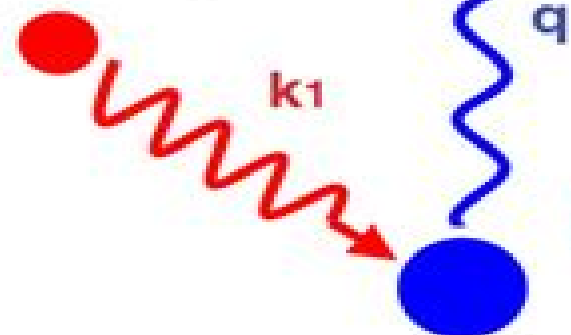


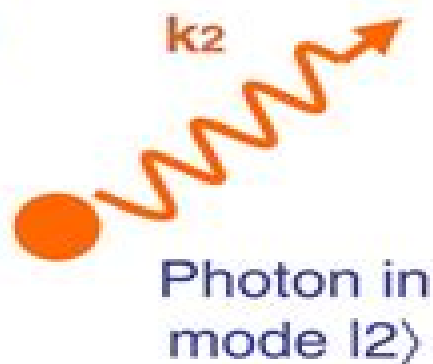
**a**

$$\mathbf{k}_2 = \mathbf{k}_1 + \mathbf{q}$$

$$\hbar\omega_2 = \hbar\omega_1 + \hbar\Omega$$

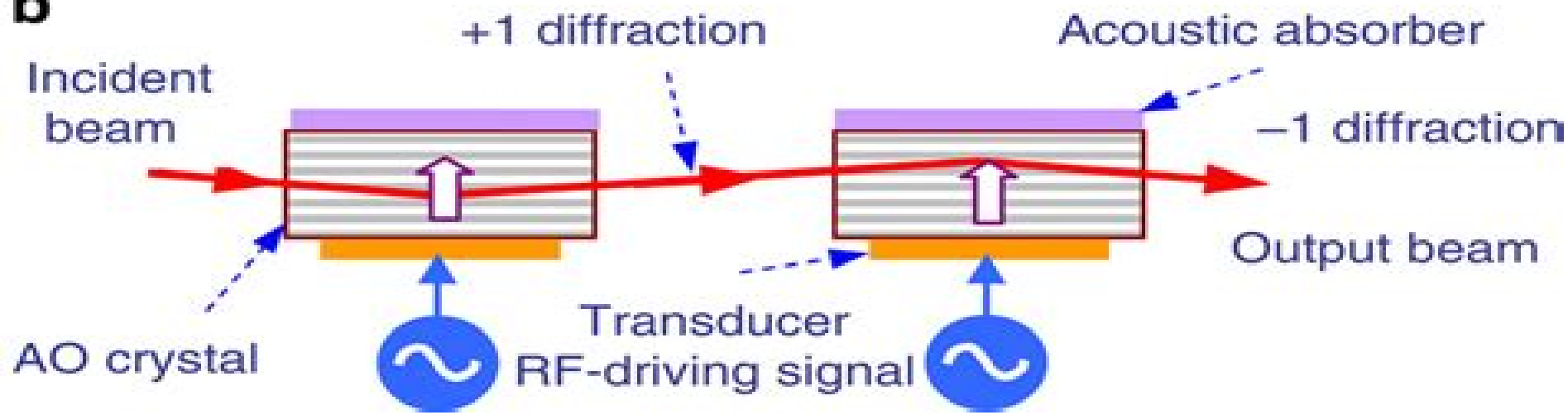
Photon in mode  $|1\rangle$ 

Phonon

Photon in mode  $|1\rangle$ 

$$\mathbf{k}_1 = \mathbf{k}_2 - \mathbf{q}$$

$$\hbar\omega_1 = \hbar\omega_2 - \hbar\Omega$$

**b**

# Electron Phonon Interactions And Phase Transitions

**T. Riste**

A decorative graphic consisting of a red circular shape with a white center, partially obscured by a white horizontal bar that extends from the left edge of the slide.

## **Electron Phonon Interactions And Phase Transitions:**

Electron-Phonon Interactions and Phase Transitions T. Riste, 2013-03-09 This NATO Advanced Study Institute was the fourth in a series devoted to the subject of phase transitions and instabilities with particular attention to structural phase transformations Beginning with the first Geilo institute in 1971 we have seen the emphasis evolve from the simple quasiharmonic soft mode description within the Landau theory through the unexpected spectral structure represented by the central peak 1973 to such subjects as melting turbulence and hydrodynamic instabilities 1975 Sophisticated theoretical techniques such as scaling laws and renormalization group theory developed over the same period have brought to this wide range of subjects a pleasing unity These institutes have been instrumental in placing structural transformations clearly in the mainstream of statistical physics and critical phenomena The present Geilo institute retains some of the counter cultural flavour of the first one by insisting whenever possible upon peeking under the skirts of even the most successful phenomenology to catch a glimpse of the underlying microscopic processes Of course the soft mode remains a useful concept but the major emphasis of this institute is the microscopic cause of the mode softening The discussions given here illustrate that for certain important classes of solids the cause lies in the electron phonon interaction Three major types of structural transitions are considered In the case of metals and semimetals the electron phonon interaction relies heavily on the topology of the Fermi surface

