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Abstract

The differential elastic scattering cross sections were measured for the scattering of 104 MeV alpha particles on ^{6}Li, ^{9}Be, ^{12}C, ^{14}N, ^{16}O, ^{20}Ne, ^{40}Ar, ^{64}Ni, ^{90}Zr, ^{124}Sn, ^{208}Pb, and ^{209}Bi. All angular distributions show a pronounced diffraction pattern. For the lightest nuclei measured (^{6}Li to ^{16}O) the cross section exceeds the Rutherford cross section by a factor up to 15 at angles around 45^{o}. The cross section data were analysed in terms of parametrised phase shift functions using 9 free parameters and in terms of the spinless optical model using up to 7 free parameters. Good fits were obtained. A strong absorption was found for the heavy nuclei, $A \geq 124$. For these nuclei, only the outermost region of the nuclear surface contributes to the scattering. A potential radius cannot be extracted regardless of the pronounced diffraction pattern. The absorption is not so strong for the medium weight nuclei, $20 \leq A \leq 90$. Information about the nuclear surface can be extracted from the differential cross section. The well known phase ambiguity in the optical model was found for these nuclei. For the light nuclei ($A \leq 16$) the inner region of the interaction potential contributes to the scattering. A repulsive core for small interaction distances was able to explain the observed cross sections which indicates the nonlocal character of the true interaction.

The phase shift analysis leads to good fits, but the phase shifts obtained differ significantly from those of the optical model analysis. This indicates that the phase shift analysis is ambiguous, too.

1. Introduction

The alpha particle scattering in the medium energy range has frequently been investigated both experimentally and theoretically. Most of the investigations have been performed[1-11] at 42-44 MeV, some experiments[12-14] at 65 MeV; reported investigations at higher energies are scarce[15-17]. Almost all of these studies have been motivated by the success in describing both elastic and inelastic cross sections by DWBA calculations or the Austern-Blair theory.

The optical model, usually applied in analogy with scattering of nucleons, describes the elastic scattering of alpha particles fairly well[18,19]. Good agreement between experimental and calculated cross sections is obtained by suitably choosing the values of the several parameters characterizing a complex potential. Nevertheless, there remains the difficulty that alpha particles are compound particles for which the validity of the optical model has not been established.

The obvious success of the optical model, e.g., in describing the diffraction pattern of the angular distributions is based on the strong absorption: the de Broglie wave length and the absorption length in nuclear matter are small compared to the nuclear dimensions so that the target nucleus appears black (with diffuse edge) for the incoming particle. As a consequence the information on the interior of the nucleus is modest which is reflected by the known ambiguities[20,21]. The concept of strong absorption is independent of the optical model. It can be exploited by a direct parametrisation of the scattering function. Such a model was proposed by Akhiezer and Pomeranchuk[22] and Blair[23] (APB-Model) and generalized in a special way by Frahn and Venter[24]. More recently Inopin[25] and Ericson[26] have formulated the black nucleus model in the Regge representation of the scattering amplitude. The direct way of parametrisation of the scattering amplitude avoids the extensive computer calculations needed in the frame of the optical model and further leads to approximate analytical expressions of the cross sections in some special cases.

In this paper we report on experimental studies of the elastic scattering of 104 MeV alpha particles using the Karlsruhe Isochronous Cyclotron. The experiments were undertaken in view of the question if the optical model - the applicability of which is a neccessary prerequisite for DWBA analyses - and the concept of strong absorption describe the experimental cross sections at this energy satisfactorily. For heavy nuclei we found a sharp diffraction pattern due to strong absorption as seen for lighter nuclei at lower energies. Light nuclei, however, appear to be more transparent at our energy, and the basic concept of an opaque nucleus seems to become inapplicable. Due to the higher transparency, the alpha particles probe deeper into the nucleus and the ambiguities of the model parameters disappear.

2. Experimental procedure

2.1 Beam optics

Fig. 1 shows the layout of the beam line. The vertical and horizontal directions of the beam are adjusted by two steering magnets. A quadrupole triplet focusses the beam on a slit in front of the switching magnet. This slit is the only beam defining element in the system. A second quadrupole triplet behind the switching magnet focusses the beam on the target in the center of the scattering chamber. The beam pipe behind the switching magnet holds two antiscattering diaphragms for reducing the background. The excitations of the various magnets and the width of the beam along the beam line were calculated+ by means of an analogue computer++, and fine adjustments were done by viewing the beam spot on ZnS screens at the positions indicated in fig. 1 and at the

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+We are indebted to Dipl.-Phys. D. Hartwig and Miss Chr. Rämer for carrying out these calculations.

++Particle track computer AERE No. 3037, purchased from C & N (Electrical) Ltd., England

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centre of the scattering chamber. The diameter of the beam spot on the target was typically 2 mm. The horizontal phase space of the external deuteron beam of the Karlsruhe Isochronous Cyclotron has been measured to be 5.6 mm mrad[27]. Assuming this value also to be valid for the α particle beam we obtain a divergence of the beam at the target of 0.16° (FWHM).

The extraction efficiency from the cyclotron was between 50 and 80 %, and the transmission of the slit amounted to approximately 30 %.

2.2. Scattering Chamber

The scattering chamber+ is cylindrical with an inner diameter of 70 cm and a height of 20 cm. The detector was

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+The chamber was designed by Dr. B. Duelli and Dipl.- Phys. O. Meyer to whom we are indebted for placing it at our disposal.

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mounted on a wheel inside the chamber close to the bottom. The wheel could be rotated by means of a precision drive which was adapted to this purpose from a machine tool. Drive and wheel were connected to the scattering chamber support such that deformation of the chamber during evacuation had no influence on the detector position. The angular position of the wheel could be read via a television camera to a precision of 0.02^{o}. Foil targets were introduced from above through a vacuum lock.

2.3 Targets

The targets used were partly foils and partly gaseous. In all cases the isotopic abundance of the target isotope was about 99 %. Table 1 summarizes the relevant data.

The targets of ^{6}Li, ^{9}Be, ^{12}C, ^{64}Ni, ^{124}Sn, ^{208}Pb, and ^{209}Bi were foils without backing, the ^{90}Zr target was a deposit of ZrO_2 on melinex. All foil targets were circular with a diameter of 14 mm. The thickness of the foil targets was measured by weighing and by measuring the energy loss of ^{241}Am α particles.

The gas targets were cylindrical sealed off containers made of brass and sized 140 Ø x 35 mm. A 10 mm high slit that ran almost all around the cyclinder and that was covered by a 6 μm thick havar foil provided entrance and exit for the primary beam and the scattered particles. These targets containers were filled to approximately 1 atmosphere. The pressure was checked before and after measurement. The effective target thickness[28)] was defined by the 1.7 x 6 mm entrance slit of the detector and a second 3 mm wide slit placed 75 mm in front of the detector.

An additional check of all target thickness determinations was provided by the scattering data themselves. When the data were analyzed according to the models described in section 4 it became evident that the cross section below 8^o scattering angle is virtually independent of the nuclear parameters for a wide range around the best set of parameters. This is due to the dominating influence of the Rutherford scattering at small angles.

All independent thickness determinations of a specific target agreed within 5 %[+].

[+]An exception to this was a measurement on ^{140}Ce which was reported in a preceeding publication[17)]. The target consisted of cerium oxide on a carbon backing. Due to the uncertain chemical composition the results of different thickness determinations differed by up to a factor of 4. These data have, therefore, not been included in the present analysis, and the absolute cross section is more inaccurate than indicated by the 25 % error quoted previously.

2.4 Detectors and electronics

All data given in this paper were taken with Si(Li) detectors of 100 mm^2 area. The detectors were mounted inside a copper block of 38 mm diameter with an entrance slit of 1.7 x 6 mm^2 at a distance of 300 mm from target center. The calculated angular resolution of this system is 0.6^o assuming a beam diameter of 2 mm and an angular divergence of 0.2^o. The detectors allowed measurements down to 4.0^o in the laboratory system. The copper housing of the detectors was cooled with water of 0^o C.

Two detectors of 3 mm and 5 mm depletion depth, respectively, have been used in the course of the experiments. As the range of 104 MeV alpha particles in silicon is approximately 4 mm an aluminium absorber in front of the 3 mm thick detector was used in order to degrade the energy of the scattered particles. This resulted in an energy spread of 1.2 MeV. A resolution between 300 and 600 keV was obtained with the thick detector. Most of this line width is attributed to the energy spread of the primary beam. Fig. 2 shows a spectrum taken with the 5 mm thick detector.

No particle identification was applied during the measurements presented in this paper. This is unneccessary as the maximum energy loss of protons, deuterons, ^{3}H, and ^{3}He nuclei is 31, 42, 50, and 108 MeV, respectively, in 5 mm silicon. So only ^{3}He particles could possibly cause detector pulses in the energy region of interest in elastic alpha particle scattering. Due to the large difference in binding energies between ^{3}He and ^{4}He the maximum energy of ^{3}He particles produced is considerably lower than that of the elastically scattered alpha particles, though.

The electronics consisted of a preamplifier, an amplifier, and a base line restorer (Ortec models 105, 410 and 438, respectively). The pulses were then fed to an ADC which was directly coupled to a CDC 3100 on-line computer.

2.5 Data acquisition

For most of the angular range data were taken at 0.5° intervals. The smallest angle of measurement was between 4° and 5° (laboratory system), the largest was determined by the magnitude of the cross section. Most targets were measured down to a differential cross section of 10 μb/ster. The zero of the angular scale was determined by measuring the cross section on either side of the incident beam for small scattering angles. It was possible to establish the zero to an accuracy of 0.1° due to the strong variation of cross section at small scattering angles.

The incident current was adjusted to keep the deadtime losses below 10 %. It varied between 0.05 nA and 1 μA depending on scattering angle and target thickness. It was integrated by means of an Elcor model A309B current integrator. The integrator initiated and stopped data storage via the computer interrupt system.

The CDC 3100 on-line computer was programmed as a 1024 channel pulse height analyzer. The program included a routine to sum the spectrum between two selectable channels and to correct the sum for a linear background and for dead time. The spectra were recorded on magnetic tape for further processing.

For some targets the peaks of elastically and inelastically scattered alpha particles overlapped and had to be separated by means of a Fortran program on an IBM 7074 computer.

2.6 Estimate of errors

The errors of the individual experimental results shown in figs. 3 to 5 include

a) the statistical error which is negligible for most points and

b) an error due to the uncertainty of the angle of measurements (0.1^{o}). This error is due to the uncertainty of the angular scale zero and was converted into an error of the cross section by multiplying it by the slope of the measured cross section.

The errors of the absolute value of the cross section due to inaccuracies of target thickness, solid angle, and current measurements are estimated to be 5 % and have not been included in the error bars shown in the figures.

3. Results

The measured cross sections+ normalized to the Rutherford cross section are shown in figs. 3 to 5. The curves are theoretical

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+For numerical results see table 5

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results and will be discussed in the following section.

For the heavier nuclei the curves exhibit a pronounced and regular diffraction pattern which had not been observed at forward angles at lower energies. The results for the lighter elements are somewhat more unexpected. The oscillations which are very pronounced at small scattering angles are soon damped, and the cross sections show a broad maximum around 45°. In this region the cross sections exceed the Rutherford cross section considerably (up to a factor of 15 for ^{6}Li). The height of this maximum decreases steadily from ^{6}Li to ^{16}O, and it has virtually vanished for ^{20}Ne.

The amplitude of the oscillations of the cross section shows a maximum which is shifted from about 10° for ^{6}Li to 45° for ^{208}Pb. Beyond the maximum the oscillation is rapidly damped. A new increase of the oscillation as predicted by different models could not be found.

4. Data Analysis

The elastic scattering cross section $\sigma(\Theta)$ is given by the absolute square of the scattering amplitude $f(\Theta)$, which can be expanded in the following way

$$f(\Theta) = f_c(\Theta)+(2ik)^{-1} \sum_{\ell=0}^{\infty} (2\ell+1)(S_\ell-1)\exp(2i\sigma_\ell)P_\ell(\cos \Theta). \quad (1)$$

Here, θ is the scattering angle, k is the wave number, $f_c(\theta)$ is the Coulomb scattering amplitude, σ_ℓ are the Coulomb phase shifts, S_ℓ are the partial scattering amplitudes relative to the Coulomb scattering and $P_\ell(\cos\theta)$ are the Legendre polynomials. In the following analysis the nonrelativistic expressions were used

$$k = (2mc^2E)^{1/2}/\hbar c \quad ; \quad \hbar c = 197.315 \text{ MeV} \cdot \text{fm}$$

where mc^2 is the reduced mass and E the center of mass energy. The Coulomb phase shifts were calculated with the recurrence relation

$$\sigma_{\ell-1}(\eta) = \sigma_\ell(\eta) - \text{arc tg}(\eta/\ell) \qquad (2)$$

starting from $\sigma_3(\eta)$ which is directly obtained from the asymptotic series expansion for large ℓ values[30]. The Coulomb scattering amplitude is given by

$$f_c(\theta) = -\frac{\exp\{2i[\sigma_0 - \eta\cdot\ln(\sin\theta/2)]\}}{2k\sin^2\theta/2} \qquad (3)$$

and the Coulomb parameter is $\eta = \alpha Z/\beta$ where Z is the product of the charge numbers, α the hyperfine structure constant and β the relative velocity in units of c. The partial scattering amplitudes S_ℓ are related to the complex phase shifts δ_ℓ by

$$S_\ell = \exp\,[2i(\delta_\ell - \sigma_\ell)] \qquad (4)$$

Spin orbit terms can contribute to the scattering in the cases of ^6Li, ^9Be and ^{14}N. This contribution is expected to be small and has therefore been neglected.

The partial scattering amplitudes S_ℓ will be obtained in two different ways. a) Assuming that the S_ℓ may be represented by a continuous function of the quantum number ℓ, a direct parametrisation of this function is introduced. b) Assuming that the interaction of the alpha particle with the target nucleus may be considered as a spinless two body problem with a complex interaction potential V(r) the Schrödinger equation may be solved to obtain the amplitudes S_ℓ. In this case the interaction potential V(r) is parametrised. The radial Schrödinger equation

$$U''_\ell(\rho) + \left[1 - \frac{V(r)}{E} - \frac{\ell(\ell+1)}{\rho^2}\right] U_\ell(\rho) = 0 \quad ; \quad \rho = kr \qquad (5)$$

is integrated numerically from r = 0 to an outside point $r = R_\psi$ where the potential V(r) differs by less than 10 keV from the Coulomb potential. At this point the partial scattering amplitude is given by the logarithmic derivative U'_ℓ/U_ℓ and the Coulomb wave functions F_ℓ and G_ℓ

$$\frac{U'_\ell}{U_\ell} = \frac{F'_\ell+iG'_\ell+S_\ell(F'_\ell-iG'_\ell)}{F_\ell+iG_\ell+S_\ell(F_\ell-iG_\ell)} \quad ; \quad r = R_\Psi \qquad (6)$$

The fitting program consists of a general χ^2 minimizing subroutine[31)+] small subroutines for calculating the quantities S_ℓ,V(r) and the Coulomb functions, and the driving main program[32)]. The

+We thank Dr. M.J.D. Powell for making available the Fortran code of the subroutine.

fitting procedure minimizes the sum

$$\chi^2 = \sum_{i=1}^{N} [\sigma_{exp}(\theta_i)-\sigma_{theor}(\theta_i)]^2/\Delta\sigma^2_{exp}(\theta_i) \qquad (7)$$

The computations were carried out with the Karlsruhe IBM 7074 computer++.

++Some preliminary calculations were done with the Abacus code[33)] with the IBM 7090 Computer of the Institut für Hochenergiephysik der Universität Heidelberg.

4.1 Phase shift analysis

In the elastic scattering of 104 MeV alpha particles the number of partial waves contributing to the sum in equ.(1) is sufficiently large (up to 60) to consider the coefficients S_ℓ as continuous function of the angular momentum number ℓ. The function $S(\ell) = S_\ell$ obtained from optical model calculations at lower energies suggested the parametrisations proposed by Akhiezer and Pomeranchuk[22] and by Frahn and Venter[24]. The expressions for the S_ℓ function are

$$|S_\ell| = \varepsilon_1 + (1-\varepsilon_1)\{1+\exp[(\ell_1-\ell)/\delta_1]\}^{-1} \qquad (8)$$

$$\arg S_\ell = \mu\cdot\{1+\exp[(\ell-\ell_2)/\delta_2]\}^{-1}$$

in the APB model, and

$$\mathrm{Re}S_\ell = \varepsilon_1 + (1-\varepsilon_1)\{1+\exp[(\ell_1-\ell)/\delta_1]\}^{-1} \qquad (9)$$

$$\mathrm{Im}S_\ell = \mu\cdot\exp[(\ell_2-\ell)/\delta_2]\{1+\exp[(\ell_2-\ell)/\delta_2]\}^{-2} + \varepsilon_2\{1+\exp[(\ell-\ell_1)/\delta_1]\}^{-1}$$

in the model of Frahn and Venter. The parametrisation of Frahn and Venter restricts the value of arg S_ℓ to values smaller than 360°.

With these parametrisations good fits were obtained for the heavy nuclei only. Figure 6 shows the bad quality of the fits for the ^{12}C data; in table 2 the corresponding parameters of the best fits are given. The values $|S_\ell|$ are similar in both fits but the arg S_ℓ differ considerably for the small partial waves.

The reason why the cross sections of light nuclei cannot be reproduced with the parametrisations (8) and (9) is the finite transmission of the partial waves with angular momentum numbers less than 10. Hence we introduced a more general parametrisation[17])

$$|S_\ell| = \varepsilon + (1-\varepsilon)\,\{1 + \exp\,[(L-\ell)/\delta_1]\}^{-1} \tag{10}$$

$$\arg S_\ell = [a_o + a_1(\ell-L) + \ldots + a_4(\ell-L)^4]\,\{1+\exp\,[(\ell-L)/\delta_2]\}^{-1}$$

The values of $|S_\ell|$ is the same as in the APB model but the arg S_ℓ is now given by a polynomial multiplied by a step function.

With this parametrisation the fits were considerably improved. The results are shown in the figures 3 to 5. Table 3 summarizes the best fit parameters and fig. 7 shows the resulting S_ℓ functions. The fit to the ^{20}Ne data shows systematic deviations around 17^o, the fit to the ^{64}Ni data around 35^o. The fit to the ^{40}Ar data is poor for scattering angles beyond 45^o. Such statistically significant deviations of the best fit curves from the experimental data manifest an inherent limitation of the used parametrisations.

4.2 Optical Model Analysis

In the optical model calculations the Coulomb potential V_c was deduced from experimental nuclear charge distributions[34]. The numerically computed Coulomb potential was fitted by a polynomial of order 6 for values of r where the charge density is different from zero. The coefficients of the polynomials were not varied in the subsequent optical model analysis of the experimental cross section data.

The nuclear potential V_N was used in two different parametrisations:

a. The Woods-Saxon form

$$V_N(r) = (V_o + iW_o)\{1+\exp[(r-R)/a]\}^{-1};\ V_o \text{ and } W_o < 0 \tag{11}$$

in the usual meaning of the symbols for the four parameters V_o, W_o, R and a.

b. A nuclear potential composed of bell shaped functions generating a form factor similar to that of a "wine bottle" potential

$$V_N(r) = V_o g_V(r) + iW_o\, g_W(r) \tag{12}$$

$$g(r) = 4\,\exp(x)\,/\,[1 + \exp(x)]^2$$

$$x = \begin{cases} 3.525\cdot(r-R_i)/a_i^- \;;\; r \leq R_i \\ 3.525\cdot(r-R_i)/a_i^+ \;;\; r > R_i \end{cases} \quad ; \; i = v,w$$

The coefficients in the form factors g(r) are chosen in such a way that they have their maxima normalised to 1 at $r = R_i$ and their FWHM is $\frac{1}{2}\,(a_i^+ + a_i^-)$. We introduced two values of a in order to allow asymmetrical form factors.

. A form factor similar to that in expression (11) (Woods-Saxon) is **obtained** by setting

$$a_i^- = \infty \;;\quad a_i^+ = 5.2\cdot a \;;\; R_i = R - 2.6\cdot a \quad \text{for } i = v,w$$

The potential form (12) was introduced since the four parameter Woods-Saxon potential is not able to reproduce the elastic scattering for the light nuclei. In figure 8 we show the best fit for the ^{12}C data using the Woods-Saxon form factor. At the minimum of χ^2 the real potential depth found is 70 MeV starting from 35 and 150 MeV in the fitting procedure. Further test calculations with potential depthsup to 200 MeV let us conclude that the χ^2 minimum found at $-V_o$ = 70 MeV is the only one for $-V_o \leq$ 200 MeV.

Using the expression (12) with six free parameters: V_o, W_o, R_V, R_W, a_V^+ and a_V^+ ($a_V^- = a_W^- = \infty$)better agreement is obtained (see figure 8). Nevertheless the fit is poor compared to that deduced from the phase shift analysis. A considerable improvement is achieved with asymmetrical bell shaped form factors for both the real and the imaginary parts, defined by up to eight free parameters altogether in expression (12).

Figure 9 presents the best fits for the 7 parameter interaction potential of ^6Li, ^9Be, ^{12}C, ^{14}N, and ^{16}O. Figure 12 shows the corresponding potentials⁺. A well type imaginary form factor

⁺The cross section of ^{9}Be is best described with the potential shown in figure 12; but test calculations with wine bottle potentials reproduce the cross section almost equally well.

proves to be the best. Therefore the parameter $\bar{a}_W$ was not varied in the final analysis. The influence of the central region of the interaction potential is demonstrated in figure 13.

The experimental results for the medium weight nuclei are described well enough using only six free parameters. This is due to the reduced contribution of the interior of the nucleus. As an example we show in figure 14 the almost identical scattering cross sections for ^{64}Ni resulting from two potentials differing in the central region of the real part of V_N. There is a continuous ambiguity for the value of the potential parameter $\bar{a}_V$. The potential part for $r > R_i$ is ambiguous, too. Here the known phase ambiguity[20,21] was found. There exist at least two discrete sets of parameters which describe the ^{64}Ni cross sections equally well (see table 4).

The situation for the heavy nuclei ^{124}Sn, ^{208}Pb, and ^{209}Bi becomes extreme. Only the outermost region of the nuclear surface contributes to the scattering. In this region expression (11) reduces to[19,12,7]

$$V_N(r) = (V_o+iW_o)\cdot\exp(R/a)\cdot\exp(-r/a);(r-R)/a > 1 \qquad (13)$$

Expression (13) clearly shows that the radius R of the interaction potential cannot be determined, regardless of the pronounced diffraction pattern of the scattering cross section. Therefore we chose arbitrarily a depth of 60 MeV for the real part of the nuclear potential. As a check for ^{209}Bi a very large potential was used setting arbitrarily R = 4 fm, V_o = -19 GeV and W_o = - 13.8 MeV in expression (13). The two calculated cross sections are shown in figure 15. The experimental points lie between the two curves. Figs.10 and 11 show the best fits for the medium weight and heavy nuclei, fig. 12 the corresponding potentials. The results of the optical model calculations are summarized in table 4. For comparison with the phase shift calculations the corresponding S_ℓ values are given in fig. 16.

4.3 Model independent improvements of the fits

The best fits obtained with the two models, phase shift function and optical potential, are in good agreement with the experimental cross sections, but statistical significant deviations are still present. These deviations are a consequence of the simplifying assumptions made in the models applied. Now we drop these assumptions and try to correct each single partial scattering amplitude. The correction of the S_ℓ values will reduce the systematic deviations between the experimental and calculated cross sections.

