

# Collective excitation in solids

In contrast to quasiparticles, **collective excitations are bosons**, and they bear no resemblance to constituent particles of real system. They involve collective (i.e., coherent) motion of many physical particles.

- **Phonon**: Corresponds to coherent motion of all the atoms in a solid — quantized lattice vibrations with typical energy scale of  $\hbar\omega = 0.1 \text{ eV}$
- **Exciton**: Bound state of an electron and a hole with binding energy  $e^2/\epsilon a = 0.1 \text{ eV}$
- **Plasmon**: Collective excitation of an entire electron gas relative to the lattice of ions; its existence is a manifestation of the long-range nature of the Coulomb interaction. The energy scale of plasmons is  $\hbar\sqrt{ne^2/m_e} : 5 - 20 \text{ eV}$
- **Magnon**: Collective excitation of the spin degrees of freedom on the crystalline lattice. It corresponds to a spin wave, with an energy scale of  
 $\hbar\omega : 0.001 - 0.1 \text{ eV}$

# Collective Excitations In Solids

**Mike Jess**



## **Collective Excitations In Solids:**

*Collective Excitations in Solids* Baldassare Di Bartolo, Joseph Danko, 2012-12-06 This book presents an account of the NATO Advanced Study Institute on Collective Excitations in Solids held in Erice Italy from June 15 to June 29 1981 This meeting was organized by the International School of Atomic and Molecular Spectroscopy of the Ettore Majorana Centre for Scientific Culture The objective of the Institute was to formulate a unified and coherent treatment of various collective excitation processes by drawing on the current advances in various branches of the physics of the solid state A total of 74 participants came from 54 laboratories and 20 nations Australia Belgium Burma Canada China France F R Germany Greece Israel Italy Mexico The Netherlands Pakistan Poland Portugal Romania Switzerland Turkey The United Kingdom and The United States The secretaries of the course were Joseph Danko for the scientific aspects and Nino La Francesca for the administrative aspects of the meeting Forty four lectures divided in eleven series were given Nine long seminars and eight short seminars were also presented In addition two round table discussions were held

**Spectroscopy and Dynamics of Collective Excitations in Solids** Baldassare di Bartolo, 2012-12-06 This book presents the proceedings of the course Spectroscopy and Dynamics of Collective Excitations in Solids held in Erice Italy from June 17 to July 1 1995 This meeting was organized by the International School of Atomic and Molecular Spectroscopy of the Ettore Majorana Centre for Scientific Culture The purpose of this course was to present and discuss physical models mathematical formalisms experimental techniques and applications relevant to the subject of collective excitations in solids By bringing together specialists in the field of solid state spectroscopy this course provided a much needed forum for the critical assessment and evaluation of recent and past developments in the physics of solids A total of 83 participants came from 57 laboratories and 20 different countries Austria Belgium Brazil Denmark Finland France Germany Greece Israel Italy Japan The Netherlands Norway Portugal Russia Spain Switzerland Turkey the United Kingdom and the United States The secretaries of the course were Stamatios Kyriakos and Daniel Di Bartolo 45 lectures divided in 13 series were given In addition 8 one or two hour long seminars 1 special lecture 2 interdisciplinary lectures 29 short seminars and 16 posters were presented The sequence of lectures was in accordance with the logical development of the subject of the meeting Each lecturer started at a rather fundamental level and ultimately reached the frontier of knowledge in the field

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**Interaction of Helicons with Other Collective Excitations in Solids** Peter Roman Antoniewicz, 1965 [Fast-electron Spectroscopy of Collective Excitations in Solids](#) A. A. Lucas, M. Šunjić, 1972

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Solids Atomic Energy Commission (India), Introduction to Solid-State Theory Otfried Madelung,1978 This textbook for graduate students of physics and materials science also provides the theoretical background needed by physicists carrying out research in pure solid state physics and its applications to electrical engineering Ultrafast dynamics of collective excitations in solids ,2005 **Elementary Excitations in Solids** Alexei A. Maradudin,G. F. Nardelli,1969 **Theory of Liquids** Kostya Trachenko,2023-08-17 Of the three basic states of matter liquid is perhaps the most complex While its flow properties are described by fluid mechanics its thermodynamic properties are often neglected and for many years it was widely believed that a general theory of liquid thermodynamics was unattainable In recent decades that view has been challenged as new advances have finally enabled us to understand and describe the thermodynamic properties of liquids This book explains the recent developments in theory experiment and modelling that have enabled us to understand the behaviour of excitations in liquids and the impact of this behaviour on heat capacity and other basic properties Presented in plain language with a focus on real liquids and their experimental properties this book is a useful reference text for researchers and graduate students in condensed matter physics and chemistry as well as for advanced courses covering the theory of liquids **Quantum Optics and the Spectroscopy of Solids** T. Hakiogammalu,Alexander S. Shumovsky,2013-03-09 Remarkable recent progress in quantum optics has given rise to extremely precise quantum measurements that are used in the research into the fundamentals of quantum physics and in different branches of physics such as optical spectroscopy This progress stimulates new technologies in the field of optical communications optical computation and information systems This state of the art volume presents work from a Summer School on Advances in Quantum Optics and Spectroscopy of Solids held in Ankara Turkey in 1995 The various contributions written by leading scientists in the field cover a wide range of subjects in this exciting area of physics and report new and important results and ideas Topics dealt with include the interaction of quantum light with trapped atoms and condensed matter quantum tomography and phase analysis and many applications of quantum optics from mesoscopic physics to correlation spectroscopy of non classical states which are of major importance in understanding the nature of collective excitations in solids Audience This book will be of interest to postgraduate students and researchers whose work involves quantum optics solid state spectroscopy and its applications *Collective Electronic Excitations in Solids and Quantum Transport in Mesoscopic Systems* Xiaoju Wu,1996 **Nonequilibrium Dynamics of Collective Excitations in Quantum Materials** Edoardo Baldini,2018-03-28 This book studies the dynamics of fundamental collective excitations in quantum materials focusing on the use of state of the art ultrafast broadband optical spectroscopy Collective behaviour in solids lies at the origin of several cooperative phenomena that can lead to profound transformations instabilities and phase transitions Revealing the dynamics of collective excitations is a topic of pivotal importance in contemporary condensed matter physics as it provides information on the strength and spatial distribution of interactions and correlation The experimental framework explored in this book relies on setting a

material out of equilibrium by an ultrashort laser pulse and monitoring the photo induced changes in its optical properties over a broad spectral region in the visible or deep ultraviolet Collective excitations e g plasmons excitons phonons emerge either in the frequency domain as spectral features across the probed range or in the time domain as coherent modes triggered by the pump pulse Mapping the temporal evolution of these collective excitations provides access to the hierarchy of low energy phenomena occurring in the solid during its path towards thermodynamic equilibrium This methodology is used to investigate a number of strongly interacting and correlated materials with an increasing degree of internal complexity beyond conventional band theory

**Dynamics at Solid State Surfaces and Interfaces, Volume 2** Uwe Bovensiepen, Hrvoje Petek, Martin Wolf, 2012-05-21 This two volume work covers ultrafast structural and electronic dynamics of elementary processes at solid surfaces and interfaces presenting the current status of photoinduced processes Providing valuable introductory information for newcomers to this booming field of research it investigates concepts and experiments femtosecond and attosecond time resolved methods as well as frequency domain techniques The whole is rounded off by a look at future developments

**Elementary Excitations in Solids, Molecules and Atoms**, 1974

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