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CENTRAL RESEARCH INSTITUTE FOR PHYSICS
OF THE
HUNGARIAN ACADEMY OF SCIENCES

Institute for Atomic Energy Research

BUDAPEST

Revised version of the program system FEDGROUP

P. Vértes

The program system FEDGROUP which process the evaluated nuclear data files disseminated by IAEA was revised and supplemented during the year 1977. This is published in the report INDC /HUN/-15/L.

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Research Institute for Particle and Nuclear Physics

BUDAPEST

SOFT X-RAY EMISSION OF THE PLASMA OF THE TOKAMAK T-10

G. Hordósy, G. Hrehuss, B. Kardon, I. Szentpétery

The soft X-ray radiation of a hot plasma arises from the scattering and capture of the thermal electrons on the plasma ions. The spectral intensity distribution consists of an exponentially decreasing thermal continuum with characteristic lines superimposed. The absolute intensity of the continuum radiation is a sensitive measure of the effective atomic number Z_{eff} of the plasma while its slope closely relates to the electron temperature T_e.

For measuring the intensity distribution in the soft X-ray region a Policarpo-type scintillation-ionization chamber as developed in our institute for plasma diagnostical purposes has been used at the tokamak T-10 in the Kurchatov Atomic Energy Institute, Moscow.

The efficiency of the spectrometer is so high that even the time-evolution of the spectra with good counting statistics can be measured in four successive intervals of each tokamak discharges. Also the detailed time dependence of the integral radiated power can be measured by means of a separate display circuit so that this measurement and the registration of the spectra can be performed by one spectrometer at the same time. In the same way, the well known saw-tooth relaxation oscillations of the plasma can be demonstrated as well.

The anomalous enhancement of the spectral intensity in the region $h\nu < 1500$ eV has been clearly demonstrated in our measurements. The gross structure and time development agrees with what has been suggested, quite recently, by the PLT group on the base of indirect measurements.

VUV-spectra measured by the TFR group show a large number of intensive characteristic lines distributed over the region in question. They arise from carbon, oxygen, nitrogen and from the heavier elements of the first wall and limiter. Some of them could be resolved, at least partially, in the present measurement. We note, however, that in some cases the enhancement becomes strongly attenuated. The correlation of this anomaly and also of the intensity of the resolved Cr, Fe, Ni and Mo lines with the parameters of the individual discharges has not been established as yet and is to be investigated further.

This work has been performed in cooperation with the Plasma Physics Laboratory /Department T-10/ of the Kurchatov Atomic Energy Institute, Moscow, Soviet Union.

LASERS FOR PLASMA DIAGNOSTICS

J.S. Bakos, I. Földes, P. Ignácz, Zsuzsa Sörlei, J. Szigeti

Phase objects as plasmas can be investigated among other methods by interferometric technique which delivers easily the space distribution of the plasma density. For the determination of the three dimensional density distribution many interferometric measurements have to be performed by object beams being distributed in wide solid angle. Therefore holographic interferometry is the popular method for simultaneous recording of large amount of interferometric patterns formed by different object beams.

Plasma produced by giant pulse ruby laser in air of atmospheric pressure was investigated. The second double pulse ruby laser was used for taking the holographic interferometric picture of the spark. The first pulse of this second laser takes the hologram of the scene 200 /usec before the spark. The delay of the second pulse to the time of the spark can be varied. So the time history of the laser produced discharge can be recovered by taking the second hologram at the same film at different time after the spark.

THEORETICAL PLASMA PHYSICS

Á. Ág, G. Párizs

The effect of the electrostatic turbulence on the macroinstabilities in a collisionless magnetized plasma is investigated. In the turbulent dispersion relation the inhomogenities in density and in magnetic field, a drift motion and a temperature anisotropy are taken into account. In the isotropic case in very strong magnetic fields the turbulence is found to be ineffective. In case of temperature anisotropy, provided a fluctuating electric field is strong enough and the vertical wave numbers of the turbulence and the macroinstability are in the vicinity of the inverse Larmor radius, the effect may be large. This effect is a correction in the dispersion relation which influences the damping and the frequency shift.

The radial diffusion of a cylindrical plasma filament is investigated for the case the diffusionccoefficient is a simple power function of the number density. Self similar solutions are procuced.

Soliton potentials, propagating in a thin cylindrical plasma have been calculated. Potential wells of soliton type have been found in both positive and negative range of potentials.

In the simple case of the nonlinear wave-wave interaction an instable limiting cycle has been found by numerical integration. The limiting cycle encloses the well known stable focus.

QUASI-ELASTIC INTERACTIONS OF INTERMEDIATE ENERGY PROTONS

J. Erő, Z. Fodor, P. Koncz, Z. Seres

The /p,nd/ reaction on ^{6}Li and ^{7}Li nuclei have been investigated by 660 MeV protons in a kinematically complete experiment.* Deuterons at angle of 6.5° to the beam were detected in coincidence with neutrons flying in a backward direction according to the kinematics of the quasi-elastic scattering on two-nucleon clusters. The cross sections $d^2\sigma/d\Omega_d d\Omega_n$ of these reactions for neutrons of energy greater than 20 MeV have been determined to be 0.1 and 0.16 mb/sr^2 for ^{6}Li and ^{7}Li, respectively. These values are 2.4 % and 7.0 % of the cross sections of the corresponding /p,pd/ reactions.

In the ^{7}Li/p,nd/^{5}Li reaction about 50 % of the events led to residual nuclei of low excitation energy. Neutrons from these processes may be regarded as products of an exchange scattering of protons on di-neutron clusters in the p-shell of the ^{7}Li nucleus. According to a crude estimation the cross section of this elementary process is about 4 % of the free p-d scattering at the same angle. In the reactions leading to highly excited states in residual nuclei the neutrons were produced by multiple scattering processes inside the nucleus.

In the ^{6}Li/p,nd/^{4}Li reaction the residual system was created mainly with high excitation and a clear quasi-elastic character has not been observed.

*Experiment performed at the Dubna synchrocyclotron.

ISOBARIC ANALOGUE RESONANCES

Ilona Lovas-Fodor, J. Sziklai

The $g_{9/2}$ IAR in the $^{56}Fe/p, \gamma/^{57}Co$ reaction has been found in two fragments at E_p = 3735 and 3735 keV bombarding proton energies. At high level densities the differential type of measurement was performed i.e. the excitation function for each stronger γ -transition was measured in the energy region of interest.

To identify the IARs the Coulomb energy displacement was taken into account as well and at the position of the possible condidates angular distribution measurements were carried out.

The measurements were performed in cooperation with the coworkers of the ZfK, Rossendorf bei Dresden.

HIGHER ORDER PROCESSES IN $^{40}Ca/^{6}Li,d/^{44}Ti$ REACTION

G. Pálla

Coupled channels calculations have been performed for the reaction $^{40}Ca/^{6}Li,d/^{44}Ti/3^-/_{3.94}$ assuming coupling of α -transfer with inelastic scattering in both the entrance and the exit channels. It is shown, that the higher order processes strongly influence the cross sections in particular when the direct transition is hindered by nuclear structure effects.

The α -transfer strength observed previously* was consistent with two-step reaction mechanism including inelastic excitation of the collective 3_1^- octupole state of both the target and the final nuclei /Table/. The coupled channels analysis has resulted in new spectroscopic information, namely the relative spectroscopic factor /$^{44}Ti/3^-/$; $^{40}Ca/3^-/$, α /, which could not be provided by the usual DWBA method.

Table

Parameters involved in $^{40}Ca/^{6}Li,d/^{44}Ti$ reaction via various states

Transition	Cluster quantum numbers N L S	ℓ_{tr}	Binding energy /MeV/	S_{lj}	
$^{40}Ca/0^+/\rightarrow{}^{44}Ti/0^+/$	6 0 0	0	5.126	1.0	/0.7/
$^{40}Ca/0^+/\rightarrow{}^{44}Ti/3^-/$	4 3 0	3	1.206	0.023	/0.018/
$^{40}Ca/3^-/\rightarrow{}^{44}Ti/3^-/$	6 0 0	0	4.90	0.59	/0.42/

*U. Strohbusch, C.L. Fink, B. Zeidman, R.G. Markham, H.W. Fulbright and R.N. Horoshko, Phys. Rev. C9, 965 /1974/

POSITRON ANNIHILATION STUDIES OF PHASE TRANSITIONS

I. Dézsi, Zs. Kajcsos, B. Molnár

Positron lifetime studies have been performed in different phases of 4 n-Octyloxibenzoicacid -4-nitrophenylesther liquid crystal over the 25-91 ^{o}C temperature range. The results suggest that there is no high probability for positronium formation or significant change in the τ_1 lifetime values, which could be correlated to the solid-smectic phase transition, while a change in τ_2 and in I_2 occurs in the vicinity of the nematic-isotropic phase transition.

Positron lifetime measurements have been performed in the amorpheus and liquid phases of glycerine-water solution over a broad temperature range. The effect of various quenchers and inhibitors at different concentration was investigated in both phases. The results support the validity of the spur-model.

Paper

I. Dézsi, Zs. Kajcsos, B. Molnár: A new source -preparation technique for positron lifetime measurements in liquids
Nucl. Instr. Meth. 141, 401 /1977/

POSITRON LIFETIME STUDIES IN SOME ELEMENTS

A. Balogh and I. Dézsi

Recently more experimental and theoretical papers were published, in order to systematize the measured lifetime values of the elements. For the description of the periodic relation between the experimental lifetime values and the atomic number two interpretations were suggested. One of these interpretations is based on the dynamic screening of the positron charge by the metallic electron gas, the other on a calculation where the ionic core is treated as a repulsive squarewell potential. Although both models seem to reflect the characteristic behaviour of the experimental lifetime values versus atomic number, slight differences are apparent at certain atomic number range.

To complete the experimental data we have performed lifetime measurements on Ga, Se, Sb, W and Tl. The results were in good agreement with the calculations based on the dynamic screening model.

Paper

A. Balogh, I. Dézsi: Further Positron Lifetimes of Some Elements,
Phys. Stat. Sol. /6/ 81, K81 /1977/

ON THE HYPERFINE FIELD DISTRIBUTION IN $Fe_{80}B_{20}$

J. Balogh and I. Vincze

The temperature dependence of the hyperfine field distribution in amorphous alloys was studied. The rapid temperature decrease in magnetization characteristic of amorphous alloys in often attributed to short-range exchange interactions. The temperature dependence of the hyperfine field distribution in an amorphous $Fe_{80}B_{20}$ /METGLAS 2605/ measured by Mössbauer technique disagrees with such an explanation. It was shown that for this alloy each magnetic moment follows the same magnetization curve, i.e. the temperature dependence of the magnetization is determined by long-range interactions.

Paper

J. Balogh and I. Vincze: Temperature Dependence of the Hyperfine Field Distribution in an Amorphous Ferromagnet,
Solid State Comm. 25 695 /1978/

POSITRON ANNIHILATION IN WATER-DIOXAN SYSTEM

A. Balogh and G. Brauer*

Detailed positron lifetime measurements have been performed on water-dioxan liquid mixtures in the concentration range of 23-35 vol. % dioxan. The measured spectra were analyzed by a two-term fit. The first component results from the annihilation of para -positronium and of free positrons, whereas the longer lifetime component is due to the pick-off annihilation of ortho-positronium. Our results support the hypothesis of cluster formation at mol-ratios 1:15 and 1:10, suggested by the results of optical investigations.

*ZfK Rossendorf, GDR

MÖSSBAUER STUDIES ON $LiTaO_3$

I. Dézsi, I. Földes Jr. and D.L. Nagy

Iron doped $LiNbO_3$ and $LiTaO_3$ are trigonal crystals and potential holographic storage media. In both systems high spin ferrous and ferric ions are formed.

Similarly to former studies on ^{57}Fe and ^{57}Co doped $LiNbO_3$, Mössbauer measurements have been performed on ^{57}Fe and ^{57}Co doped $LiTaO_3$ single crystals in a broad temperature range. In some spectra depending on the treatment of the sample in various atmospheres the coexistence of Fe^{2+} and Fe^{3+} ions was observed. The spectra of Fe^{3+} showed at room temperature and below paramagnetic hyperfine splitting characteristic of long spin relaxation times.

From the fits of the quadrupole splitting vs. temperature in T approximation for the energy of the lowest lying orbital doublet 274 cm^{-1} and 233 cm^{-1}, for the coefficient of the spin-orbit coupling -80 cm^{-1} in both cases and for the lattice quadrupole splitting -0.07 mm/s and 0.00 mm/s was obtained for Fe^{2+} in $LiNbO_3$ and $LiTaO_3$, respectively. From the comparision of the values of the trigonal splitting with existing quadrupole coupling constant data for the location of the Fe^{2+} ions a random distribution along the trigonal axis is the most probable.

PIXE ANALYSIS OF CHLOROPLASTS

I.Demeter, K.Hollós-Nagy*, L.Keszthelyi, Z.Szőkefalvi-Nagy, and L.Varga.

Lincomycin has an inhibitor effect on the synthesis of protein in the chloroplasts of greening plants. Bean leaves treated with lincomycin have shown the symptoms of Mn deficiency.

Chloroplasts from the leaves treated and untreated with lincomycin have been isolated by biochemical method, and this samples were analysed by PIXE applying protons of 2 MeV energy as bombarding particles.

The comparison of the spectra shows, that their trace element content is unaltered, except the Mn which is strongly diminished in the samples of plants treated with lincomycin.

*Institute of Biophysics, Biological Research Center, Szeged.

DETERMINATION OF THE PROTEIN CONTENT OF BIOLOGICAL SAMPLES

L. Varga

A method for determining the nitrogen content applying the $^{14}N/d,p/^{15}N$ nuclear reaction has been elaborated. Charged particles emerging from a biological sample while bombarding it with deuterons are detected simultaneously by two detectors. An absorber in front of the first detector only allows the passage of high energy protons originating from nitrogen atoms; the other detector is thin enough to stop protons from carbon atoms and the absorber placed before it retains all charged particles of lower energy than these. This arrangement enables the use of a very high efficiency nitrogen detector and the determination of the carbon content is independent of the humidity of the sample.