**Electron-Phonon Interactions and Phase Transitions** T. Riste, 2014-01-15

**ELECTRON PHONON INTERACTIONS AND PHASE TRANSITIONS.** T RISTE (ED.), 1977 Electron-phonon Interactions and Phase Transitions Annette Bussmann-Holder, Heinz Bilz, 1997 Euroconference on Electron-Phonon-Interactions and Phase Transitions Euroconference Electron Phonon Interactions and Phase Transitions, Euroconference Electron Phonon Interactions and Phase Transitions. 1997, Erice, Heinz Bilz, 1997

**Euroconference on Electron-Phonon Interactions and Phase Transitions**, 1997 **Euroconference on Electron-phonon-interactions and Phase Transitions**, 1997 **Electron-Phonon Interactions and Phase Transitions: Euroconference [Erice, Sicily, 9 - 15 June 1997, International School of Solid State Physics] ; Dedicated: Heinz Bilz** A. Bussmann-Holder, Euroconference Electron Phonon Interactions and Phase Transitions, 1997

**Electron-phonon Interaction And Lattice Dynamics In High Tc Superconductors** Han Zhang, 2020-02-13 Understanding the mechanism of the high temperature superconductors has been a very important topic in condensed matter physics Researchers have been trying to explain the role of electron phonon interaction EPI in cuprates Some important properties of the cuprates could not be explained by conventional BCS theory This book contains the experimental and theoretical studies on the EPI The experimental part covers the results of angle resolved photoemission spectroscopy ARPES isotopic effect elastic neutron scattering study of electron phonon lattice role and so on The theoretical part covers the electron phonon polaron and bipolaron effect of lattice fine structure in the tunnelling spectra of electron doped cuprates

identification of the bulk pairing symmetry in high temperature superconductors Students and researchers interested in high temperature superconductors especially the EPI in cuprates will find this title very useful Electron-Phonon Interaction in Conventional and Unconventional Superconductors Pegor Aynajian, 2011-01-19 The problem of conventional low temperature superconductivity has been regarded as solved since the seminal work of Bardeen Cooper and Schrieffer BCS more than 50 years ago However the theory does not allow accurate predictions of some of the most fundamental properties of a superconductor including the superconducting energy gap on the Fermi surface This thesis describes the development and scientific implementation of a new experimental method that puts this old problem into an entirely new light The nominee has made major contributions to the development and implementation of a new experimental method that enhances the resolution of spectroscopic experiments on dispersive lattice vibrational excitations the glue responsible for Cooper pairing of electrons in conventional superconductors by more than two orders of magnitude Using this method he has discovered an unexpected relationship between the superconducting energy gap and the geometry of the Fermi surface in the normal state both of which leave subtle imprints in the lattice vibrations that could not be resolved by conventional spectroscopic methods He has confirmed this relationship on two elemental superconductors and on a series of metallic alloys This indicates that a mechanism qualitatively beyond the standard BCS theory determines the magnitude and anisotropy of the superconducting gap *Quantum Theory and Symmetries* M. B. Paranjape, Richard MacKenzie, Zora Thomova, Pavel Winternitz, William Witczak-Krempa, 2021-03-26 This volume of the CRM Conference Series is based on a carefully refereed selection of contributions presented at the 11th International Symposium on Quantum Theory and Symmetries held in Montr al Canada from July 1 5 2019 The main objective of the meeting was to share and make accessible new research and recent results in several branches of Theoretical and Mathematical Physics including Algebraic Methods Condensed Matter Physics Cosmology and Gravitation Integrability Non perturbative Quantum Field Theory Particle Physics Quantum Computing and Quantum Information Theory and String ADS CFT There was also a special session in honour of Decio Levi The volume is divided into sections corresponding to the sessions held during the symposium allowing the reader to appreciate both the homogeneity and the diversity of mathematical tools that have been applied in these subject areas Several of the plenary speakers who are internationally recognized experts in their fields have contributed reviews of the main topics to complement the original contributions *Spectroscopy of Crystals Containing Rare Earth Ions* A.A. Kaplyanskii, R.M. McFarlane, 2012-12-02 Spectroscopy of Crystals Containing Rare Earth Ions contains chapters on some key problems selected from a broad range of spectroscopic studies of RE activated solids including both crystalline and glassy materials Progress in crystal field theory is surveyed an area which is basic to our understanding of the energy levels The treatment of dynamical properties includes studies of coherence phenomena in isolated ions energy transfer between ions and cooperative phenomena associated with ion ion and ion lattice interactions In addition the role of electron spins and nuclear

