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HELVETICA PHYSICA ACTA
Zusammenfassungen der letzten eingegangenen Arbeiten
Résumés des derniers articles reçus

On the Uniqueness of the Hamiltonian and of the Representation of the CCR for the Quartic Boson Interaction in Three Dimensions

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(4. V.71)

Abstract. Glimm has constructed a Hamiltonian for the $(:\Phi^4:)_{2+1}$ interaction with space cutoff, using a truncated version of the formal wave operator in order to define a domain for this Hamiltonian. For a wide class of such truncations we obtain equivalent representations of the canonical commutation relations in the sense of Fabrey. We establish unitary equivalence of the closures of the Hamiltonians obtained for many different truncations.

The Inverse Problem of Potential Scattering According to the Klein-Gordon Equation

by R. WEISS and G. SCHARF
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(6. V. 71)

Abstract. The inverse problem of constructing a spherically symmetric potential from its scattering data is solved for the Klein-Gordon equation, following the approach of Marchenko for the Schrödinger equation. This theory is well suited for the application to actual scattering processes. The interaction potential can be calculated uniquely from the scattering phase shift and the bound state data.

A Study of the $^{11}B(d, n)\,^{12}C$ Reaction with Polarized Deuterons at $\bar{E}_d = 900$ keV

by S.M. RIZVI, P. HUBER, F. SEILER and H.R. STRIEBEL
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(6. V. 71)

Abstract. The Analysing power of the $^{11}B(d,n)^{12}C$ reaction for the neutron group leaving the ^{12}C nucleus in the ground state has been measured at a mean deuteron energy of $E_d = 900$ keV. An analysis of the results shows that the major contribution to the reaction at this energy comes from a $5/2^-$ state of the compound nucleus ^{13}C with s-waves in the entrance channel. It is shown that this is possibly the 19.7–MeV level in ^{13}C.

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[2)] On leave from the University of Geneva, Switzerland
[3)] Supported by the National Science Foundation, Grant GP-24003.

Messung des differentiellen Wirkungsquerschnitts der Reaktionen $^{14}N(n, \alpha)\,^{11}B$ nnd $^{12}C(n, \alpha)\,^{9}Be$ im Energiegebiet von 14,8 bis 18,7 MeV

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(6. V. 71)

Abstract. The differential cross-section of $^{14}N(n, \alpha_0)^{11}B$, $^{14}N(n, \alpha_1)^{11}B^*$ and $^{12}C(n, \alpha_0)^{9}$ Be has been measured at 30 neutron energies between 14.8 and 18.8 MeV with 60 keV energy spread at angles between 0 and 156 degrees. Indications are given that the reaction $^{14}N(n, \alpha_0)^{11}B$ proceeds partly by formation of a compound nucleus.

Die Tensorpolarisation von elastisch an ^{12}C gestreuten Deuteronen zwischen 1,6 und 2,7 MeV

von H. O. Meyer, P. Huber und E. Baumgartner
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(6. V. 71)

Abstract. The spin tensor moments t_{20}, t_{21} and t_{22} of initially unpolarized deuterons elastically scattered from ^{12}C have been measured with the $^{3}He(d,p)^{4}He$ reaction as an analyzer of deuteron polarization. The three deuteron polarization parameters are presented as functions of incident deuteron energy between 1.6 and 2.7 MeV at 30°, 51°, 75° and 105° scattering lab angles. A phase-shift analysis of the differential cross-section and the polarization near the 2.50 MeV resonance confirmed the level parameters of the 12.41 MeV level in ^{14}N as assigned by McEllistrem et al. [5]. No reasonable set of parameters could be found to reproduce the data near the anomaly at 1.79 MeV.