An application of the method was the determination of the protein distribution on the cut surface of a grain of corn by allowing the passage of the bombarding beam via a diaphragm of 0.2 mm diameter and by shifting the sample by 0.5 mm steps. The inhomogen nature of the distribution reflects the difficulties inherent in selecting seed-corns according to their protein content by applying sampling method not including the whole mass of the corn.

MOLECULAR WEIGHT AND METAL CONTENT OF SUPEROXID DISMUTASE ENZYME

I.Demeter, Katalin Hollós-Nagy*, L.Keszthelyi, Z.Szőkefalvi-Nagy, L.Varga.

Superoxide dismutase/SOD/ enzymes play important protecting roles in the living cells by eliminating released O_2^- in different biochemical reactions / for example in photosynthesis/. Their prosthetic groups contains Mn, Fe, Ni, Cu or Zn ions.

SOD was isolated and purified from Anacystis nidulans unicellular alga/by the Institute of Plant Physiology at the Biological Centre, Szeged/. The trace element content has been measured with proton induced X-ray emission analysis /PIXE/ and by using the $^{14}N/d,p/^{15}N$ nuclear reaction the protein content was determined. This enzyme proved to contain Fe. On the ground of the quantitative assesments of these two measurements the molecular weight could be calculated: 38000 ± 8000 dalton. It shows a good degree of coincidence with different other methods /for example SDS electroforesis, gel filtration/. In contrast to the above measuring techniques the displayed method has the advantage of its high sensitivity, it needs very low material quantities /the bombarded material was ~ 0.4 picomol protein it contained 2.2×10^{-11} g Fe/ and the purity of the preparation can also be controlled.

* Institute of Biophysics, Biological Research Center, Szeged

ION CONTENT OF SINAPTIC VESICLES

I.Demeter , Katalin Hollós-Nagy*, L.Keszthelyi, Z.Szőkefalvi-Nagy, L.Varga.

As known at present, information is transmitted between the neurons of the nervous system of mammals by neurotransmitter molecules which are packed in small spheres, the so-called synaptic vesicles.

X-ray spectra of cholinergic and adrenergic vesicles after sucrose gradient separation /CEG, AEG/ and after purification with glass bead chromatography /CEB, AEB/ were measured.

The samples were investigated for protein content by the $^{14}N/d,p/^{15}N$ nuclear reaction. The weight of N multiplied by 6,5 gives the weight of protein in biological samples with a very good approximation.

The number of P, S, K, Ca, Fe, Ni, Cu and Zn atom/g of sample material were determined and related to the protein content of the sample assuming:

a/ the size of a vesicle is 3×10^{-17} cm^3 and its weight is 3×10^{-17}, i.e. its density is unity,

b/ the weight of a vesicle is composed of 1/3 protein, 1/3 lipid, and 1/3 transmitter, water, etc. So 10^{17} vesicles contain 1 g protein.

The results are collected in the following table.

Vesicle	P	S	K	Ca	Fe	Ni	Cu	Zn
CEG	3.5×10^3	960	130	60	22	0.4	0.5	10
AEG	6.3×10^3	1050	150	90	12	0.7	0.8	14
CEB	2.0×10^3	980	110	80	25	0.7	0.7	10
AEB	3.0×10^3	1400	160	100	30	1.0	1.0	14

Number of atoms/vesicle.

* Institute of Biophysics, Biological Research Center, Szeged

PARTICLE INDUCED X-RAY EMISSION (PIXE) ANALYSIS RELATED TO THE PROTEIN CONTENT OF BIOLOGICAL SAMPLES

L.Keszthelyi and L.Varga

The relation of the quantity of trace elements to the protein content of biological samples is very important data for the biochemists.

In applying our nuclear method for protein determination we are bombarding the samples with deuterons of 2 MeV energy. When detecting the protons of the $^{14}N(d,p_0)^{15}N$ nuclear reaction we measure the energy spectrum of X-rays induced in the same bombarding process. Although the deuterons are not commonly used bombarding particles in PIXE measurements due to the rather high nuclear background, generally we find a peak in this X-ray spectrum, the area of which can be related to the protein content. In the following step we are bombarding the sample with protons, and comparing the two X-ray spectra we can relate the quantity of each trace elements to the protein content determined in the first step.

As an application of this method we measured the ratio of the protein and sulphur content of a human hair along its length, and it turned out that it is constant. That means, that the quantity of any trace elements found in a proton-PIXE measurement can be related to the sulphur content determined in the same measuring process. In this measurements we bombarded the outermost surface of the hair – we are going to repeat them applying the microbeam technics for bombarding the cut surface of the hair.

COMBINATIORIAL PROBLEMS IN N-PARTICLE SCATTERING THEORIES

Gy. Bencze

There exist various formulations of exact N-particle integral equations which differ in the number of coupled equations and the properties of the kernel. The common feature is, however, that the quantities determined by the equations are labelled by one or more partitions or chains of partitions of the N-particle system. Correspondingly, the number of coupled equations is determined by solving the combinatorial problem of enumerating the different labels. If the labels are single partitions, the enumeration problem is readily solved in terms of the Stirling numbers of the second kind. In more complicated cases the problem is not at all trivial. It is interesting to note that despite the extensive literature on Yakubovskii's N-particle equations the number of coupled equations for a general N is not known.

It will be shown that the maximal chains of partitions of the N-particle system can be enumerated by elementary considerations, i.e. the number of coupled Yakubovskii equations can be given by a simple formula.

The problem of identical particle scattering is also studied and is shown to lead to the problem of enumerating equivalence classes of the set of labels with respect to the permutation group of the N-particle system. In particular it is shown that for N identical particles the number of coupled Yakubovskii equations cannot be given in closed form.

THREE-CLUSTER REACTION MODELS EMBEDDED IN THE N-BODY PROBLEM

Gy. Bencze, V. Vanzani[*]

A simple procedure leading to integral equations for three-cluster systems in an N-body context is described. It is based upon the use of the following distribution property for the residual interactions: the interaction external to the two-cluster partition b_2, which contains a fixed three-cluster partition b_3, can be split up into the interactions $V_{c_2}^{b_3}$ which are internal to the two-cluster partitions $c_2 \neq b_2$ and b_3 and external to b_3[1]. Since there are three two-cluster partitions, which contain the same three-cluster partition, we have a set of three coupled equations in correspondence to each three-cluster partition. These equations closely resemble the Faddeev-like ones: the b_3-channel resolvent G_{b_3} takes the place of the free resolvent G_o and the operators $T_{c_2}^{b_3}$ for the scattering due to $V_{c_2}^{b_3}$ for the scattering due to $V_{c_2}^{b_3}$ within c_2 take the place of the two-body scattering operators. They can be used for scattering problems involving three cluster each tightly bound. In these cases, in carrying out intermediate state integrations, one can reasonably limit oneself to taking account of the discrete spectrum of each of the three clusters only. In this way, by writing down the above equations in the space of the internal states of the b_3 partition, one arrives at effective multi-channel three-body Faddeev-like equations.

/1/V.Vanzani: Lett.Nuovo Cimento, 16, 1 /1976/.

[*]Istituto di Fisica dell'Università, Padova, Italy

THE RELATIONSHIP OF CONNECTED-KERNEL THEORY TO THE SCHRODINGER EQUATION AND IMPLICATIONS FOR REACTION MODELS

P.C. Tandy[*], Gy. Bencze, M.L'Huillier[**] & E.F. Redish[***]

Recent formulations of equations for many-particle scattering offer possibilities for developing new models for nuclear reactions. To start from a theory which can in principle treat multi-cluster intermediate states, the formal descriptions of many-particle scattering employ coupled channel integral equations having a kernel which is connected after a finite number of iterations. However the complexity of such equations can obscure the relationship with the underlying Schrodinger equation upon which much of our intuition for building reaction models is based. In this talk we summarise the relation of a general class of connected-kernel theories with the Schrodinger equations, and emphasize conditions for equivalence and uniqueness of solution. Special properties of the Bencze-Redish kernel are discussed. In particular, those features responsible for the generation of outgoing scattered waves of any number of clusters are demonstrated. Several choices for constructing model equations for coupled two-cluster channels are outlined.

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THE REAL STRUCTURE INFORMATION CONTENT OF DIRECT NUCLEAR REACTION CROSS-SECTIONS

I. Borbély

The dominance of simple direct processes makes it possible to calculate the dynamics of the processes more or less reliably and therefore to extract information on the structure of nuclei involved. It is necessary to emphasize that the calculation of the singularities of Feynman graphs provides an easy and effective way of choosing the correct mechanism. It is also not widely known that the extracted spectroscopic factor presents information on the asymptotical normalization of the wave-function rather than on the overlap integral with the model single particle wave-function used in the analysis. This property directly follows from the surface character of the direct process, the supression of the nuclear interior contribution being a necessary prerequisite of the simple description of the reaction as a direct one. It is illustrated in some detail on the example of one nucleon transfer. Based on the experience obtained there one can conclude that for two or more nucleon transfer it is vital to describe the nuclear surface correctly with its cluster structure.

The new and very effective empirical continuation methods are also described. They use the analycity of the differential cross-section and in favourable cases they yield very accurate information on the asymptotical normalization of the wave-functions.

STRENGTH DECOUPLING FROM THE GIANT DIPOLE RESONANCE IN THE PARTICLE-HOLE SHELL MODEL

L.P. Csernai, J. Zimányi, B. Gyarmati[*], R.G. Lovas[*]

The main features of the GDR have been understood in the Brown-Bolsterli schematic model /1/ in which, appearing as a coherent superposition of degenerate particle-hole states mixed by separable forces, it carries all the dipole strength and so, immersing into a uniform dense background of complicate states, produces a strength function of pure Lorentz-shape. Experiment exhibits minor deviations from this prediction. Some of them turn up systematically in ranges of the mass number in which the binding energy of a low ℓ-value single-particle neutron state is near to zero /threshold state/. Such are the ones often referred to as pygmy dipole resonances /PDR/, the name suggesting that they are supposed to carry appreciable strength and to be of collective nature.

The distinguishing feature of threshold states, viz. that their logaritmic r-derivatives at the nuclear surface differ from those of other states and vary rapidly with energy, may manifest in their mixing with other states. It was shown /2/ that this causes decoupling in the mixing of the GDR into the background, but in published results we have not found conclusive evidence to whether the diagonalization of a less schematic force on the basis of non-degenerate particle-hole states may result in PDR.

We report here on a calculation in ^{116}Sn with full particle-hole basis in one oscillator shell /27 basis states/ with Gaussian and δ-force. The single-particle functions were calculated in a Saxon-Woods well of /3/ normalized as in /4/ when unbound. The force constants were fixed by setting

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the lowest state at zero and the GDR at its measured position.

Our findings are the following: Considerable weights of particle-hole states containing threshold states are retained in states near their unperturbed energy, and the weights are diminishing when these are moved off the threshold. These particle-hole states do not form collective states among themselves. However δ-forces brought about some coherence concentrating the $d_{5/2}^{-1} f_{7/2}$ state to one of the candidates of the PDR, but the more the range of the force increased the more the $d_{5/2}^{-1} f_{7/2}$ state is scattered among neighbouring states.

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THREE NUCLEON SCATTERING CALCULATIONS

P. Doleschall

The Faddeev equations with different partial-wave separable interactions have been solved for the 2n+p system at energy 22.7 MeV Lab. The most complete solution fully takes into account the one-term S /$n_{\tau}n$/, S /n-p/, P- and D-wave interactions and two term tensor forces with P = 4 % and 7 %. The sensitivity of the rank-1 and rank-2 polarizations of the elastic scattering to the different components of the n-n interactions and to the P are discussed. The measured nucleon and deuteron vector polarization are reproduced /figs.1. and 2./. The break-up differential cross sections show significant sensitivity to the D-wave components of the n-n interaction.

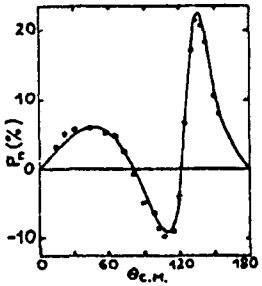


Fig.1.

Nucleon polarization of n-d elastic scattering at 22.7 MeV Lab. The calculation includes the S/n-n/, S/n-p/, 2T4, P- and D-wave interactions. The p-d experimental points are taken from J.C.Faivre et al. Nucl.Phys. A127 /1969/ 169.

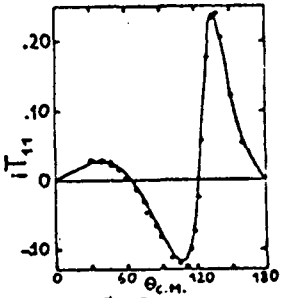


Fig.2.

Deuteron vector polarization of n-d elastic scattering at 22.7 MeV Lab. The calculation includes the S/n-n/,S/n-p/, 2T4, P- and D-wave interactions. The p-d experimental points are taken from F.N.Rad et al. Phys. Rev.Lett. 33 /1974/ 1227.

THE HALF-SHELL PHASE SHIFT IN TERMS OF THE ON-SHELL PHASE FUNCTION

T. Dolinszky

The Karlsson-Zeiger three-body equations work exclusively with half-off-shell scattering amplitudes as two-body input. The half-off-shell phases, themselves, can be calculated by solving Sobel's non-linear differential equations. Present paper proposes an explicit form for the half-shell phase in terms of the on-shell phase functions, i.e. just the solution to the Sobel equation, in any partial wave.

HALF-OFF-SHELL PHASE EQUATIONS FOR NON-LOCAL INTERACTIONS

T. Dolinszky

There are systems of integral equations available for the three-body scattering problem that work with half-off-shell phase shifts at all energies as two-body input. Sobel set up differential equations for the half-shell phase functions for the case of local potentials. Via explicit expressions of the half-shell phase shift in terms of the on-shell phase functions, the Sobel equations are now generalized to cover also non-local interactions.

GENERAL OFF-SHELL PHASE EQUATIONS FOR LOCAL INTERACTIONS

T. Dolinszky

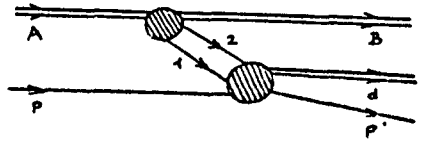
First order linear differential equations are developed for the completely off-shell phase shift in terms of the cut-off radius of the local two-body interaction. The input to these equations involves on-shell as well as half-off-shell phase functions the latter of which in turn satisfy first order linear differential equations with on-shell phase functions as input.