spins is studied by light scattering and double resonance techniques The presence of inhomogeneous broadening of spectral lines is observed and studied in many contexts leading to new insights into general problems of the disordered state Considerable attention is devoted to describing new experimental techniques whose development is of prime importance for progress in the spectroscopy of RE activated solids Many of these rely on the development and application of tunable lasers At the moment this is a very active field of spectroscopy with more exciting developments likely to occur in the future

**Physics and Materials Science of High Temperature Superconductors, IV** R. Kossowsky, Miroslav Jelinek, Josef Novák, 2012-12-06 Five questions dominated the ARW on Physics and Materials Science of High Temperature Superconductors of which this book forms the permanent record Briefly these are i How close are we to a unified theory The consensus is that we are not ii Flux pinning can it be achieved in bulk materials Still an open question The following three questions are related iii Can grain boundary contributions be brought under control iv What is the real requirement for purity and general chemistry control v What is the practical outlook for bulk products tapes and wires One of the conclusions is that the geometry and dimensions in thin films are the key parameters that facilitate the realization of high current densities and consequently their commercial application On the other hand the very large number of poorly understood microstructural chemical and mechanical variables involved in the preparation of bulk materials are currently prohibiting large scale commercialization of wires and tapes

**Polymers, Liquid Crystals, and Low-Dimensional Solids** Norman H. March, Mario P. Tosi, 2012-12-06 This book deals with three related areas having both fundamental and technological interest In the first part the objective is to provide a bird's eye view on structure in polymeric solids This is then complemented by a chapter directly technological in its emphasis dealing with the influence of processing on polymeric materials In spite of the technological interest this leads to some of the current fundamental theory Part II concerned with liquid crystals starts with a discussion of the physics of the various types of material and concludes with a treatment of optical applications Again aspects of the theory are stressed though this part is basically phenomenological in character In Part III an account is given first of the use of chemical bonding arguments in understanding the electronic structure of low dimensional solids followed by a comprehensive treatment of the influence of dimensionality on phase transitions A brief summary of dielectric screening in low dimensional solids follows Space charge layers are then treated including semiconductor inversion layers Effects of limited dimensionality on superconductivity are also emphasized Part IV concludes the volume with two specialized topics electronic structure of biopolymers and topological defects and disordered systems The Editors wish to acknowledge that this book had its origins in the material presented at a course organized by the International Centre for Theoretical Physics Trieste

**Ferroelectrics Literature Index** T. F. Connolly, 2012-12-06 Research on ferroelectricity and ferroelectric materials started in 1920 with the discovery by Valasek that the variation of spontaneous polarization in Rochelle salt with sign and magnitude of an applied electric field traced a complete and reproducible hysteresis loop Activity in the field was

sporadic until 1935 when Busch and co workers announced the observation of similar behavior in potassium dihydrogen phosphate and related compounds Progress thereafter continued at a modest level with the undertaking of some theoretical as well as further experimental studies In 1944 von Hippel and co workers discovered ferroelectricity in barium titanate The technological importance of ceramic barium titanate and other perovskites led to an upsurge of interest with many new ferroelectrics being identified in the following decade By 1967 about 2000 papers on various aspects of ferroelectricity had been published The bulk of this widely dispersed literature was concerned with the experimental measurement of dielectric crystallographic thermal electromechanical elastic optical and magnetic properties A critical and excellently organized compilation based on these data appeared in 1969 with the publication of Landolt Bornstein Volume 111 3 This superb tabulation gave instant access to the results in the literature on nearly 450 pure substances and solid solutions of ferroelectric and antiferroelectric materials Continuing interest in ferroelectrics spurred by the growing importance of electrooptic crystals resulted in the publication of almost as many additional papers by the end of 1969 as had been surveyed in Landolt Bornstein

**Air Force Research Resumés** , Phase Transitions in Materials Brent Fultz, 2014-08-14 Offering a fresh viewpoint on phase changes and the thermodynamics of materials this textbook covers the thermodynamics and kinetics of the most important phase transitions in materials science spanning classical metallurgy through to nanoscience and quantum phase transitions Clear concise and complete explanations rigorously address transitions from the atomic scale up providing the quantitative concepts analytical tools and methods needed to understand modern research in materials science Topics are grouped according to complexity ensuring that students have a solid grounding in core topics before they begin to tackle more advanced material and are accompanied by numerous end of chapter problems With explanations firmly rooted in the context of modern advances in electronic structure and statistical mechanics and developed from classroom teaching this book is the ideal companion for graduate students and researchers in materials science condensed matter physics solid state science and physical chemistry

