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HELVETICA PHYSICA ACTA

Zusammenfassungen der letzten eingegangenen Arbeiten
Résumés des derniers articles reçus

Supraleitung in Alkalimetallen?

von T. SCHNEIDER, E. STOLL und W. BÜHRER
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(19. III. 68)

Summary. The contribution of the electron-phonon interaction to the density of states and other parameters of the superconducting state are calculated using the pseudopotential approach. On the basis of these calculations we discuss the occurence of superconductivity in alkali metals.

Normal Solutions of the Linearized Boltzmann Equation

by G. SCHARF
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(21. III. 68)

Summary. The problems of initial and boundary conditions in hydrodynamics are discussed on the basis of the linearized Boltzmann equation. Using the hydrodynamic approximation involving the normal solutions, the connection problem of relating the actual initial values of the hydrodynamic quantities to the initial values appropriate to the equations of fluid dynamics is solved. Explicit formulae correcting the initial layer are given in the Navier-Stokes approximation. The normal solutions are then applied to steady state problems of the Boltzmann equation. In this connection a useful method for treating boundary value problems is employed. Finally the nature of the hydrodynamic approximation is investigated. It is found that this approximation is correct in the two limiting cases, either (i) finite mean free path ε as $t \to \infty$, or (ii) finite time as $\varepsilon \to 0$. The approach to equilibrium or to a steady state is also considered.

Effect of Nonlinear Excitation on Magnetoacoustic Resonance in a Cold Plasma

by K. FÄSSLER, J. VACLAVIK and H. SCHNEIDER
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(1. IV. 68)

Abstract. In magnetoacoustic resonance, amplification of the exciting magneting field was studied, both theoretically and experimentally, in the region where B_z is not small compared with magnetostatic field B_0. Dependence on the mutual polarity of B_0, B_z and on the exciting energy was found and excitation of higher harmonics was observed.

Calculation of the N-N Phase-Shifts Taking into Account Exited States of the Nucleons

by S. WAGNER
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and P. WINIGER
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(10. IV. 68)

Summary. Elastic N–N phase-shifts are calculated using the stron-coupling potential derived by FIERZ [1] who employed the fixed source PS–PS meason theory of WENTZEL [2]. In the limit of strong coupling, isobaric states of the nucleon appear, and consequently the N–N interaction has to be treated as a multi-channel problem. Using the experimental values of the renormalized pion coupling constant and of the N_{33} resonance energy, we introduce a hardcore of about 0.5 fermi as the only phenomenological parameter. The multi-channel Schrödinger equation is solved for positive energies. As a result of the calculations we obtain the correct energy dependence of the two S-wave phase-shifts at intermediate energies. All D-wave phase-shifts check with the experimental values up to 100 MeV; for higher energies the computed phase-shifts are too large. For high values of angular momentum they tend to OPEC phase-shifts; here all phase-shifts with $J \geqslant 3$ are in agreement with experiment. But for most of the intermediate odd phase-shifts there occurs the same kind of disagreement that is known from perturbation theory, when no vector measons and no spinorbit potential are introduced into the theory.

Etude des centres paramagnétiques du soufre condensé à basse température. Fonctions d'onde d'une chaîne de soufre

par JEAN BUTTET
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(16 IV 68)

Résumé. Les variétés instables du soufre, formées par condensation de molécules S2 sur un support refroidi à 77 °K, ou par condensation simultanée de molécules S2 et d'atomes de gaz rare sur un support à 4 °K, ont été étudiées par la technique de résonance paramagnétique électronique. Deux types de centres paramagnétiques ont été observés, l'un est attribué à l'électron non pairé à l'extrémité d'une chaîne de soufre, l'autre est un état ionisé positivement dû à l'interaction de 2 extrémités de chaîne.

Les fonctions d'onde d'une chaîne de soufre ont été calculées par une méthode semi-empirique, les valeurs du facteur de Landé et les coefficients de structure hyperfine calculés sont comparés aux valeurs mesurées. L'accord indique que l'électron non pairé est essentiellement localisé dans une orbitale de type π, antiliante, répartie sur les 2 atomes à l'extrémité d'une chaîne.