The minimum correction is obtained assuming that the argument $\alpha(\theta)$ of the experimental scattering amplitude

$$f_{exp}(\theta) = \left[\sigma_{exp}(\theta)\right]^{\frac{1}{2}} \cdot \exp\left[i\alpha\ (\theta)\right]$$

is the same argument as that of the scattering amplitude $f(\theta)$ of the best fit. Expanding $f_{exp}(\theta)$ according to expression (1), but with the coefficients $S_{\ell,exp}$, the corrections $\Delta S_\ell = S_{\ell,exp} - S_\ell$ can be obtained from the difference of the scattering amplitudes

$$\Delta f(\theta) = f_{exp}(\theta) - f(\theta).$$

$$\Delta f(\theta) = (2ik)^{-1} \sum_{\ell=0}^{\infty} (2\ell+1) \cdot \Delta S_\ell \cdot \exp(2i\sigma_\ell) \cdot P_\ell\ (\cos\theta) \qquad (14)$$

Hence

$$\Delta S_\ell = ik \cdot \exp\ (-2i\sigma_\ell) \int_0^\pi \Delta f(\theta) \cdot \sin\theta \cdot P_\ell(\cos\theta) \cdot d\theta \qquad (15)$$

The integrand of integral (15) becomes zero for small scattering angles. Hence, the lower integration limit can be set equal to the smallest scattering angle measured. For large scattering angles the cross section drops rapidly to very small values. Therefore, the contribution of the large scattering angles is assumed to be negligible. Hence, the integration interval was chosen to be equal to the experimental angular range. In practical calculations the difference function $\Delta f(\Theta)$ was interpolated linearly between the experimental points.

As an example fig. 17 shows the resulting corrections of the partial amplitudes for ^{12}C. The solid curve connects the S_ℓ values of the best fit from the phase shift analysis, the crosses represent the corrected amplitudes. Only the corrections for angular momentum numbers less than 13 are appreciable. The corrected S_ℓ values scatter around the S_ℓ function of the best fit. This behavior cannot be reproduced by the models used. The improvements achieved are demonstrated in fig.18 for the light nuclei; the corrected χ^2 values are listed in table 3.

Furthermore, the corrections offer an estimate of the accuracy of the S_ℓ values. Any successful model should reproduce the experimental cross section to an accuracy equal to the experimental errors. In this case the relative experimental errors are an upper limit of the errors of the S_ℓ values. If a fit within the experimental errors cannot be achieved the relative deviations between the experimental cross section and the fit are an upper limit of the errors of the S_ℓ values.

In addition, equation (15) can be modified in order to indicate ambiguities in the phase shift analysis. The argument of the scattering amplitude cannot be determined from the elastic scattering alone. Therefore, we can define a difference function

$$\Delta f(\Theta) = f_2(\Theta) - f(\Theta)$$

such that

$$\left|f_2(\Theta)\right| = \left|f(\Theta)\right|$$

in the experimental angular range and

$$\arg \Delta f(\Theta) \longrightarrow 0 \quad \text{for} \quad \Theta \longrightarrow 0$$

in order to preserve the normalization to the Rutherford scattering.

In this way other S_ℓ functions may be obtained by inserting $\Delta f(\Theta)$ in the integral (15) which leads to the same cross section. On the new S_ℓ function some restrictions due to its physical interpretation must be done:

$$\left|S_\ell\right| \leq 1 \text{ for all } \ell$$

$$S_\ell \longrightarrow 1 \text{ for large } \ell.$$

The phase shift and optical model fits of the ^6Li and ^9Be cross sections are equally good but the resulting phase shift functions differ significantly (compare figure 7 and 16). The phase shift functions satisfy the restrictions due to their physical interpretations. Hence, we have an ambiguity due to the unknown arg $f(\Theta)$.

5. Discussion

The results of the phase shift analysis show that the measured scattering cross sections may be described by an almost smooth phase shift function as given by equ. (10) in section 4.1. The phase shifts are complex for low angular momentum numbers ℓ as expected from the large number of open reaction channels, the partial amplitudes S_ℓ are restricted to the physically meaningful region: $\left|S_\ell\right| \leq 1$. The correction procedure presented in section 4.3 manifests some more detailed features. The S_ℓ values deduced in the frame of the models must be corrected slightly in order to improve the agreement between experimental and theoretical cross section curves. The corrections are small but indicate that the used parametrisation is still too simple and has not enough degrees of freedom. The corrections to the partial scattering amplitudes are proportional to the relative deviations between the experimental and the theoretical scattering cross sections. Hence, an estimate of the accuracy of the S_ℓ values is given.

Furthermore, the correction procedure elucidates the question of uniqueness of the resulting S_ℓ values. Several different S_ℓ sets may describe the same cross section as discussed in section 4.3

From optical model analyses it is concluded that the elastic scattering of 104 MeV alpha particles on light nuclei may be described by a local potential containing a repulsive inner core added to the larger attractive well. Such a repulsive core which is explained by the nonlocal character of the true alpha-nucleus interaction[35)] was previously only seen in the scattering of alpha particles on helium[15)]. As shown in fig. 13 precise measurements are necessary to detect the repulsive core.

For the heavier nuclei the lack of transparency and the resulting ambiguities prevent an insight into the central region of the interaction potential. The ambiguities of the optical model analysis are twofold: a) the well known phase ambiguity for the wave function in the medium weight nuclei. The two parameter sets given for the ^{64}Ni potential in tab. 4 demonstrate this case. b) the continuous ambiguity in the potential depths for the heavy nuclei as a consequence of the strong absorption; the nuclear interior remains invisible.

These facts influence the question of nuclear radii. The pronounced diffraction pattern of the angular distributions allows to ectract radii in the ℓ-space. In tab. 3 the cut-off angular momentum number L is given. In the optical model approach an answer is more difficult. Comparing the real and imaginary part of the interaction potential one clearly sees in fig.12 that the radius (at half maximum) of the real part is smaller than that of the imaginary part. Nevertheless both nuclear potential parts have the same range and it is evident that a criterion is needed how to compare the two radii. The radius may be defined as a half maximum radius or by use of the energy scale e.g. as a 5 MeV radius. In the case of strong absorption for the heavy nuclei, where the potential maximum remains unknown, a half maximum radius cannot be stated.

A common feature of our results obtained from the analysis is the following: The presented theoretical curves resulting from the best fits describe the cross sections in the experimental range. But they may differ at larger angles. As example compare the ^{64}Ni curves in figs. 4 and 10. Due to the increased sensitivity to the scattering mechanism large angle scattering will provide a tool to study the models in more detail.

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Figure Captions

Fig. 1 : The experimental layout.

Fig. 2 : Energy spectrum of alpha particles scattered elastically and inelastically by ^{20}Ne at 104 MeV incident energy and 20^{o} scattering angle (lab. system) measured with a 5mm Si(Li) detector.

Fig. 3 : Cross sections of the elastic scattering of 104 MeV alpha particles. Experimental errors are indicated where they exceed 4 %. The solid curves show the results of the phase shift analysis.

Fig. 4 : Cross sections for the elastic scattering of 104 MeV alpha particles. Experimental errors are indicated where they exceed 4 %. The solid curves show the results of the phase shift analysis.

Fig. 5 : Cross sections for the elastic scattering of 104 MeV alpha particles. Experimental points are indicate where the exceed 4 %. The solid curves show the results of the phase shift analysis.

Fig. 6 : Fits to the ^{12}C data obtained with the parametrisation of the phase shifts by the APB model (dashed curves) and by Frahn and Venter (dotted curves).

Fig. 7 : Phase shift functions obtained from the best fits shown in figures 3 to 5.

Fig. 8 : Best fits to the ^{12}C data obtained with 4 (dotted curves) and 6 (dashed curves) parameters in the optical potentials shown. The potentials include the Coulomb potential.

Fig. 9 : Best optical model fits to the elastic scattering cross sections obtained with 7 free parameters.

Fig. 10 : Best optical model fits to the elastic scattering cross sections obtained with 6 free parameters.

Fig. 11 : Best optical model fits to the elastic scattering cross sections obtained with 3 free parameters.

Fig. 12 : Optical potentials obtained from the analysis of the elastic scattering cross sections. The sum of the Coulomb and nuclear potentials is shown. Solid curves show the real part and dashed curves the imaginary part of the optical potential. The inner part of the potential is not shown for the heavy nuclei because this part does not contribute to the scattering.

Fig. 13 : Influence of the real part of the optical potential for small interaction distances on the elastic scattering of 104 MeV alpha particles by ^{6}Li.

Fig. 14 : Influence of the real part of the optical potential for small interaction distances on the elastic scattering of 104 MeV alpha particles by ^{64}Ni.

Fig. 15 : Influence of the nuclear interior on the elastic scattering of104 MeV alpha particles by ^{209}Bi.

Fig. 16 : Phase shift functions obtained form the optical model fits.

Fig. 17 : Phase shift function (solid curve) obtained from the phase shift analysis of the ^{12}C data. The crosses show the corrected S_ℓ values.

Fig. 18 : Cross sections calculated from the corrected phase shift analysis for the light nuclei.

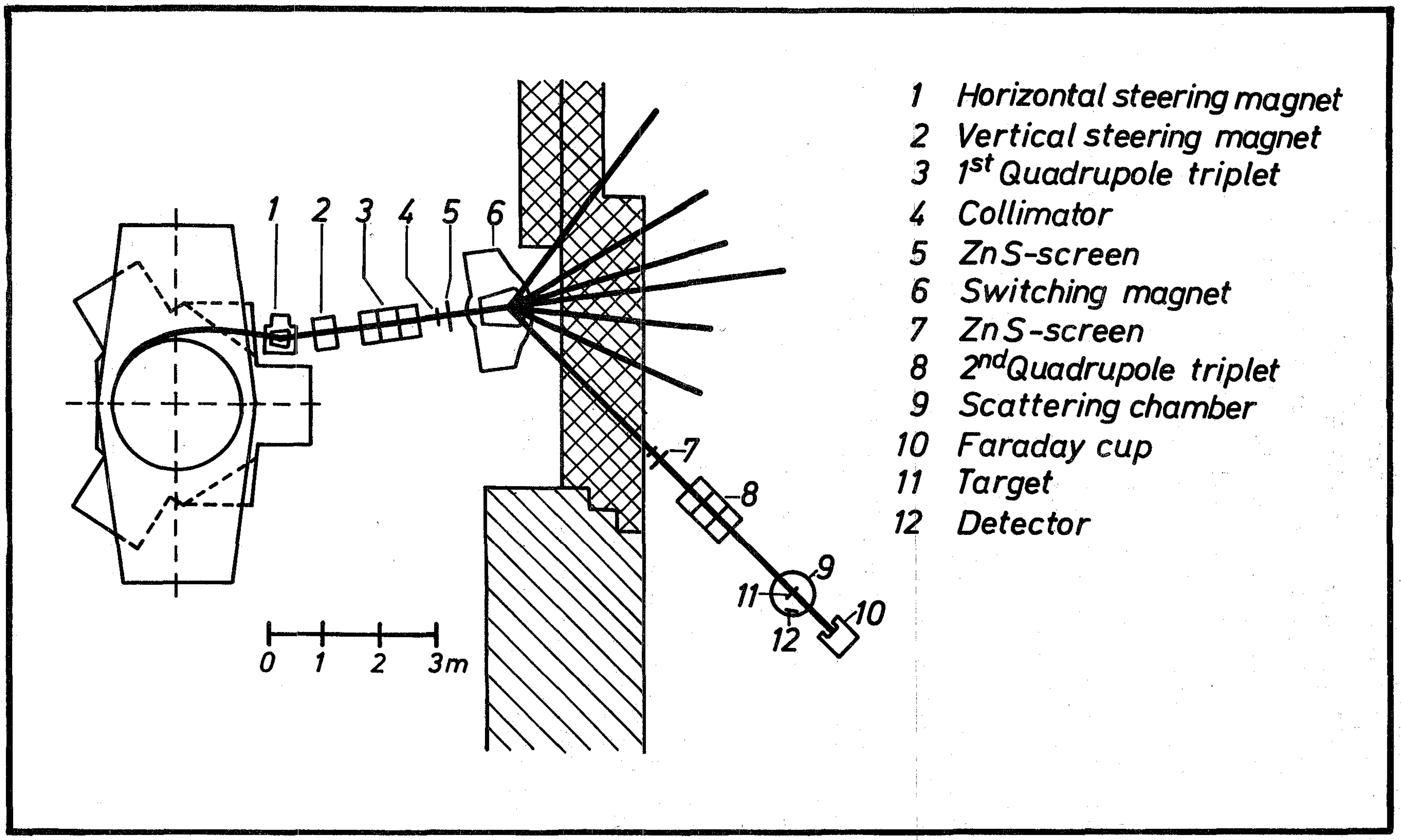
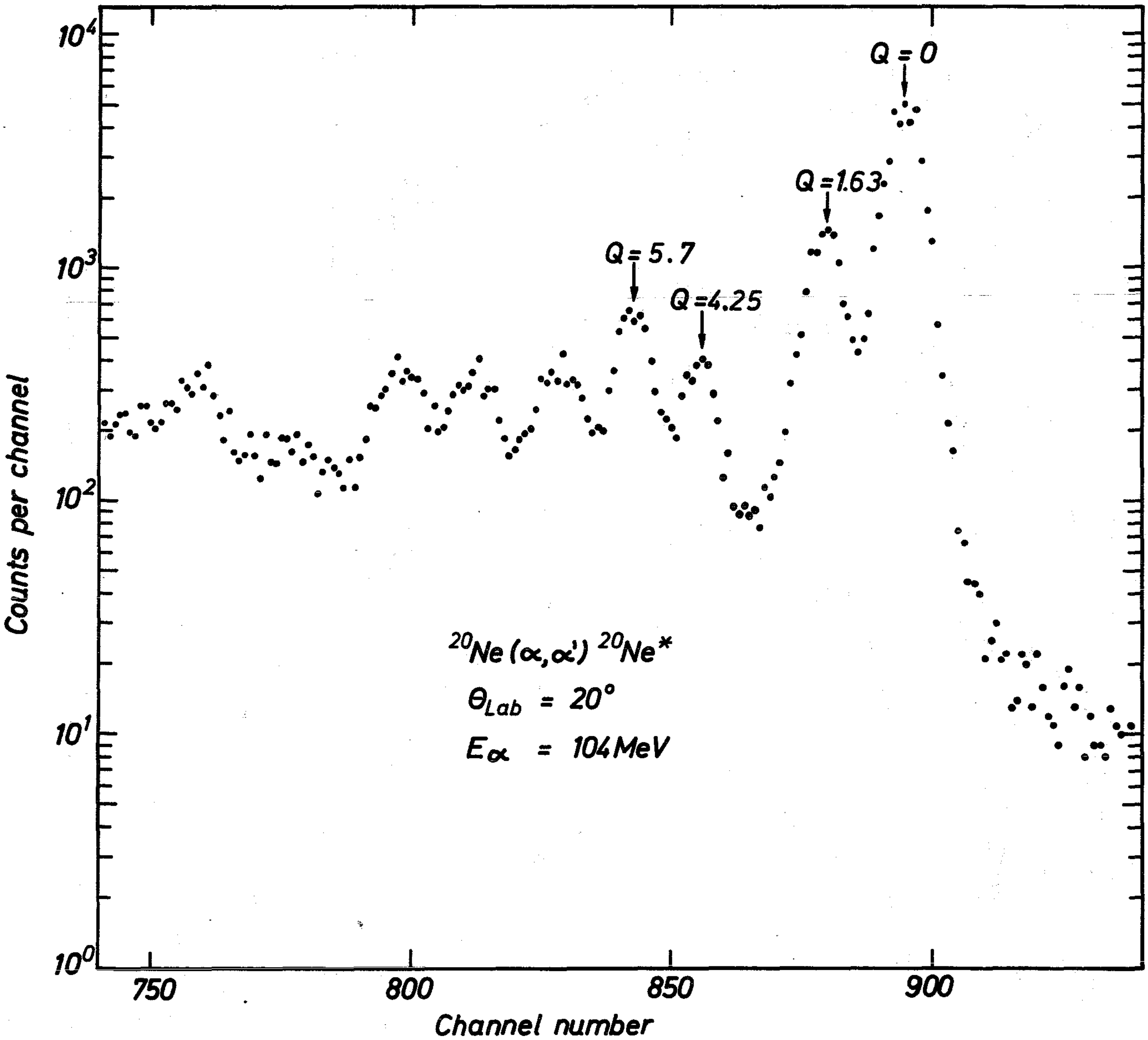
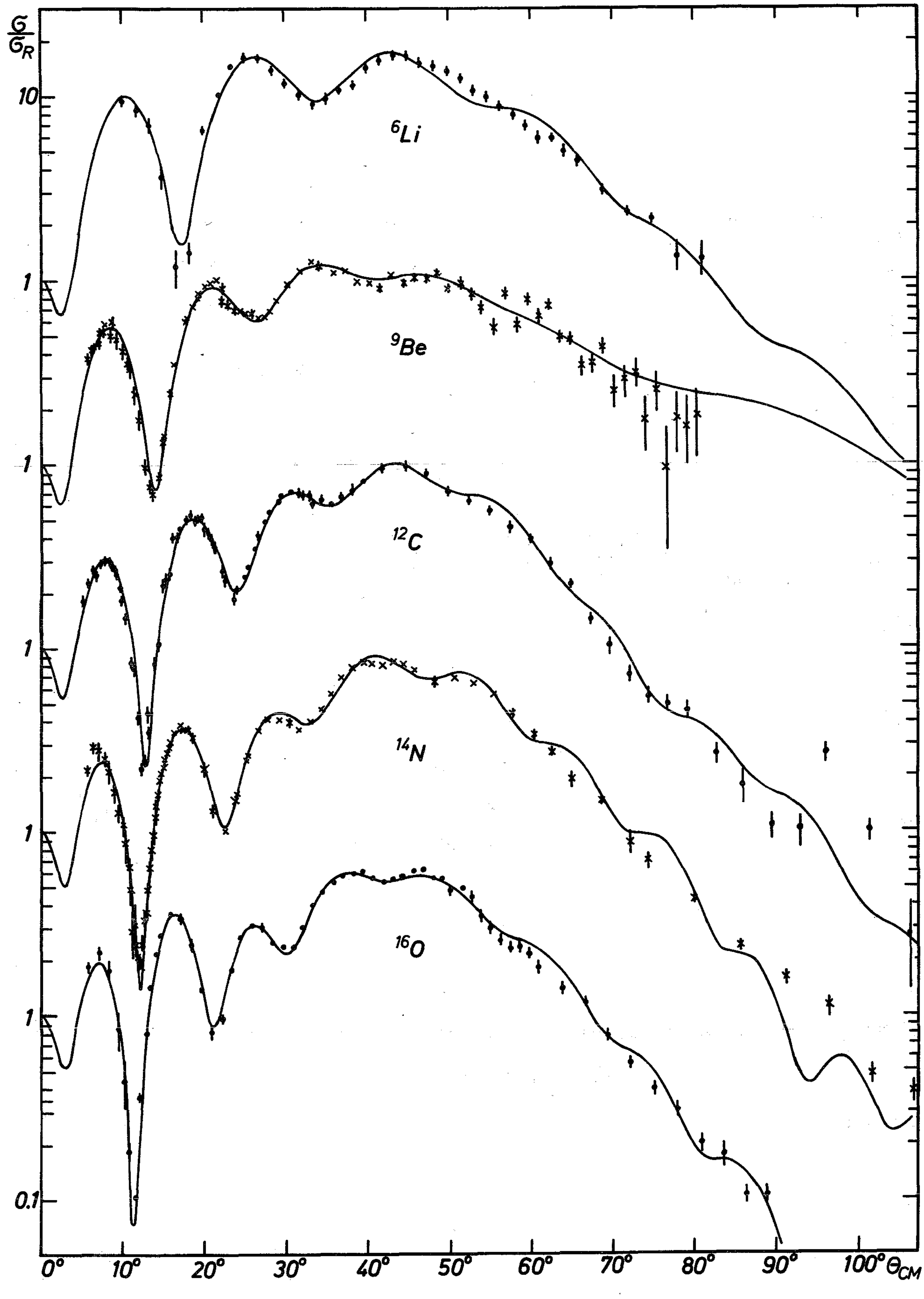

1 2 3 4 5 6
7
8
9
10
11
12
0 1 2 3m
1 Horizontal steering magnet
2 Vertical steering magnet
3 1st Quadrupole triplet
4 Collimator
5 ZnS-screen
6 Switching magnet
7 ZnS-screen
8 2nd Quadrupole triplet
9 Scattering chamber
10 Faraday cup
11 Target
12 Detector

Figure 1



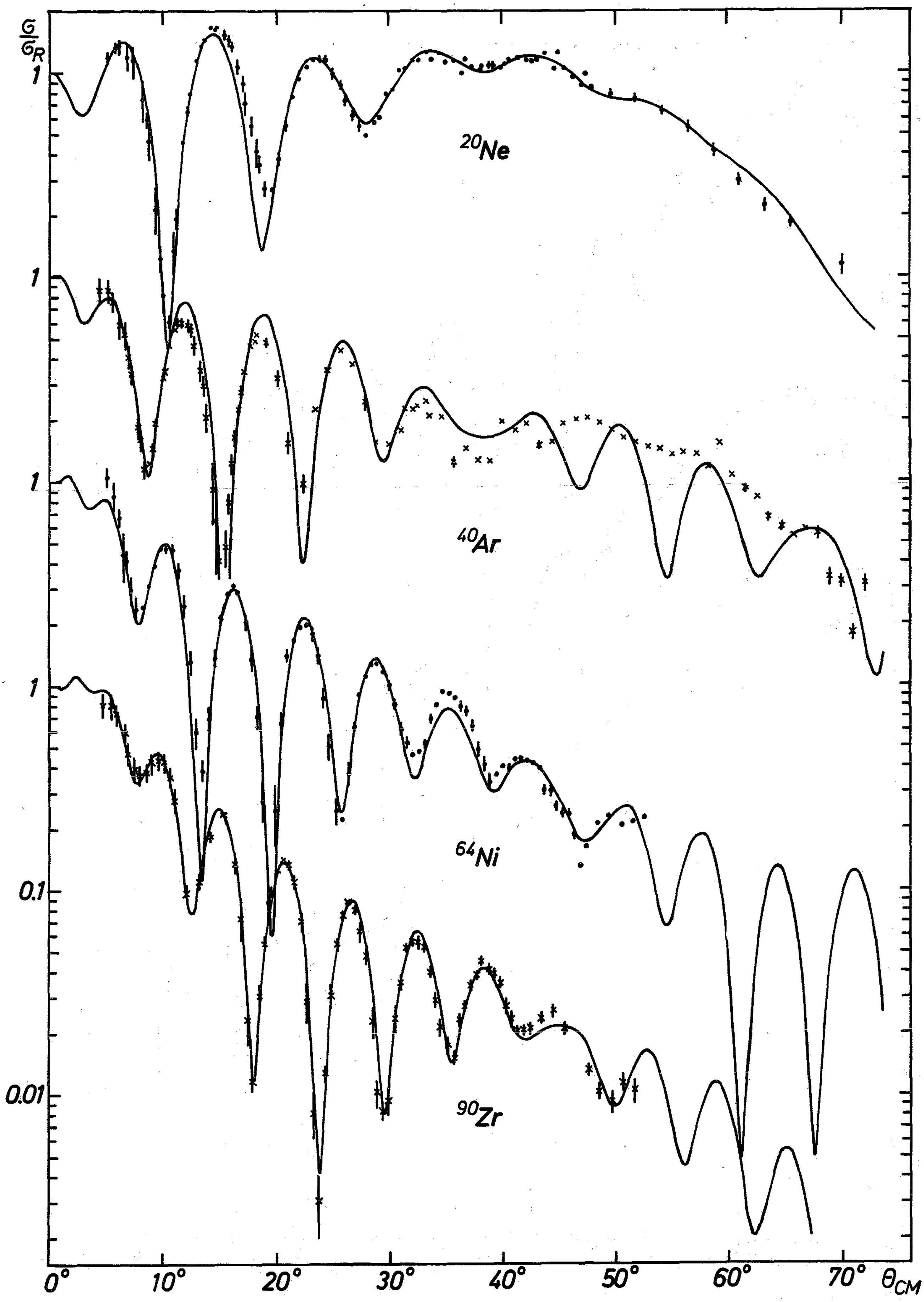
Q = 0
Q = 1.63
Q = 5.7
Q = 4.25
$^{20}Ne(\alpha,\alpha')\,^{20}Ne^*$
Θ_{Lab} = 20°
E_α = 104 MeV
Counts per channel
10^4
10^3
10^2
10^1
10^0
750
800
850
900
Channel number