**Models and Phenomenology for Conventional and High-Temperature Superconductivity** Società italiana di fisica, 1998 The search for microscopic models to explain the many superconducting substances has introduced seminal concepts and techniques in many body physics and in statistical mechanics The complexity of the high temperature superconductors has required a remarkable refinement of experimental techniques in order to allow a reliable characterization of the samples and is partly the reason why so many different microscopic models have so far been proposed This Enrico Fermi Course on Superconductivity was provided an up to date presentation of selected experimental and theoretical theories on the so called conventional superconductivity and on the high temperature superconductivity The attention was focused on those reliable measurements which are expected to provide the theory with key constraints viz Raman and Infrared Spectroscopy Nuclear Spin Resonance Angular Resolved Photoemission Spectroscopy transport measurements Josephson effect The lectures devoted to the overview of the BCS

theory and to the discussion of minimal models and of the crossover from BCS to Bose Einstein condensation may be particularly useful. The remaining part of the program was shared between phonon and non phonon based mechanisms. On the one hand special emphasis has been devoted to the breakdown of the Migdal theorem and to polaronic theories. On the other the book contains an overview of strongly correlated electron theories including magnetic interactions. A survey of the physics of vortices completes the theoretical part of the lectures.

*Photoferroelectrics* Vladimir M. Fridkin, 2012-12-06

Since Valasek's discovery of the ferroelectric properties of Rochelle salt nearly 60 years ago ferroelectricity has been regarded as one of the traditional branches of dielectric physics. It has had important applications in lattice dynamics, quantum electronics and nonlinear optics. The study of electron processes in ferroelectrics was begun with VUL's investigations of the ferroelectric properties of barium titanate. Intrinsic and extrinsic optical absorption band structure, conductivity and photoconductivity, carrier mobility and transport mechanisms were examined in this compound and in other perovskite ferroelectric semiconductors. An important discovery was that of the highly photosensitive photoconducting ferroelectrics of type AVB<sub>1-x</sub>VI<sub>x</sub> e.g. SbSI by MERZ et al in 1962 [1, 2, 3]. A large number of ferroelectric semiconductors, some photosensitive, some not, are now known including broad band materials e.g. lithium niobate, lithium tantalate, barium and strontium niobate and type AB<sub>2</sub> compounds. BI and narrow band semiconductors e.g. type A<sub>1-x</sub>IVB<sub>x</sub> compounds. A series of improper ferroelectric semiconductors and photosensitive ferroelastics have been discovered, of which Sb<sub>0.9</sub>I is an example [7]. Owing to the uncertainty of their band structure, the difficulty in determining the nature of the levels, the complexity of alloying and their generally low mobility values, ferroelectrics are rarely of interest, regarded as nonlinear semiconductors. The most fruitful approach has been the study of the influence of electrons, especially nonequilibrium electrons and electron excitations, on phase transitions and ferroelectric properties. A large group of phenomena have recently been discovered and investigated.

*Measuring, Interpreting and Translating Electron Quasiparticle - Phonon Interactions on the Surfaces of the Topological Insulators Bismuth Selenide and Bismuth Telluride* Colin Howard, 2016-10-14

The thesis presents experimental and theoretical results about the surface dynamics and the surface Dirac fermion DF spectral function of the strong topological insulators Bi<sub>2</sub>Te<sub>3</sub> and Bi<sub>2</sub>Se<sub>3</sub>. The experimental results reveal the presence of a strong Kohn anomaly in the measured surface phonon dispersion of a low lying optical mode and the absence of surface Rayleigh acoustic phonons. Fitting the experimental data to theoretical models employing phonon Matsubara functions allowed the extraction of the matrix elements of the coupling Hamiltonian and the modifications to the surface phonon propagator that are encoded in the phonon self energy. This allowed for the first time calculation of phonon mode specific DF coupling  $q$  from experimental data with average coupling significantly higher than typical values for metals, underscoring the strong coupling between optical surface phonons and surface DFs in topological insulators. Finally, to connect to experimental results obtained from photoemission spectroscopies, an electronic DF Matsubara function was constructed using the determined electron-phonon

matrix elements and the optical phonon dispersion. This allowed calculation of the DF spectral function and density of states allowing for comparison with photoemission and scanning tunneling spectroscopies. The results set the necessary energy resolution and extraction methodology for calculating from the DF perspective.



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