Etude des formes instables du soufre piégées à basse température et description d'un équilibre thermodynamique

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(16 IV 68)

Résumé. L'étude du retour à l'équilibre des formes instables du soufre piégées à basse température (irradiation du solide, condensation de la vapeur ou trempe du liquide) à l'aide de la résonance paramagnétique électronique montre qu'il faut distinguer quatre stades de restaurations; les trois

premiers sont attribuables à l'évolution du paramagnétisme d'extrémités de chaînes et le quatrième à des impuretés. Dans un premier stade, deux extrémités de chaînes non totalement recombinées durant les processus de piégeage peuvent ou achever cette combinaison ou donner deux extrémités libres. Les deuxième et troisième stades concernent la migration et la recombinaison des extrémités libres de chaînes (polymérisation) de manière corrélée d'abord puis non corrérée (cinétique du second ordre). A température ambiante, la structure est celle du soufre mou (très longues chaînes); ainsi durant ces processus, les chaînes augmentent de longueur en même temps que leur concentration diminue. La cristallisation du soufre mou en soufre orthorhombique se fait ensuite par arrachements successifs, aux extrémités des chaînes, de molécules S8 qui se ferment.

L'état d'équilibre à température ambiante (soufre orthorhombique) est caractérisé par l'existence d'un paramagnétisme résiduel (6,5 centres/gramme) attribuable à des extrémités de chaînes S16. Il est possible d'expliquer ce phénomène par un calcul thermodynamique de l'équilibre dans un réseau d'anneaux S8 (liquide ou solide) en admettant les réactions d'initiation et de polymérisation imaginées par Tobolsky pour le liquide. Ce calcul fait intervenir principalement la variation des fréquences propres de vibration lorsqu'un anneau S8 s'ouvre.

Localizability for Particles of Mass Zero

by W. O. Amrein
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(1. V. 68)

Abstract. We investigate the consequences of the concept of weak localizability which was recently introduced by Jauch and Piron. It is found to be the appropriate mathematical tool for describing the localization of particles of given helicity in relativistic quantum mechanics. It treats particles of mass zero and those of positive mass on an equal footing. Particles of one fixed value of the helicity and spin $J \neq 0$ can never be described by states which are localized in a finite region of space. The neutrinos fall into this category. Particles which may exist in superpositions of states of different helicities (such as photons) can be localized in arbitrarily small volumes. We show that the localization of any particle is closely related to its energy density, but that this relation is always non-local. At large distances d from the region of localization of a particle of mass zero, its energy density does not vanish but falls off as d^{-7}. We give explicit expressions for the operators representing the number of particles localized in an arbitrary volume of space in relativistic quantum field theory. They will be compared with a similar expression given by Mandel for the photon field.

On the Scalar Field Model

by Marcel Guenin
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and Giorgio Velo
Department of Physics, New York University, New York, N.Y., USA

(10. V. 68)

Abstract. The scalar field model is studied on a mathematically rigorous basis. Using algebraic techniques, we get the explicit cut-off dependent operator solution, and discuss the existence of the limit whenever the cut-off is removed. It is shown that the Wightman functions are tempered distributions in the limit of no cut-off and in a space with dimension less or equal to three.

A Note on the Commutation Relations of Field Operators

by WALTER SCHNEIDER
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(10. V. 68)

Abstract. Let $\phi(.)$ and $\psi(.)$ be two fields transforming according to finite irreducible representations of SL(2, C). Then the (anti-) commuting of two properly chosen components of $\phi(x)$ and $\psi(y)$, (x, y) varying in a domain $G \subset R^4 \times R^4$, implies the vanishing of all (anti-) commutators between any component of $\phi(x)$ and $\psi(y)$ respectively.