Figure 2



σ/σR
10
1
1
1
1
1
0.1
6Li
9Be
12C
14N
16O
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100° θCM

Figure 3



$\frac{\sigma}{\sigma_R}$
1
^{20}Ne
1
^{40}Ar
1
1
^{64}Ni
0.1
0.01
^{90}Zr
0°
10°
20°
30°
40°
50°
60°
70°
θ_{CM}

Figure 4

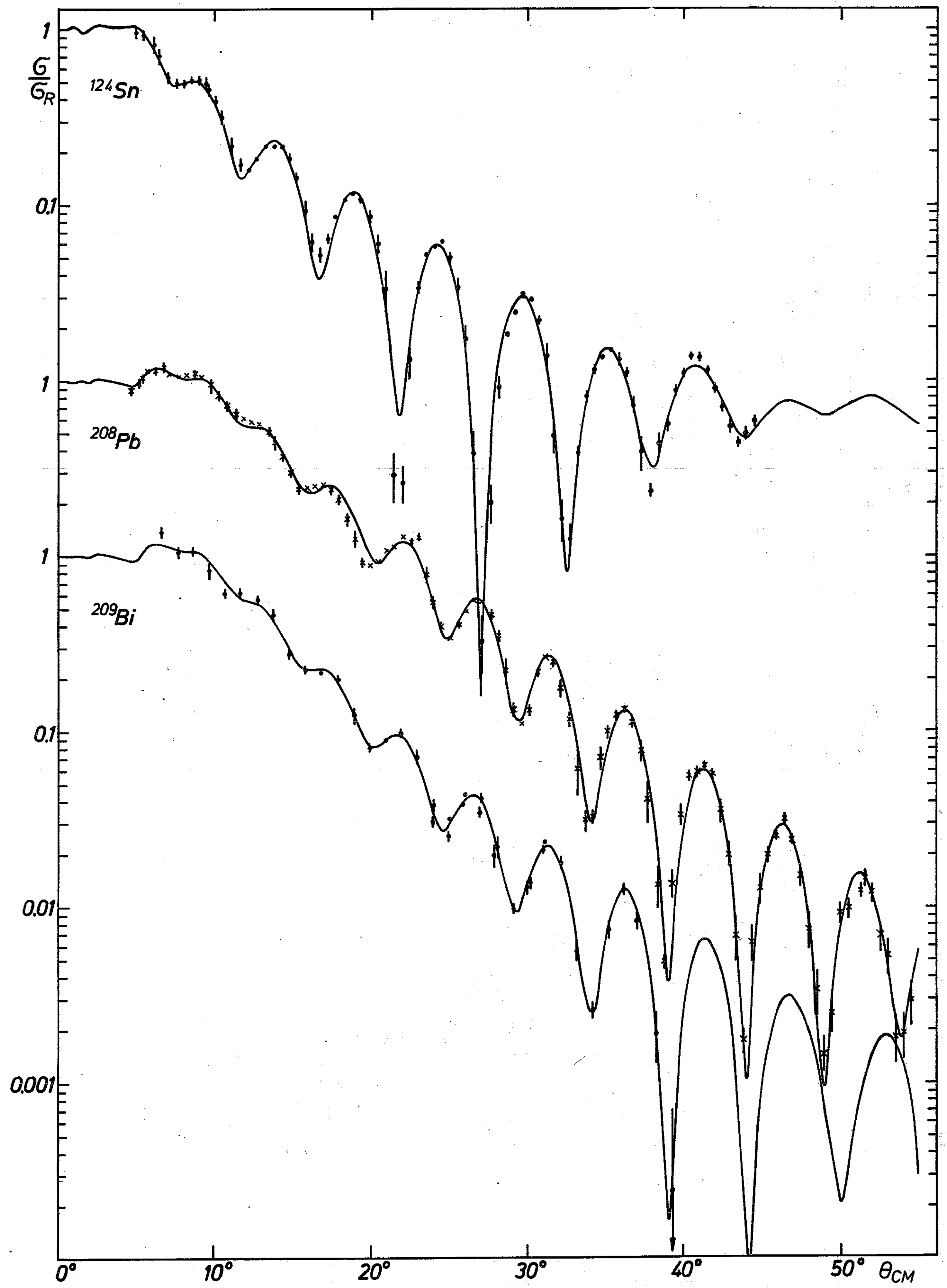

1
$\frac{\sigma}{\sigma_R}$
^{124}Sn
0.1
1
^{208}Pb
1
^{209}Bi
0.1
0.01
0.001
0°
10°
20°
30°
40°
50°
θ_{CM}

Figure 5

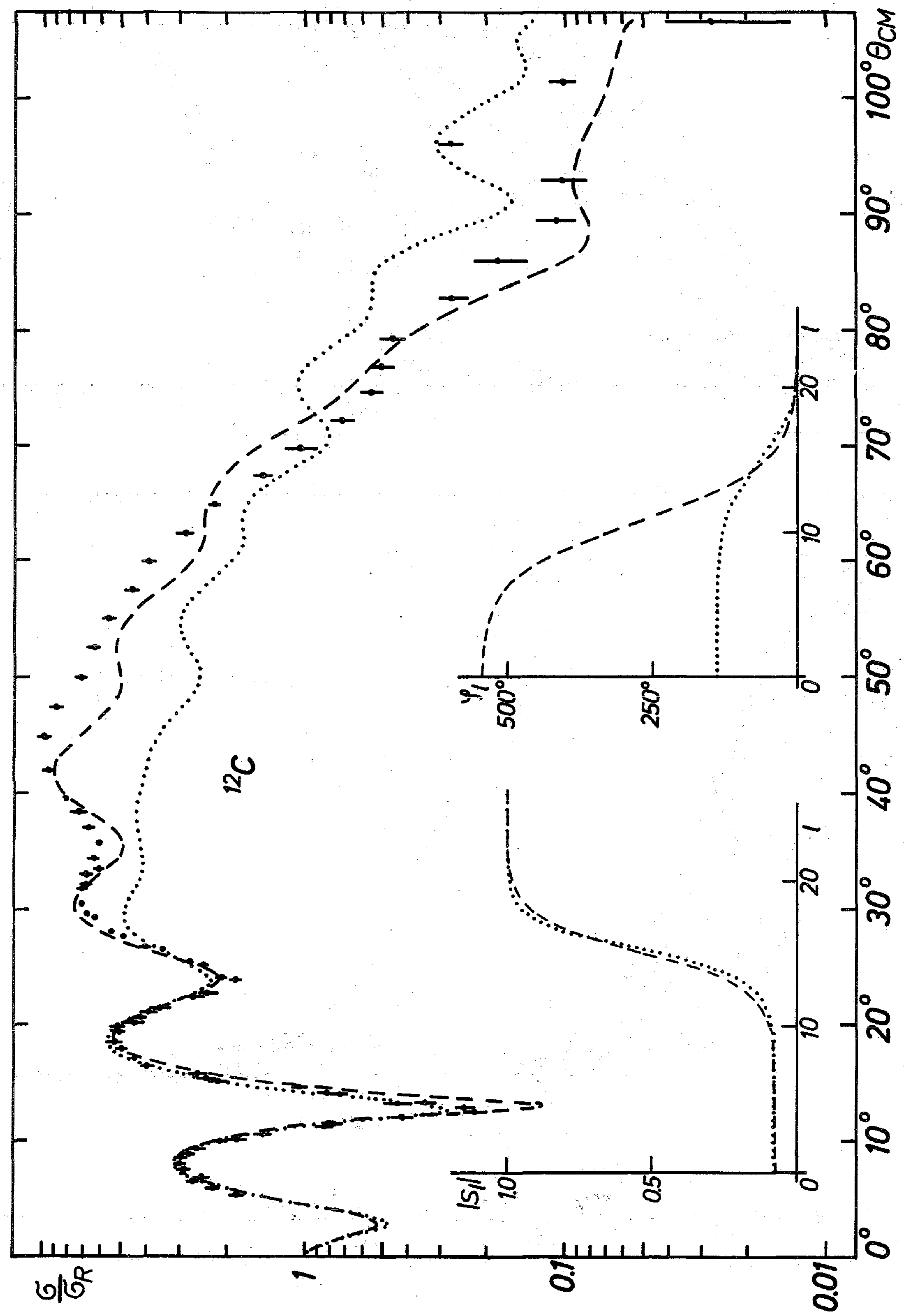

σ/σ_R
1
0.1
0.01
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100° θ_CM
12C
|S_l|
1.0
0.5
0
10
20
l
φ_l
500°
250°
0
10
20
l

Figure 6

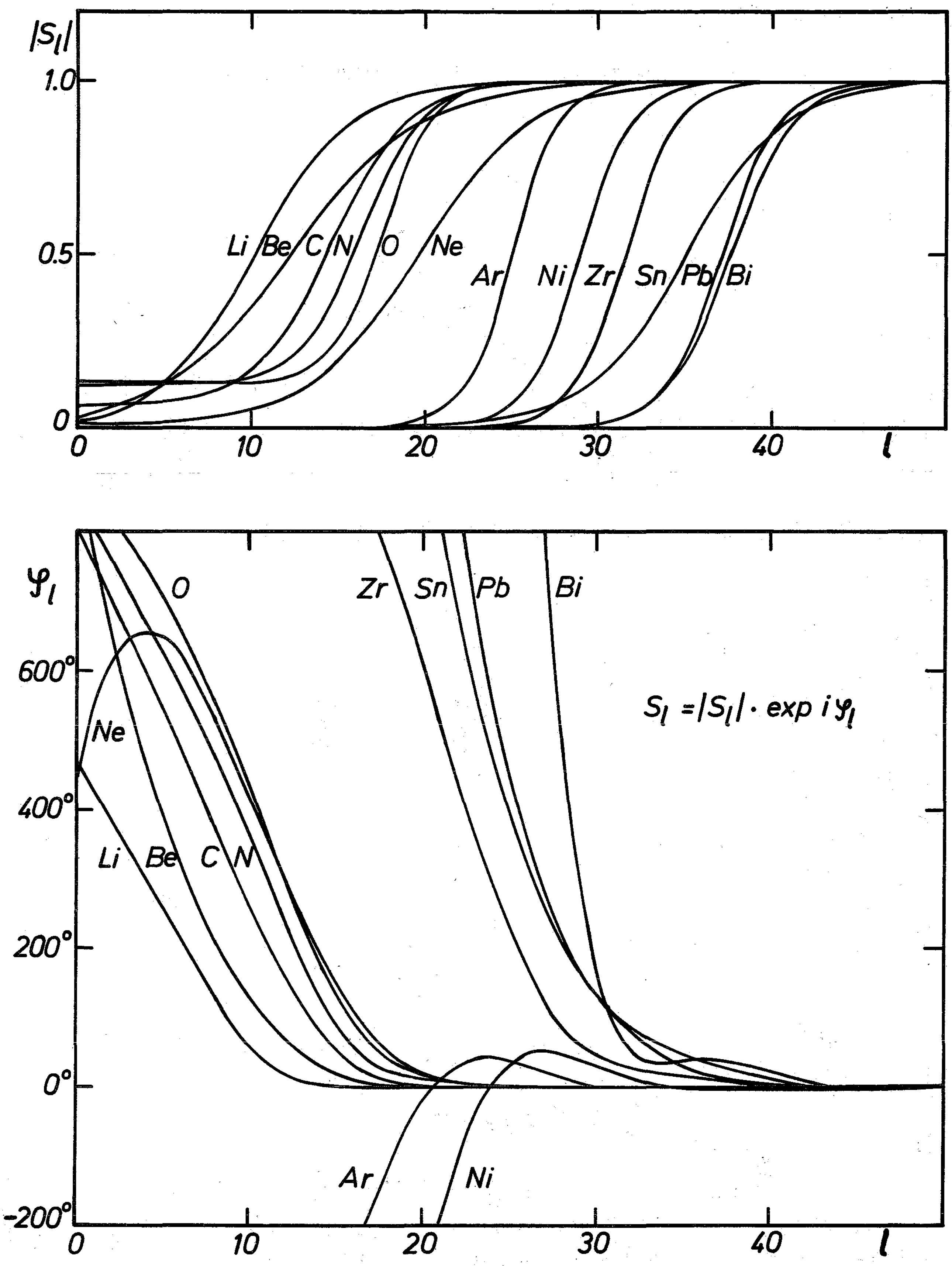
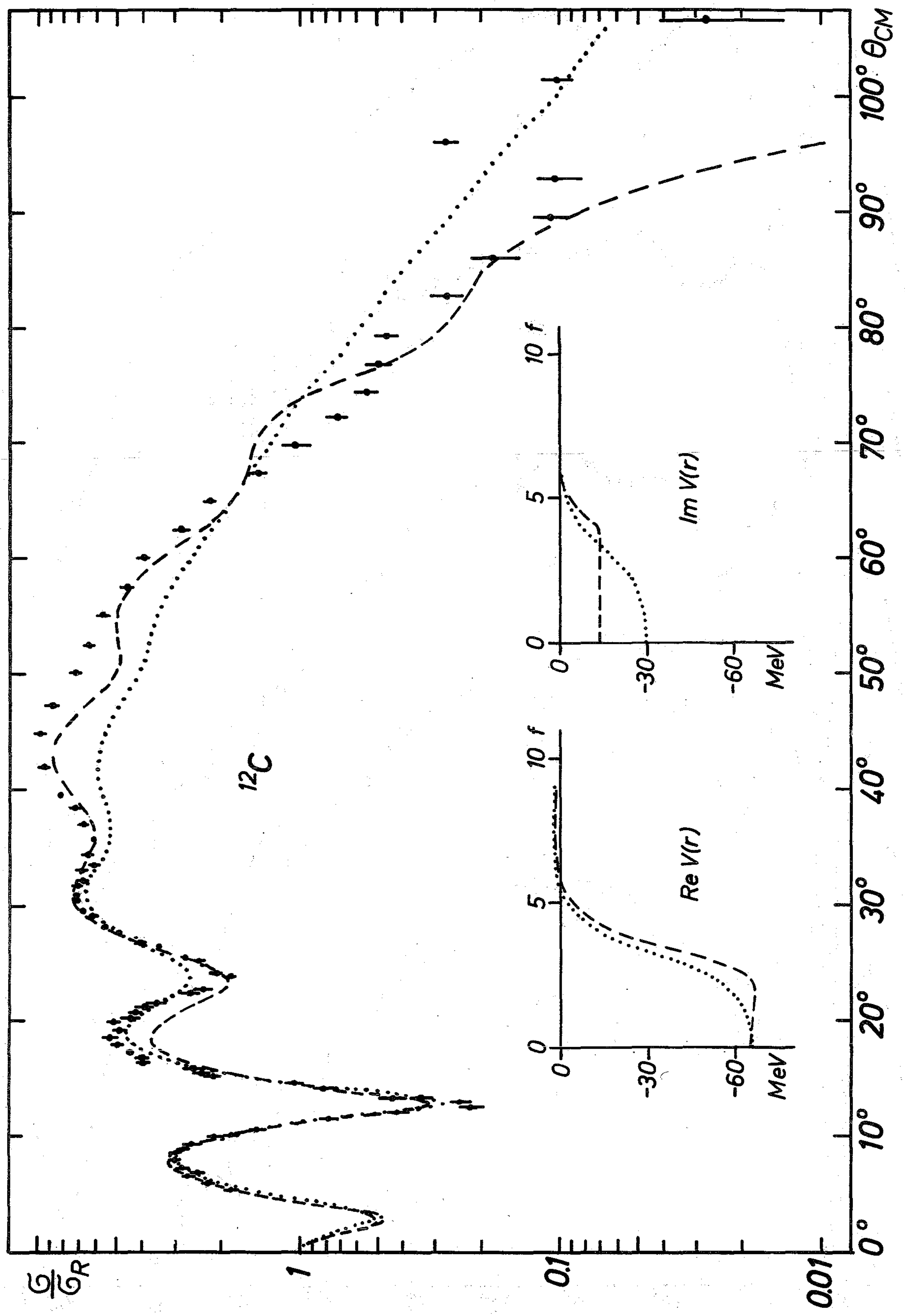
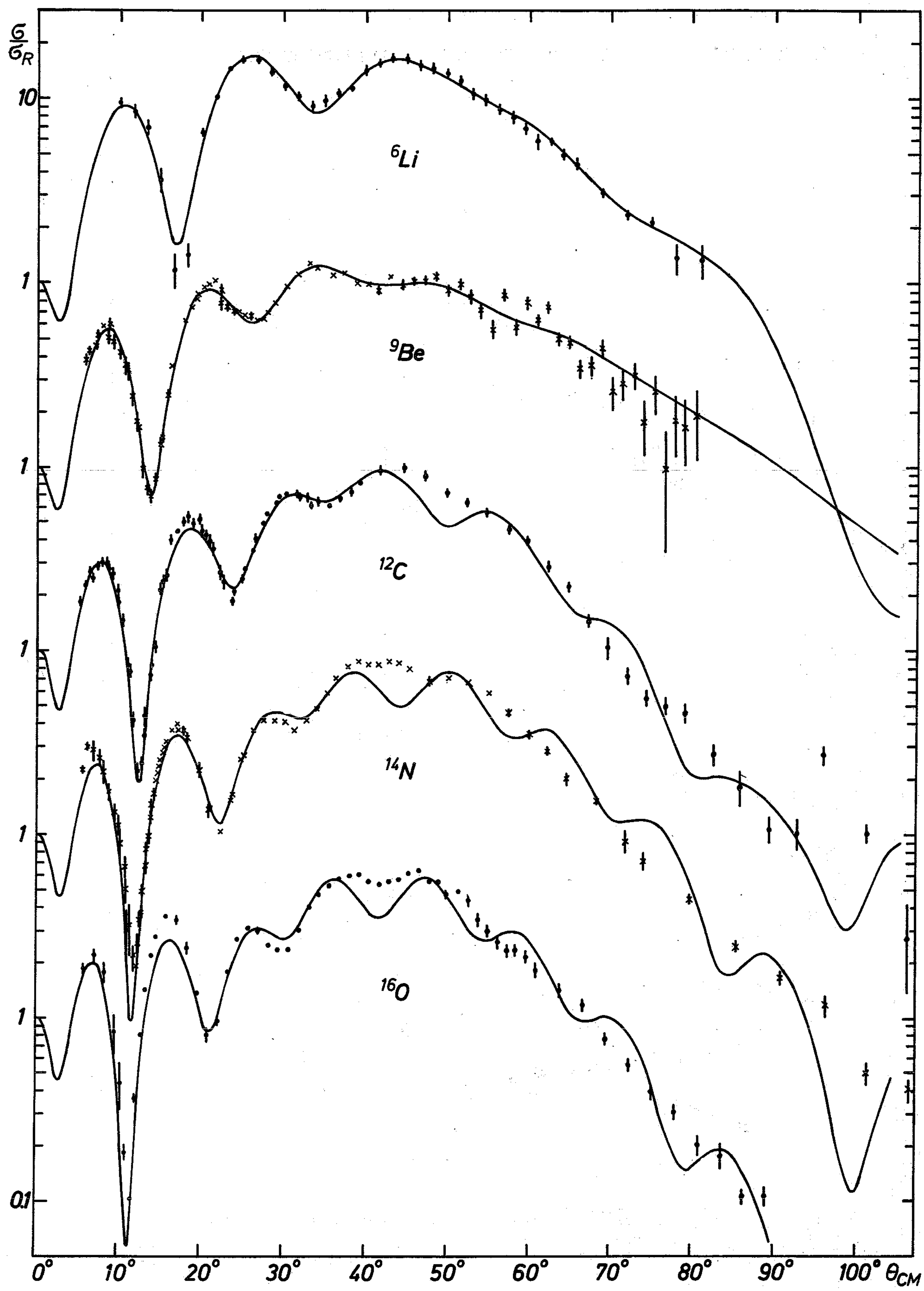

|S_l|
1.0
0.5
0
Li Be C N O Ne
Ar Ni Zr Sn Pb Bi
0 10 20 30 40 l
φ_l
O
Zr Sn Pb Bi
600°
400°
200°
0°
-200°
Ne
Li Be C N
Ar Ni
$S_l = |S_l| \cdot \exp i\varphi_l$
0 10 20 30 40 l

Figure 7



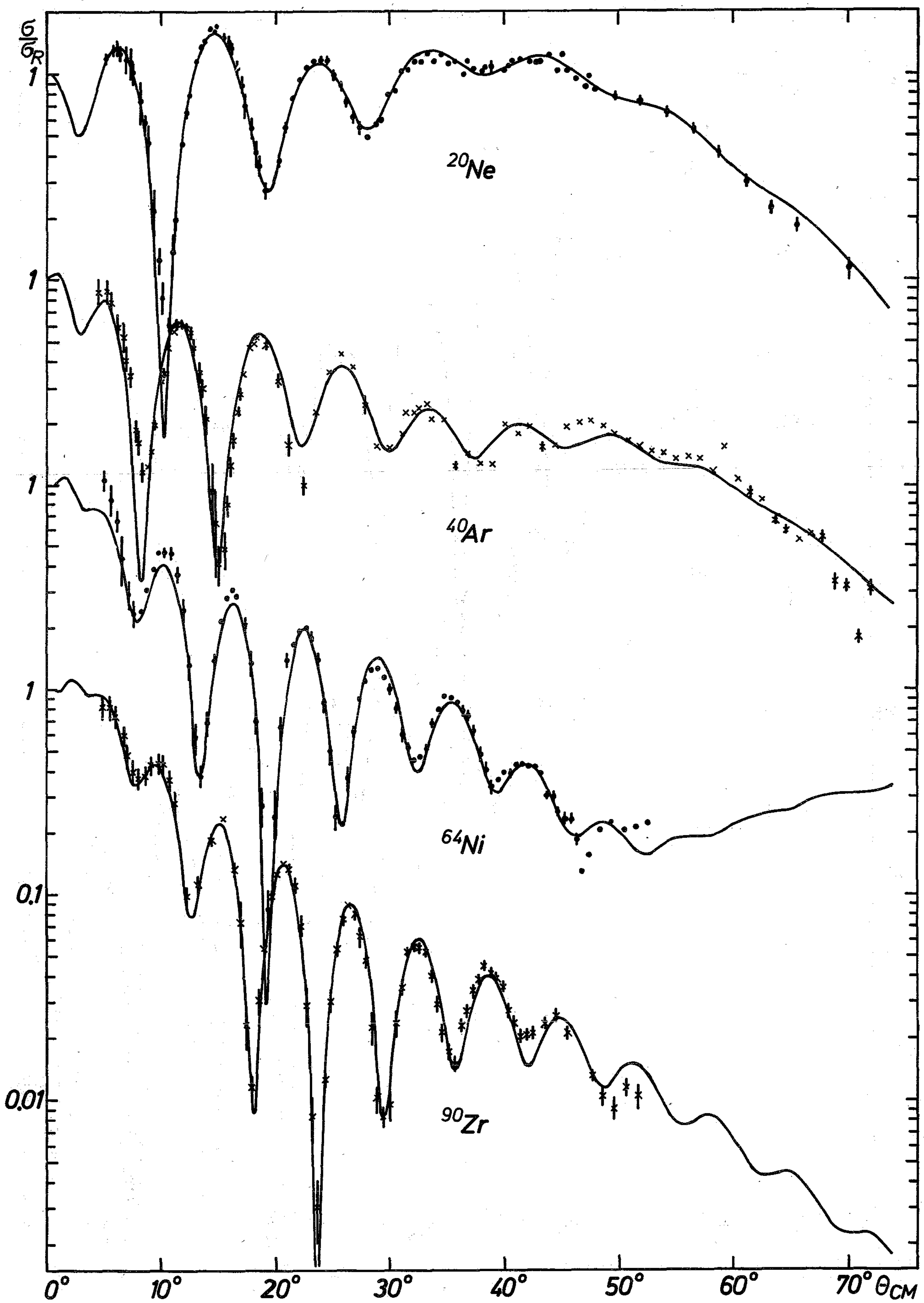
$\frac{\sigma}{\sigma_R}$
1
0.1
0.01
^{12}C
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100° θ_{CM}
Re V(r)
Im V(r)
0
5
10 f
0
-30
-60
MeV