HIGH ENERGY /p,pd/ REACTIONS

I. Lovas

A surprisingly large number of high energy deuterons are produced in the forward direction by high energy protons. The formation of the high energy deuterons is possible in two ways. Either the target contains high momentum neutrons with large enough probability and the deuteron formation takes place by a pick-up mechanism, or the high momentum neutron is produced by the interaction of the incident proton with some of the target nucleons. If this second possibility is the dominant then the study of the /p,pd/ reaction has no special importance. If, however, the second possibility is the dominant then the /p,pd/ reaction can be considered as a tool for the study of the nucleon-nucleon correlations in the nucleus, since the high momentum component of the neutron wave function is closely connected with the short range nucleon-nucleon correlations.

The simplest way to represent the transition amplitude of the process $A+p \longrightarrow B+d+p$ is given by the following diagram:



As it is seen the transition amplitude is the combination of two factors. The first of them is the break-up amplitude of the target nucleus A into a nucleus B and two nucleons with momenta $\underline{K}_1$ and $\underline{K}_2$:

$$\langle B \mid a(\underline{K}_1)\ a(\underline{K}_2) \mid A \rangle$$

The second factor is the off-shell amplitude of the three-nucleon collision

$$p + N_1 + N_2 \longrightarrow d + p'$$

which can be obtained in a reliable way from the solution of the Faddeev-equations.

The comparison of the measured and calculated cross sections may provide information for the unknown amplitude

$$\langle B \mid a(\underline{K}_1)\ a(\underline{K}_2) \mid A$$

which is connected with the nucleon-nucleon correlations.

A SIMPLE ANALYTIC HYDRODYNAMIC MODEL FOR EXPANDING FIREBALLS

J.P. Bondorf*, S. Garpman**, J. Zimányi

A simple analytic similarity solution is presented for the non linear hydrodynamic equations describing a spherical, free, isentropic expansion of an ideal gas into vacuum. The solution for the density and velocity fields are

$$p\,/r,t/ = a\,\frac{1}{R/t/^3}\left[1-\left(\frac{r}{R/t/}\right)^2\right]^{\alpha} \qquad \text{for } r \leq R, \text{ zero elsewhere}$$

$$u/r,t/ = r\,\frac{dR/dt}{R} \qquad \text{for } r \leq R, \text{ zero elsewhere}$$

with

$$R/t/ = d/t^2 + t_o^2/^{\frac{1}{2}}$$

and α is a shape parameter.

The quantities calculated from this solution are similar to the results of Monte Carlo calculations of central heavy ion collisions /fig.1/. For the calculation of cross sections the time for the break up of the gas into non interacting particles must be defined. We define it as the time for which the "fly apart flow velocity" of neighbouring particles exceeds the average thermal velocity. In fig.2 differential cross sections calculated for the head on U+U collision at E_{LAB}=400 MeV/nucleon are shown.

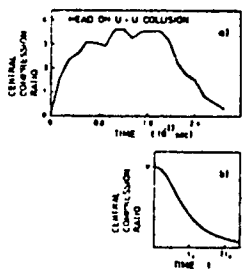


fig. 1

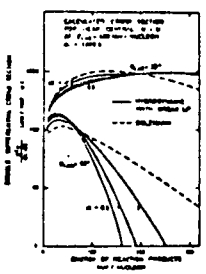


fig. 2

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INSTITUTE OF ISOTOPES

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BUDAPEST

Determination of the 1.18 MeV activation level of ^{195}Pt by the calibration of the microspectrum of γ-radiation from radioactive sources.

A.Veres, I. Pavlicsek

Institute of Isotopes, Budapest.

By means of the excitation of stable nuclei having an isomeric state, it is possible to observe those levels as well, which, by other methods of nuclear spectroscopy, were not achievable. One of those is the ^{195}Pt nucleus the excitation levels of which are unknown in the range around 1 MeV. Activation level energies have been determined earlier using accelerator bremsstrahlung, but the ^{195}Pt nucleus was not included in these studies.

The microspectrum, scattered to the 1.078 MeV resonance range of ^{115}In from the γ-radiation of ^{60}Co and ^{182}Ta sources, was determined by the integral cross-section. Irradiating the platinum target by the same radioactive sources, and calculating the integral cross-section values corresponding to different activation level energies, the values matching /within the error limit/ provided the true activation level energy, being between 1.17 and 1.19 MeV. Thus the first activation level energy of ^{195}Pt is 1.18 ± 0.01 MeV. The Γ_o partial level width corresponding to the γ-ray resonance absorption, calculated by the Breit-Wigner formula, was found to be 1.74 meV.

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DEBRECEN

EXPERIMENTATION FACILITIES

1./ A Van de Graaff accelerator with 5 MV nominal voltage, used with proton- deuteron- alpha- and heavy ion beams. The measuring center of the accelerator is equipped with a Nuclear Data 50/50 data acquisition and handling system, coupled to a PDP 11/40 computer.

2./ A Van de Graaff accelerator with 1 MV nominal voltage.

3./ In-beam superconducting magnetic spectrometer for investigation of electron conversion.

4./ In-beam electrostatic spectrometer to study inner shell ionisation phenomena induced by charged particles.

5./ A Cockroft-Walton accelerator up to a voltage of 700 kV. This accelerator is applied to generate proton-- deuteron- and electron beams for reaction studies for irradiation purposes and for inner shell ionisation investigations.

6./ Neutron generator
to produce D+D neutrons at a voltage of 150 kV, with a maximal D^+ ion current of 500 uA /analysed beam/.

7./ Electrostatic electron spectrometers for ESCA studies

8./ Computer facilities include a PDP 11/40 computer. Access to a CDC 3300 computer is made possible through a fully equipped UT-200 terminal.

9./ Beta-, gamma- and X-ray spectrometers of different types are available in the Institute to carry out investigations in different fields of nuclear spectroscopy and its applications, including research in other branches of science and practical applications.

FLUCTUATIONS IN THE LANE POTENTIAL AND (p,n) TRANSITIONS TO ANTI-ANALOGUESTATES

R.G. LOVAS

Phys. Lett. 71B /1977/ p. 16

The difference between the asymmetry potentials of neighbouring even nuclei near doubly closed shells is shown to arise from the shell effects that cause /p,$\tilde{n}$/ transition to anti-analogues states. The macroscopic description of /p,$\tilde{n}$/ transitions by this difference is satisfactory.

IMPROVED COUPLED-CHANNEL TREATMENT OF THE (d,$\bar{n}$) THRESHOLD EFFECT

R.G. LOVAS

Nucl. Phys. A285 /1978/ p.41

Calculations for the ^{90}Zr/d,p/ excitation function in a charge-exchange coupling model suggest that the /d,$\bar{n}$/ threshold effect can be explained with the resonant solution of the Lane equations taken as the proton form factor.

STRENGTH DECOUPLING FROM THE GIANT DIPOLE RESONANCE UPON DIAGONALIZING A GAUSSIAN FORCE AND δ -FORCE ON A PARTICLE-HOLE BASIS

L.P. CSERNAI*, J. ZIMÁNYI*,

B. GYARMATI, R.G. LOVAS

Nuclear Physics A294 /1978/ 41-48.

The finite-range Gaussian force and δ-force have been diagonalized in a basis of 27 particle-hole states with $J^\pi = 1^-$ in ^{116}Sn. Depending on the range of the force, 3.9-7.1 % of the total transition rate has been found in the 6-9 MeV excitation energy region, which comprises the unperturbed energies of the basis states containing neutron threshold states.

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CORE PLUS SINGLE-PARTICLE MODEL FOR QUASI-ELASTIC /p,n/ SCATTERING

R. G. LOVAS

/To be published in Proc. Conf. on Nuclear Reactions, Balatonfüred, 1977/

A model in introduced for /p,n/ scattering from a target nucleus of a core plus one neutron to the isobaric enelogue state $[(p,\bar{n})\,(IAS)]$ and to the anti-analogue state $[(p,\tilde{n})\,(AAS)]$. Preliminary results of its application to fine effects in these processes are presented.

LANE-MODEL DESCRIPTION OF /p,n/ REACTIONS TO ANTI-ANALOGUE STATES

R. G. LOVAS

/To be published in Proc. Conf. on Nuclear Reaction, Balatonfüred, 1977./

The assumption of the equality of the isovector effective interactions for different nuclei leads to Lane-model expressions for /p,$\tilde{n}$/ transitions to the anti-analogue states. These formulae describe the /p,$\tilde{n}$/ processes quite well.

STUDY OF THE COHERENCE EFFECT IN A DIRECT ALPHA-TRANSFER REACTION

B. APAGYI* and T. VERTSE

/To be published in Proc. Conf. on Reaction Models'77 Balatonfüred 1977/

Li induced stripping reactions are generally considered as excellent tools for studying alpha clustering in light nuclei. The majority of the measured angular distributions suggests that the /^{6}Li,d/ reaction proceeds predominantly via a direct alpha-particle transfer at energies lying reasonably high above the Coulomb barrier. The dynamics of this process can be described by a simple zero-range /ZR/ DWBA because of the predominant S state in the mutual alpha-d motion in the ^{6}Li and since the momentum transfer is small. In spite of this, ZR DWBA calculations could reproduce little of the experimental data. Even the use of finite range codes did not improve the fit considerably. We suspect that besides the effect of other reaction mechanisms the usual approximation in which one selects only one term in the expansion of the formfactor may be responsible for this. The aim of this work is to test the importance of the use of more than one /N,L/ terms in the formfactor on the example of the ^{12}C/^{6}Li,d/^{16}O at E_{Li}= 20 MeV. We used ZR DWBA and one body transfer with charge, mass and spin of an alpha-particle. Optical potentials were those of Bethge et al /Z.Phys. 208, 486/ and Newman et al /Nucl. Phys. A100, 225/ reproducing elastic scattering of Li and d in the entrance and exit channels, respectively. The formfactor responsible for the alpha transfer in our approximation is as follows

$$F_L(\vec{r}) = D_0 \, A_{N'L'}(^6\mathrm{Li}) \sum_N A_{NL}(^{16}\mathrm{O}) \frac{u_{NL}(r)}{r} Y_L^M(\hat{r}) \, .$$

where $A_{N'L'}$ (^{6}Li) and A_{NL} (^{16}O) are the alpha spectroscopic amplitudes of the projectile and the final state, respectively, with N'=2 and L=L'=0. The amplitudes A_{NL} listed in Table 1 were calculated using Zuker wave function by Apagyi et al /J. Phys. G to be publ./. The functions $u_{NL}(r)$ are the normalized single alpha-particle radial functions of a Saxon-Woods well with r_0= 1.71 fm, a=0,65 fm and V_0 adjusted to reproduce separation energy. The form of the experimental anguler distribution measured by Meier-Ewert et al /Nucl. Phys. A110,142/ is reproduced by the calculation reasonably well up to 120 degrees. The form of the individual cross-sections for different N values is quite different. The importence of the different N's can be seen from the integrated cross-sections listed in Table 1. Only the contribution of N=0 can be omitted, the others are comparable, therefore none of them could be neglected.

N	A_{NL}	$\sigma_{tot}^{(N)}$ [mb/sr]	$\sigma_{tot}^{incoherent}$ [mb/sr]	$\sigma_{tot}^{coherent}$ [mb/sr]
4	+ 0.046	0,074		
3	+ 0.064	0,115		
2	+ 0.122	0.400	0.663	0.850
1	+ 0.041	0.073		
0	+ 0.004	0.001		

Table 1

× University of Technology, Budapest

CHARGE-EXCHANGE TRANSITIONS ON NEIGHBOURING NUCLEI IN A SEMI-MICROSCOPIC MODEL

R. G. LOVAS

/To be published in Nucl. Phys./

The /p,n/ scattering from a target of a core plus one nucleon /or hole/ to the isobaric analogue and anti-analogue state is described in terms of the Lane potential of the core and a local effective interaction between the projectile and the excess particle /or hole/. In this model it is possible to distinguish static shell fluctuations from certain changes in the reaction dynamics between proximate nuclei. In particular, it is suggested that the giant resonance effects in /p,n/ depend strongly on the target nucleus.

This work was partly performed by the author at the Nuclear Physics Laboratory Oxford.

INVESTIGATION OF THE $^{20}Ne/d,p/^{21}Ne$ REACTION AT LOW BOMBARDING ENERGIES

A. VALEK

Acta Physica Academiae Scientiarum Hungaricae, Tomus 42, pp. 207-214 /1977/

The reaction $^{20}Ne/d,p/^{21}Ne$ was studied in the deuteron energy range 0.5-0.66 MeV. Excitation functions and angular distributions of the proton groups p_0, p_1, p_2 and p_4 were measured. DWBA calculations reproduced the averaged angular distributions of the proton groups p_1 and p_4, indicating the presence of direct processes at low bombarding energies.

INVESTIGATION OF THE $^{20}Ne/d,p_o/^{21}Ne$ REACTION AT E_d = 0.500-0.662 MeV

L. VÉGH and A. VALEK

J. Phys. G: Nucl. Phys. 4/1978/ 569-573.

In the $^{20}Ne/d,p_o/^{21}Ne$ reaction between E_d= 0.500 and 0.662 MeV two strong resonances were observed in the excitation function at E_d= 0.641 MeV and E_d= 0.564 MeV. The resonances could be assigned to levels lying at energies E_x= 11.860 MeV and E_x= 11.790 MeV in the compound nucleus ^{22}Na. The possible spin and parity values of the levels, determined with a two-level multichannel R-matrix fitting, are 1^+ or 2^+ and 1^- or 2^- respectively. In the calculations a considerable amount of continuous compound-like background had to be included.

Si/Li/ ELECTRON SPECTROMETER WITH SUPERCONDUCTING MAGNET TRANSPORTERS I. DESIGN.