Caractéristiques paramagnétiques de centres luminescents dans les halogénures alcalins

par F. PORRET et J. ROSSEL
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(18 V 68)

Wechselwirkung von 14,7 MeV Neutronen mit ^{238}U und ^{232}Th

von P. BOSCHUNG, ST. GAGNEUX, B. HOOP jr., P. HUBER, Z. LEWANDOWSKI und R. WAGNER
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(5. VI. 68)

Abstract. The neutron spectra resulting from the bombardment of ^{232}Th and Uranium by 14.7 MeV neutrons were measured with a time-of-flight equipment using the associated particle method. Nuclear temperatures, from the analysis of the inelastic part of the spectra, are: (720 ± 70) keV for ^{232}Th and (850 ± 80) keV for ^{238}U. The discrepancies at a mean excitation energy of approximately 13 MeV among the earlier experimental results are explained by the different ways of subtracting the spectrum of the postfission-neutrons. The level density parameters, based on the Fermi-gas model including pairing and shell effects, were found to be a'_p = (27 ± 5) MeV^{-1} for ^{232}Th and a'_p = (20.5 ± 4) MeV^{-1} for ^{238}U. They are in agreement with results from experiments at lower neutron energies. The evaporation distributions were analyzed in terms of the LANG and LE COUTEUR spectra.

A Monte Carlo program was developed and successfully used to calculate the spectrum distortions due to multiple interactions in the scattering samples.

The inverse cross sections appearing in the evaporation spectra were represented by optical model values.

On the Analyticity Properties of the N-Body Scattering Amplitude in Non-Relativistic Quantum Mechanics

by F. RIAHI
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(4. VI. 68)

Abstract. We consider the scattering of N non-relativistic, spinless, distinguishable particles interacting via two-body superpositions of Yukawa potentials. The on-energy-shell amplitude is studied as a function of the total center-of-mass kinetic energy E and for physical values of the 'angular' variables $\boldsymbol{x}_i = (1/k)\,\boldsymbol{p}_i$, $\boldsymbol{y}_i = (1/k)\,\boldsymbol{q}_i$, $1 \leqslant i \leqslant N$, $k^2 = E$, where $\boldsymbol{p}_1, \ldots, \boldsymbol{p}_N$ and $\boldsymbol{q}_1, \ldots, \boldsymbol{q}_N$ are the initial, respectively the final momenta.

It is shown that this amplitude is the boundary value of a function analytic in the energy E in a complex plane cut from $-\infty$ to $-\varrho^2$ for some $\varrho > 0$ and from 0 to $+\infty$ and in all variables $(\boldsymbol{x}_1, \ldots, \boldsymbol{y}_N)$ in a neighbourhood of their physical values, up to an algebraic set of codimension 1.

Equations de Ginzburg-Landau et equations phénoménologiques de transport dans les superconducteurs

par F. ROTHEN

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(26. VI. 68)

Summary. It will be shown that in the neighbourhood of the critical temperature the application of the theory of irreversible processes to the superconductors necessitates no other specific hypothesis but that of the validity of the time-dependent Ginzburg-Landau equations. Especially the vanishing of the thermo-electric effects and the particularly simple form of the thermal conductivity in superconductors are connected with the fact that the pseudo-wave function ψ introduced by Ginzburg-Landau satisfies a diffusion equation in the mentioned temperature region.

Wirkungsquerschnitt der $^{27}Al(n, \alpha)^{24}Na$-Reaktion im Energiebereich von 13.8 MeV bis 14.8 MeV

von P. BOSCHUNG, St. GAGNEUX, P. HUBER, E. STEINER und R. WAGNER

Physikalisches Institut der Universität Basel

(2. VII. 68)

Abstract. The total $^{27}Al(n, \alpha)^{24}Na$-reaction cross section was measured in the energy range of 13.8 MeV to 14.8 MeV using the activation method. Our results are in good agreement with data of other recently published measurements. The absolute value of the total cross section at 14.2 MeV was determined to be (120 ± 5) mb.

The Convergence of the Perturbation Series in a Model of Quantum Field Theory

von ULRICH H. NIEDERER

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(17. VII. 68)

Abstract. We study the behaviour of the vacuum expectation value of a regularized scalar field operator as a function of the coupling constant μ^2 in the Fierz model. The vacuum expectation value exhibits an essential singularity at $\mu^2 = 0$. Therefore, the perturbation series diverges, representing only an asymptotic expansion of the vacuum expectation value under consideration.