Figure 8



$\frac{\sigma}{\sigma_R}$
10
1
0.1
^6Li
^9Be
^{12}C
^{14}N
^{16}O
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
θ_{CM}

Figure 9



$\frac{\sigma}{\sigma_R}$
1
1
1
1
0,1
0,01
^{20}Ne
^{40}Ar
^{64}Ni
^{90}Zr
0°
10°
20°
30°
40°
50°
60°
70° θ_{CM}

Figure 10

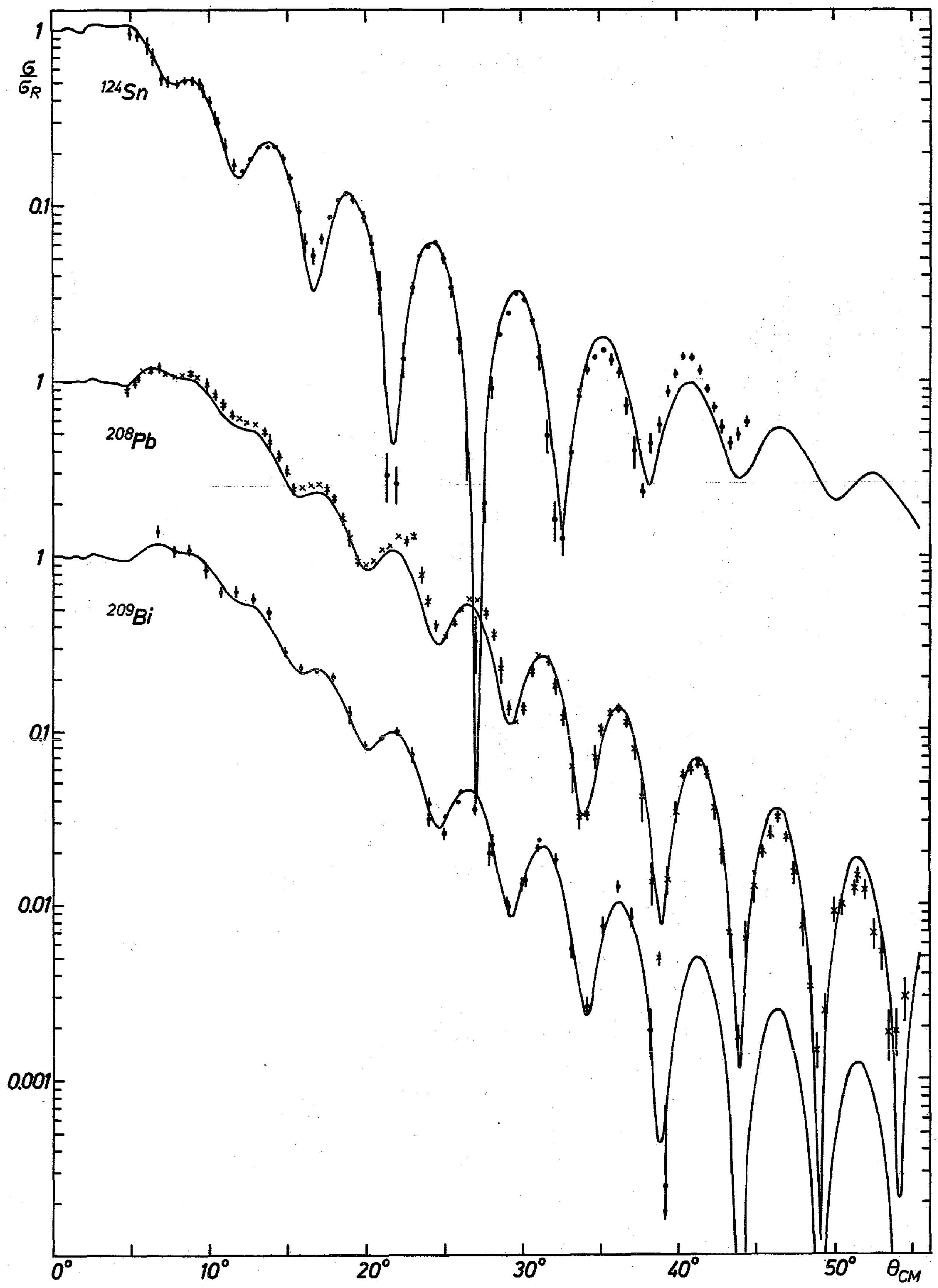
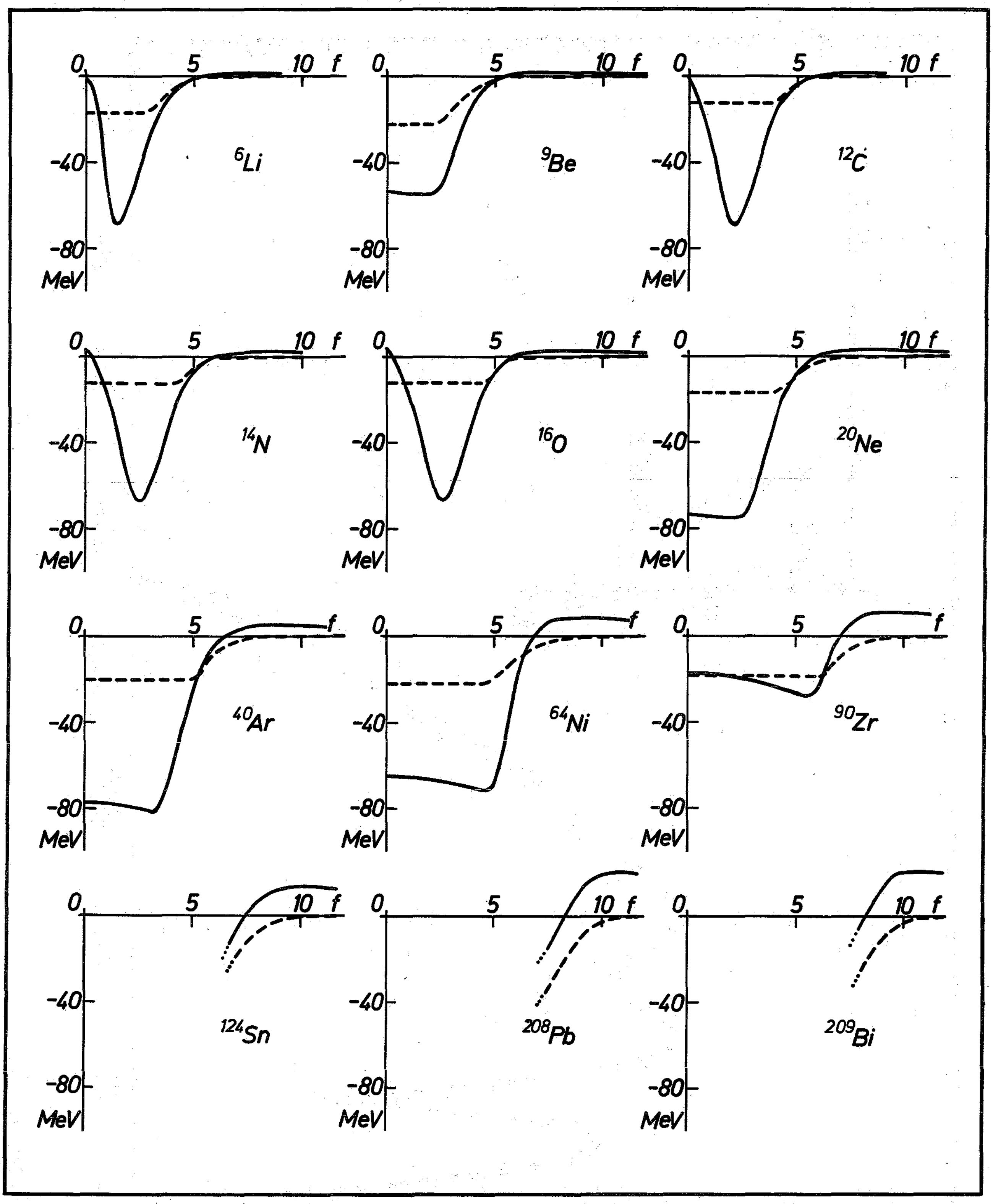

1
$\frac{\sigma}{\sigma_R}$
^{124}Sn
0.1
1
^{208}Pb
1
^{209}Bi
0.1
0.01
0.001
0°
10°
20°
30°
40°
50°
θ_{CM}

Figure 11



0
5
10
f
-40
-80
MeV
^{6}Li
^{9}Be
^{12}C
^{14}N
^{16}O
^{20}Ne
^{40}Ar
^{64}Ni
^{90}Zr
^{124}Sn
^{208}Pb
^{209}Bi

Figure 12

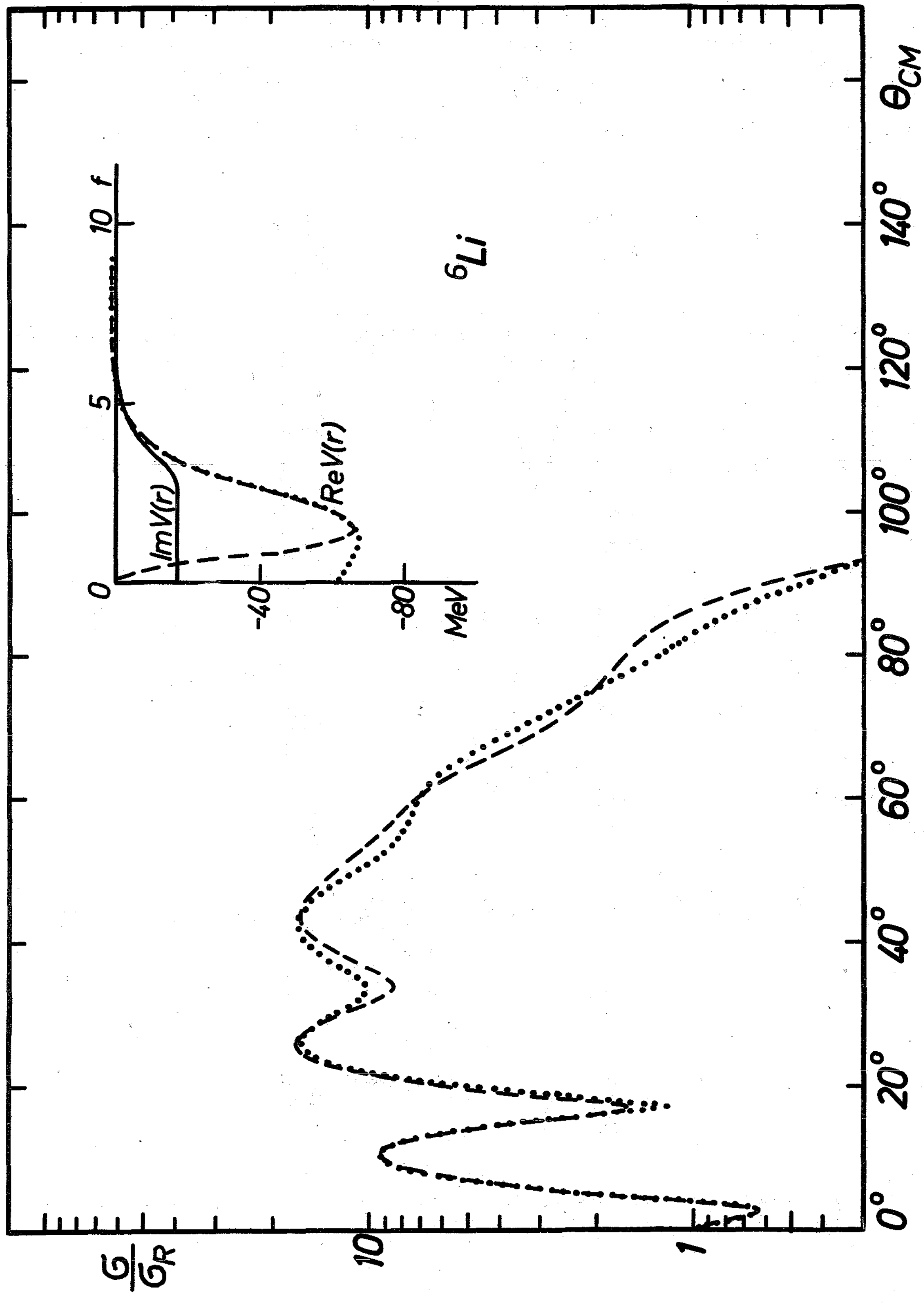
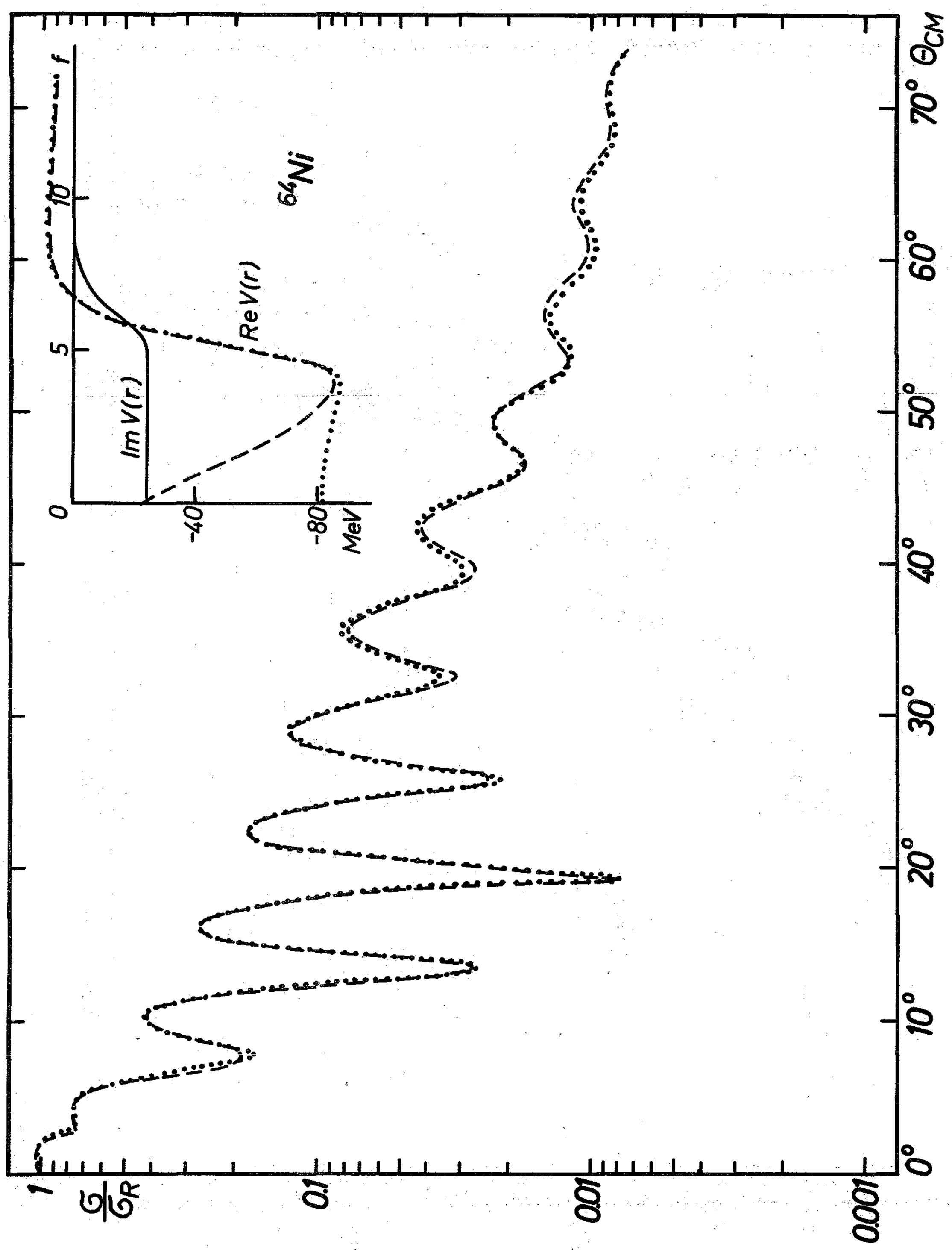
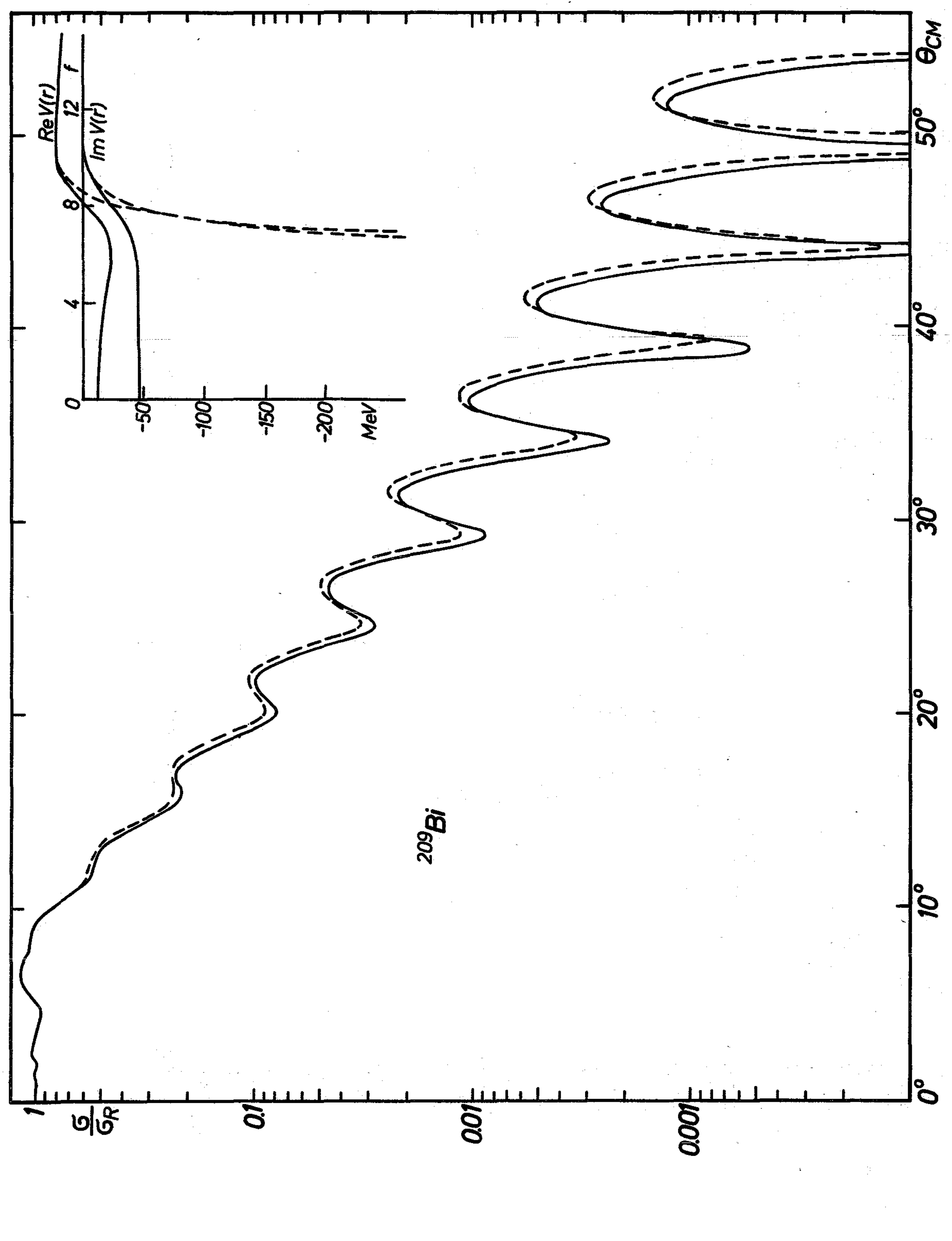

$\frac{\sigma}{\sigma_R}$
10
1
θ_{CM}
0°
20°
40°
60°
80°
100°
120°
140°
^6Li
0
5
10 f
-40
-80
MeV
ImV(r)
ReV(r)

Figure 13



1
σ/σR
0.1
0.01
0.001
0°
10°
20°
30°
40°
50°
60°
70°
θCM
64Ni
Im V(r)
Re V(r)
0
5
10
f
-40
-80
MeV

Figure 14



$\frac{\sigma}{\sigma_R}$
1
0.1
0.01
0.001
0°
10°
20°
30°
40°
50°
θ_{CM}
^{209}Bi
Re V(r)
Im V(r)
0
4
8
12
f
-50
-100
-150
-200
MeV