T. FÉNYES, K. FÖLE, GY. MÓRIK, D. NOVÁK
F. TÁRKÁNYI

ATOMKI Közlemények 19 /1977/ 107-121

The Si/Li/ electron spectrometer with superconducting magnet transporters described here serves first of all for the measurement of internal conversion electron spectra, but the two built-in detectors provide possibility for e^-e^--coincidence and other measurements, too. The transmission of the spectrometer is $\sim$ 70 % from 4π. The magnetic field increases the transmission of electrons by a factor of about 400.

Si/Li/ ELECTRON SPECTROMETER WITH SUPERCONDUCTING MAGNET TRANSPORTERS. II. TECHNICAL MEASUREMENT AND CALIBRATION WITH RADIOACTIVE SOURCE.

T. FÉNYES, K. FÖLE, I. MAHUNKA, Z. MÁTÉ, GY. MÓRIK
D. NOVÁK, F. TÁRKÁNYI

ATOMKI Közlemények 19 /1977/ 187-199

The building experiences, the technical measurement and off-line calibration of a Si/Li/ electron spectrometer with superconducting magnet transporters are described in this paper. The measured data for one of the symmetrically arranged two detectors are as follows: the maximum electron transmission and the maximum detection efficiency in peak are 76 % and 57 % /from 2π/ respectively, the maximum effective solid-angle-increase factor at 88 mm source-detector distance is 350.

Si/Li/ ELECTRON SPECTROMETER WITH SUPERCONDUCTING MAGNET TRANSPORTERS. III. ON-LINE OPERATION

Z. ÁRVAY, T. FÉNYES, K. FÜLE, E. KOLTAY, Z. MÁTÉ, GY. MÓRIK
D. NOVÁK, F. TÁRKÁNYI

/To be published in ATOMKI Közl., 20 /1978//

A superconducting magnet transporter, Si/Li/ electron spectrometer was set on a Van de Graaff accelerator beam. The paper describes the results of the first in-beam conversion electron spectrum measurements. The electron transmission of the spectrometer in on-line operation is 20-26 % /from 4π for two detectors/, at strongly reduced background radiation. The given transmission value pertains to 200-800 electron energy range at 6 mm baffle diameter. The energy resolution of the spectrometer is 25-30 keV /FWHM at 300 keV/.

γ AND CONVERSION ELECTRON SPECTRA OF THE ^{97}Mo/p,nγe^-/^{97}Tc REACTION

Z. ÁRVAY, T. FÉNYES, J. GULYÁS, T. KIBÉDI, E. KOLTAY
A. KRASZNAHORKAY, S. LÁSZLÓ, D. NOVÁK

/To be published in Proc. of XV. Symposium on Nuclear Spectroscopy and Nuclear Theory, Dubna, 1978./

Enriched /to 93 %/, 0.43 mg/cm² thick ^{97}Mo metal target was bombarded with 3 MeV protons. The γ and conversion electron radiations of the ^{97}Mo/p,nγe^-/^{97}Tc reaction were measured with 35 cm³ Ge/Li/ γ -and superconducting magnet transporter /1/ Si/Li/ e^- -spectrometers. The energies and relative intensities of the observed γ -and e^- -radiations, as well as the multipolarity of some transitions in ^{97}Tc /see table/ have been determined.

Table. The multipolarity of some transitions in ^{97}Tc

E_{level} keV	E_γ keV	I_γ rel.	I_{e^-} rel.	Exp. conv. coeff. α_K	Multipolarity /a/
215.68	215.68±0.09	860±87	K 48 ±19	0.036 ±0.017	M1+E2
324.51	324.51±0.10	842±86	K 22 ± 5	0.017	E2 /2/
580.26 /3/	482.82±0.38	600±80	K 3.1±1.6	0.0033 ±0.0019	E2 /+M1/
656.85 /3/	560.13±0.61	726±76	K 4.9±1.0	0.0044 ±0.0015	E2 /+M1/

/a/ Deduced by comparison with the theoretical conversion electron coefficients of Hager and Seltzer.

1. Z. Árvay, T. Fényes, K. Füle, Z. Máté, Gy. Mórik, D. Novák, F. Tárkányi, Collection of abstracts of the recent Symposium.

2. M.E. Phelps, D.G. Sarantites, Nucl. Phys., A171 /1971/ 44.

3. W. Huber, K. Krämer, Z. Physik, 267 /1974/ 111.

STUDY OF THE ^{98}Mo/p,n γ/^{98}Tc REACTION γ-RAYS

T. FÉNYES, J. GULYÁS, T. KIBÉDI, Á. KISS, E. KOLTAY

Institute of Nuclear Research of the Hung. Acad. of Sci., Debrecen, Hungary

/To be published in Proc. of International Conference on Reaction Models 1977, Balatonfüred /Hungary/ 1977./

The measurement of the ^{98}Mo/p,n γ/^{98}Tc reaction γ-ray spectra has been performed with a high resolution 100 cm³ Ge/Li/ detector at different bombarding proton energies from 2.4 to 3.6 MeV. For the reliable identification of γ-rays in some experiments the thick enriched ^{98}Mo targets were replaced by thick, enriched ^{97}Mo and ^{100}Mo targets, and the reaction γ-rays were analysed under the same conditions. The energies of the observed ^{98}Mo/p,n γ/^{98}Tc reaction γ-rays and their relative intensities at E_p = 3.6 MeV and 55° observation angle have been determined.

γ - RAYS FROM THE ^{100}Mo/p,n γ/^{100}Tc REACTION

T. FÉNYES, J. GULYÁS, T. KIBÉDI, Á. KISS, E. KOLTAY

/To be published in Proc. of International Conference on Reaction Models 1977, Balatonfüred /Hungary/ 1977./

The spectra and excitation functions of γ-rays from the ^{100}Mo/p,n γ/^{100}Tc reaction have been measured in the 1.2-3.6 MeV proton energy range using thick, enriched targets and a Ge/Li/ spectrometer. For the reliable identification of γ-rays ^{97}Mo+p and ^{98}Mo+p reaction γ-rays were analysed too under the same conditions, using enriched targets. The energies of the observed ^{100}Mo/p,n γ/^{100}Tc γ-rays and their relative intensities at E_p = 3.6 MeV and 55° observation angle have been determined.

COMPUTER CODES FOR MULTI-LEVEL MULTI-CHANNEL R-MATRIX FITS.

L. VÉGH

ATOMKI Közlemények 20 /1978/ 45-49

Two R-matrix computer codes have been written in FORTRAN for CDC-3300 computer. One of them is a program for evaluation of reactions, the other is used to fit elastic scattering cross-sections. Following the description of the formalism of the R-matrix fitting codes some of their characteristics are presented.

LEVELS OF ^{10}B FROM THE ^{9}Be /p, $\alpha_2\gamma$/ ^{6}Li AND ^{9}Be /p,p/ ^{9}Be REACTIONS AT E_p = 2.56 MeV

Á. KISS, E. KOLTAY, GY. SZABÓ and L. VÉGH

Nuclear Physics A282 /1977/ 44-52;

To determine J^{π} values of the pair of states at 8.89 MeV in ^{10}B given so far as 2^+ and $3^{(\,)}$, we have investigated the ^{9}Be /p, $\alpha_2\gamma$/ ^{6}Li reaction, which selects the natural parity states. We have deduced the /p, α_2/ angular distribution at 17 energy points from the measured Doppler-broadened γ-line shapes. We have found a 2^+ and a 3^- resonance and determined their parameters by a two-level multi-channel R-matrix fit. The energies and widths obtained are about the same as those from the ^{9}Be /p,n/ ^{9}B and earlier /p, γ/ measurements. On this basis, the levels found in our /p, α_2/ measurements and in the /p,n/ reaction are assumed to be identical and the resonance parameters derived from them have been used to predict the ^{9}Be /p,p/ ^{9}Be elastic scattering cross sections. The calculated curve resonably agree with our measured elastic excitation functions.

THE LOWEST FIVE LEVELS OF ^{25}Na: LIFETIME, SPIN AND TRANSITION STRENGTH MEASUREMENTS

R. BERTINI*, S. JOLY*, J.C. MERDINGER*, M.S. ANTONY*, Á. KISS and A. KNIPPER*

Nuclear Physics A283 /1977/ 64-76;

Particle-gamma angular correlations and lifetime measurements /delayed coincidences and DSAM/ have been performed in the ^{26}Mg /t, α/ ^{25}Na reaction. The results for J^{π} /and τ_m / are $\frac{3}{2}^+$ or $\frac{5}{2}^+$ /7.4±0.4 ns/, $\frac{1}{2}^+$ /2.3$^{+2.0}_{-0.8}$ ps/, $\frac{3}{2}^+$ /< 25 fs/, $\frac{7}{2}^+$ /200±140 fs/ and $\frac{3}{2}$ or $\frac{7}{2}$ for the levels at 90, 1069, 2202, 2417 and 2788 keV respectively. Branching and mixing ratios have been measured, and strengths of the transitions calculated. Evidence for configuration mixing is given. The results are compared with shell-model calculations.

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LIFETIME OF THE 3590 keV STATE IN ^{10}B

Á. KISS, E. KOLTAY, B. NYAKÓ and GY. SZABÓ

Izv. Akad. Nauk. SSSR Ser. Fiz. 41 /1977/ 1975

The mean lifetime of the 3590 keV excited state of ^{10}B has been measured with the Doppler shift attenuation method in the reaction ^{9}Be /p,γ/^{10}B at the resonance E_p = 1.29 MeV.

The centroid shifts of the 2871 keV γ-line have been detected by a large volume /100 cm³/ Ge/Li/ detector at five angles from 0° to 125° and were analysed on the basis of LSS theory with the extension of Blaugrund.

The measurements led to the mean lifetime $\tau_m = 192^{+35}_{-29}$ fs. A comparison was made with earlier results in other reactions.

PROGRAMME FOR COMPUTING F (τ) FUNCTION FOR THE DETERMINATION OF LIFETIMES IN DSA MEASUREMENTS

B. NYAKÓ, GY. SZABÓ, Á. KISS

ATOMKI Közlemények 19 /1977/ 327-334

A FORTRAN programme is presented for computing the F (τ) function, based upon the Blaugrund formalism of the Doppler shift attenuation method to determine lifetimes of excited levels in nuclei.

DETERMINATION OF ANGULAR DISTRIBUTION OF NUCLEAR REACTIONS ON THE BASIS OF THE INVESTIGATION OF GAMMA-LINE SHAPE

GY. SZABÓ, B. NYAKÓ, Á. KISS

ATOMKI Közlemények 19 /1977/ 335-348

A system of FORTRAN programmes for deducing angular distribution of particles from the analysis of the Doppler broadened γ-line shape is described. Some remarks on its application in the analysis of the reaction ^{9}Be /p,$\alpha\gamma$/^{6}Li are given, and, for the second excited level of ^{6}Li a new, more accurate energy value /E_x = 3562.7±0.9 keV/, is obtained.

TARGET CHAMBER FOR NUCLEAR LIFETIME MEASUREMENTS BASED ON THE DOPPLER-EFFECT

Á. KISS, E. KOLTAY, B. NYAKÓ, I. PAPP, E. SOMORJAI

ATOMKI Közlemények 20 /1978/ 133-141

A vacuum chamber has been built in order to be used in experiments aiming at the investigation of the Doppler-effect appearing in nuclear reactions. In this kind of investigations it is very important to improve the vacuum in the chamber. Rest gas analyses have been performed in order to obtain data characterizing the construction in this respect. The results have been compared with the corresponding data taken in another experimental channel of the Van de Graaff accelerator.

RESONANCE LEVELS OF ^{23}Na IN THE REACTIONS $^{19}F/\alpha,\alpha/^{19}F$, $^{19}F/\alpha,p/^{22}Ne$ AND $^{19}F/\alpha,\gamma/^{23}Na$

J. CSEH, E. KOLTAY, Z. MÁTÉ, E. SOMORJAI, L. ZOLNAI

/The work is in progress./

The excitation functions were measured in the reactions /α,α/ and /α,p/ at five angles and simultaneously in the reaction /α,γ/ at 90°, in the bombarding energy range E_α = 1.6 - 3.6 MeV. The elastic scattering and /α,p/ data are under analysis by using the R-matrix theory. A few resonances were found in the /α,γ/ reaction channel below the neutron threshold. Spectrum and angular-distribution measurements are planned.

INVESTIGATION OF ^{28}Si LEVELS WITH THE (α,γ) AND (p,γ) REACTIONS

J.W. MAAS*, E. SOMORJAI, H.D. GRABER***, C.A. VAN DEN WIJNGAART**, C. VAN DER LEUN** and P.M. ENDT**

/To be published in Nuclear Physics/

Particle energies have been measured for resonances in the $^{27}Al/p,\gamma/^{28}Si$ and $^{24}Mg/\alpha,\gamma/^{28}Si$ reactions with an accuracy of 0.5×10^{-4} and 1×10^{-4}, respectively. The E_p = 991.88±0.04 keV $^{27}Al/p,\gamma/^{28}Si$ resonance served as calibration point. From these data the Q-value of the reaction $^{27}Al/p,\alpha/^{24}Mg$ has been determined as 1600.14±0.21 keV.

Excitation energies of ^{28}Si levels have been measured with the $^{27}Al/p,\gamma/^{28}Si$ reaction; the reaction energy is Q= 11584.5±0.4 keV.

Of 33 resonances observed in the $^{24}Mg/\alpha,\gamma/^{28}Si$ reaction /E_α = 1.5 - 3.8 MeV/, energies, strengths and γ-ray decay have been measured; five of these resonances had not been reported previously. Gamma-ray angular distribution measurements at three resonances yield the resonance J^π values and the mixing ratios of the strongest transitions involved in the decay. The 10.38 MeV level has $J^\pi = 3^+$, T = 1. The arguments on which T-assignments can be based are critically reviewed. These arguments are used to assign T = 1 character to 19 states of ^{28}Si.

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*** On sabbatical leave from Physics Department, Cornell College, Mount Vernon /Iowa/, U.S.A.

INVESTIGATION OF EXCITED STATES IN ^{28}Si BY REACTIONS $/\alpha,\alpha/$ AND $/\alpha,\gamma/$.