Elastische Streuung polarisierter Neutronen von 3,25 MeV an mittelschweren Kernen

von D. ELLGEHAUSEN, E. BAUMGARTNER, R. GLEYVOD, P. HUBER, A. STRICKER und K. WIEDEMANN

Physikalisches Institut der Universität Basel

(19. VII. 68)

Summary. Angular distributions of the azimuthal asymmetry of elastically scattered polarized neutrons have been measured between 30 and 140 degrees for the six elements titanium, chromium, iron, copper, zinc and zirconium. As a source of polarized neutrons the $D(d, n)^3He$-reaction in a

thick ice-target was used (mean neutron energy: 3.25 MeV). The asymmetry was measured with fixed counter position by rotating the polarization of the incident neutron beam through an angle of $\pm$ 90 degrees by means of an axial magnetic field. The overall behaviour of the analysing power of the above elements with the exception of zirconium could be described using an optical model-potential with parameters found by ROSEN [2], whereas the maximum measured value of the latter was about a factor of three higher than that predicted by the model.

Messung des Neutronen-Polarisationsvermögens der Elemente Mg, Al, Si, S für die mittlere Neutronen-Energie $E_n = 3{,}25$ MeV

von K. WIEDEMANN, E. BAUMGARTNER, D. ELLGEHAUSEN, R. GLEYVOD und P. HUBER
Physikalisches Institut der Universität Basel

(19. VII. 68)

Summary. The analyzing power $P^a(\theta)$ of Mg, Al, Si and S in the angular range from 30° to 140° has been measured for (d, d)-neutrons of mean energy 3.25 MeV with spread of 300 keV. The polarization vector of the incident neutron beam was rotated through $\pm$ 90° by means of a solenoid and the left right asymmetry was measured with a fixed counter position. The experimental results disagree with optical model predictions.

Analyse des resultats d'une mesure du moment magnétique de l'hyperon Λ°

par GÉRARD CHARRIÈRE
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(22. VII. 68)

Abstract. A method is described for the kinematic reconstruction of 874 Λ decays observed in nuclear emulsions. Their angular distribution is studied in order to determine the Λ magnetic moment.

Selecting 151 events, we obtain $\mu_\Lambda = -0.50 \pm 0.28$ nuclear magneton.

A discussion of the systematic errors is given and the method of selection of the events is justified.

Effets d'interférences dans la réaction ^{7}Li(d, n) ^{8}Be au voisinage de la résonance à 1 MeV

par CHRISTIAN NUSSBAUM
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(1 VII 68)

Sommaire. Différentes sections efficaces différentielles de la réaction ^{7}Li$(d, n)^8$Be ont été mesurées au voisinage et au travers de la résonance à 1 MeV afin d'étudier leur comportement et mettre en évidence des effets d'interférences entre la résonance et les contributions à la diffusion faiblement dépendantes de l'énergie. Un modèle simplifié, utilisant deux éléments de matrice rend compte de façon satisfaisante de l'ensemble des mesures. Ces mesures sont composées de 6 distributions angulaires pour des énergies de deutons de: 0,91; 0,94; 0,97; 1,01; 1,05; 1,09 MeV et deux distributions en énergie de deutons variant de 0,86 à 1,33 MeV pour 0° et 90°.

Vitesse du son dans des alliages de Pd dopés avec des éléments de transition

par J. Ortelli, C. Susz, E. Walker et M. Peter
Institut de Physique Expérimentale, Université de Genève

(2. VIII. 68)

Abstract. By means of a pulse method using magnetostrictive transducers, we have measured the temperature dependance of torsional speed of sound in the alloys Rh_xPd_{1-x} and Pd_xAg_{1-x} doped with the transition elements Mn, Fe, Ni, Co, Ru, Os, Pt. The temperature variation of the speed of sound in undoped alloys shows an anomaly at the composition $Pd_{95}Rh_5$. We show that the decrease or the increase of this anomaly is in good correlation with the decrease or increase of the band susceptibility measured by usual methods (susceptibility, high field susceptibility, electronic paramagnetic resonance). We have also observed a ΔE effect having very specific properties. A brief discussion of this effect is given.

