS
CIRCI	UITS
KONSTA	VTIN K. LINHAREV

K. Likharev **Dynamics of Josephson junctions and circuits CRC** Press

Physics and applications of the Josephson effect

PHYSICS AND APPLICATIONS OFTHE JOSEPHSON EFFECT ANTONIO BARONE AND GIANFRANCO PATERNÓ

EWILEYVCH idited by ohn Clarke and Alex I. Braginsh The SQUID Handbook

Vol. 1 Fundamentals and Technology of SQUIDs and SQUID Systems



The SQUID Handbook

J. Clarke, A. Braginski (eds).

Wiley-VCH

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Free Electron Gas

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Free Electron Gas





Free Electron Gas

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		Electron density Wig	ner-Seitz ra	adius Fermi vector	Fermi velocity in cm s ⁻¹ Fermi energy in eV	Fermi energy	Fermi temperature
Valence	metal	ın cm ⁻³	$r_{\rm s}/a_{\rm o}$	in cm ⁻¹		$T_{\rm F} = E_{\rm F}/k_{\rm B}$ in K	
1	Li	$4,70 \times 10^{22}$	3,25	$1,11 \times 10^{8}$	$1,29 \times 10^{8}$	4,72	$5,48 \times 10^{4}$
	Na	2,65	3,93	0,92	1,07	3,23	3,75
	K	1,40	4,86	0,75	0,86	2,12	2,46
	Rb	1,15	5,20	0,70	0,81	1,85	2,15
	Cs	0,91	5,63	0,64	0,75	1,58	1,83
	Cu	8,45	2,67	1,36	1,57	7,00	8,12
	Ag	5,85	3,02	1,20	1,39	5,48	6,36
	Au	5,90	3,01	1,20	1,39	5,51	6,39
2	Be	24,2	1,88	1,93	2,23	14,14	16,41
	Mg	8,60	2,65	1,37	1,58	7,13	8,27
	Ca	4,60	3,27	1,11	1,28	4,68	5,43
	Sr	3,56	3,56	1,02	1,18	3,95	4,58
	Ba	3,20	3,69	0,98	1,13	3,65	4,24
	Zn	13,10	2,31	1,57	1,82	9,39	10,90
	Cd	9,28	2,59	1,40	1,62	7,46	8,66
3	Al	18,06	2,07	1,75	2,02	11,63	13,49
	Ga	15,30	2,19	1,65	1,91	10,35	12,01
	In	11,49	2,41	1,50	1,74	8,60	9,98
4	Pb	13,20	2.30	1.57	1.82	9,37	10,87
	$Sn(\omega)$	14,48	2,23	1,62	1,88	10,03	11,64