J. CSEH, E. KOLTAY and E. SOMORJAI

/To be published in "Problemi yadernoi fiziki i kosmicheskikh luchei"/

Resonance levels of ^{28}Si were examined in the excitation energy range of 12.72-13.26 MeV. The experimental data measured at four angles were analysed by using the R-matrix theory. The resonance parameters are presented. Among them there are the spectroscopic factors estimating the weight of α-structure in state configuration. A comparison of resonances existing in different reaction channels /especially in the $/\alpha,\gamma/$ channel/ is also given.

INVESTIGATION OF EXCITED STATES IN ^{23}Na BY THE REACTION $^{19}F/\alpha,\alpha/^{19}F$

J. CSEH, E. KOLTAY, Z. MÁTÉ, E. SOMORJAI, L. VÉGH, L. ZOLNAI

/To be published in Proc. of XV. Symposium on Nuclear Spectroscopy and Nuclear Theory, Dubna, 1978./

Excitation curves of the elastic α-scattering on ^{19}F were measured in the ^{23}Na excitation energy range of $12.1 \leq E_x \leq 13.5$ MeV. The cross sections were measured at five scattering angles simultaneously by using surface-barrier detectors.

The analysis of experimental data was performed with a fitting computer code working on the basis of the many-level formulas of the R-matrix theory. Results are given for J^π-, Γ-and Γ_α/Γ-values of resonances analysed until now.

OPTICAL MODEL ANALYSIS OF PROTON SCATTERING ON TIN ISOTOPES NEAR THE COULOMB-BARRIER.

A.I. BARISNYIKOV*, A.F. GURBICH*, V.A. ERSHOVA, E.L. YADROVSKI*
B. GYARMATI, T. VERTSE, L. ZOLNAI

/In Proc. of 28th Conference on Nuclear Spectroscopy and Nuclear Structure Alma-Ata, 1978, to be published in Izv. Akad. Nauk. Ser. Fiz./

Recently some hints have been made /see e.g. [1] / that the energy dependence of the real and imaginary well depths /V and W/ of the optical potential /OP/ in the vicinity of the Coulomb-barrier shows deviations from the values predicted by the commonly used systematics [2] . The systematic investigation of this effect throughout the whole mass-number region is prevented by the lack of elastic scattering data at low energies [2] , which, at the same time, also puts a limit to the validity region of the optical parameter systematics.

The aim of this work is to investigate the energy dependence of the proton O.P. of $^{116,120}Sn$ isotopes in the region $5.8 \leq E_p$ [MeV] ≤ 9 . The angular distributions were measured with the tandem generator of FEI from 60° to 165° in $3\text{-}4^\circ$ steps at five off-resonance energies which were in no case nearer an isobaric analogue resonance than $10.\Gamma_{IAR}$. The accuracy of the cross-section data varies from 5 % at forward angles to 1 % at backward ones. Very few published works have been found coinciding with one or the other of

* Physical-Energetical Institute /FEI/ Obninsk USSR

our cases. All the existing data agree with ours within the limits of errors.

The optical model analysis was carried out in ATOMKI on a CDC-3300 slightly modified version of D. Wilmore's code computer. As our cases are out of the validity region of Porey's /P/ systematics because $A < 100$ and Becchetti-Greenlees /B-G/ because $E_p < 10$ MeV, first we decided, by fixing the geometrics, if which of them covers better our data. With P geometry the fits to the measured angular distributions were systematically better than with B-G, at the same time, the resulted V and W values scattered much less around the predicted energy dependence of P than that of B-G. Full /6-parameter/ search was also carried out. As for the existence of an anomaly at the Coulomb-barrier further investigations are under way.

References:

1 J.S. Eck, W.J. Thompson, Nucl. Phys. A237 /1975/ 83

2 C.M. Perey, F.G. Perey, Atomic Data and Nuclear Data Tables 17 /1976/ 1

SOME EVALUATIONAL PROBLEMS CONNECTED WITH ELASTIC PROTON SCATTERING DIFFERENTIAL CROSS SECTION DATA MEASURED FOR DERIVING OPTICAL MODEL PARAMETERS BELOW THE COULOMB BARRIER

A. BARISNIKOV*, T. VERTSE, L. ZOLNAI, N. TITARENKO*

and E. YADROVSKY*

/To be published in ATOMKI Közlemények/

The disscussion of the following problems is given:

1./ The effect of geometrical alignment of the scattering chamber on the accuracy of the measured cross section data.

2./ The effect of the isobar-analogue resonances on the cross section data.

3./ The effect of isotopic purity of the target material on the cross section data.

In order to correct the measured cross section data for effects /2/ and /3/ a code was written in FORTRAN. Some illustrative examples are given for tin isotopes.

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THE ENERGY DEPENDENCE OF PROTON OPTICAL PARAMETERS BELOW THE COULOMB BARRIER

A. BARISNIKOV*, V. ERSHOVA*, A. GURBICH*, B. GYARMATI, E. KOLTAY, N. TITARENKO*, T. VERTSE, E. YADROVSKY*
L. ZOLNAI

Differential cross sections have been measured in proton elastic scattering on the ^{12}C, ^{16}O, ^{40}Ca, and $^{116,118,120,122}Sn$ isotopes near the Coulomb barrier, for deriving optical parameters.

Optical model analyses have been made with Perey and Becchetti-Greenleess geometry.

Similar analyses are planned on $^{32,34}S$ and titanium isotopes.

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RESONANCE LEVELS OF ^{28}Si EXCITED WITH LOW ENERGY PROTONS AND ALPHA PARTICLES

J. CSEH, I. HUNYADI, E. KOLTAY, E. SOMORJAI
L. ZOLNAI, L. VÉGH

Resonance levels of ^{28}Si were examined partly in the excitation energy range of 13.095-13.707 MeV by measuring the /p, α_0/, /p, α_1/ and /p, γ / reactions on ^{27}Al and partly in the excitation energy range of 12.72-13.26 MeV by the elastic α-scattering on ^{24}Mg. The yields of /p, α_0/ and /p, γ/ reactions were taken simultaneously with semiconductor detectors and NaI/Tl/ crystal, respectively, to locate the corresponding resonances. By using solid state track detectors /SSNTD/ the excitation function of the /p, α_1/ reaction as well as angular distributions at the observed /p, α_0/ and /p, α_1/ resonances were measured in the angular range 20^0-170^0.

The elastically scattered α -particles were detected with semiconductor detectors at four angles.

The experimental data were analysed on the basis of the R-matrix theory and resonance parameters were deduced. The comparison of resonances existing in different reaction channels are in progress.

INVESTIGATION OF DIRECT PROCESSES INDUCED BY LOW ENERGY PROTONS

E. SOMORJAI, P. DECOWSKI*

/The work is in progress/

The work is devoted to the structure investigations of nuclei in the sd-shell by direct /p, γ/ reactions. The common experiment has been started in 1978 with measurements on ^{28}Si target. The analysis of the data measured is in progress.

RAPID RADIOCHEMICAL SEPARATION OF RADIOGOLD FROM Tl TARGET AND EXISTENCE OF THE NUCLEAR REACTION ^{203}Tl /n,α/^{200m}Au

A. SZALAY, MOHAMED A.A. NAIM

Radiochem. Radioanal. Letters 30 /5-6/ 397-404 /1977/

Radio-isotopes of gold produced in Tl /n,α/ Au reactions by 14 MeV neutrons are quickly extracted onto a gold-coated glass fibre filter by filtration. By measuring the gamma-radiation of the filters, the presence of ^{200m}Au /T = 18,7 h / was observed. This very high /12^-/ spin metastable state was produced earlier by 18 MeV deuterons only, so its production by 14 MeV n-bombardment is surprising.

* Experimental Nuclear Physical Dept., Warsaw University

HALF-LIFE SYSTEMATICS OF THE RADIOACTIVE NUCLIDES, PART 2, THE DIAGRAMS

L. SARKADI and I. TÖRÖK

ATOMKI Közlemények 19 /1977/ 283-314

The first part of this paper was published in the ATOMKI Közlemények 18 /1976/ 609-615, where the description of the diagrams with the key of the symbols used and a list of figures are given. Here the diagrams are reproduced in the order of the aobve mentioned list of figures. The IAEA /Vienna/ kindly supplied us with an up to date list of half-lives. The drawings were updated according to this list.

SOME CROSS SECTIONS OF NUCLEAR REACTIONS INDUCED BY 14 MeV NEUTRONS ON Bi

P. BORNEMISZA-PAUSPERTL, I. TÖRÖK, I. URAY

Radiochem. Radioanal. Letters 32/5-6/ 277-282 /1978/

The nuclear reactions $^{209}Bi/n,\alpha/^{206m}Tl$ and $^{209}Bi/n,3n/^{207}Bi$ have been generated by neutrons of /14.6±0.3/ MeV energy. Cross section values of /9.8±1.5/ μb and /2±1/ mb have been determined for the above processes. An upper limit of 6 μb has been found for the reaction $^{209}Bi/n,^3He/^{207}Tl$. The possibilities of the analytical applications are treated.

ON THE /n,2n/ NUCLEAR REACTION ABOVE THE THRESHOLD OF THE /n,3n/ PROCESS

L. SARKADI and I. URAY

ATOMKI Közlemények 20 /1978/ 27-33

We show that earlier calculations for the cross section of the /n,2n/ nuclear reaction systematicelly deviate from the experience above the threshold of the /n,3n/ process. An expression is derived from the statistical model with the constant - nuclear - temperature approximation for level density. It reproduces the experimental excitation function shapes better than those used in earlier calculations. An approximation for practical applications is given.

EXCITATION OF 12^- ISOMERIC STATE OF ^{206}Tl BY FAST NEUTRONS

I. URAY, I. TÖRÖK, P. BORNEMISZA-PAUSPERTL, L. VÉGH

/To be published in Z. Physik A. ZfK-336 /Rossendorf bei Dresden, 1977/ p.58./

The 12^- isomeric state of ^{206}Tl formerly produced by charged particles, was produced in 14 MeV neutron induced /n,α/ reaction on Bi. An intensity balance was deduced from known gamma lines and several new weak gamma lines were observed. Theoretical considerations on the production probability of the isomeric state and on some intensity ratios are given. The half-life of the isomeric state was determined in good agreement with former measurements.

MODIFIED EXTRACTION GEOMETRY IN A RADIO-FREQUENCY ION SOURCE

I. KISS, E. KOLTAY and P. BORNEMISZA-PAUSPERTL

Revue de Physique Appliquée 12 /1977/ p. 1481

This paper is to show that a number of plausible arguments supporting the use of Bayly and Ward's extraction geometry in radio-frequency ion source can be put forward. The Thonemann-Harrison and the Schmidt-Eyrich version of this method have been compared in a series of measurements from the points of view of working parameters and beam characteristics. Current, gas supply rate, mass spectrum and emittance curve have been used to characterize the performance of the sources.

CONSTRUCTION OF THE STACK INSULATORS AND ACCELERATION TUBE ELEMENTS USED IN THE 5 MV VAN DE GRAAFF OF ATOMKI

I. BERECZ, Á. KISS, E. KOLTAY, I. PAPP, A. SZALAY and R. DŽMURAŇ *

Revue de Physique Appliquée 12 /1977/ p. 1511

Mechanical, optical and electrical tests have been performed on stack insulators and acceleration tube elements made of different borosilicate glasses produced by the Hungarian glass industry. The aim of the investigation was to select the proper construction elements for a home-made 5 MV Van de Graaff accelerator. The experiences obtained during the first ten thousand hours of running the machine will be presented.

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GLASS INSULATOR ELEMENTS OF THE 5 MV VAN DE GRAAFF ACCELERATOR OF ATOMKI

I. BERECZ, Á. KISS, E. KOLTAY, I. PAPP, A. SZALAY
R. DŽMURAŇ [*]

ATOMKI Közlemények 19 /1977/ 379-396

In an earlier paper a general description of the 5 MV Van de Graaff accelerator of ATOMKI has been given [1] . Pressure vessel, annular lift and gas handling system have been described in [2] . In ref. [3] the design and the working parameters of the voltage generator have been presented. The aim of the work described in this paper was to select the proper insulator elements to be used in the accelerator. Details of the experiments on material testing are treated and a description is given on the design of stack insulators and acceleration tubes used here. Technological questions are briefly mentioned. Experiences obtained during the first ten thousand hours of running the machine are also presented.

References:

[1] E. Koltay, A. Szalay; ATOMKI Közlemények 16 /1974/ p.181

[2] E. Koltay et al.:ATOMKI Közlemények, 17 /1975/ p. 131

[3] A. Kiss et al.: ATOMKI Közlemények, 11 /1976/ p. 1.

[*] Nuclear Research Institute of the Czecho-Slovakian Academy of Sciences, Řež, Czecho-Slovakia

TECHNICAL REPORT ON THE 5 MV VAN DE GRAAFF ACCELERATOR OF ATOMKI

A series of technical papers being published on the construction and running of the home-made 5 MV Van de Graaff accelerator on the basis of the experience gathered through a period of 11000 hours of operation. In earlier papers a general description has been given, pressure vessel, annular lift and gas handling system as well as the high voltage generator have been treated. Insulator elements and the energy stabilization circuit are introduced in further issues.

I. BERECZ, A. KISS, E. KOLTAY, I. PAPP, A. SZALAY, R. Dzmuran[*]

ATOMKI Közlemények 19 /1977/ 379

A. KISS, E. KOLTAY, GY. MÓRIK, A. PAÁL, M. RUBECZ

To be published in ATOMKI Közlemények

E. KOLTAY, GY. MÓRIK, I. PAPP, GY. SZABÓ, GY. BÁCSKAI

Submitted to ATOMKI Közlemények

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ELECTRON SPECTROSCOPY IN THE FAMILY OF THE VARIOUS SPECTROSCOPIC TECHNIQUES

D. BERÉNYI

Proc. of 7. International Conference on Atomic Spectroscopy Praha 1977

A short survey is given on the application of electron spectroscopy in surface analysis, in chemical and trace analysis.

K-SHELL IONIZATION CROSS SECTIONS OF Pd, Ag, In AND Sn FOR RELATIVISTIC ELECTRONS.