Das Analysatorvermögen der $^{3}\vec{He}(d, p)\,^{4}He$-Reaktion für Targetpolarisation im Energiegebiet von 300 keV – 2,5 MeV

von U. Rohrer, P. Huber, Ch. Leemann, H. Meiner und F. Seiler
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(6. V. 71)

Abstract. The analysing power of the $^{3}\vec{He}(d,p)^{4}He$-reaction for polarized target and unpolarized beam has been measured at 7 energies between 300 keV and 2.5 MeV and at angles between 30 and 150 degrees. The angular distributions show that a small part of the reaction proceeds via incoming p- and d- wave channels. In particular, d-wave contributions are considerably enhanced at 430 keV, the energy of the $3/2^{+}$-resonance. The incoming p-waves apparently proceed through a direct reaction mecanism, while the d-wave contributions are mainly produced by one d-wave matrix element, otherwise identical to the resonant s-wave matrix element.

An optical method, capable of measuring the targetpolarisation continuously during nuclear physics experiments, is also described.

Perturbations and Non-Normalizable Eigenvectors

by William G. Faris
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(10. V. 71)

Abstract. A spectral representation of a self-adjoint operator acting in a Hilbert space is given by eigenvectors of an extension of the operator to a suitable space containing the original Hilbert space. A perturbation argument shows the extended operator has no eigenvalues that do not belong to the spectrum of the original operator. The abstract result is applied to Schrödinger operators $-\Delta + V$.

Analyse globale de la conduction ionique dans NaCl

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(7 VI 71)

Summary. It is shown that the usual method of analyzing the $ln(\sigma T) = f(1/T)$ curve in 3 distinct linear leads regions to incorrect results for the activation energies occurring in the ionic conduction mechanism. The results obtained from the measurement of pure and Sr^{++} doped NaCl crystals, submitted to an overall exact theoretical analysis, are compared with published data and the predicted deviations are observed. Additional effects due to $SrCl_2$ precipitation are suggested by small residual inconsistencies in the lower temperature range.

First order Perturbation Calculation for the Dynamical Correlation Function of a Classical Gas

by P. PETALAS
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(9. VI. 71)

Abstract. For a classical gas with a finite twobody potential the dynamical correlation function has been evaluated to first order in the interaction. An extrapolation of this result is discussed for gases with more realistic interactions.

Zusammenfassung. Für ein klassisches Gas von identischen Teilchen, ohne innere Struktur, welche durch ein beschränktes Zweikörper-Potential wechselwirken, wird die dynamische Korrelationsfunktion in erster Ordnung der Kopplungskonstante berechnet. Das Resultat wird auf Gase mit einer realistischeren Wechselwirkung extrapoliert.

Erweiterte Untersuchung des differentiellen Charge-Pumping-Effekts bei MOS-Transistoren

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(17. VI. 71)

Summary. As a consequence of variations of the gate potential, interface states in MOS-transistors are filled and emptied by capture and emission of both electrons and holes. If small periodical variations are applied, capture processes on the average slightly predominate, as was shown in a previous paper. In p-enhancement-mode devices, where the contributions of holes and electrons can be observed separately, this predominance of capture-processes gives rise to a net DC-current "pumped" from the p-regions (drain and source) into the substrate.

In the first sections, this paper deals with the influence of carrier diffusion through the substrate and the inversion layer. Theoretical and experimental results agree in showing that this influence is negligibly small in devices with low interface state densities. It is then shown, that the comparison of theory and experiment for such a device yields the values for the capture cross sections σ_n and σ_p (for electrons and holes, respectively) as well as for the density of the interface states contributing to the effect.

Rigged Hilbert Spaces in Quantum Field Theory: A Lesson Drawn from Charge Operators

by J.-P. Antoine
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(17 VI 71)

Abstract. Motivated by the problem of defining a charge operator, a systematic study is made of several classes of rigged Hilbert spaces suitable for Quantum Field Theory. The result is that (essentially) only one of them satisfies all the requirements, namely $\boldsymbol{H}_{ql} \subset \boldsymbol{H} \subset (\boldsymbol{H}_{ql})'$, where $\boldsymbol{H}_{ql}$ is the wellknown space of quasi-local states. It is then shown that, even in the case of a non-conserved current, the charge operator always exists as a continuous operator from $\boldsymbol{H}_{ql}$ into $(\boldsymbol{H}_{ql})'$.