Les règles de superselection continues

par C. Piron
Institut de Physique Théorique Genève

(2. VIII. 68)

Abstract. Starting from the calculus of propositions, we develop a formalism which allows to treat continuous superselection rules and give some examples of applications of this formalism.

Impossibility of Quantum Mechanics in a Hilbertspace over a Finite Field

by J.-P. Eckmann and Ph. Ch. Zabey
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(12. VIII. 68)

Abstract. In this paper, we show that the lattice of propositions of a quantum mechanical system cannot be represented as subspaces of Hilbertspace with coefficients from a finite field.
The only exceptions are the two dimensional lattices, for which the restriction on the field is only that it may not be of characteristic 2.

Core Excitation in Semi-closed Nuclei

by U. Goetz and J. Hadermann
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(14. VIII. 68)

Abstract. Four-particle-two-hole core excitation in nuclei with two nucleons outside the closed shells is treated by direct extension of the configuration space. Some applications to a simple two-level case are given.

Contribution à la théorie des excitons de Wannier dans les cristaux anisotropes

par J.-A. Déverin
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(28 VIII 68)

Résumé. Sur la base d'un modèle simple, nous avons établi que l'influence de la discontinuité du réseau sur l'énergie de liaison des excitons de Wannier était négligeable. En respectant les règles de symétrie de la théorie des groupes et à l'aide de la méthode des perturbations, nous avons calculé les corrections à apporter à l'énergie de liaison pour tenir compte de l'anisotropie, pour des cristaux uniaxes et biaxes. Les résultats de ces calculs, appliqués aux CdS, CdSe et GaSe, permettent d'interpréter les spectres excitoniques observés avec des valeurs des paramètres de bandes raisonnables.

On the Quantum Mechanical N-Body Problem

von KLAUS HEPP
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(13. IX. 68)

Abstract. Systems of a finite number of nonrelativistic particles are studied in the framework of time-independent quantum scattering theory in the approach of Faddeev. For a non-empty class of 2-body potentials, we shall prove the unitarity of the S-matrix and a singularity structure of resolvent kernels and scattering amplitudes in the physical region, which is qualitatively the same as in perturbation theory.

Elasticité des métaux paramagnétiques

par Ø. FISCHER et M. PETER
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et S. STEINEMANN
Institut Dr. Reinhard Straumann, Waldenburg et Institut de Physique Expérimentale de l'Université de Lausanne

(24 IX 68)

Abstract. The kinetic energy of itinerant electrons gives a definite contribution to the elasticity of metals. The free energy of itinerant electrons and their chemical potential is examined in a Stoner model and expressions for the susceptibility, compression modulus and thermal dilatation are derived. The 'internal pressure' of an equation of state for simple metals is explained by a same model. The main contribution of the band structure and exchange interaction appears for volume conserving shears and is demonstrated for the whole series of transition metals and their alloys; correlations between shear modulus and susceptibility refer in fact to the same contribution of band structure and exchange interaction.

Interactions p-noyau à 3 GeV/c dans l'émulsion nucléaire

par M. BOGDANSKI, E. JEANNET et C. METZGER
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(1 X 68)

Summary. The results of an analysis of about 700 'stars' induced by 3 GeV/c protons in photographic emulsion are presented. A new technique used for measuring the tracks is described.

Size distributions of stars in terms of black, grey and shower tracks, angular distributions of emitted particles, energy spectra of protons and alphas, emission ratios of protons and alphas as well as the excitation energy distribution of the residual nuclei after the intranuclear cascade are in good agreement with the cascade-evaporation model of nucleon – nuclei high energy interactions.

Residual Interactions and Properties of Nuclear States in the Lead Region

by J. HADERMANN and K. ALDER
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(14. X. 68)

Abstract. Introducing a residual interaction with a spin-spin and a tensor part, energy levels and transition probabilities of the three single-closed shell nuclei Pb^{206}, Pb^{210}, Po^{210} have been computed and compared with experimental data. The parameters of the residual interaction potential are close to the values known from nucleon-nucleon scattering data and from deuteron theory.