S. RICZ, B. SCHLENK, D. BERÉNYI, G. HOCK and A. VALEK

Acta Physica Hung 42. /1977/ p. 269.

The K-shell electron impact ionization cross sections for $_{46}Pd$, $_{47}Ag$, $_{49}In$ and $_{50}Sn$ were determined in the 300-600 keV region of bombarding energy. The experimental values of cross sections were in fairly good agreement with the BEA theory in the region investigated. No dip or irregularities were observed inside the limits of the errors around Z=48 suggested by A. Li-Scholz et al. at 2.04 MeV bombarding energy.

ELECTRON IMPACT L-SHELL IONIZATION IN THE BOMBARDING ENERGY REGION FROM 300 TO 600 keV

B. SCHLENK, D. BERÉNYI, S. RICZ, A. VALEK, and G. HOCK

J. Phys. B: Atom. Molec. Phys., Vol 10, No. 7. 1977.

The X-ray production cross sections and yield ratios for the L lines and the total L shell, measured by electron impact ionization in the bombarding electron energy region 300-600 keV, are determined for Yb, Au and Pb. The experimental data are compared with theoretical calculations.

K_α/K_β X-RAY INTENSITY RATIOS AND K-SHELL IONISATION CROSS SECTIONS FOR BOMBARDMENT BY ELECTRONS OF 300-600 keV

D. BERÉNYI, G. HOCK, S. RICZ, B. SCHLENK and A. VALEK

J. Phys. B: Atom. Molec. Phys 11 /1978/ p.709

The K_α/K_β intensity ratios were measured for X-rays from $_{26}Fe$, $_{27}Co$, $_{28}Ni$, $_{29}Cu$, $_{34}Se$ and $_{39}Y$ produced by electrons of 300-600 keV by using a Cockcroft-Walton accelerator. Absolute K-shell ionisation cross sections were also determined for Cu and Se.

L X-RAY PRODUCTION CROSS SECTION FOR Sm, Ho, Er, AND Bi AT SEVERAL HUNDRED keV ELECTRON IMPACT

S. RICZ, B. SCHLENK, D. BERÉNYI, A. VALEK, G. HOCK and S.A.H. SEIF EL NASR*

/Submitted to Journ. Phys. B: Atom. Molec. Phys./

Absolute L X-ray production cross sections for individual X-ray lines are determined at four different energies of bombarding electrons in the region from 300 to 600 keV. For the present experiment only the BEA theory is available for comparison. The calculated values are compared with the experimental data, as a function of atomic number of the target.

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LARGE MO K X-RAY ANISOTROPY FROM A VERY LIGHT COLLISION SYSTEM

J. SCHADER*, GY. SZABÓ, and K.O. GRÖNEVELD*

Nuclear Instruments and Methods 151 /1978/ 211-215

The angular distribution of MO X-rays emitted in Ne impacting on Al-foils /thickness 30 to 100 $\mu g/cm^2$/ has been studied for projectile energies ranging from 1.5 MeV to 12 MeV. The broadening and energy shift of the characteristic Al $K_{\alpha,\beta}$ peak can be explained quantitatively by multiple ionization /$K^{-1} L^{-m}$, $m > 2$/. The measured "half-widths" of the MO X-ray continua agree very well with those proposed by collision broadening theory. The MO X-rays exhibit an anisotropy strongly increasing with collision energy which can be reproduced qualitatively by a model of rotationally induced transitions in a transiently formed quasimolecule. Because of the high projectile energies however, this anisotropy is assumed to be preferentially produced by alignment effects, i.e. by anisotropic emission of spontaneous quasimolecular radiation.

* Institut für Kernphysik der Universität Frankfurt/Main, Germany

Ar^{+12} /1.4 MeV/amu/ ⟶ C-FOIL: Ar $K_{\alpha,\beta}$ AND REC X-RAY PRODUCTION DEPENDENCE ON FOIL THICKNESS

K.D. SEVIER*, GY. SZABÓ, F. FOLKMANN*

Submitted for publication in Zeitschrift für Physik

The average Ar K_α, K_β, and K-REC X-ray production cross sections for 1.4 MeV/amu Ar^{+12} bombarding C-foils of effective thicknesses between 1 and 450 $\mu g/cm^2$ have been measured. Average cross section values for the excitation and several de-excitation channels were obtained by a computer fit of the data. The obtained high post-foil K-fluorescence yield value $\omega_K = 0.8$ indicates that the K-vacancy ions are highly ionized, $(\bar{q}(K^{-1}) \simeq +13.8$ vs. $\bar{q}_{Tot.} \simeq +12.2$ or $+12.5)$. The agreement of measured K_α energy values for thinner foils $(\lesssim 100\ \mu g/cm^2)$ with theoretical Be-like Ar-ion K_α radiation energy supports this result.

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AUGER ELECTRON EMISSION FROM TARGET IONS UNDER HEAVY ION IMPACT AFTER MOLECULAR DISSOCIATION

R. MANN* and F. FOLKMANN*

R.S. PETERSON**, GY. SZABÓ and K.-O. GROENEVELD***

/To be published in Journal of Physics B/

The line shape of the /1s 2s 2p/ ^4P /metastable/ $\rightarrow$ /$1s^2$/^1S + e^-. Auger electron transition from heavy ion impact is measured for targets containing carbon, nitrogen, oxygen and neon. The angular distribution of this transition is also measured for molecular gas targets containing carbon. Ar, Kr, Xe and U projectiles from the UNILAC were used with energy 1.4 MeV/amu. It is found that the line shape depends strongly on the initial molecular target. Kinematic effects such as projectile induced target recoil do not account well for these changes. A simple model is proposed that assumes the creation of a highly ionized molecule. The line shape is due to Doppler broadening from the velocity acquired by the dissociation of the molecule. Reasonable agreement between this Coulomb explosion model and the experimental results is found, allowing dissociation velocities to be calculated from the experimental line shapes.

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** Physics Department, North Texas State University Denton, Texas, USA.

*** Institut für Kernphysik der Universität Frankfurt/Main, Germar

K_β/K_α INTENSITY RATIOS FOR X-RAY PRODUCTION BY HEAVY IONS

T. MUKOYAMA*, L. SARKADI, D. BERÉNYI and E. KOLTAY

/Submitted to Phys. Lett. A./

The K_β/K_α intensity ratios for low-energy proton /2 MeV/ and N-ion /2.8 MeV/ bombardments have been measured for several targets. The experimental results indicate the relative importance of K- and M-shell simultaneous ionization. In the paper a qualitative interpretation is given.

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X-RAY PHOTOELECTRON SPECTROSCOPIC INVESTIGATION OF ELECTROCHEMICALLY OXIDIZED AND REDUCED PLATINUM SURFACES

L. KÖVÉR, CS. UJHELYI, D. BERÉNYI, D. VARGA, I. KÁDÁR Á. KÖVÉR and J. MILLER*

/To be published in Journal Electron Spectr./

On smooth and platinised platinum surfaces the growing of oxide layer with the time of anodic oxidation in 1 M, 3.5 M and 8.8 M $HClO_4$ has been investigated by XPS. The presence of a single species, probably PtO, can be evaluated from the XPS measurements. Pure metallic platinum surfaces were prepared by acidic digestion, ignition, and cathodic reduction, and their electron spectra have been compared. Calculated values of PtO film thickness for different time intervals of the electrolytic oxidation are given at various concentrations of $HClO_4$.

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INVESTIGATION OF ELECTRONS FROM TARGETS BOMBARDED BY HEAVY PARTICLES IN ACCELERATORS

D. BERÉNYI

/To be published in Fizika Elementarnich Chastich i Atomnogo Yadra./

After surveying shortly the instrumental techniques, the data /energy and angular distribution, cross section/ on ejected electrons from the collision process itself are summarized separately for gaseous and solid targets /foils/ of nuclear accelerators. The energy distribution of these electrons is continuous in general and their angular distribution is strongly anisotropic. Afterwards, the Auger--processes of the atoms participating in the collision in targets of accelerators bombarded by charged particles are treated. The results are given separately for gaseous and solid targets /foils/ including atomic-molecular beams and beam-foil as well as beam-gas excitation. Finally, the possibility of practical applications are shortly treated.

CONCENTRATION PROFILE DETERMINATION BY PIXE METHOD UTILIZING THE VARIATION OF BEAM ENERGY

J. VÉGH, D. BERÉNYI, E. KOLTAY, I. KISS, S. SEIF EL-NASR*
and L. SARKADI

/To be published in Nucl. Instr. Meth./

The applicability of the PIXE method by varying the beam energy for in-depth analysis was investigated. The measurements were carried out on different Al samples containing Zn and Mg, annealed during different time periods. The Zn concentration profiles for samples with different annealing were determined up to 30 μ. The method has a relatively poor depth resolution but its advantages /non-destructive multielemental method, applicable for a wide range of elements/ make it useful especially in connection with some other profiling methods.

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ANGULAR DISTRIBUTION OF CHARACTERISTIC X-RAYS EXCITED BY ELECTRON IMPACT AT RELATIVISTIC ENERGIES

J. PÁLINKÁS, B. SCHLENK, A. VALEK

The angular distribution of K_α, K_β and L_{tot} characteristic X-rays from Se target excited by electron impact at 300 keV and 600 keV energies and that of L_e, L_α, L_β and L_γ from Bi target at 300 keV electron energy have been measured.

The angular distribution of the characteristic X-lines examined was found to be isotropic within an error limit of 1.5-2 percent in the 15-150° angular range.

ON THE RELAXATION OF ELECTRON CLOUD IN ELECTRON CAPTURE

E. VATAI

Izvestiya Akad. Nauk SSSR, ser. fiz. 42, 826 /1978/

Comparison of experimental electron capture ratios is made with theoretical ones, calculated with different approximations. It is shown that not only the M/L capture ratios, but also the L/K ratios give the best agreement with exhange and overlap correction calculated with full or nearly full Hartree-Fock relaxation of the final atom.

ADDENDUM TO THE "CORRECTION OF ELECTRON CAPTURE RATIOS MEASURED BY MULTI-WIRE PROPORTIONAL COUNTER" [1]

E. VATAI

Acta Physica Academiae Scientiarum Hungaricae, Tomus 42 (3), pp. 185-187 /1977/

The formulas for the calculation of the corrections of multi-wire proportional counters published in [1] are explained, simplified and corrected.

[1.] E. Vatai, Acta Phys. Hung., 28 103. 1970.

STATIC MAGNETIC SHIELD FOR ELECTROSTATIC ELECTRON SPECTROMETERS

L. KÖVÉR, D. VARGA, L. MORAVECZ*

ATOMKI Közlemények 20 /1978/ 51-58 .

Against external static fields magnetic shieldings have been constructed for two cylindrical mirror electrostatic electron spectrometers ESA-11 and ESA-12, developed in ATOMKI. After demagnetization the magnetic field inside the spectrometers was < 350 nT and < 30 nT respectively. The results of the magnetic field measurements and the demagnetization process are presented.

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INVESTIGATION OF ELECTRON DETECTION CHARACTERISTICS OF CHANNEL ELECTRON MULTIPLIERS.

E. SZMOLA*, Á. KÖVÉR

ATOMKI Közlemények 20 /1978/ 59-69

The relative efficiency curves of channel electron multipliers were investigated in function of the energy /200-1200 eV range/ and the place of electron impact on the detector. The electrons were produced by the help of a low current electron gun.

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INVESTIGATION OF SOME INORGANIC COMPOUNDS IN HUMAN HAIR

J. BACSÓ, P. KOVÁCS, S. HORVÁTH*

Radiochem. Radioanal. Letters 33 /4/ 273-280 /1978/

The S and Ca content of human hair has been investigated with radioisotope excited X-ray emission analytical method. By the investigation of 204 samples the average S content of hair was found to fluctuate between 6 ± 1 %, the Ca content between 0.03-1.0 %. The Ca concentration of inferction suffered patients' hair is significantly lower /0.091 %/ than by healthy persons. /0.241 %/.

* Medical University, Debrecen, Hungary

ACCUMULATION OF ARSENIC? LEAD AND OTHER HEAVY ELEMENTS IN THE IRON-MANGANESE OXIDE-HYDROXIDE PRECIPITATION IN THE PIPELINES OF CITY WATERWORKS

J. BACSÓ and A. SZALAY

K. KISS[*]

The Science of the Total Environment, 9 /1978/ 271-276

Iron-manganese oxide-hydroxide precipitates in the pipelines of waterworks of several Hungarian cities were analyzed and the accumulation of significant amounts of As, Pb, Cu and Zn, was observed. The investigations demonstrated that the concentration of these trace elements in water is very small, but the high colloidal surface of the iron-manganese oxide-hydroxide precipitate lining pipes is highly enriched in these elements. Assay of these precipitates provides a very sensitive technique for monitoring water contamination.

[*] City Waterworks, Debrecen, Hungary

TRACE ELEMENT ANALYSIS OF FISH-MEALS BY X-RAY EMISSION ANALYSIS

J. BACSÓ, M. KIS-VARGA, A. PALÓCZ[*],

IZOTÓPTECHNIKA /Budapest/ 20 /1977/ 118-124

The analysis of fish-meals used by corn industry for producing fodder was performed by Si/Li/ semiconductor detector X-ray spectrometer. The Ca, Fe, Zn, Br, Rb, and Sr content of some imported fish-meals was determined.

[*] Trust of Cereals Budapest

AUTOMATIC SPARK COUNTING OF ALPHA-TRACKS IN PLASTIC FOILS

G. SOMOGYI, L. MEDVECZKY, I. HUNYADI and B. NYAKÓ

Nuclear Track Detection 1 /1977/ pp.131-138

The possibility of α-track counting by jumping-spark counter in cellulose acetate and polycarbonate nuclear track detectors was studied. A theoretical treatment is presented which predicts the optimum residual thickness of the etched foils in which completely through-etched tracks /i.e., holes/ can be obtained for α-particles of various energies and angles of incidence. In agreement with the theoretical prediction, it is shown that a successful spark counting of α-tracks can be performed even in polycarbonate foils. Some counting characteristics, such as counting efficiency vs particle energy at various etched-foil thicknesses, surface spark density produced by electric breakdowns in unexposed foils vs foil thickness, etc., have been determined. Special attention is given to the spark counting of α-tracks entering thin detectors at right angle. The applicability of the spark-counting technique is demonstrated in angular-distribution measurements of the $^{27}Al\ /p,\alpha_0/^{24}Mg$ nuclear reaction at E_p = 1899 keV resonance energy. For this study 15 μm thick Makrofol-G foils and a jumping-spark counter of improved construction have been used.