Etude de la réaction ^{176}Lu(n, γ) ^{177}Lu au moyen d'un spectromètre a paires et anti-compton

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(21. VI. 71)

Abstract. The ^{176}Lu(n, γ) reaction has been studied by means of a pair and anti-Compton spectrometer. The high energy resolution and peak-to-background ratio have allowed to observe new γ-lines to improve the energy accuracy of the known ones. New transitions have been fitted into a more precise level scheme. The neutron separation energy was found to be $E_n = 7072.4 \pm 0.6$ keV. The results are interpreted in terms of the collective model. We discuss inconsistencies about the $1/2^+$ [411] rotational band, for which we give two alternative constructions. The $5/2^-$ ground level of the $1/2^-$ [541] band was disclosed at 761.7 keV. A tentative rotational band is built on this state.

Scattering into Cones

by J. M. Jauch, R. Lavine and R. G. Newton
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(29. VI. 71)

Abstract. Dollard's result concerning scattering into cones is generalized for arbitrary dimension of space and more general Hamiltonians.

Time-Delay in Scattering Processes

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(5. VII. 71)

Abstract. The relation between time-delay and the phase-shift operator is derived in the context of the time-dependent scattering theory for simple (single- channel) scattering systems.

The sufficient conditions on the interaction under which this relation can be established in a mathematical correct manner are formulated and the precise sense in which this relation can be interpreted is discussed.

The results obtained here generalize and unify various partial results previously published on this subject.

Properties of High Field Superconductors Containing Localized Magnetic Moments

by Oystein H. Fischer
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(17 VII 71)

Abstract. The problem of paramagnetic impurities in high field superconductors is analyzed. Special emphasis is put on the effects that appear when the impurity spins align in an external field or due to interactions. The impurities then produce an exchange field on the conduction electron spins which in some cases may counteract the effect of the external field on the conduction electron spins. In such cases the critical field of the dilute alloy may rise above the value of the pure system and the phase boundary Hc_2 (T) will have an anormalous shape. This effect is discussed theoretically in detail and experimental results on the system $Mo_{1-x}M_xGa4$ (M = Nb, Ru, Mn, Fe, Co) are presented.

Influence of Chemical Environment on M1 Internal Conversion Rates and their Connection with the Mössbauer Isomer Shift

by U. Raff, K. Alder and G. Baur
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(19 VII 71)

Abstract. By measuring the change in decay rate $\Delta\lambda/\lambda$ for M1 transitions and the corresponding Mössbauer isomer shift it is possible to extract the change of nuclear charge radius $\delta R/R$. Numerical results are given for ^{119}Sn (23.87 KeV), ^{57}Fe (14.4 KeV) and ^{195}Pt (99 KeV).

Etude des sections efficaces différentielles des réactions (n, p) et (n, α) sur ^{19}F, ^{29}Si, ^{32}S et ^{40}Ca à 5,85 MeV

par F. Foroughi et J. Rossel
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(19 VII 71)

Summary. Using $\Delta E \cdot E$ discrimination in a counter telescope, $\sigma(\theta)$ and σ_t have been measured for (n, α) and (n, p) reactions in open shell nuclei (^{19}F, ^{29}Si, ^{32}S) and in double magic ^{40}Ca.

Results are given concerning $^{19}F(n, \alpha_0+\alpha_1+\alpha_2+\alpha_3)$; $^{29}Si(n, \alpha_0)$ and (n, α_1); $^{32}S(n, \alpha_0)$, (n, p_0+p_1) and (n, p_2); $^{40}Ca(n, \alpha_0)$, $(n, \alpha_1+\alpha_2)$ and (n, p_0+p_1). In the open shell nuclei $\sigma(n, \alpha)$ angular distributions are mostly forward compared to (n, p) processes but no other specific shell effect is observed. In ^{40}Ca the situation is reversed; $\sigma(\theta)$ has no remarquable structure for (n, α) whereas for (n, p) it is strongly peaked forward. Previous conclusions on α particle dominance in compound ^{41}Ca decay are confirmed. As a by product of preliminary measurements we give upper bounds for (n, α) and (n, p) cross-sections in ^{53}Cr and ^{47}Ti.