Figure 15

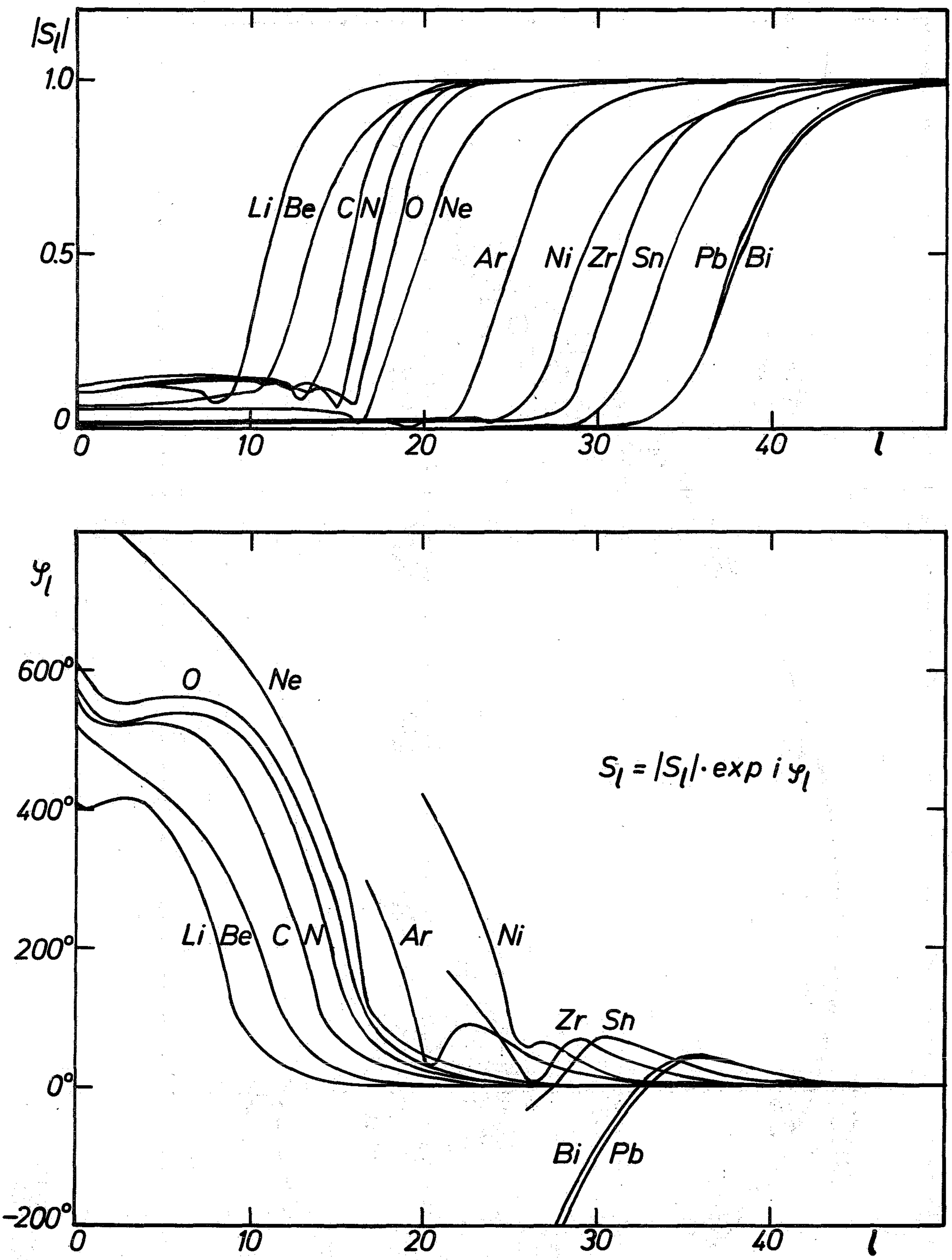
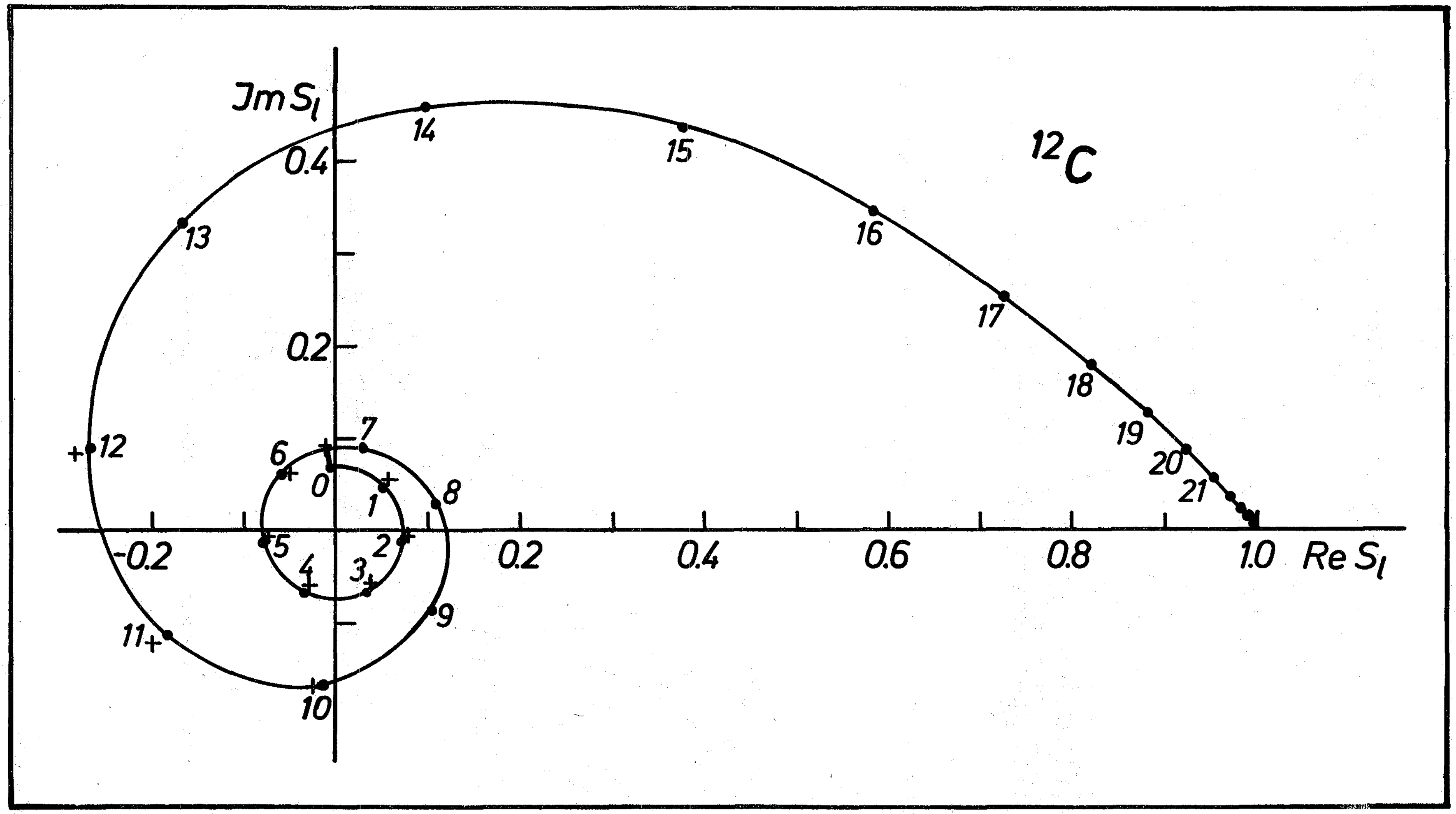
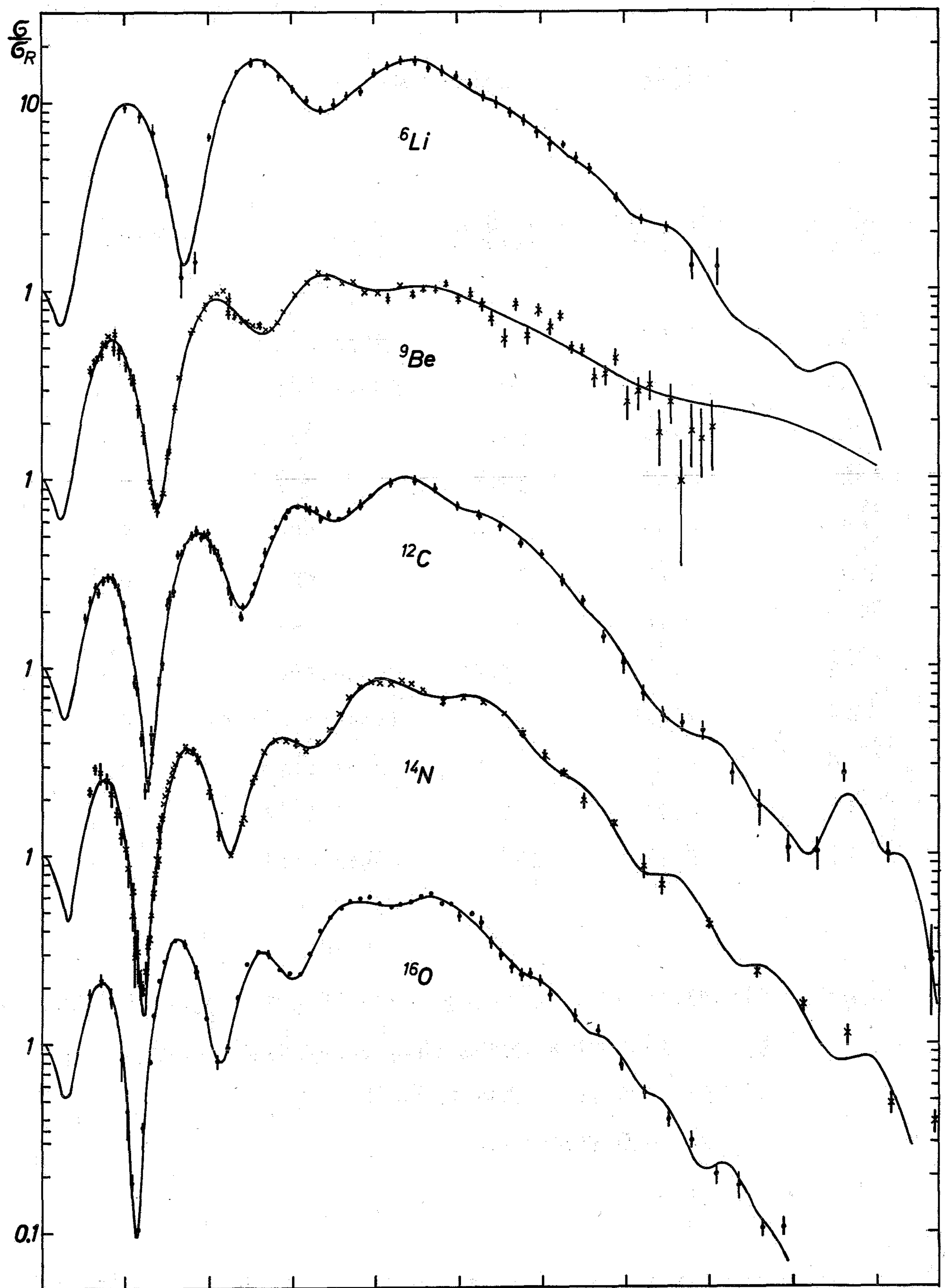

|S_l|
1.0
0.5
0
Li
Be
C
N
O
Ne
Ar
Ni
Zr
Sn
Pb
Bi
0
10
20
30
40
l
φ_l
600°
400°
200°
0°
-200°
O
Ne
$S_l = |S_l| \cdot \exp i \varphi_l$
Li
Be
C
N
Ar
Ni
Zr
Sn
Bi
Pb
0
10
20
30
40
l

Figure 16



^{12}C
$Re\, S_l$
$Jm\, S_l$
0.2
0.4
0.6
0.8
1.0
-0.2
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

Figure 17



$\frac{\sigma}{\sigma_R}$
10
1
1
1
1
1
0.1
^6Li
^9Be
^{12}C
^{14}N
^{16}O
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
θ_{CM}

Figure 18

Table 1 : Target Data

target isotope	thickness mg/cm^2	isotopic abundance	form	remarks
^{6}Li	4.37	99.3	metal foil	d
^{9}Be	13.56	100	metal foil	
^{12}C	18.05	98.9	foil	
^{14}N	0.52	99.6	gas	a
^{16}O	0.45	99.8	gas	a
$^{20}N_e$	0.38	99.9	gas	a,b
^{40}Ar	0.76	99.6	gas	a
^{64}Ni	4.88	99.2	metal foil	c
^{90}Zr	4.22	97.5	ZrO_2 on mlinex	c
^{124}Sn	5.56	99.3	metal foil	c
^{208}Pb	8.02	99.2	metal foil	c
^{209}Bi	6.15	100	metal foil	

Remarks: a) effective target thickness at 90^{o} scattering angle;

b) obtained from Mound Laboratory, Miamisburg;

c) obtained from AERE, Harwell;

d) obtained from ORNL.

Table 2: Parameters for the best fits of the ^{12}C data with the Frahn and Venter, and the APB parametrisation of the S_ℓ function.

	ε_1	ε_2	ℓ_1	ℓ_2	δ_1	δ_2	μ	χ^2/F
Frahn and Venter	-0.0592	0.0550	16.026	16.167	0.871	1.223	0.1235	38.9
APB	0.0775	-	15.056	10.779	1.285	1.937	9.531	10.9

The meaning of the symbols is given in equations (8) and (9).

Table 3 : Parameters for the best fits with the generalised parametrisation of the phase shift functions.

Target	L	ε	$4 \cdot \delta_1$	$4 \cdot \delta_2$	a_o	$a_1 \cdot 10^2$	$a_2 \cdot 10^2$	$a_3 \cdot 10^3$	$a_4 \cdot 10^4$	χ^2/F	χ_c^2/F	L_1	σ_R [b]
^{6}Li	10.235	$2 \cdot 10^{-7}$	10.774	4.956	1.816	-24.91	7.712	4.491	0.5173	5.53	1.87	25	0.864
^{9}Be	12.194	$5 \cdot 10^{-7}$	14.851	6.510	2.256	-15.17	4.239	-4.885	-1.582	2.85	2.95	30	0.990
^{12}C	14.582	0.067	8.738	5.241	2.089	-17.44	12.01	7.463	1.581	2.59	1.07	35	0.840
^{14}N	16.380	0.128	7.221	4.748	1.649	- 3.008	19.15	15.53	4.145	4.69	2.68	24	0.880
^{16}O	17.575	0.131	5.799	4.171	1.753	+16.19	21.91	15.20	3.307	3.72	1.47	40	0.906
^{20}Ne	19.687	0.010	12.677	9.994	0.778	-29.42	2.792	-3.946	-2.646	4.79			1.286
^{40}Ar	25.050	0.009	5.401	3.660	1.251	42.73	14.19	30.00	12.85	54.47			1.387
^{64}Ni	28.974	0.003	6.065	13.241	1.363	- 8.305	-3.501	4.633	-2.860	12.33			1.719
^{90}Zr	31.601	0.003	5.979	8.872	1.105	3.907	5.983	-4.451	-2.778	2.99			1.950
^{124}Sn	35.134	0.008	11.194	7.765	1.068	- 6.557	2.762	-2.490	-0.0994	4.20			2.508
^{208}Pb	37.202	0.005	6.427	9.362	1.109	- 5.471	-0.7944	-3.072	0.7789	3.39			2.540
^{209}Bi	37.658	0.005	7.236	5.451	1.291	25.26	4.311	13.55	21.02	1.90			2.628

F : number of measurement points minus 9

χ_c^2 /F: fit corrected for $\ell = 0$ up to $\ell = L_1$, see section 4.3

σ_R : reaction cross section computed with the S_ℓ values of the best fit

The meaning of the remaining symbols is explained in section 4.1, expression (10)

Table 4 : Parameters for the best fits with the optical model calculations

Target	R_v fm	a_v^- fm	a_v^+ fm	$-V_o$ MeV	R_w fm	a_w^+ fm	$-W_o$ MeV	χ^2/F	Model[a)]	σ_R b
^{6}Li	1.443	1.312	2.760	72.40	2.658	2.278	17.03	2.40	7	0.749
^{9}Be	2.103	∞	2.558	59.20	1.950	2.940	22.59	2.92	7	0.855
^{12}C	3.281	-	0.6921	74.21	-	-	30.23	18.34	4	0.832
^{12}C	2.139	∞	2.779	74.04	3.728	1.637	13.81	13.97	6	0.844
^{12}C	2.074	2.159	2.836	74.92	3.843	1.599	12.38	7.37	7	0.844
^{14}N	2.470	2.275	2.740	73.67	4.201	1.409	12.27	21.67	7	0.911
^{16}O	2.537	2.362	2.808	73.95	4.364	1.417	12.19	28.05	7	0.964
^{20}Ne	2.362	∞	2.944	84.45	3.941	2.156	16.95	3.12	6	1.129
^{40}Ar	3.130	∞	3.051	94.95	4.718	2.179	20.24	19.85	6	1.487
^{64}Ni	4.911	∞	2.538	39.98	5.451	2.812	13.06	16.74	6	1.929
^{64}Ni	4.694	∞	2.216	88.55	4.253	3.430	22.00	16.09	6	1.979
^{90}Zr	5.448	∞	2.533	47.43	5.838	2.542	18.37	3.62	6	2.032
^{124}Sn	6.896	-	0.7423	60.00	-	-	40.88	8.44	3	2.375
^{208}Pb	8.246	-	0.6556	60.00	-	-	43.85	8.90	3	2.746
^{209}Bi	8.118	-	0.7017	63.98	-	-	46.34	2.26	4	2.788

a) The number indicates the number of free parameters.
Model 3,4 : The meaning of the parameters is given by expression (11) with $R = R_v$ and $a = a_v^+$
Model 6,7 : The meaning of the parameters is given by expression (12)

F: number of degrees of freedom.

Table 5

Experimental cross sections for the elastic
scattering of 104 MeV alpha particles.

ECM	: centre of mass energy
K	: wave number
ETA	: Coulomb-parameter
LABOR DATEN	: experimental data in the laboratory system
CM DATEN	: experimental data in the centre of mass system
RUTHERFORD	: experimental data normalised to the Rutherford cross section
THETA	: scattering angle
SIGMA	: differential elastic cross section
DSIGMA	: experimental error due to the statistics in the number of counts and 0.1° uncertainty in the scattering angle
PROZENT	: relative experimental error =100·DSIGMA/SIGMA
SR	: Rutherford cross section

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 6 LI

ECM = 62.392 MEV K = 2.67703 PRO FERMI ETA = 0.18534

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
6.00	5.379E 00	2.761E-01	5.13	9.482E 00	4.867E-01	10.06	1.920E 00	9.855E-02
7.00	2.608E 00	1.904E-01	7.30	8.514E 00	6.214E-01	11.74	9.328E-01	6.809E-02
8.00	1.257E 00	1.142E-01	9.09	6.992E 00	6.356E-01	13.41	4.503E-01	4.094E-02
9.00	4.122E-01	5.902E-02	14.32	3.671E 00	5.256E-01	15.09	1.481E-01	2.120E-02
10.00	8.758E-02	1.904E-02	21.74	1.188E 00	2.582E-01	16.76	3.155E-02	6.858E-03
11.00	7.235E-02	9.520E-03	13.16	1.435E 00	1.888E-01	18.43	2.614E-02	3.439E-03
12.00	2.361E-01	9.520E-03	4.03	6.623E 00	2.671E-01	20.10	8.558E-02	3.451E-03
13.00	2.618E-01	8.568E-03	3.27	1.010E 01	3.307E-01	21.77	9.523E-02	3.117E-03
14.00	2.806E-01	7.616E-03	2.71	1.456E 01	3.948E-01	23.44	1.025E-01	2.781E-03
15.00	2.380E-01	9.520E-03	4.00	1.624E 01	6.494E-01	25.10	8.727E-02	3.491E-03
16.00	1.828E-01	7.616E-03	4.17	1.612E 01	6.716E-01	26.76	6.732E-02	2.805E-03
17.00	1.247E-01	5.712E-03	4.58	1.399E 01	6.409E-01	28.42	4.615E-02	2.114E-03
18.00	8.378E-02	3.808E-03	4.55	1.179E 01	5.361E-01	30.08	3.116E-02	1.416E-03
19.00	5.855E-02	2.856E-03	4.88	1.021E 01	4.982E-01	31.74	2.189E-02	1.068E-03
20.00	4.294E-02	1.904E-03	4.43	9.179E 00	4.071E-01	33.39	1.614E-02	7.159E-04
21.00	3.741E-02	1.904E-03	5.09	9.703E 00	4.938E-01	35.05	1.415E-02	7.201E-04
22.00	3.446E-02	1.428E-03	4.14	1.074E 01	4.452E-01	36.69	1.311E-02	5.434E-04
23.00	3.075E-02	1.428E-03	4.64	1.143E 01	5.307E-01	38.34	1.178E-02	5.470E-04
24.00	3.237E-02	1.428E-03	4.41	1.423E 01	6.278E-01	39.98	1.248E-02	5.507E-04
25.00	3.016E-02	1.238E-03	4.10	1.559E 01	6.392E-01	41.62	1.172E-02	4.807E-04
26.00	2.751E-02	1.238E-03	4.50	1.659E 01	7.461E-01	43.26	1.077E-02	4.843E-04
27.00	2.351E-02	1.142E-03	4.86	1.645E 01	7.990E-01	44.89	9.273E-03	4.505E-04
28.00	1.875E-02	9.520E-04	5.08	1.513E 01	7.682E-01	46.52	7.456E-03	3.785E-04
29.00	1.571E-02	9.520E-04	6.06	1.455E 01	8.817E-01	48.15	6.297E-03	3.816E-04
30.00	1.295E-02	6.664E-04	5.15	1.370E 01	7.050E-01	49.77	5.236E-03	2.695E-04
31.00	1.038E-02	5.712E-04	5.50	1.248E 01	6.872E-01	51.39	4.234E-03	2.331E-04
32.00	7.835E-03	4.760E-04	6.08	1.067E 01	6.485E-01	53.00	3.227E-03	1.961E-04
33.00	6.436E-03	3.808E-04	5.92	9.888E 00	5.851E-01	54.61	2.676E-03	1.584E-04
34.00	5.103E-03	2.856E-04	5.60	8.810E 00	4.931E-01	56.21	2.143E-03	1.200E-04
35.00	4.141E-03	2.856E-04	6.90	8.007E 00	5.522E-01	57.81	1.758E-03	1.212E-04
36.00	3.199E-03	1.904E-04	5.95	6.902E 00	4.109E-01	59.41	1.372E-03	8.167E-05
37.00	2.485E-03	1.904E-04	7.66	5.965E 00	4.571E-01	60.99	1.078E-03	8.258E-05
38.00	2.228E-03	9.520E-05	4.27	5.933E 00	2.535E-01	62.58	9.772E-04	4.176E-05
39.00	1.695E-03	9.520E-05	5.62	4.993E 00	2.805E-01	64.16	7.521E-04	4.225E-05
40.00	1.352E-03	7.616E-05	5.63	4.394E 00	2.476E-01	65.73	6.072E-04	3.421E-05
42.00	7.902E-04	4.760E-05	6.02	3.103E 00	1.870E-01	68.86	3.640E-04	2.193E-05
44.00	5.046E-04	2.856E-05	5.66	2.373E 00	1.343E-01	71.96	2.387E-04	1.351E-05
46.00	3.806E-04	1.904E-05	5.00	2.126E 00	1.063E-01	75.03	1.852E-04	9.262E-06
48.00	2.094E-04	3.808E-05	18.18	1.378E 00	2.506E-01	78.08	1.049E-04	1.908E-05
50.00	1.714E-04	3.808E-05	22.22	1.320E 00	2.934E-01	81.10	8.857E-05	1.968E-05