PROCESSING OF PLASTIC TRACK DETECTORS

G. SOMOGYI

Nuclear Track Detection, Vol.1, No.1.pp.3-18.

A survey of some actual problems of the track processing methods available at this time for plastics is presented. In the case of the conventional chemical track-etching technique, mainly the etching situations related to detector geometry, and the relationship between registration sensitivity and the etching parameters are considered. Special attention is paid to the behaviour of track-revealing by means of electrochemical etching. Finally, some properties of a promising new track processing method based on graft polymerization are discussed.

A NEW TECHNIQUE FOR TRACK VISUALIZATION

SOMOGYI Gy. és TÓTH-SZILÁGYI M.

ATOMKI Közlemények 19 /1977/ 349-364

By improving the graft copolymerization technique, proposed by Monnin, for creating fluorescens tracks a new method has been developed for visualizing nuclear particle tracks in various plastic sheets. At the present state of development the method is capable of producing, repeatably, so-called dyed tracks in different cellulose derivates for fission fragments, middle-heavy ions and fast-neutron-induced recoil nuclei. Preliminary results related to the parameters influencing the track revelation process are given. It has been found that in several cases the formation of dyed tracks cannot be understood on the basis of graft copolymerization, thus polycondensation or chemisorption track enhancement processes should be supposed.

A SPATIAL TRACK FORMATION MODEL AND ITS USE FOR CALCULATING ETCH-PIT PARAMETERS OF LIGHT NUCLEI

G. SOMOGYI, R. SCHERZER*, K. GRABISCH* and W. ENGE*.

Nuclear Instruments and Methods 147 /1977/ 11-18

A generalized geometrical model of etch-pit formation in three dimensions is presented for nuclear particles entering isotropic solids at arbitrary angles of incidence. With this model one can calculate the relations between any particle parameter /Z= charge, M= mass, R= range, Θ= angle of incidence/ and etching or track parameter /h= removed detector layer, L= track length, d= track diameter, etch-pit profile and contour/ for track etching rates varying monotonically along the trajectory of particles. Using a computer algorithm, calculations have been performed to study identification problem of nuclei of Z= 1-8 registered in a stack of polycarbonate sheet. For these calculations the etching rate ratio vs residual range curves were parametrized with a form of $V^{-1}(R) = 1 - \sum a_i \exp(-b_i R)$ which does not involve the existence of a threshold for track registration. Particular attention was paid to the study of the evolution of etch-pit sizes for relatively high values of h. For this case, data are presented for the charge and isotope resolving power of the identification methods based on the relations L/R/ or d/R/. Calculations were also made to show the effect of the relative /parallel and opposite/ orientations between the

directions of track etching and particle speed on etch-pit evolution. These studies offered new identification methods based on the determination of the curves L/parallel/ vs L /opposite/ and d /parallel/ vs d /opposite/, respectively.

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COMPARATIVE STUDY OF THE ION TRANSPORT PROCESS IN A MEMBRANE SYSTEM BY QUANTITATIVE AUTORADIOGRAPHY USING PHOTOEMULSION AND PLASTIC TRACK DETECTOR

T. VARRÓ*, G. SOMOGYI, A. BÜLCSKEI§ and I. MÁDI*

Nuclear Track Detection, Vol. 1. No.3/4, pp.181- 188

The diffusion of $^{241}Am^{3+}$ ions in a sulphonic acid polystyrene type ion-exchange membrane has been studied. Ion diffusion-concentration profiles within the membrane is determined using quantitative microautoradiography performed with Agfa-Gevaert photoemulsions and plastic nuclear track detectors. The diffusion coefficients derived from the radiograms of the ion-concentration profiles and the results obtained by the two different methods are compared.

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ON THE DETECTION OF LOW-ENERGY ^{4}He, ^{12}C, ^{14}N, ^{16}O IONS IN PC FOILS AND ITS USE IN NUCLEAR REACTION MEASUREMENTS

G. SOMOGYI, I. HUNYADI, E. KOLTAY and L. ZOLNAI

Nuclear Instruments and Methods 147 /1977/ 287-295

It is shown that by using a proper etching reagent the registration sensitivity of polycarbonate foils can be enhanced and they prove to be very suitable track recorders for alpha-particles emitted from nuclear reaction. At 6 MeV an energy resolution of 0.2 MeV can be achieved when using the track diameters as a measure of the particle energy. A theoretical way to calculate the track parameters important in nuclear reaction measurements involving alpha-particles recorded in polycarbonate foils is given. For this purpose the track etch rate vs residual range curve was determined by a parameter optimization procedure. The energy resolution of the track-diameter method as a function of the particle energy was predicted. In our earlier studies the track-diameter method was mostly used in angular distribution measurements of /d,α/ nuclear reactions. In this work it is shown that with polycarbonate foils it can be well applied to excitation function measurements, as well. Such studies are presented for the α_0 and α_1 groups of the $^{27}Al/p,\alpha/^{24}Mg$ reaction in an energy interval between 1540 and 1920 keV. Finally, preliminary results on the track etching properties of low-energy O^+, N^+ C^+ and He^+ ions accelerated with a 5 MV Van de Graaff generator are given.

A STUDY OF THE BASIC PROPERTIES OF ELECTROCHEMICAL TRACK ETCHING

G. SOMOGYI

Radiation Effects 1977, Vol. 34 pp.51-56

The basic properties of the electrochemical track etching method proposed by Tommasino were studied for PC and PET foils irradiated with fission fragments and/or alpha-particles. Etching was performed in a specially designed double-wall vessel applying electric fields of different strengths and frequencies. The variation in the diameters of the discharge spots produced around the tracks of fission fragments entering PC and PET foils at right angles was systematically studied as a function of the strength and frequency of the electric field, etching time and etchant temperature. For alpha-tracks registered in PC foils the dependence of the discharge spot diameter on particle energy was also determined. It was found that the production of discharge spots started at a threshold field strength depending on the type of particle. The temperature dependence of the growing rate of discharge spots followed the Arrhenius law, but with a reduced activation energy as compared to that obtained for the chemical etching rate of the bulk material.

STUDY OF THE TRANSPORT PROCESS OF URANYL IONS IN AN ION-EXCHANGE MEMBRANE BY SOLID-STATE TRACK DETECTOR FISSIONOGRAPHY

T. VARRÓ*, G. SOMOGYI, ZS. VARGA, and I. MÁDI*

/To be published in Int. J. Appl. Rad. Isotopes/

The diffusion of uranyl ions in an ion-exchange membrane of polystyrenesulphonic acid type was studied. The solid-state track detector technique was used to prepare radiograms on the diffusion concentration profiles in the interior of the membrane in the event of various diffusion times and temperatures. The fission fragments formed from ^{238}U on the action of fast neutrons were detected in mica plates, and the local variations in the uranyl ion concentration were employed to determine the characteristic parameters of the transport process: the diffusion coefficients, the frequency factor and the activation energy.

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FIELD MACRORADIOGRAPHY MEASURING RADON EXHALATION

G. SOMOGYI, L. MEDVECZKY, ZS. VARGA, I. GERZSON*, I. VADOS*

/To be published in Isotopenpraxis/

A macroradiographic technique for measuring radon exhalation of various soils in Hungary has been developed. The method is based on the long-term simultaneous measurement of the alpha-activity of soil gas at numerous points of a given area with plastic nuclear track detectors. In the present work two-year experiences related to calibration measurements in laboratory, methodical studies on stationary points of field basic stations and mapping of radon anomalies over different geological profiles are surveyed. Several case-studies are presented to show the effectiveness of radon macroradiography in revealing geological structures below the area to be explored.

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SPARK COUNTING OF ALPHA-RADIOGRAMS RECORDED ON STRIPPABLE CELLULOSE NITRATE LR-115 FILM

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/To be published in Nuclear Track Detection/

In this paper a study on the spark counting of etch-holes of α-particle tracks recorded on 13 μm strippable cellulose nitrate track detectors /Kodak-Pathé LR-115 films/ is described. Results for the counting characteristics as a function of etching and irradiation parameters are given. Applications of the spark counting technique to α-radiograms obtained by /p,α/ nuclear reaction and soil radon exhalation measurements are presented.

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EXPERIMENTAL FACILITIES

1. A 0.30 mg Cf-252 /fission/ neutron source;
2. 200 kV /2 mA/ neutron generator /home made/ with analysed beam;
3. 180 kV /1.2 mA/ Activatron-111 neutron generator, it can be pulsed, pulse period: down to 10 microsec;
4. Pu-Be neutron sources from 0.5. to 5 Ci;
5. 40 cm^3 Ge/Li/ detector with 3 keV FWHM at 1332 keV; and Si/Li/ X-ray spectrometer; with 350 eV FWHM at 6.4 keV;
6. 4000 channel DIDAC /Intertechnique/ analyser and MULTI-20 Plurimat N data processing system with peripherals; AI-1024 type MCA
7. Time-of-flight system with associated particle and klystron bunching method for fast neutrons is under construction;
8. Low-background proportional counter for measuring weak beta and/or gamma rays, e.g. tritium, with a sensitivity of a few pCi; $4\pi\beta$ - flow gas counter.

MEASUREMENT OF /n,t/ CROSS SECTIONS AT 14 MeV AND CALCULATION OF EXCITATION FUNCTIONS FOR FAST NEUTRON REACTIONS

S. Sudár and J. Csikai

Systematic investigations were carried out for the determination of gross trends in the /n,t/ cross sections at around 14 MeV neutron energy. New data have been measured for the ^{27}Al, ^{55}Mn, ^{93}Nb and ^{209}Bi isotopes using the vacuum extraction and tritium beta counting method. The /n,t/ cross sections as a function of N-Z /A are separated into two groups for odd and even target mass number. For odd nuclei the values are higher by a factor of about 10 than for even ones which can be attributed to the differences in the threshold energies. This observation was confirmed by the calculation of excitation functions for the /n,2n/, /n,p/, /n,α/ and /n,t/ reactions in the case of ^{27}Al, ^{32}S, ^{55}Mn, ^{58}Ni, ^{59}Co using the Hauser-Fashbach model. For a given nucleus, in the case of the above mentioned reactions the measured and calculated excitation funcitons are in good agreement using the same level density parameter deduced from the /n,α/ fitting. For even nuclei at around 14 MeV the /n,t/ cross section curves change significantly with neutron energy which might be a reason of the large spread in the data measured at different laboratories. The good agreement between the measured and calculated σ/n,t/ values indicates that the /n,t/ reaction can be described by the statistical model [1].

[1] S. Sudár, Thesis, Kossuth University, Debrecen, 1978.

SHELL EFFECTS IN RMS CHARGE RADII

I. Angeli and M. Csatlós

A comprehensive study of experimental rms charge radii shows that the deviation from the rough $A^{1/3}$ dependence follows simple trends. Isotopic sequences show marked shell- and deformation effects at neutron numbers N=20, 28, 50, 82, 88, 90, 114 and 126; an "odd-even staggering" of the order of 6×10^{-4} has also been observed [1].

Isotonic, isobaric and isosymmetric /N-Z=const./ sequences reflect the effect of proton shell structure [2] at least for proton numbers Z=28, 50 and 82. There are strong deviations from the $A^{1/3}$ rule in the case of light nuclei, but these deviations do not follow the simple pattern mentioned above. In the appendix of ref. [2], a table of recommeded rms charge radii is included.

References:

[1] : I. Angeli and M. Csatlós, Nucl. Phys. A288 /1977/ 480.

[2] : I. Angeli and M. Csatlós, ATOMKI Közl. 20 /1978/ 1.

LOW-ENERGY CROSS SECTION FOR $^{6}Li/d,n/^{7}Be$

J.Szabó, Z.T.Bődy, S.Szegedi and M.Várnagy

The investigation of nuclear reactions induced by low-energy charged particles on light nuclei is especially important from the point of view of nuclear astrophysics, as well as for planning controlled thermonuclear reactors. Among these the $^{6}Li/d,n/^{7}Be$ reaction is of the highest priority. Cross-section data are needed for this reaction with errors less than 25 % in the energy range E_d=0.1-5 MeV.

Cross-sections were determined for the $^{6}Li/d,n/^{7}Be$ reaction between 100 and 180 keV deuteron energy using the ectivation method. Different methods of extrapolation were employed and compared down to the energy region of astrophysical interest.

[1] J.Szabó, Z.T.Bődy, S.Szegedi, M.Várnagy: Nucl. Phys. A289 /1977/ 526.

FISSION YIELD MEASUREMENTS OF ^{235}U FOR 14.6 MeV NEUTRONS

S.Daróczy, S.Nagy P.Raics, I.Hamvas[x]

The direct Ge/Li/-spectrometry was applied for the determination of the mass yields of ^{235}U fission induced by 14.6 MeV neutrons. This method is based on the γ-spectrometry of the irradiated sample, i.e. both any separation process /radiochemical or physical/ and the application of the so called "R-method" are avoided. It was checked by several experiments made on the $^{238}U/n,f/$ process [1].

Uranium sample of 1 g U_3O_8 enriched to 92,3 % in ^{235}U was irradiated by neutrons, the flux density of which was determined by the $^{27}Al/n,\alpha/$ reaction. The absolute efficiency of the Ge/Li/-spectrometer was determined by standard point-like and extended sources. γ-spectra were recorded from 100 h to 1 year. Preliminary cumulative yields were determined for nuclides of half-life 1 h to 30 y. Statistical uncertainties at the results are 2-5 % and the systematic errors were estimated to be about 5%.

[1] S.Daróczy, P.Raics, S.Nagy, L.Kövér, I.Hamvas, ATOMKI Közl. 18 /1976/ 317.