Solid State Reactions and Defects in Doped Verneuil Sapphire III Systems α-Al_2O_3: Fe, α-Al_2O_3; Ti and α-Al_2O_3: (Fe, Ti)

by Kaspar Eigenmann, Karl Kurtz, and Hs. H. Günthard
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(27. VIII. 71)

Abstract. Extending earlier work on Ni and Co doped sapphire to Ti, Fe and doubly doped (Fe, Ti) sapphire the phenomenon of non additive color of multiply doped corundum was given special attention. Since in all these cases Verneuil grown crystals show dopant inhomogeneous

distribution, local concentrations were determined by electron microprobe analysis calibrated by neutron activation analysis. Polarized and high resolution UV-VIS spectra, polarized IR and quantitative ESR spectra of the doped crystals in the untreated state and after oxidation by O_2 and reduction by H_2 at 1500 °C are given. Information derived therefrom shows Ti to be present as Ti^{+3} and Ti^{+4}, Fe as Fe^{+2} and Fe^{+3} and (Fe, Ti) as $(Fe, Ti)^{+6}$ and $(Fe, Ti)^{+7}$ in the reduced state and oxidized state, respectively. In the reduced state hydrogen is shown by polarized infrared spectra and isotopic shifts to occupy an inte4stitial site between two O^{-2} ions of the larger oxygen triangles on (001) planes. For assignment of the UV-VIS bands near 385 and 450 nm of α-Al_2O_3 : Fe^{+3} extended crystal field calculations were carried out based on a point charge lattice, using all $3d^n$ electron configurations of Ti^{+3} and Fe^{+3} and Hartree-Fock atomic orbitals for free ions. In order to obtain acceptable agreement between observed and calculated spectra the quantity (r^4) is considered as a fitting parameter, leading to considerably higher (r^4) values for both Ti^{+3} and Fe^{+3}. Under this assumption an assignment for the α-Al_2O_3 : Fe^{+3} spectrum compatible with the observed polarization and high resolution UV-VIS data may be given. The characteristic and nonadditive spectrum of α-Al_2O_3 : (Fe, Ti) in the reduced state is shown by various arguments to originate from a biparticle $(Fe, Ti)^{+6}$. Finally thermodynamic data for redox reactions and relatively detailed models for the substituted ions in different oxidation states are given.

Thermal Radiation in Finite Cavities

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(18. IX. 71)

Abstract. The mode density $D(\nu)$ of the electromagnetic resonances of a lossless closed cavity plays a dominant role in the theory of far-infrared radiation standards, the Einstein coefficients of spontaneous and stimulated emission, and radiation corrections as e.g. the Lamb-shift. Refinements of the Planck-Weyl asymptotic density $D_0(\nu)$ for cavities of finite size are studied by computational methods involving the first 10^6 eigenvalues. In the average, i.e. for large bandwidth, $\Delta\nu$, second order corrections of the type $D/D_0 = 1 - C\nu^{-2}\ V^{-2/3}$ with V = volume of the cavity are obtained for a variety of cavity geometries including the parallelepiped, the circular cylinder, the sphere, the hemisphere, and cyclindrial as well as spherical sectors (wedges and cones). The relation of the constant C to the edge lengths and curvatures of the cavity is investigated.

The second order corrections resulting for the Wien displacement law and for the Lamb-shift are determined. The implications for the Stefan-Boltzmann radiation law as well for on the thermodynamical properties of the radiation field are studied. A rigorous connection between the asymptotic *spectral* and *total* radiation formulae is established in terms of Abelian and Tauberian theorems.

For narrow bandwidth $\Delta\nu$, fluctuations of the mode density are much stronger than the second order average correction. The relative mean fluctuation is found to be proportional to $\nu^{-1}\ (\Delta\nu)^{-1}$.

A new proof for the wellknown vanishing of the average first order or surface correction term is given in terms of the scalar E- and H-type wave potentials. Surface terms appear only if the E- and H-type densities D_E and D_H are determined separately. The surface corrections of D_E and D_H are equal, but have opposite signs. The corresponding first order refinement of the temporal autocorrelation functions of the black-body radiation field is studied.