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 9 BE

ECM = 71.993 MEV K = 3.08898 PRO FERMI ETA = 0.24712

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
4.10	1.755E 01	1.029E 00	5.86	3.793E 00	2.224E-01	5.96	8.326E 00	4.882E-01
4.40	1.477E 01	6.200E-01	4.20	4.233E 00	1.777E-01	6.39	7.009E 00	2.942E-01
4.60	1.278E 01	5.220E-01	4.08	4.375E 00	1.787E-01	6.68	6.066E 00	2.478E-01
5.00	9.484E 00	5.120E-01	5.40	4.531E 00	2.446E-01	7.26	4.504E 00	2.431E-01
5.10	1.001E 01	5.110E-01	5.10	5.176E 00	2.643E-01	7.41	4.754E 00	2.427E-01
5.40	8.106E 00	3.140E-01	3.87	5.268E 00	2.041E-01	7.84	3.851E 00	1.492E-01
5.60	7.640E 00	3.110E-01	4.07	5.742E 00	2.337E-01	8.13	3.630E 00	1.478E-01
6.00	5.076E 00	5.030E-01	9.91	5.028E 00	4.981E-01	8.71	2.414E 00	2.391E-01
6.10	5.546E 00	5.050E-01	9.10	5.868E 00	5.342E-01	8.86	2.638E 00	2.401E-01
6.40	3.740E 00	3.520E-01	9.41	4.793E 00	4.511E-01	9.30	1.779E 00	1.674E-01
7.00	2.290E 00	2.020E-01	8.82	4.198E 00	3.703E-01	10.17	1.090E 00	9.617E-02
7.40	1.550E 00	1.610E-01	10.39	3.548E 00	3.685E-01	10.75	7.384E-01	7.670E-02
7.50	1.370E 00	1.500E-01	10.95	3.308E 00	3.622E-01	10.89	6.528E-01	7.147E-02
8.00	7.690E-01	9.000E-02	11.70	2.403E 00	2.812E-01	11.62	3.667E-01	4.292E-02
8.40	4.610E-01	6.000E-02	13.02	1.750E 00	2.278E-01	12.20	2.200E-01	2.863E-02
8.50	4.069E-01	5.000E-02	12.29	1.620E 00	1.990E-01	12.34	1.942E-01	2.387E-02
9.00	1.970E-01	2.000E-02	10.15	9.852E-01	1.000E-01	13.06	9.412E-02	9.555E-03
9.40	1.282E-01	1.030E-02	8.03	7.627E-01	6.128E-02	13.64	6.130E-02	4.925E-03
9.50	1.119E-01	1.030E-02	9.20	6.944E-01	6.392E-02	13.79	5.352E-02	4.926E-03
10.00	1.121E-01	8.200E-03	7.31	8.537E-01	6.245E-02	14.51	5.367E-02	3.926E-03
10.40	1.480E-01	1.220E-02	8.24	1.318E 00	1.086E-01	15.09	7.092E-02	5.846E-03
10.50	1.550E-01	9.200E-03	5.94	1.434E 00	8.512E-02	15.24	7.429E-02	4.410E-03
11.00	2.170E-01	1.310E-02	6.04	2.417E 00	1.459E-01	15.96	1.041E-01	6.286E-03
11.40	2.740E-01	8.300E-03	3.03	3.519E 00	1.066E-01	16.54	1.316E-01	3.987E-03
11.50	2.760E-01	8.300E-03	3.01	3.670E 00	1.104E-01	16.68	1.326E-01	3.988E-03
12.40	3.360E-01	5.400E-03	1.61	6.033E 00	9.696E-02	17.98	1.618E-01	2.601E-03
12.50	3.370E-01	5.300E-03	1.57	6.248E 00	9.826E-02	18.13	1.623E-01	2.553E-03
13.00	3.400E-01	3.500E-03	1.03	7.369E 00	7.586E-02	18.85	1.640E-01	1.688E-03
13.40	3.290E-01	3.400E-03	1.03	8.046E 00	8.315E-02	19.43	1.589E-01	1.642E-03
13.50	3.410E-01	3.600E-03	1.06	8.590E 00	9.068E-02	19.57	1.647E-01	1.739E-03
14.00	3.220E-01	6.000E-03	1.86	9.375E 00	1.747E-01	20.29	1.558E-01	2.903E-03
14.40	2.970E-01	7.800E-03	2.63	9.673E 00	2.540E-01	20.87	1.439E-01	3.778E-03
14.50	2.950E-01	7.800E-03	2.64	9.876E 00	2.611E-01	21.01	1.429E-01	3.780E-03
15.00	2.640E-01	1.020E-02	3.86	1.011E 01	3.908E-01	21.73	1.281E-01	4.950E-03
15.40	1.800E-01	1.420E-02	7.89	7.657E 00	6.041E-01	22.31	8.748E-02	6.901E-03
15.50	2.090E-01	1.400E-02	6.70	9.122E 00	6.111E-01	22.45	1.016E-01	6.806E-03
16.00	1.480E-01	6.500E-03	4.39	7.329E 00	3.219E-01	23.17	7.207E-02	3.165E-03
16.50	1.250E-01	5.500E-03	4.40	6.995E 00	3.078E-01	23.89	6.098E-02	2.683E-03
17.00	1.100E-01	3.200E-03	2.91	6.931E 00	2.016E-01	24.61	5.376E-02	1.564E-03
17.50	9.350E-02	3.200E-03	3.42	6.610E 00	2.262E-01	25.33	4.578E-02	1.567E-03
18.00	8.290E-02	3.700E-03	4.46	6.554E 00	2.925E-01	26.04	4.067E-02	1.815E-03
18.50	7.080E-02	1.400E-03	1.98	6.240E 00	1.234E-01	26.76	3.481E-02	6.882E-04
19.00	6.480E-02	1.200E-03	1.85	6.348E 00	1.176E-01	27.48	3.192E-02	5.911E-04
19.50	6.310E-02	6.300E-04	1.00	6.852E 00	6.841E-02	28.19	3.115E-02	3.110E-04
20.00	6.450E-02	7.800E-04	1.21	7.743E 00	9.363E-02	28.91	3.191E-02	3.859E-04
21.00	6.530E-02	7.700E-04	1.18	9.509E 00	1.121E-01	30.34	3.245E-02	3.826E-04
22.00	6.300E-02	6.400E-04	1.02	1.103E 01	1.120E-01	31.76	3.146E-02	3.195E-04
23.00	6.010E-02	1.090E-03	1.81	1.254E 01	2.274E-01	33.19	3.016E-02	5.469E-04
24.00	4.840E-02	1.220E-03	2.52	1.194E 01	3.011E-01	34.61	2.441E-02	6.153E-04
25.00	3.780E-02	1.290E-03	3.41	1.096E 01	3.739E-01	36.03	1.917E-02	6.541E-04
26.00	3.280E-02	9.000E-04	2.74	1.110E 01	3.044E-01	37.44	1.672E-02	4.589E-04
27.00	2.490E-02	8.500E-04	3.41	9.770E 00	3.335E-01	38.86	1.277E-02	4.359E-04

9Be Fortsetzung

28.00	2.150E-02	8.000E-04	3.72	9.732E 00	3.621E-01	40.27	1.109E-02	4.128E-04
29.00	1.740E-02	7.500E-04	4.31	9.038E 00	3.896E-01	41.67	9.034E-03	3.894E-04
30.00	1.810E-02	7.000E-04	3.87	1.074E 01	4.152E-01	43.07	9.459E-03	3.658E-04
31.00	1.420E-02	6.500E-04	4.58	9.576E 00	4.384E-01	44.47	7.471E-03	3.420E-04
32.00	1.330E-02	6.000E-04	4.51	1.015E 01	4.581E-01	45.87	7.046E-03	3.178E-04
33.00	1.180E-02	5.500E-04	4.66	1.016E 01	4.735E-01	47.26	6.296E-03	2.934E-04
34.00	1.120E-02	5.000E-04	4.46	1.083E 01	4.835E-01	48.65	6.020E-03	2.687E-04
35.00	8.360E-03	5.000E-04	5.98	9.049E 00	5.412E-01	50.03	4.528E-03	2.708E-04
36.00	8.030E-03	5.000E-04	6.23	9.697E 00	6.038E-01	51.41	4.383E-03	2.729E-04
37.00	6.210E-03	5.000E-04	8.05	8.340E 00	6.715E-01	52.79	3.417E-03	2.751E-04
38.00	4.780E-03	4.500E-04	9.41	7.118E 00	6.701E-01	54.16	2.652E-03	2.496E-04
39.00	3.400E-03	4.000E-04	11.76	5.598E 00	6.585E-01	55.53	1.902E-03	2.238E-04
40.00	4.700E-03	3.500E-04	7.45	8.532E 00	6.354E-01	56.89	2.652E-03	1.975E-04
41.00	2.900E-03	3.000E-04	10.34	5.790E 00	5.990E-01	58.25	1.651E-03	1.708E-04
42.00	3.580E-03	2.500E-04	6.98	7.842E 00	5.476E-01	59.60	2.057E-03	1.437E-04
43.00	2.630E-03	2.000E-04	7.60	6.306E 00	4.795E-01	60.95	1.525E-03	1.160E-04
44.00	2.810E-03	1.500E-04	5.34	7.359E 00	3.928E-01	62.29	1.646E-03	8.784E-05
45.00	1.730E-03	1.200E-04	6.94	4.937E 00	3.425E-01	63.63	1.023E-03	7.096E-05
46.00	1.540E-03	1.200E-04	7.79	4.780E 00	3.725E-01	64.96	9.198E-04	7.167E-05
47.00	1.010E-03	1.200E-04	11.88	3.403E 00	4.043E-01	66.28	6.095E-04	7.241E-05
48.00	9.790E-04	1.200E-04	12.26	3.574E 00	4.381E-01	67.61	5.969E-04	7.317E-05
49.00	1.110E-03	1.200E-04	10.81	4.383E 00	4.738E-01	68.92	6.841E-04	7.395E-05
50.00	6.050E-04	1.200E-04	19.83	2.579E 00	5.116E-01	70.23	3.769E-04	7.476E-05
51.00	6.210E-04	1.200E-04	19.32	2.854E 00	5.514E-01	71.53	3.912E-04	7.560E-05
52.00	6.330E-04	1.100E-04	17.38	3.130E 00	5.440E-01	72.83	4.033E-04	7.008E-05
53.00	3.260E-04	1.100E-04	33.74	1.732E 00	5.845E-01	74.12	2.101E-04	7.089E-05
54.00	4.430E-04	1.100E-04	24.83	2.526E 00	6.272E-01	75.41	2.889E-04	7.173E-05
55.00	1.570E-04	1.000E-04	63.69	9.591E-01	6.109E-01	76.69	1.036E-04	6.599E-05
56.00	2.710E-04	1.000E-04	36.90	1.771E 00	6.537E-01	77.96	1.810E-04	6.680E-05
57.00	2.310E-04	1.000E-04	43.29	1.614E 00	6.985E-01	79.22	1.562E-04	6.763E-05
58.00	2.480E-04	1.000E-04	40.32	1.849E 00	7.455E-01	80.48	1.698E-04	6.848E-05

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 12 C

ECM = 77.994 MEV K = 3.34646 PRO FERMI ETA = 0.37068

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA GRAD	SIGMA B/SR	DSIGMA B/SR	PROZENT	SIGMA/SR	DSIGMA/SR	THETA GRAD	SIGMA B/SR	DSIGMA B/SR
3.95	2.220E 01	1.110E 00	5.00	1.834E 00	9.172E-02	5.29	1.237E 01	6.186E-01
4.45	1.710E 01	8.550E-01	5.00	2.276E 00	1.138E-01	5.96	9.534E 00	4.767E-01
4.95	1.313E 01	6.560E-01	5.00	2.674E 00	1.336E-01	6.63	7.324E 00	3.659E-01
5.05	1.132E 01	5.660E-01	5.00	2.498E 00	1.249E-01	6.77	6.315E 00	3.157E-01
5.45	9.360E 00	4.680E-01	5.00	2.801E 00	1.400E-01	7.30	5.223E 00	2.612E-01
5.55	8.980E 00	4.490E-01	5.00	2.890E 00	1.445E-01	7.44	5.012E 00	2.506E-01
5.95	7.150E 00	3.580E-01	5.01	3.039E 00	1.521E-01	7.97	3.992E 00	1.999E-01
6.45	5.060E 00	2.540E-01	5.02	2.969E 00	1.490E-01	8.64	2.827E 00	1.419E-01
6.55	4.500E 00	2.700E-01	6.00	2.808E 00	1.685E-01	8.78	2.514E 00	1.508E-01
6.95	3.290E 00	2.300E-01	6.99	2.601E 00	1.818E-01	9.31	1.839E 00	1.286E-01
7.45	2.040E 00	1.430E-01	7.01	2.129E 00	1.492E-01	9.98	1.141E 00	7.998E-02
7.55	1.650E 00	1.150E-01	6.97	1.816E 00	1.266E-01	10.11	9.229E-01	6.433E-02
7.95	1.090E 00	8.730E-02	8.01	1.474E 00	1.181E-01	10.65	6.100E-01	4.886E-02
8.45	4.900E-01	3.920E-02	8.00	8.456E-01	6.764E-02	11.32	2.744E-01	2.195E-02
8.55	4.320E-01	3.460E-02	8.01	7.813E-01	6.258E-02	11.45	2.420E-01	1.938E-02
8.95	1.940E-01	1.940E-02	10.00	4.211E-01	4.211E-02	11.99	1.087E-01	1.087E-02
9.45	8.220E-02	8.220E-03	10.00	2.217E-01	2.217E-02	12.65	4.611E-02	4.611E-03
9.55	8.600E-02	7.740E-03	9.00	2.419E-01	2.177E-02	12.79	4.825E-02	4.342E-03
9.90	1.350E-01	1.675E-02	12.41	4.383E-01	5.439E-02	13.25	7.579E-02	9.403E-03
9.95	1.040E-01	1.040E-02	10.00	3.445E-01	3.445E-02	13.32	5.839E-02	5.839E-03
10.45	1.830E-01	1.280E-02	6.99	7.372E-01	5.157E-02	13.99	1.028E-01	7.193E-03
10.55	1.950E-01	1.950E-02	10.00	8.160E-01	8.160E-02	14.12	1.096E-01	1.096E-02
10.90	2.220E-01	1.550E-02	6.98	1.058E 00	7.388E-02	14.59	1.249E-01	8.717E-03
11.45	3.740E-01	2.620E-02	7.01	2.169E 00	1.520E-01	15.32	2.106E-01	1.475E-02
11.55	3.970E-01	2.780E-02	7.00	2.384E 00	1.669E-01	15.46	2.236E-01	1.565E-02
11.90	3.800E-01	2.900E-02	7.63	2.570E 00	1.961E-01	15.92	2.141E-01	1.634E-02
12.45	4.920E-01	2.460E-02	5.00	3.984E 00	1.992E-01	16.66	2.776E-01	1.388E-02
12.55	4.800E-01	2.400E-02	5.00	4.013E 00	2.006E-01	16.79	2.709E-01	1.354E-02
12.90	4.760E-01	9.600E-03	2.02	4.440E 00	8.955E-02	17.26	2.688E-01	5.421E-03
13.45	4.530E-01	2.260E-02	4.99	4.990E 00	2.490E-01	17.99	2.561E-01	1.278E-02
13.55	4.440E-01	2.220E-02	5.00	5.037E 00	2.519E-01	18.12	2.511E-01	1.256E-02
13.90	4.240E-01	2.700E-02	6.37	5.324E 00	3.391E-01	18.59	2.400E-01	1.528E-02
14.46	3.340E-01	1.670E-02	5.00	4.895E 00	2.447E-01	19.32	1.893E-01	9.466E-03
14.55	3.370E-01	1.690E-02	5.01	5.076E 00	2.546E-01	19.45	1.911E-01	9.582E-03
14.90	3.110E-01	1.870E-02	6.01	5.149E 00	3.096E-01	19.92	1.765E-01	1.061E-02
15.10	2.530E-01	2.020E-02	7.98	4.417E 00	3.527E-01	20.19	1.436E-01	1.147E-02
15.55	2.160E-01	1.080E-02	5.00	4.238E 00	2.119E-01	20.78	1.228E-01	6.139E-03
15.90	1.830E-01	1.460E-02	7.98	3.923E 00	3.130E-01	21.25	1.041E-01	8.308E-03
16.10	1.580E-01	1.260E-02	7.97	3.559E 00	2.838E-01	21.51	8.995E-02	7.174E-03
16.90	9.600E-02	7.680E-03	8.00	2.622E 00	2.098E-01	22.58	5.478E-02	4.383E-03
17.10	8.200E-02	6.560E-03	8.00	2.347E 00	1.877E-01	22.84	4.682E-02	3.746E-03
17.90	5.300E-02	2.120E-03	4.00	1.819E 00	7.275E-02	23.90	3.034E-02	1.213E-03
18.10	5.800E-02	2.320E-03	4.00	2.080E 00	8.320E-02	24.17	3.322E-02	1.329E-03
18.90	5.730E-02	2.290E-03	4.00	2.439E 00	9.749E-02	25.23	3.290E-02	1.315E-03
19.10	6.240E-02	2.480E-03	3.97	2.770E 00	1.101E-01	25.49	3.585E-02	1.425E-03
19.90	6.650E-02	2.000E-03	3.01	3.473E 00	1.044E-01	26.55	3.831E-02	1.152E-03
20.10	7.450E-02	2.980E-03	4.00	4.048E 00	1.619E-01	26.81	4.295E-02	1.718E-03
20.90	7.770E-02	2.330E-03	3.00	4.927E 00	1.477E-01	27.87	4.493E-02	1.347E-03
21.10	8.450E-02	2.540E-03	3.01	5.564E 00	1.672E-01	28.13	4.889E-02	1.470E-03
21.90	8.300E-02	2.480E-03	2.99	6.331E 00	1.892E-01	29.19	4.817E-02	1.439E-03
22.10	8.520E-02	2.560E-03	3.00	6.737E 00	2.024E-01	29.45	4.948E-02	1.487E-03
22.90	7.730E-02	2.320E-03	3.00	7.034E 00	2.111E-01	30.51	4.504E-02	1.352E-03

12C Fortsetzung

23.10	7.60CE-02	2.280E-03
23.90	6.55CE-02	2.620E-03
24.10	6.12CE-02	2.450E-03
24.90	5.35CE-02	2.140E-03
25.10	4.70CE-02	1.880E-03
25.90	4.350E-02	2.180E-03
26.90	3.58CE-02	1.430E-03
27.90	3.39CE-02	1.360E-03
28.90	3.200E-02	1.600E-03
29.90	3.16CE-02	1.260E-03
31.90	2.86CE-02	1.430E-03
33.90	2.32CE-02	9.280E-04
35.90	1.69CE-02	8.450E-04
37.90	1.10CE-02	5.500E-04
39.90	8.05CE-03	4.020E-04
41.90	5.86CE-03	2.930E-04
43.90	4.00CE-03	2.000E-04
45.90	2.92CE-03	1.460E-04
47.90	1.80CE-03	1.080E-04
49.90	1.19CE-03	6.000E-05
51.90	6.75CE-04	4.100E-05
53.90	4.23CE-04	4.200E-05
55.90	2.54CE-04	2.300E-05
57.90	1.70CE-04	1.600E-05
59.90	1.37CE-04	1.300E-05
61.90	1.11CE-04	1.200E-05
64.90	5.50CE-05	7.000E-06
67.90	3.10CE-05	7.000E-06
70.90	1.60CE-05	2.500E-06
73.90	1.30CE-05	2.500E-06
76.90	3.00CE-05	3.500E-06
81.90	9.00CE-06	1.000E-06
86.90	2.00CE-06	1.000E-06

3.00	7.157E 00	2.147E-01
4.00	7.055E 00	2.822E-01
4.00	6.812E 00	2.727E-01
4.00	6.773E 00	2.709E-01
4.00	6.140E 00	2.456E-01
5.01	6.430E 00	3.222E-01
3.99	6.141E 00	2.453E-01
4.01	6.712E 00	2.693E-01
5.00	7.273E 00	3.637E-01
3.99	8.206E 00	3.272E-01
5.00	9.564E 00	4.782E-01
4.00	9.832E 00	3.933E-01
5.00	8.947E 00	4.474E-01
5.00	7.183E 00	3.591E-01
4.99	6.409E 00	3.201E-01
5.00	5.630E 00	2.815E-01
5.00	4.594E 00	2.297E-01
5.00	3.974E 00	1.987E-01
6.00	2.880E 00	1.728E-01
5.04	2.222E 00	1.121E-01
6.07	1.462E 00	8.877E-02
9.93	1.055E 00	1.048E-01
9.06	7.258E-01	6.572E-02
9.41	5.534E-01	5.209E-02
9.49	5.055E-01	4.797E-02
10.81	4.621E-01	4.996E-02
12.73	2.721E-01	3.463E-02
22.58	1.806E-01	4.078E-02
15.63	1.088E-01	1.701E-02
19.23	1.025E-01	1.970E-02
11.67	2.720E-01	3.173E-02
11.11	1.015E-01	1.128E-02
50.00	2.762E-02	1.381E-02

30.77	4.432E-02	1.329E-03
31.82	3.832E-02	1.533E-03
32.08	3.583E-02	1.434E-03
33.13	3.143E-02	1.257E-03
33.40	2.764E-02	1.105E-03
34.44	2.567E-02	1.286E-03
35.75	2.122E-02	8.477E-04
37.06	2.019E-02	8.100E-04
38.36	1.915E-02	9.577E-04
39.66	1.901E-02	7.580E-04
42.25	1.739E-02	8.695E-04
44.83	1.427E-02	5.707E-04
47.39	1.052E-02	5.260E-04
49.95	6.934E-03	3.467E-04
52.49	5.143E-03	2.568E-04
55.01	3.796E-03	1.898E-04
57.52	2.629E-03	1.315E-04
60.01	1.949E-03	9.745E-05
62.49	1.221E-03	7.324E-05
64.95	8.203E-04	4.136E-05
67.39	4.733E-04	2.875E-05
69.81	3.019E-04	2.998E-05
72.21	1.846E-04	1.672E-05
74.59	1.259E-04	1.185E-05
76.96	1.035E-04	9.817E-06
79.30	8.550E-05	9.243E-06
82.77	4.369E-05	5.560E-06
86.19	2.542E-05	5.741E-06
89.56	1.356E-05	2.119E-06
92.88	1.140E-05	2.192E-06
96.15	2.723E-05	3.177E-06
101.47	8.670E-06	9.633E-07
106.63	2.048E-06	1.024E-06

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 14 N

ECM = 80.883 MEV K = 3.47043 PRO FERMI ETA = 0.43246

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
4.45	2.230E 01	9.090E-01	4.06	2.186E 00	8.880E-02	5.75	1.343E 01	5.454E-01
4.95	1.930E 01	1.156E 00	5.99	2.886E 00	1.729E-01	6.39	1.158E 01	6.938E-01
5.45	1.250E 01	1.540E 00	12.32	2.746E 00	3.383E-01	7.04	7.506E 00	9.247E-01
5.95	8.010E 00	7.600E-01	9.49	2.499E 00	2.371E-01	7.68	4.812E 00	4.565E-01
6.45	4.910E 00	6.870E-01	13.99	2.115E 00	2.959E-01	8.33	2.951E 00	4.129E-01
6.95	2.820E 00	2.940E-01	10.43	1.637E 00	1.706E-01	8.97	1.696E 00	1.768E-01
7.45	1.650E 00	1.600E-01	9.70	1.264E 00	1.226E-01	9.62	9.927E-01	9.626E-02
7.85	1.130E 00	1.760E-01	15.58	1.067E 00	1.661E-01	10.14	6.802E-01	1.059E-01
7.95	8.600E-01	1.780E-01	20.70	8.539E-01	1.767E-01	10.26	5.177E-01	1.072E-01
8.35	5.290E-01	6.550E-02	12.38	6.390E-01	7.912E-02	10.78	3.186E-01	3.945E-02
8.45	3.800E-01	6.600E-02	17.37	4.814E-01	8.361E-02	10.91	2.289E-01	3.976E-02
8.65	2.080E-01	6.560E-02	31.54	2.893E-01	9.124E-02	11.17	1.253E-01	3.953E-02
8.85	2.000E-01	7.000E-02	35.00	3.047E-01	1.067E-01	11.42	1.205E-01	4.219E-02
8.95	1.500E-01	1.920E-02	12.80	2.390E-01	3.060E-02	11.55	9.042E-02	1.157E-02
9.15	1.180E-01	1.920E-02	16.27	2.054E-01	3.342E-02	11.81	7.115E-02	1.158E-02
9.35	1.040E-01	6.300E-03	6.06	1.973E-01	1.195E-02	12.07	6.272E-02	3.800E-03
9.45	9.300E-02	2.500E-03	2.69	1.841E-01	4.949E-03	12.20	5.610E-02	1.508E-03
9.65	1.120E-01	1.410E-02	12.59	2.411E-01	3.035E-02	12.46	6.758E-02	8.508E-03
9.85	1.420E-01	1.340E-02	9.44	3.317E-01	3.130E-02	12.71	8.571E-02	8.088E-03
9.95	1.500E-01	1.330E-02	8.87	3.648E-01	3.235E-02	12.84	9.055E-02	8.029E-03
10.15	1.820E-01	1.380E-02	7.58	4.792E-01	3.633E-02	13.10	1.099E-01	8.333E-03
10.35	2.270E-01	2.270E-02	10.00	6.461E-01	6.461E-02	13.36	1.371E-01	1.371E-02
10.45	2.680E-01	2.640E-02	9.85	7.926E-01	7.808E-02	13.49	1.619E-01	1.595E-02
10.65	2.950E-01	2.700E-02	9.15	9.410E-01	8.612E-02	13.74	1.783E-01	1.632E-02
10.85	3.470E-01	3.100E-02	8.93	1.192E 00	1.065E-01	14.00	2.098E-01	1.874E-02
10.95	3.900E-01	3.450E-02	8.85	1.390E 00	1.229E-01	14.13	2.358E-01	2.086E-02
11.15	4.090E-01	3.500E-02	8.56	1.567E 00	1.341E-01	14.39	2.474E-01	2.117E-02
11.35	4.630E-01	7.000E-03	1.51	1.904E 00	2.878E-02	14.64	2.801E-01	4.235E-03
11.45	4.800E-01	6.000E-03	1.25	2.044E 00	2.555E-02	14.77	2.905E-01	3.631E-03
11.65	4.900E-01	6.000E-03	1.22	2.235E 00	2.737E-02	15.03	2.966E-01	3.632E-03
11.85	5.000E-01	7.400E-03	1.48	2.441E 00	3.613E-02	15.29	3.028E-01	4.481E-03
11.95	5.300E-01	6.400E-03	1.21	2.676E 00	3.231E-02	15.42	3.210E-01	3.876E-03
12.15	5.300E-01	6.100E-03	1.15	2.859E 00	3.290E-02	15.67	3.211E-01	3.696E-03
12.35	5.350E-01	1.040E-02	1.94	3.080E 00	5.987E-02	15.93	3.243E-01	6.304E-03
12.45	5.300E-01	6.400E-03	1.21	3.151E 00	3.804E-02	16.06	3.213E-01	3.880E-03
12.65	5.400E-01	5.800E-03	1.07	3.420E 00	3.674E-02	16.32	3.275E-01	3.518E-03
12.85	5.260E-01	6.000E-03	1.14	3.547E 00	4.046E-02	16.57	3.191E-01	3.640E-03
12.95	5.050E-01	1.300E-02	2.57	3.512E 00	9.040E-02	16.70	3.065E-01	7.889E-03
13.35	4.850E-01	1.380E-02	2.85	3.807E 00	1.083E-01	17.22	2.946E-01	8.381E-03
13.45	4.400E-01	1.500E-02	3.41	3.558E 00	1.213E-01	17.34	2.673E-01	9.112E-03
13.95	3.760E-01	1.530E-02	4.07	3.516E 00	1.431E-01	17.99	2.286E-01	9.304E-03
14.45	3.010E-01	1.540E-02	5.12	3.238E 00	1.657E-01	18.63	1.832E-01	9.375E-03
15.45	1.550E-01	1.300E-02	8.39	2.176E 00	1.825E-01	19.91	9.458E-02	7.932E-03
16.45	7.200E-02	5.000E-03	6.94	1.297E 00	9.006E-02	21.19	4.404E-02	3.058E-03
17.45	4.400E-02	7.200E-04	1.64	1.002E 00	1.639E-02	22.47	2.698E-02	4.415E-04
18.45	5.200E-02	1.460E-03	2.81	1.477E 00	4.147E-02	23.75	3.198E-02	8.978E-04
18.65	5.300E-02	1.440E-03	2.72	1.571E 00	4.269E-02	24.01	3.261E-02	8.860E-04
19.45	7.000E-02	1.670E-03	2.39	2.451E 00	5.847E-02	25.03	4.317E-02	1.030E-03
19.65	7.100E-02	1.670E-03	2.35	2.589E 00	6.089E-02	25.28	4.381E-02	1.031E-03
20.65	8.000E-02	1.270E-03	1.59	3.550E 00	5.636E-02	26.56	4.952E-02	7.861E-04
21.65	7.600E-02	1.670E-03	2.20	4.067E 00	8.936E-02	27.83	4.720E-02	1.037E-03
22.65	6.300E-02	1.920E-03	3.05	4.029E 00	1.228E-01	29.10	3.926E-02	1.196E-03