[x]Present address: Nuclear Power Station, Paks, Hungary

THE POSSIBILITY OF THE APPLICATION OF SSNTDs TO MEASURE FUEL BURN-UP

M.Várnagy, P.Raics

The spontaneous fission neutron activity of the spent fuel may give information on the degree of burn-up. The neutron flux can be measured by SSNTD with converters of fissionable materials. These detectors can be applied for such purposes even in high gamma-background.

[1] M.Várnagy, P.Raics, Issledovania V oblasty pererabotki obluchennovo topiliva /Chechoslovackaja Komissia po Atomnoj Energij, Praha 1977/ Tom III, pp.164-171

[2] M.Várnagy, P.Raics, IZOTÓPTECHNIKA /Budapest/ 20 /1977/ 207

MEASUREMENT OF GAMMA DOSE BY MEANS OF SOLID STATE NUCLEAR TRACK DETECTORS

M.Várnagy, E.Molnár, É.Dávid

The CA 80-15 cellulose nitrate sheet has been found to be suitable for measurement of gamma-dose in the interval of 1-3 MRad applying either etching rate or optical absorbance measurement. The variation of the a amplitude of first derivate e.p.r. spectrum of free radicals formed in polycarbonates was tested, too. The investigations are important in the surgical instrument sterilisation.

[1] M.Várnagy, E.Molnár, É.Dávid IZOTÓPTECHNIKA 20 /1977/ 389.

[2] M.Várnagy, Nucl. Instr. and Meth., In press

LOW-ENERGY CROSS SECTIONS FOR $^{6}Li/d,\alpha/^{4}He$ AND $^{6}Li/d,p/^{7}Li$

M.Várnagy, J.Szabó, S.Szegedi, Z.T.Bődy
B.Kertész

A method has been developed for the simultaneous determination of the angular distributions of alpha-particles and protons from the $^{6}Li/d,\alpha/^{4}He$ and $^{6}Li/d,p/^{7}Li$ reactions at bombarding energies below 180 keV applying CA 80-15 cellulose nitrate SSNTD. Both reactions have potential applications in the controlled thermonuclear research. Cross section data are also presented and comparison is made with previously reported results between 100 and 180 keV deuteron energies. Different methods of extrapolation were employed and compared down to the energy region of astrophysical interest.

[1] M.Várnagy, J.Szabó, S.Szegedi, Nucl.Instr. and Meth., to be published

[2] Z.T.Bődy, J.Szabó, M.Várnagy, B.Kertész, in preparation

DETERMINATION OF URANIUM CONTENT IN MINERALS BY SSNTDs

J.Csikai, M.Várnagy, S.Juhász, G.Petó
M.Lferde[x]

A method - described in [1] - was adapted for the determination of uranium in powdered solid samples. The standard powders consisting of different concentrations of homogeneously distributed uranium in various matrixes were pressured to discs, contacted with Makrofol KG foils and irradiated with Cf-252 neutrons. To the measured points /sparks/area/irradiation time vs. concentration/ a line was fitted by the least-square-method and the concentrations of unknown samples /from Morocco and Pécs/ were calculated. The reproducibility /including the reproducibility of counting, variations in the foil-thickness, neutron fluence/ was 3-6 %, but the 95% confidency intervals for the calculated concentrations were between 3-10 %. Irradiations with D+D and D+T neutrons has also been made to show that the samples do not have thorium.

[1] M.Várnagy et al., Nucl.Instr. and Meth. 141 /1977/ 489.

[x]Department of Nuclear Physics, University Mohammed V Rabat Morocco

ACTIVATION MEASUREMENT OF THE CROSS SECTION OF NEUTRON INDUCED REACTIONS AT 14 MeV

P.Raics, S.Daróczy, S.Nagy, K.Sailer

Cross section of neutron induced reactions for fissionable nuclei and those of atomic number Z=20 to 50 are of reactor physical as well as of theoretical interest. Part of the excitation functions were measured around 14 MeV changing the angle between the neutron and deuteron beam direction from 0^{o} to 150^{o}.

The neutron flux density was generally determined by the $^{27}Al/n,\alpha/$ reaction. The γ-activity of the product nuclei was measured by a calibrated Ge/Li/ spectrometer. Effects at scattered neutrons on the measured cross sections have been investigated by the foil activation method using reactions of different threshold: $^{115}In/n,n'/^{115m}In$, $^{27}Al/n,p/$, $^{27}Al/n,\alpha/$, $^{63}Cu/n,2n/$, $^{65}Cu/n,2n/$. Special experiments were made and continuous effort is paid to explore the best circumstances for the measurement of /n,γ/ cross sections.

$^{238}U/n,2n/$ reaction cross section has been determined for neutron energies of 14.8, 14.45, 14.12, 13.75 and 13.52 MeV. The corrections for scattered neutrons amount up to 13 % in the case of a water cooled iron target assembly. The overall uncertainty of the results were estimated to be 6-7 % including a systematic error of 4-5 %.

/n,2n/, /n,p/ and /n,α/ reaction cross sections have been measured for Cr and Zr isotopes at 14.8 MeV [1]. The experimental conditions were similar to those mentioned above. The statistical uncertainties of the data were 2 to 10 % while the systematic ones were about 5 %.

Preliminary results were obtained for the $^{89}Y/n,2n/$ reaction at 14.8, 14.45, 14.12, 13,75 and for $^{58}Ni/n,2n/$, $^{58}Ni/n,p/^{58m,g}Co$, $^{58}Ni/n,d/$ reactions at 14.8, 14.45, 14.12, 13,75, 13.52 MeV. The irradiations were performed by an air-cooled aluminium target assembly thus the corrections for the scattered neutrons were 2-4 % only. The overall uncertainty of the results were 3-5 %.

The experimental results were tried to be explainedd on the basis of the simple continuum statistical solution of the equilibrium compound nucleus model. The calculations included the competition between particle emission, fission and γ-deexcitation. Qualitative agreement with the experimental excitation functions was achieved well above the thresholds.

[1] K.Sailer, S.Daróczy, P.Raics, S.Nagy; Neitronnaya fizika, /Materialy 4-i Vsesoyuznoi konferentsii po neitronnoi fizike, Kiev, 18-22 aprelya 1977 g./ Chast'1, 246; Moskva - 1977.

EFFECT OF CLIMATE ON CHEMICAL COMPOSITION OF FOSSIL BONES

Cs.M.Buczkó[x], L.Vas

The suggestion that microanalysis of nitrogen, fluorine and uranium in fossil bones should be used for age determination assumes that the concentration of these elements varies uniformly in time. We found a fluctuation of the N content of bones that seems to correlate with climatic change.

We investigated the concentration of N, Fe, Al and Ca in bones from the past 9.000 yr in human vertebrae of known ages buried in the Great Hungarian Plain.

The N, Fe and Al content was determined by fast and thermal neutron activation analyses using the $^{14}N/n,2n/^{13}N$, $^{56}Fe/n,p/$ ^{56}Mn and $^{27}Al/n,\gamma/$ ^{28}Al reactions, respectively. The concentration of Ca and Fe was measured by X-ray fluorescence using an Si/Li/ detector and ^{55}Fe and ^{125}I exciting sources.

Both the trends and the absolute values for iron measured by X-ray fluorescence and neutron activation are in good agreement within $\pm$ 5%, proving the reliability of the methods applied.

[1] Cs.M.Buczkó, L.Vas, Nature 269 /1977/ 792.

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ROLE OF SECONDARY NUCLEAR REACTIONS IN THE DETERMINATION OF NITROGEN

Cs.M.Buczkó,[x] M.Váradi

Fast neutron activation analysis seems to be the most suitable nuclear method for nondestructive determination of nitrogen in various matrices. In the case of organic samples there are interfering secondary reactions due to their hydrogen, oxygen and carbon contents. The yields of these reactions have been studied in a wide range of O/H and C/H ratios [1].

[1] Cs.M.Buczkó, M.Váradi, Radiochem. Radioanal. Letters 30 /1977/ 319.

[x]Isotope Laboratory, Kossuth University, Debrecen

DETERMINATION OF Na, Cl, I AND S IN MINERAL WATER SAMPLES BY NEUTRON ACTIVATION ANALYSIS AND X-RAY FLUORESCENCE METHOD

S.M.Al-Jobori,[x] S.Szegedi, Á.Pázsit

The applicability of thermal neutron activation analysis and X-ray fluorescence analysis for the determination of Na, Cl, I and S concentration in mineral waters has been investigated. A 0.4 mg ^{252}Cf neutron seource in water moderator and a Ge/Li/ detector for neutron activation analysis as well as a ^{55}Fe exciting source and a Si/Li/ detector for X-ray fluorescence analysis were used in the investigations. Sensitivity for Na, Cl and I is about 10 ppm, for S about 30 ppm [1].

[1] S.M.Al-Jobori, S.Szegedi, Á.Pázsit: Radiochem. Radioanal. Letters 30 /1977/ 45.

[x]On leave from Iraqi Atomic Energy Commission, Baghdad

DETERMINATION OF SOME ELEMENTS IN BAUXITE BY NEUTRON ACTIVATION AND X-RAY FLUORESCENCE METHOD

Cs.M.Buczkó,[x] Á.Pázsit

The determination of the titanium content of bauxite samples of various origin was studied by thermal neutron activation and X-ray analysis. A ^{252}Cf-fission neutron source and a Ge/Li/ detector as well as a ^{3}H exciting source and a Si/Li/ detector were used in the investigations. Within equal measuring times and with a sample weight of 8 g the sensitivity of the activation method is 0.35 w% Ti with an absolute statistical error less than 10 %, while that of the X-ray method is 0.06 w% Ti and the absolute statistical error does not exceed 5% [1].

A nondestructive method has been developed for the determination of Sr, Y and Zr in bauxite using X-ray fluorescence method based on a Si/Li/ detector and an ^{125}I source. A sensitivity of about 10 ppm for Sr, Y and Zr was found choosing 30 min measuring time. The relative error of the reproducibility is 5 % for a few hundred ppm concentration. For Ga an upper limit of 100 ppm is given [2], [3].

[1] Cs.M.Buczkó, S.Mukherjee, Z.Dezső, M.Hegedüs, M.Várady J.Radioanal, Chem.29 /1976/ 295.

[2] Á.Pázsit, Cs.M.Buczkó[x], Radiochem. Radioanal Lett. 27 /1977/ 381

[3] Cs.M.Buczkó, Á.Pázsit, Izotóptechnika 20 /1977/ 19

[x]Isotope Laboratory Kossuth University, Debrecen.

NEUTRON ACTIVATION ANALYSIS OF ALUMINIUM ALLOYS AND TOBACCO

K.Sailer, S.Daróczy, S.Nagy, P.Raics

The Mn- and Hf-content of aluminium-alloys /of mass ~1 g/ were determined by absolute thermal neutron activation analysis in the interval of concentration 100-30000 ppm and 800-1400 ppm, respectively, using ^{252}Cf neutron source placed in a water tank and by a well-calibrated Ge/Li/ γ-spectrometer. A detailed investigation was performed to lower the random and systematic errors of the absolute analytical method. An optimum position for irradiation as well as optimal time-schedules for analyses /irradiation-, cooling - and counting times/ were obtained to achieve greater sensitivity. The absolute thermal and epithermal flux density measurements were performed with thin Au and In foils and they were in good agreement with each other. The systematic error of the determination of Mn-content in aluminium-alloys wae found experimentally to be +5 % which can be taken into account. Thus the method, developed under the given circumstances makes it possible to calibrate Al-Mn-alloys in the interval of Mn-concentration 10-30000 ppm with relative standard deviation of 3-1,5 per cents. The sensitivity of the determination with the relative standard deviation of 10 per cents for manganese and hafnium are 7 ppm and 310 ppm, respectively, using ^{252}Cf neutron source of mass 1 mg with the time-schedule $T_{cooling}=0$, $T_{irradiation}=T_{counting}=1$ h for Mn, 1 min for Hf.

Using a small neutron generator for irradiation with 14 MeV neutrons, the determination of Zr-Si and Fe-content in aluminium-alloys were performed in the region 0.6-6 w%, 0.2-1 w% and 0.6-1 w%, respectively. The sensitivity of the analysis was determined for the elements above mentioned as well as for Cr. The relative reaction cross-sections to the reaction $^{27}Al/n,\alpha/$ were measured for a few isotopes of Cr and Zr [1].

The Na-, C-, K-, Mn- and Br - content of a few kind of tobacco were determined by thermal neutron activation analysis, using ^{252}Cf neutron source [2]. The flux perturbation in the samples of a few cm dimensions was investigated by means of aluminium foils which themselves cause negligible perturbation.

[1] K.Sailer, S.Daróczy, P.Raics, S.Nagy: Neitronnaya fizika, /Materialy 4-i Vsesoyuznoi konferentsii po neitronnoi fizike, Kiev, 18-22 aprelya 1977 g./ Chast'1, 246; Moskva - 1977.

[2] Gy. Batta, M.Barta, K.Sailer, S.Daróczy, S.Nagy, P.Raics, S-né Nagy, Izotóptechnika 19 /1976/ 140.

AVERAGE CROSS SECTION MEASUREMENTS FOR THE ^{252}Cf FISSION NEUTRON SPECTRUM

Z.Dezső, J.Csikai

Average cross sections for the unmoderated spontaneous fission neutron spectrum of ^{252}Cf have been measured for 52 different reactions by activation method in a scattering free arrangement. These measurements provide integral tests for evaluated cross section data.

A comparison of evaluated spectrum-averaged cross sections with the measured values for titanium /n,p/ reactions shows that in the case of ^{46}Ti and ^{48}Ti our results support the recent evaluation for exitation function of Philis et al., while for ^{47}Ti the values measured by different authors are significantly lower than the calculated ones using ENDF/B-IV or the evaluated cross section of Philis.

Further experiments are in progress to decrease the systematic errors of the measured cross section values and to use these integral measurements for checking the evaluated cross section data, especially for those used in reactor dosimetry as catagory II. reactions.

[1] Z.Dezső, J.Csikai: The 4th All Uniun Conference on Neutron Physics, Kiev, 18-22. April. 1977. Ed. in Moscow Vol. 3 p.32.

[2] Z.Dezső, J.Csikai, Proc. of the VII. Symp. on Interactions of Fast Neutrons With Nuclei, Gaussig, 21-25. Nov. 1977. /to be published/.

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