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HELVETICA PHYSICA ACTA

Zusammenfassungen der letzten eingegangenen Arbeiten

Résumés des derniers articles reçus

Internal Manifolds, a Description of Exact and Broken Symmetries, Incorporating Rotational Excitations as Implied by the Hypothesis of Regge-Recurrences

by P. MINKOWSKI

Institute for Theoretical Physics, University of Leuven, Belgium

(20. II. 68)

Abstract. An attempt is made to introduce the concept of an internal manifold in elementary particle physics, and to realize the simultaneous action of the Poincaré group and of an internal SU 3 symmetry group on this manifold. A restricted class of manifolds is investigated, Riemannian globally symmetric spaces of type II, on which the internal symmetry group acts through the adjoint representation.

The interplay of the two groups supplemented by several auxiliary assumptions determines the manifold uniquely. The abstract manifold and the two Lie transformation groups acting on it are reexamined considering a linear boundary value problem on the manifold, stripped partly of its structure as homogeneous space, to allow the symmetry substitutions of the solutions determine the actions of the two transformation groups. The boundary value problem gives rise to a spectrum of masses depending on spin and internal quantum numbers. Meson and baryon masses are calculated defining special models, in which a continuation to complex angular momenta is carried out.

The situation for space like momenta is investigated and the restrictions imposed on the potentials defining the aforementioned models, by demanding that no solutions exist for space like momenta, are studied. The differential equation on the manifold is separable and is reduced to a second order linear differential equation in one dimension. The location of the bound solutions is determined from an associated Jost function. The differential equation is studied by mapping it on an analog potential scattering equation. The analog energy and potential strength appear as algebraic functions of mass, spin and internal quantum numbers.

The breaking of symmetry is treated as a perturbation. Mass splittings within meson and baryon SU 3 multiplets are obtained in first approximation with respect to the strength of the breaking.

Optische Aktivierung von Haftstellen in Anthrazeneinkristallen

VON M. SCHADT

Institut für angewandte Physik, Universität Basel

(2. III. 68)

Abstract. The photoelectric behaviour of the space charge limited hole current in Anthracene single crystals is examined as a function of wavelength. It is shown that the wavelength dependence of the current – below the absorption edge of Anthracene – is correlated to the optical activation of traps.

From the two rises observed in the current at 1.5μ and 1.1μ we conclude that there are two types of traps with different energies, energy distributions and cross sections.

In order to explain the measurements, the trap-model proposed by Mark and Helfrich is modified insofar as an energy distribution for the deep lying traps is assumed. This distribution is determined from the measurements.

Résonance paramagnétique du dibutyldithiocarbamate de chrome

par J. ORTELLI et R. LACROIX

Institut de physique expérimentale, Université de Genève

(11 III 68)

Résumé. Des cristaux de dibutyldithiocarbamate d'indium dotés de chrome ont été étudiés par la résonance paramagnétique. Les mesures ont permis de déterminer les constantes de l'hamiltonien de spin.

Supraleitung in Alkalimetallen?

VON T. SCHNEIDER, E. STOLL und W. BÜHRER

Delegation für Ausbildung und Hochschulforschung am EIR, 5303 Würenlingen

(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 occurrence 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 $t \rightarrow \infty$, or (ii) finite time as $\varepsilon \rightarrow 0$. 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 magnetizing 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

II. Institut für theoretische Physik der Universität Hamburg
and P. WINIGER

Physikalisches Institut der Universität Fribourg

(10. IV. 68)

Summary. Elastic N-N phase-shifts are calculated using the strong-coupling potential derived by FIERZ [1] who employed the fixed source PS-PS meson 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 $J \geq 3$ 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 mesons 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 S_2 sur un support refroidi à 77°K, ou par condensation simultanée de molécules S_2 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 païré 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 païré 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

par ANDRÉ CHATELAIN

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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 recombinaisonées 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 corrélée (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

Institut de Physique Théorique, Université de Genève, Geneva, Switzerland

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 $\phi(\cdot)$ and $\psi(\cdot)$ 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

Institut de Physique de l'Université, Neuchâtel

(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

Physikalisches Institut der Universität Basel

(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 $a'_p = (27 \pm 5)$ MeV $^{-1}$ for ^{232}Th and $a'_p = (20.5 \pm 4)$ 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

Seminar für theoretische Physik, ETH, Zürich

(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 $\mathbf{x}_i = (1/k) \mathbf{p}_i$, $\mathbf{y}_i = (1/k) \mathbf{q}_i$, $1 \leq i \leq N$, $k^2 = E$, where $\mathbf{p}_1, \dots, \mathbf{p}_N$ and $\mathbf{q}_1, \dots, \mathbf{q}_N$ 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 (x_1, \dots, 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 $^{27}\text{Al}(n, \alpha)^{24}\text{Na}$ -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 $^{27}\text{Al}(n, \alpha)^{24}\text{Na}$ -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

Institut für theoretische Physik der Universität Bern

(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 $\text{D}(d, n)^3\text{He}$ -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 ± 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 $\pm 90^\circ$ 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^0

par GÉRARD CHARRIÈRE

Institut de Physique Nucléaire de l'Université, Lausanne

(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.