14 N Fortsetzung

23.65	5.200E-02	2.580E-03	4.96	3.944E 00	1.957E-01	30.37	3.252E-02	1.613E-03
24.65	4.000E-02	1.000E-03	2.50	3.572E 00	8.930E-02	31.64	2.510E-02	6.276E-04
25.65	3.800E-02	7.500E-04	1.97	3.968E 00	7.832E-02	32.91	2.394E-02	4.725E-04
26.65	3.800E-02	6.800E-04	1.79	4.612E 00	8.254E-02	34.17	2.404E-02	4.301E-04
27.65	4.000E-02	7.000E-04	1.75	5.611E 00	9.819E-02	35.43	2.541E-02	4.446E-04
28.65	4.200E-02	6.600E-04	1.57	6.772E 00	1.064E-01	36.69	2.679E-02	4.210E-04
29.65	4.300E-02	6.200E-04	1.44	7.930E 00	1.143E-01	37.95	2.755E-02	3.972E-04
30.65	4.000E-02	1.180E-03	2.95	8.399E 00	2.478E-01	39.20	2.574E-02	7.595E-04
31.65	3.400E-02	1.200E-03	3.53	8.092E 00	2.856E-01	40.45	2.199E-02	7.760E-04
32.65	3.000E-02	9.100E-04	3.03	8.061E 00	2.445E-01	41.70	1.949E-02	5.913E-04
33.65	2.800E-02	6.400E-04	2.29	8.460E 00	1.934E-01	42.95	1.829E-02	4.179E-04
34.65	2.400E-02	6.700E-04	2.79	8.126E 00	2.268E-01	44.19	1.575E-02	4.398E-04
35.65	2.000E-02	6.700E-04	3.35	7.562E 00	2.533E-01	45.43	1.320E-02	4.421E-04
37.65	1.400E-02	6.700E-04	4.79	6.538E 00	3.129E-01	47.91	9.340E-03	4.470E-04
39.65	1.200E-02	3.700E-04	3.08	6.841E 00	2.109E-01	50.37	8.099E-03	2.497E-04
41.65	9.420E-03	3.400E-04	3.61	6.487E 00	2.341E-01	52.82	6.435E-03	2.323E-04
43.65	6.830E-03	2.500E-04	3.66	5.628E 00	2.060E-01	55.25	4.725E-03	1.730E-04
45.65	4.500E-03	2.200E-04	4.89	4.398E 00	2.150E-01	57.68	3.154E-03	1.542E-04
47.65	2.900E-03	1.500E-04	5.17	3.334E 00	1.725E-01	60.08	2.061E-03	1.066E-04
49.65	2.030E-03	8.800E-05	4.33	2.726E 00	1.182E-01	62.47	1.463E-03	6.343E-05
51.65	1.240E-03	8.700E-05	7.02	1.931E 00	1.355E-01	64.85	9.070E-04	6.364E-05
54.65	7.600E-04	3.600E-05	4.74	1.462E 00	6.923E-02	68.39	5.688E-04	2.695E-05
57.65	3.700E-04	4.300E-05	11.62	8.674E-01	1.008E-01	71.88	2.837E-04	3.297E-05
59.65	2.600E-04	2.800E-05	10.77	6.910E-01	7.441E-02	74.19	2.027E-04	2.183E-05
64.65	1.200E-04	6.900E-06	5.75	4.276E-01	2.459E-02	79.89	9.769E-05	5.617E-06
69.65	5.100E-05	3.500E-06	6.86	2.374E-01	1.629E-02	85.47	4.346E-05	2.983E-06
74.65	2.700E-05	2.400E-06	8.89	1.605E-01	1.427E-02	90.92	2.414E-05	2.146E-06
79.65	1.500E-05	2.000E-06	13.33	1.116E-01	1.489E-02	96.25	1.410E-05	1.880E-06
84.65	5.300E-06	7.200E-07	13.58	4.851E-02	6.590E-03	101.45	5.243E-06	7.123E-07
89.65	3.500E-06	4.800E-07	13.71	3.876E-02	5.316E-03	106.52	3.649E-06	5.004E-07

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 16 O

ECM = 83.194 MEV K = 3.56961 PRO FERMI ETA = 0.49424

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
4.73	1.945E 01	1.211E 00	6.22	1.848E 00	1.150E-01	5.93	1.236E 01	7.692E-01
5.73	1.065E 01	8.723E-01	8.19	2.179E 00	1.785E-01	7.19	6.770E 00	5.545E-01
6.73	4.500E 00	5.859E-01	13.02	1.752E 00	2.281E-01	8.44	2.863E 00	3.728E-01
7.73	1.221E 00	2.995E-01	24.52	8.273E-01	2.028E-01	9.69	7.778E-01	1.907E-01
8.28	4.948E-01	1.484E-01	30.00	4.411E-01	1.323E-01	10.38	3.153E-01	9.458E-02
8.73	1.661E-01	1.680E-02	10.11	1.830E-01	1.850E-02	10.95	1.059E-01	1.071E-02
9.28	7.239E-02	2.083E-03	2.88	1.018E-01	2.929E-03	11.64	4.619E-02	1.329E-03
9.73	2.122E-01	1.172E-02	5.52	3.604E-01	1.990E-02	12.20	1.355E-01	7.481E-03
10.28	3.802E-01	1.367E-02	3.60	8.042E-01	2.892E-02	12.89	2.429E-01	8.734E-03
10.73	5.625E-01	2.018E-02	3.59	1.412E 00	5.065E-02	13.45	3.596E-01	1.290E-02
11.28	7.057E-01	2.318E-02	3.28	2.162E 00	7.100E-02	14.14	4.515E-01	1.483E-02
11.73	7.578E-01	1.172E-02	1.55	2.713E 00	4.196E-02	14.70	4.852E-01	7.503E-03
12.73	7.083E-01	1.628E-02	2.30	3.514E 00	8.075E-02	15.95	4.543E-01	1.044E-02
13.73	5.052E-01	2.695E-02	5.34	3.388E 00	1.807E-01	17.20	3.246E-01	1.732E-02
14.73	2.708E-01	2.239E-02	8.27	2.403E 00	1.987E-01	18.45	1.743E-01	1.442E-02
15.73	1.190E-01	3.125E-03	2.63	1.371E 00	3.600E-02	19.70	7.677E-02	2.016E-03
16.73	5.442E-02	4.557E-03	8.37	8.010E-01	6.707E-02	20.94	3.519E-02	2.946E-03
17.73	5.117E-02	2.213E-03	4.33	9.484E-01	4.103E-02	22.19	3.316E-02	1.434E-03
18.73	7.656E-02	2.604E-03	3.40	1.764E 00	6.000E-02	23.43	4.974E-02	1.692E-03
19.73	9.322E-02	1.823E-03	1.96	2.640E 00	5.162E-02	24.67	6.072E-02	1.187E-03
20.73	8.958E-02	2.734E-03	3.05	3.085E 00	9.418E-02	25.91	5.851E-02	1.786E-03
21.73	7.161E-02	2.864E-03	4.00	2.972E 00	1.189E-01	27.15	4.691E-02	1.876E-03
22.73	5.039E-02	1.953E-03	3.88	2.498E 00	9.682E-02	28.39	3.311E-02	1.283E-03
23.73	3.984E-02	1.146E-03	2.88	2.341E 00	6.732E-02	29.63	2.626E-02	7.552E-04
24.73	3.359E-02	8.072E-04	2.40	2.322E 00	5.581E-02	30.86	2.221E-02	5.338E-04
25.73	3.672E-02	8.854E-04	2.41	2.967E 00	7.155E-02	32.09	2.436E-02	5.875E-04
26.73	4.192E-02	8.072E-04	1.93	3.936E 00	7.579E-02	33.32	2.792E-02	5.375E-04
27.73	4.297E-02	8.593E-04	2.00	4.660E 00	9.319E-02	34.55	2.872E-02	5.743E-04
28.73	4.192E-02	9.635E-04	2.30	5.224E 00	1.201E-01	35.78	2.813E-02	6.464E-04
29.73	4.036E-02	1.042E-03	2.58	5.751E 00	1.484E-01	37.00	2.719E-02	7.016E-04
30.73	3.620E-02	1.146E-03	3.17	5.869E 00	1.858E-01	38.22	2.448E-02	7.749E-04
31.73	3.255E-02	9.374E-04	2.88	5.981E 00	1.722E-01	39.44	2.211E-02	6.366E-04
32.73	2.669E-02	9.895E-04	3.71	5.535E 00	2.052E-01	40.66	1.820E-02	6.749E-04
33.73	2.250E-02	8.333E-04	3.70	5.245E 00	1.943E-01	41.88	1.541E-02	5.709E-04
34.73	2.083E-02	7.291E-04	3.50	5.440E 00	1.904E-01	43.09	1.434E-02	5.018E-04
35.73	1.940E-02	5.208E-04	2.68	5.656E 00	1.518E-01	44.30	1.341E-02	3.601E-04
36.73	1.875E-02	4.948E-04	2.64	6.082E 00	1.605E-01	45.51	1.303E-02	3.438E-04
37.73	1.732E-02	4.948E-04	2.86	6.232E 00	1.781E-01	46.71	1.209E-02	3.455E-04
38.73	1.380E-02	5.468E-04	3.96	5.494E 00	2.177E-01	47.91	9.686E-03	3.838E-04
39.73	1.240E-02	4.427E-04	3.57	5.443E 00	1.944E-01	49.11	8.744E-03	3.123E-04
40.73	9.687E-03	4.948E-04	5.11	4.680E 00	2.390E-01	50.31	6.870E-03	3.509E-04
41.73	9.140E-03	3.125E-04	3.42	4.846E 00	1.657E-01	51.51	6.517E-03	2.228E-04
42.73	7.447E-03	5.208E-04	6.99	4.323E 00	3.023E-01	52.70	5.340E-03	3.734E-04
43.73	5.364E-03	3.385E-04	6.31	3.401E 00	2.147E-01	53.88	3.868E-03	2.441E-04
44.73	4.271E-03	2.864E-04	6.71	2.951E 00	1.980E-01	55.07	3.097E-03	2.077E-04
45.73	3.411E-03	2.864E-04	8.40	2.564E 00	2.153E-01	56.25	2.489E-03	2.090E-04
46.73	2.838E-03	2.213E-04	7.80	2.316E 00	1.806E-01	57.43	2.083E-03	1.624E-04
47.73	2.656E-03	1.432E-04	5.39	2.348E 00	1.266E-01	58.61	1.961E-03	1.058E-04
48.73	2.237E-03	1.562E-04	6.98	2.138E 00	1.494E-01	59.78	1.662E-03	1.161E-04
49.73	1.745E-03	1.250E-04	7.16	1.801E 00	1.290E-01	60.95	1.305E-03	9.346E-05
52.23	1.122E-03	8.593E-05	7.66	1.392E 00	1.066E-01	63.85	8.530E-04	6.531E-05
54.73	7.890E-04	4.427E-05	5.61	1.165E 00	6.535E-02	66.74	6.039E-04	3.422E-05

57.23	4.427E-04	2.864E-05	6.47	7.710E-01	4.989E-02	69.60	3.483E-04	2.253E-05
59.73	2.708E-04	2.083E-05	7.69	5.519E-01	4.245E-02	72.44	2.170E-04	1.669E-05
62.23	1.667E-04	1.562E-05	9.38	3.944E-01	3.697E-02	75.25	1.360E-04	1.275E-05
64.73	1.120E-04	1.042E-05	9.30	3.056E-01	2.842E-02	78.04	9.319E-05	8.669E-06
67.23	6.510E-05	7.812E-06	12.00	2.035E-01	2.442E-02	80.81	5.526E-05	6.632E-06
69.73	4.948E-05	7.812E-06	15.79	1.761E-01	2.781E-02	83.55	4.286E-05	6.768E-06
72.23	2.604E-05	2.604E-06	10.00	1.050E-01	1.050E-02	86.26	2.303E-05	2.303E-06
74.73	2.344E-05	2.604E-06	11.11	1.064E-01	1.182E-02	88.94	2.117E-05	2.352E-06

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 20 NE

ECM = 86.662 MEV K = 3.71839 PRO FERMI ETA = 0.61780

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
4.34	2.739E 01	1.360E 00	4.97	1.184E 00	5.879E-02	5.23	1.889E 01	9.381E-01
4.84	1.970E 01	1.230E 00	6.24	1.317E 00	8.223E-02	5.83	1.359E 01	8.486E-01
5.16	1.542E 01	1.500E 00	9.73	1.332E 00	1.295E-01	6.21	1.064E 01	1.035E 00
5.34	1.262E 01	1.120E 00	8.87	1.250E 00	1.109E-01	6.43	8.710E 00	7.730E-01
5.84	8.421E 00	1.196E 00	14.20	1.193E 00	1.694E-01	7.03	5.813E 00	8.257E-01
6.16	6.458E 00	1.130E 00	17.50	1.132E 00	1.981E-01	7.42	4.459E 00	7.803E-01
6.34	5.161E 00	1.035E 00	20.03	1.016E 00	2.035E-01	7.64	3.568E 00	7.148E-01
6.84	2.782E 00	6.700E-01	24.08	7.409E-01	1.784E-01	8.24	1.922E 00	4.629E-01
7.16	1.852E 00	2.067E-01	11.16	5.921E-01	6.608E-02	8.62	1.280E 00	1.428E-01
7.34	1.328E 00	2.682E-01	20.20	4.688E-01	9.469E-02	8.84	9.178E-01	1.854E-01
7.84	4.788E-01	1.277E-01	26.67	2.199E-01	5.866E-02	9.44	3.311E-01	8.829E-02
8.16	2.290E-01	3.390E-02	14.80	1.234E-01	1.827E-02	9.82	1.584E-01	2.345E-02
8.34	1.391E-01	2.580E-02	18.55	8.179E-02	1.517E-02	10.04	9.622E-02	1.785E-02
8.84	8.261E-02	5.640E-03	6.83	6.128E-02	4.184E-03	10.64	5.717E-02	3.903E-03
9.16	1.573E-01	3.740E-02	23.78	1.345E-01	3.198E-02	11.03	1.089E-01	2.589E-02
9.34	2.125E-01	2.320E-02	10.92	1.964E-01	2.144E-02	11.24	1.471E-01	1.606E-02
9.84	4.039E-01	9.910E-03	2.45	4.596E-01	1.128E-02	11.84	2.798E-01	6.866E-03
10.16	5.010E-01	3.030E-02	6.05	6.477E-01	3.917E-02	12.23	3.472E-01	2.100E-02
10.34	5.699E-01	1.580E-02	2.77	7.902E-01	2.191E-02	12.45	3.951E-01	1.095E-02
10.84	6.779E-01	8.820E-03	1.30	1.135E 00	1.476E-02	13.05	4.702E-01	6.118E-03
11.16	6.952E-01	1.230E-02	1.77	1.307E 00	2.312E-02	13.43	4.824E-01	8.535E-03
11.34	7.123E-01	1.098E-02	1.54	1.427E 00	2.200E-02	13.65	4.944E-01	7.621E-03
11.84	6.866E-01	1.370E-02	2.00	1.634E 00	3.260E-02	14.25	4.768E-01	9.515E-03
12.16	6.055E-01	3.110E-02	5.14	1.603E 00	8.231E-02	14.63	4.207E-01	2.161E-02
12.34	5.910E-01	2.640E-02	4.47	1.659E 00	7.409E-02	14.85	4.107E-01	1.835E-02
12.84	4.596E-01	2.700E-02	5.87	1.511E 00	8.876E-02	15.45	3.196E-01	1.878E-02
13.16	3.926E-01	2.750E-02	7.00	1.424E 00	9.972E-02	15.83	2.732E-01	1.913E-02
13.34	3.542E-01	2.000E-02	5.65	1.356E 00	7.655E-02	16.05	2.465E-01	1.392E-02
13.84	2.437E-01	2.010E-02	8.25	1.080E 00	8.907E-02	16.65	1.697E-01	1.400E-02
14.16	1.814E-01	1.760E-02	9.70	8.804E-01	8.542E-02	17.03	1.264E-01	1.226E-02
14.34	1.598E-01	1.760E-02	11.01	8.156E-01	8.983E-02	17.25	1.114E-01	1.227E-02
14.84	9.440E-02	1.100E-02	11.65	5.522E-01	6.434E-02	17.84	6.586E-02	7.674E-03
15.16	6.480E-02	9.440E-03	14.57	4.126E-01	6.011E-02	18.23	4.523E-02	6.589E-03
15.34	5.380E-02	5.140E-03	9.55	3.590E-01	3.430E-02	18.44	3.756E-02	3.589E-03
15.84	3.570E-02	2.780E-03	7.79	2.706E-01	2.108E-02	19.04	2.495E-02	1.943E-03
16.34	3.090E-02	9.300E-04	3.01	2.650E-01	7.977E-03	19.64	2.161E-02	6.505E-04
16.84	3.930E-02	2.590E-03	6.59	3.800E-01	2.504E-02	20.24	2.751E-02	1.813E-03
17.34	5.110E-02	3.020E-03	5.91	5.549E-01	3.280E-02	20.84	3.581E-02	2.116E-03
17.84	6.290E-02	2.040E-03	3.24	7.646E-01	2.480E-02	21.43	4.412E-02	1.431E-03
18.34	6.860E-02	1.610E-03	2.35	9.306E-01	2.184E-02	22.03	4.817E-02	1.131E-03
18.84	7.090E-02	1.830E-03	2.58	1.070E 00	2.762E-02	22.63	4.984E-02	1.286E-03

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19.34	6.920E-02	1.820E-03	2.63	1.159E 00	3.047E-02	23.23	4.869E-02	1.281E-03
19.84	6.260E-02	3.020E-03	4.82	1.160E 00	5.594E-02	23.82	4.410E-02	2.127E-03
20.34	5.680E-02	2.730E-03	4.81	1.161E 00	5.581E-02	24.42	4.006E-02	1.925E-03
20.84	4.390E-02	2.390E-03	5.44	9.879E-01	5.379E-02	25.01	3.100E-02	1.687E-03
21.34	3.550E-02	1.490E-03	4.20	8.774E-01	3.683E-02	25.61	2.509E-02	1.053E-03
21.84	2.730E-02	1.500E-03	5.49	7.395E-01	4.063E-02	26.21	1.932E-02	1.062E-03
22.34	2.090E-02	1.250E-03	5.98	6.191E-01	3.703E-02	26.80	1.481E-02	8.857E-04
22.84	1.710E-02	1.030E-03	6.02	5.528E-01	3.330E-02	27.40	1.213E-02	7.308E-04
23.34	1.396E-02	5.070E-04	3.63	4.915E-01	1.785E-02	27.99	9.917E-03	3.602E-04
23.84	1.494E-02	4.310E-04	2.88	5.719E-01	1.650E-02	28.58	1.063E-02	3.066E-04
24.34	1.442E-02	5.380E-04	3.73	5.990E-01	2.235E-02	29.18	1.027E-02	3.832E-04
24.84	1.755E-02	5.490E-04	3.13	7.899E-01	2.471E-02	29.77	1.252E-02	3.916E-04
25.34	1.698E-02	4.500E-04	2.65	8.266E-01	2.191E-02	30.36	1.213E-02	3.214E-04
25.84	1.944E-02	4.780E-04	2.46	1.022E 00	2.513E-02	30.96	1.390E-02	3.419E-04
26.34	1.855E-02	3.660E-04	1.97	1.051E 00	2.075E-02	31.55	1.329E-02	2.622E-04
26.84	1.901E-02	4.980E-04	2.62	1.160E 00	3.039E-02	32.14	1.364E-02	3.572E-04
27.34	1.741E-02	4.370E-04	2.51	1.142E 00	2.867E-02	32.73	1.251E-02	3.139E-04
27.84	1.790E-02	5.690E-04	3.18	1.261E 00	4.009E-02	33.32	1.288E-02	4.094E-04
28.34	1.527E-02	5.360E-04	3.51	1.154E 00	4.049E-02	33.91	1.100E-02	3.863E-04
28.84	1.541E-02	4.710E-04	3.06	1.247E 00	3.811E-02	34.50	1.112E-02	3.400E-04
29.34	1.292E-02	3.710E-04	2.87	1.118E 00	3.210E-02	35.09	9.340E-03	2.682E-04
29.84	1.246E-02	3.540E-04	2.84	1.152E 00	3.273E-02	35.68	9.022E-03	2.563E-04
30.54	9.770E-03	3.110E-04	3.18	9.889E-01	3.148E-02	36.51	7.091E-03	2.257E-04
30.84	1.110E-02	3.600E-04	3.24	1.167E 00	3.786E-02	36.86	8.064E-03	2.615E-04
31.24	9.580E-03	3.430E-04	3.58	1.059E 00	3.793E-02	37.33	6.970E-03	2.495E-04
31.84	8.530E-03	2.400E-04	2.81	1.016E 00	2.858E-02	38.03	6.219E-03	1.750E-04
31.94	8.900E-03	1.800E-04	2.02	1.073E 00	2.170E-02	38.15	6.491E-03	1.313E-04
32.64	8.230E-03	2.290E-04	2.78	1.080E 00	3.004E-02	38.97	6.017E-03	1.674E-04
32.84	8.090E-03	2.540E-04	3.14	1.087E 00	3.412E-02	39.21	5.919E-03	1.858E-04
33.34	7.290E-03	1.910E-04	2.62	1.039E 00	2.721E-02	39.79	5.343E-03	1.400E-04
33.84	7.240E-03	2.390E-04	3.30	1.093E 00	3.608E-02	40.38	5.316E-03	1.755E-04
34.04	7.360E-03	1.750E-04	2.38	1.137E 00	2.703E-02	40.61	5.408E-03	1.286E-04
34.74	7.060E-03	2.100E-04	2.97	1.180E 00	3.510E-02	41.43	5.201E-03	1.547E-04
34.84	6.970E-03	2.080E-04	2.98	1.178E 00	3.516E-02	41.55	5.137E-03	1.533E-04
35.44	6.340E-03	1.950E-04	3.08	1.145E 00	3.522E-02	42.25	4.683E-03	1.440E-04
35.84	7.080E-03	2.360E-04	3.33	1.335E 00	4.451E-02	42.72	5.238E-03	1.746E-04
36.14	5.890E-03	1.880E-04	3.19	1.147E 00	3.662E-02	43.07	4.363E-03	1.393E-04
36.84	5.800E-03	1.690E-04	2.91	1.217E 00	3.546E-02	43.88	4.308E-03	1.255E-04
37.54	4.620E-03	1.390E-04	3.01	1.042E 00	3.136E-02	44.70	3.441E-03	1.035E-04
37.84	5.390E-03	2.090E-04	3.88	1.254E 00	4.863E-02	45.05	4.020E-03	1.559E-04
38.24	4.250E-03	1.260E-04	2.96	1.030E 00	3.053E-02	45.51	3.175E-03	9.412E-05
38.94	3.660E-03	1.330E-04	3.63	9.509E-01	3.456E-02	46.32	2.742E-03	9.964E-05
39.64	3.130E-03	1.060E-04	3.39	8.709E-01	2.949E-02	47.13	2.352E-03	7.965E-05
39.84	3.470E-03	1.370E-04	3.95	9.844E-01	3.886E-02	47.37	2.610E-03	1.030E-04
40.34	2.830E-03	1.060E-04	3.75	8.422E-01	3.155E-02	47.95	2.133E-03	7.989E-05
41.84	2.290E-03	1.180E-04	5.15	7.838E-01	4.039E-02	49.68	1.737E-03	8.952E-05
43.84	1.810E-03	7.940E-05	4.39	7.404E-01	3.248E-02	51.98	1.386E-03	6.079E-05
45.84	1.340E-03	5.380E-05	4.01	6.494E-01	2.607E-02	54.27	1.036E-03	4.158E-05
47.84	9.400E-04	4.970E-05	5.29	5.354E-01	2.831E-02	56.55	7.337E-04	3.879E-05
49.84	6.220E-04	4.270E-05	6.86	4.133E-01	2.838E-02	58.82	4.905E-04	3.367E-05
51.84	3.850E-04	2.630E-05	6.83	2.965E-01	2.025E-02	61.08	3.068E-04	2.096E-05
53.84	2.490E-04	2.100E-05	8.43	2.208E-01	1.862E-02	63.33	2.006E-04	1.692E-05
55.84	1.820E-04	1.190E-05	6.54	1.847E-01	1.208E-02	65.57	1.483E-04	9.694E-06
59.84	8.560E-05	1.020E-05	11.92	1.120E-01	1.334E-02	70.01	7.137E-05	8.504E-06

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 40 AR

ECM = 94.543 MEV K = 4.05652 PRO FERMI ETA = 1.11204

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
4.14	7.817E 01	1.133E 01	14.50	8.610E-01	1.248E-01	4.56	6.434E 01	9.327E 00
4.64	4.963E 01	6.454E 00	13.00	8.623E-01	1.121E-01	5.12	4.085E 01	5.312E 00
5.14	2.902E 01	3.373E 00	11.63	7.590E-01	8.824E-02	5.67	2.389E 01	2.777E 00
5.64	1.532E 01	2.222E 00	14.50	5.808E-01	8.423E-02	6.22	1.262E 01	1.830E 00
6.14	9.821E 00	1.525E 00	15.53	5.228E-01	8.119E-02	6.77	8.088E 00	1.256E 00
6.36	6.616E 00	9.928E-01	15.01	4.053E-01	6.083E-02	7.01	5.448E 00	8.177E-01
6.64	4.596E 00	5.050E-01	10.99	3.345E-01	3.676E-02	7.32	3.785E 00	4.160E-01
7.14	1.899E 00	2.525E-01	13.30	1.847E-01	2.456E-02	7.87	1.564E 00	2.080E-01
7.36	1.458E 00	1.919E-01	13.16	1.602E-01	2.107E-02	8.11	1.202E 00	1.581E-01
7.64	9.130E-01	8.858E-02	9.70	1.164E-01	1.129E-02	8.42	7.524E-01	7.299E-02
8.14	7.373E-01	1.151E-02	1.56	1.211E-01	1.891E-03	8.97	6.077E-01	9.490E-03
8.36	7.969E-01	5.030E-02	6.31	1.455E-01	9.187E-03	9.21	6.569E-01	4.146E-02
8.64	9.272E-01	4.555E-02	4.91	1.932E-01	9.489E-03	9.52	7.644E-01	3.755E-02
9.14	1.243E 00	3.242E-02	2.61	3.242E-01	8.455E-03	10.07	1.025E 00	2.674E-02
9.36	1.212E 00	5.878E-02	4.85	3.475E-01	1.686E-02	10.32	9.996E-01	4.848E-02
9.64	1.428E 00	2.212E-02	1.55	4.606E-01	7.134E-03	10.62	1.178E 00	1.825E-02
10.14	1.402E 00	2.879E-02	2.05	5.533E-01	1.136E-02	11.17	1.157E 00	2.375E-02
10.36	1.397E 00	6.464E-02	4.63	6.005E-01	2.779E-02	11.42	1.153E 00	5.334E-02
10.64	1.265E 00	6.454E-02	5.10	6.047E-01	3.086E-02	11.73	1.044E 00	5.327E-02
11.14	1.014E 00	6.494E-02	6.40	5.824E-01	3.730E-02	12.28	8.372E-01	5.362E-02
11.36	8.959E-01	6.676E-02	7.45	5.562E-01	4.145E-02	12.52	7.398E-01	5.513E-02
11.64	6.777E-01	6.737E-02	9.94	4.637E-01	4.609E-02	12.83	5.597E-01	5.564E-02
12.14	4.333E-01	5.121E-02	11.82	3.505E-01	4.143E-02	13.38	3.580E-01	4.231E-02
12.36	3.404E-01	3.798E-02	11.16	2.958E-01	3.300E-02	13.62	2.813E-01	3.138E-02
12.64	2.182E-01	3.636E-02	16.67	2.073E-01	3.455E-02	13.93	1.803E-01	3.005E-02
13.14	8.252E-02	3.242E-02	39.29	9.151E-02	3.595E-02	14.48	6.823E-02	2.681E-02
13.36	5.464E-02	2.525E-02	46.21	6.473E-02	2.991E-02	14.72	4.519E-02	2.088E-02
13.64	3.192E-02	6.444E-03	20.19	4.107E-02	8.291E-03	15.03	2.640E-02	5.330E-03
14.14	3.232E-02	6.787E-03	21.00	4.799E-02	1.008E-02	15.58	2.674E-02	5.616E-03
14.36	4.949E-02	6.141E-03	12.41	7.815E-02	9.697E-03	15.82	4.096E-02	5.082E-03
14.64	7.171E-02	8.393E-03	11.70	1.223E-01	1.431E-02	16.13	5.936E-02	6.948E-03
14.86	9.040E-02	8.696E-03	9.62	1.636E-01	1.573E-02	16.37	7.485E-02	7.200E-03
15.14	1.156E-01	5.989E-03	5.18	2.254E-01	1.167E-02	16.67	9.578E-02	4.960E-03
15.36	1.343E-01	9.090E-03	6.77	2.772E-01	1.876E-02	16.92	1.113E-01	7.530E-03
15.64	1.566E-01	4.868E-03	3.11	3.472E-01	1.080E-02	17.22	1.297E-01	4.034E-03
16.14	1.848E-01	3.030E-03	1.64	4.645E-01	7.615E-03	17.77	1.532E-01	2.512E-03
16.36	1.838E-01	2.939E-03	1.60	4.875E-01	7.794E-03	18.02	1.524E-01	2.437E-03
16.64	1.838E-01	5.444E-03	2.96	5.215E-01	1.544E-02	18.32	1.525E-01	4.515E-03
17.36	1.424E-01	6.979E-03	4.90	4.780E-01	2.343E-02	19.11	1.182E-01	5.792E-03
18.36	7.646E-02	7.110E-03	9.30	3.205E-01	2.980E-02	20.21	6.352E-02	5.908E-03
19.36	3.030E-02	3.666E-03	12.10	1.567E-01	1.896E-02	21.31	2.520E-02	3.050E-03
20.36	1.576E-02	1.596E-03	10.13	9.948E-02	1.008E-02	22.40	1.312E-02	1.329E-03
21.36	2.969E-02	1.020E-03	3.44	2.266E-01	7.786E-03	23.50	2.476E-02	8.505E-04
22.36	3.858E-02	9.262E-04	2.40	3.528E-01	8.470E-03	24.60	3.221E-02	7.732E-04
23.36	4.000E-02	7.595E-04	1.90	4.347E-01	8.255E-03	25.69	3.343E-02	6.349E-04
24.36	2.939E-02	1.040E-03	3.54	3.768E-01	1.334E-02	26.78	2.460E-02	8.708E-04
25.36	1.626E-02	1.626E-03	10.00	2.443E-01	2.443E-02	27.88	1.363E-02	1.363E-03
26.36	8.838E-03	3.222E-04	3.65	1.546E-01	5.635E-03	28.97	7.420E-03	2.705E-04
27.36	7.464E-03	1.414E-04	1.89	1.511E-01	2.862E-03	30.06	6.276E-03	1.189E-04
28.36	7.595E-03	1.858E-04	2.45	1.770E-01	4.331E-03	31.15	6.397E-03	1.565E-04
28.64	9.393E-03	1.879E-04	2.00	2.275E-01	4.549E-03	31.46	7.915E-03	1.583E-04
29.36	8.393E-03	1.909E-04	2.27	2.240E-01	5.095E-03	32.24	7.080E-03	1.610E-04

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29.64	8.464E-03	2.000E-04	2.36	2.344E-01	5.539E-03	32.55	7.144E-03	1.688E-04
30.36	8.211E-03	2.000E-04	2.44	2.498E-01	6.084E-03	33.33	6.939E-03	1.690E-04
30.64	6.626E-03	2.535E-04	3.83	2.089E-01	7.994E-03	33.64	5.602E-03	2.143E-04
31.64	5.808E-03	1.303E-04	2.24	2.076E-01	4.657E-03	34.72	4.919E-03	1.104E-04
32.64	3.081E-03	1.364E-04	4.43	1.243E-01	5.502E-03	35.81	2.614E-03	1.157E-04
33.64	3.161E-03	1.222E-04	3.87	1.434E-01	5.545E-03	36.90	2.688E-03	1.039E-04
34.64	2.485E-03	8.302E-05	3.34	1.263E-01	4.220E-03	37.98	2.116E-03	7.072E-05
35.64	2.232E-03	5.939E-05	2.66	1.267E-01	3.371E-03	39.06	1.905E-03	5.069E-05
36.64	3.101E-03	5.929E-05	1.91	1.959E-01	3.745E-03	40.15	2.652E-03	5.070E-05
37.64	2.535E-03	6.161E-05	2.43	1.777E-01	4.318E-03	41.23	2.173E-03	5.280E-05
38.64	2.464E-03	5.525E-05	2.24	1.911E-01	4.284E-03	42.31	2.116E-03	4.745E-05
39.64	1.768E-03	8.252E-05	4.67	1.512E-01	7.059E-03	43.39	1.521E-03	7.102E-05
40.64	1.626E-03	3.868E-05	2.38	1.531E-01	3.641E-03	44.47	1.403E-03	3.337E-05
41.64	1.846E-03	4.787E-05	2.59	1.909E-01	4.945E-03	45.55	1.598E-03	4.139E-05
42.64	1.778E-03	4.979E-05	2.80	2.011E-01	5.632E-03	46.62	1.540E-03	4.315E-05
43.64	1.646E-03	5.070E-05	3.08	2.034E-01	6.264E-03	47.70	1.430E-03	4.404E-05
44.64	1.424E-03	4.444E-05	3.12	1.918E-01	5.984E-03	48.77	1.240E-03	3.870E-05
45.64	1.212E-03	4.101E-05	3.38	1.775E-01	6.006E-03	49.84	1.058E-03	3.579E-05
46.64	1.020E-03	2.889E-05	2.83	1.622E-01	4.592E-03	50.91	8.927E-04	2.528E-05
47.64	8.918E-04	2.828E-05	3.17	1.536E-01	4.871E-03	51.98	7.824E-04	2.481E-05
48.64	7.898E-04	2.454E-05	3.11	1.471E-01	4.571E-03	53.05	6.947E-04	2.159E-05
49.64	7.242E-04	2.858E-05	3.95	1.456E-01	5.746E-03	54.12	6.386E-04	2.521E-05
50.64	6.191E-04	2.404E-05	3.88	1.341E-01	5.207E-03	55.18	5.475E-04	2.126E-05
51.64	5.919E-04	2.273E-05	3.84	1.379E-01	5.295E-03	56.25	5.248E-04	2.015E-05
52.64	5.404E-04	1.606E-05	2.97	1.352E-01	4.019E-03	57.31	4.804E-04	1.428E-05
53.64	4.373E-04	1.424E-05	3.26	1.174E-01	3.822E-03	58.37	3.899E-04	1.270E-05
54.64	5.272E-04	1.727E-05	3.28	1.515E-01	4.963E-03	59.43	4.714E-04	1.544E-05
55.64	3.434E-04	1.162E-05	3.38	1.055E-01	3.569E-03	60.49	3.079E-04	1.041E-05
56.64	2.767E-04	1.283E-05	4.64	9.078E-02	4.208E-03	61.55	2.489E-04	1.154E-05
57.64	2.374E-04	9.423E-06	3.97	8.302E-02	3.296E-03	62.60	2.141E-04	8.499E-06
58.64	1.778E-04	8.120E-06	4.57	6.621E-02	3.025E-03	63.66	1.608E-04	7.346E-06
59.64	1.495E-04	8.232E-06	5.51	5.922E-02	3.261E-03	64.71	1.356E-04	7.469E-06
60.64	1.283E-04	3.545E-06	2.76	5.398E-02	1.492E-03	65.76	1.167E-04	3.226E-06
61.64	1.293E-04	2.343E-06	1.81	5.772E-02	1.046E-03	66.81	1.180E-04	2.139E-06
62.64	1.162E-04	8.100E-06	6.97	5.495E-02	3.832E-03	67.86	1.064E-04	7.418E-06
63.64	6.747E-05	6.414E-06	9.51	3.379E-02	3.212E-03	68.91	6.198E-05	5.892E-06
64.64	6.040E-05	4.171E-06	6.91	3.198E-02	2.209E-03	69.95	5.566E-05	3.844E-06
65.64	3.222E-05	2.727E-06	8.46	1.802E-02	1.525E-03	70.99	2.979E-05	2.521E-06
66.64	5.282E-05	5.121E-06	9.69	3.118E-02	3.022E-03	72.03	4.899E-05	4.749E-06

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 64 NI

ECM = 97.880 MEV　　K = 4.19974 PRO FERMI　　ETA = 1.72984

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
4.77	1.315E 02	1.462E 01	11.12	1.053E 00	1.171E-01	5.08	1.162E 02	1.292E 01
5.27	7.081E 01	1.165E 01	16.46	8.446E-01	1.390E-01	5.61	6.256E 01	1.030E 01
5.77	3.871E 01	4.070E 00	10.52	6.632E-01	6.974E-02	6.14	3.420E 01	3.597E 00
6.23	1.884E 01	5.242E 00	27.83	4.385E-01	1.220E-01	6.63	1.664E 01	4.632E 00
6.27	1.710E 01	2.050E 00	11.99	4.084E-01	4.895E-02	6.67	1.511E 01	1.811E 00
6.77	9.048E 00	1.459E 00	16.13	2.936E-01	4.736E-02	7.20	7.997E 00	1.290E 00
7.23	5.597E 00	8.179E-01	14.61	2.362E-01	3.452E-02	7.69	4.947E 00	7.230E-01
7.27	5.510E 00	5.875E-01	10.66	2.377E-01	2.534E-02	7.74	4.871E 00	5.193E-01
7.77	4.288E 00	8.755E-02	2.04	2.413E-01	4.926E-03	8.27	3.791E 00	7.740E-02
8.23	4.334E 00	5.683E-02	1.31	3.069E-01	4.023E-03	8.76	3.832E 00	5.025E-02
8.27	4.218E 00	8.390E-02	1.99	3.045E-01	6.056E-03	8.80	3.730E 00	7.419E-02
8.77	4.211E 00	6.240E-02	1.48	3.842E-01	5.694E-03	9.33	3.724E 00	5.518E-02
9.23	4.161E 00	6.221E-02	1.50	4.656E-01	6.961E-03	9.82	3.680E 00	5.502E-02
9.27	3.924E 00	7.094E-02	1.81	4.467E-01	8.077E-03	9.86	3.470E 00	6.275E-02
9.77	3.341E 00	1.555E-01	4.66	4.691E-01	2.184E-02	10.39	2.955E 00	1.376E-01
10.23	2.741E 00	1.776E-01	6.48	4.624E-01	2.996E-02	10.88	2.425E 00	1.571E-01
10.27	2.573E 00	1.517E-01	5.90	4.408E-01	2.599E-02	10.93	2.276E 00	1.342E-01
10.77	1.763E 00	1.478E-01	8.39	3.650E-01	3.062E-02	11.46	1.560E 00	1.308E-01
11.27	9.878E-01	1.344E-01	13.61	2.452E-01	3.336E-02	11.99	8.744E-01	1.190E-01
11.77	4.416E-01	6.451E-02	14.61	1.303E-01	1.904E-02	12.52	3.910E-01	5.712E-02
12.27	1.670E-01	2.928E-02	17.53	5.818E-02	1.020E-02	13.05	1.479E-01	2.593E-02
12.77	9.418E-02	1.171E-02	12.44	3.846E-02	4.783E-03	13.58	8.342E-02	1.037E-02
13.27	1.440E-01	2.064E-02	14.33	6.853E-02	9.822E-03	14.11	1.276E-01	1.829E-02
13.77	2.496E-01	2.400E-02	9.62	1.376E-01	1.323E-02	14.65	2.212E-01	2.127E-02
14.27	3.370E-01	8.419E-03	2.50	2.141E-01	5.350E-03	15.18	2.987E-01	7.463E-03
14.77	3.830E-01	8.832E-03	2.31	2.792E-01	6.437E-03	15.71	3.396E-01	7.831E-03
15.27	3.686E-01	8.918E-03	2.42	3.067E-01	7.420E-03	16.24	3.270E-01	7.910E-03
15.77	3.024E-01	8.688E-03	2.87	2.860E-01	8.216E-03	16.77	2.683E-01	7.708E-03
16.27	1.901E-01	1.805E-02	9.49	2.035E-01	1.932E-02	17.30	1.687E-01	1.602E-02
16.77	1.133E-01	1.430E-02	12.63	1.368E-01	1.727E-02	17.83	1.006E-01	1.270E-02
17.27	5.194E-02	7.171E-03	13.81	7.046E-02	9.729E-03	18.36	4.612E-02	6.368E-03
17.77	1.805E-02	4.118E-03	22.82	2.742E-02	6.258E-03	18.89	1.603E-02	3.658E-03
18.27	5.126E-03	1.133E-03	22.10	8.696E-03	1.922E-03	19.42	4.555E-03	1.007E-03
18.77	1.277E-02	4.378E-03	34.29	2.410E-02	8.265E-03	19.95	1.135E-02	3.891E-03
19.27	3.130E-02	4.118E-03	13.16	6.557E-02	8.629E-03	20.48	2.783E-02	3.662E-03
19.77	6.019E-02	3.677E-03	6.11	1.396E-01	8.527E-03	21.01	5.354E-02	3.271E-03
20.27	6.461E-02	1.507E-03	2.33	1.654E-01	3.858E-03	21.54	5.749E-02	1.341E-03
20.77	6.816E-02	1.488E-03	2.18	1.922E-01	4.195E-03	22.07	6.068E-02	1.325E-03
21.27	6.432E-02	1.421E-03	2.21	1.992E-01	4.401E-03	22.60	5.728E-02	1.265E-03
21.77	5.280E-02	3.590E-03	6.80	1.793E-01	1.219E-02	23.13	4.704E-02	3.199E-03
22.27	3.754E-02	3.274E-03	8.72	1.394E-01	1.216E-02	23.66	3.346E-02	2.918E-03
22.77	2.141E-02	2.237E-03	10.45	8.679E-02	9.068E-03	24.19	1.909E-02	1.995E-03
23.27	1.152E-02	1.766E-03	15.33	5.088E-02	7.802E-03	24.72	1.028E-02	1.576E-03
23.77	5.030E-03	7.085E-04	14.08	2.416E-02	3.403E-03	25.25	4.489E-03	6.323E-04
24.27	4.253E-03	1.114E-04	2.62	2.217E-02	5.806E-04	25.78	3.797E-03	9.943E-05
24.77	6.557E-03	8.813E-04	13.44	3.705E-02	4.979E-03	26.31	5.857E-03	7.872E-04
25.27	1.018E-02	6.048E-04	5.94	6.220E-02	3.697E-03	26.84	9.094E-03	5.405E-04
25.77	1.373E-02	5.309E-04	3.87	9.064E-02	3.505E-03	27.37	1.227E-02	4.746E-04
26.27	1.546E-02	3.686E-04	2.39	1.101E-01	2.625E-03	27.90	1.383E-02	3.298E-04
26.77	1.651E-02	2.525E-04	1.53	1.266E-01	1.936E-03	28.43	1.478E-02	2.260E-04
27.27	1.555E-02	4.253E-04	2.73	1.282E-01	3.507E-03	28.95	1.393E-02	3.808E-04
27.77	1.313E-02	4.627E-04	3.52	1.163E-01	4.097E-03	29.48	1.176E-02	4.145E-04

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28.27	1.056E-02	5.587E-04	5.29	1.003E-01	5.306E-03	30.01	9.465E-03	5.008E-04
28.77	7.901E-03	4.915E-04	6.22	8.036E-02	4.999E-03	30.54	7.085E-03	4.408E-04
29.27	5.606E-03	4.301E-04	7.67	6.100E-02	4.680E-03	31.07	5.030E-03	3.859E-04
29.77	4.483E-03	2.179E-04	4.86	5.212E-02	2.534E-03	31.60	4.025E-03	1.956E-04
30.27	3.638E-03	9.168E-05	2.52	4.515E-02	1.138E-03	32.12	3.268E-03	8.235E-05
30.77	3.581E-03	1.066E-04	2.98	4.737E-02	1.410E-03	32.65	3.218E-03	9.577E-05
31.27	3.677E-03	1.498E-04	4.07	5.179E-02	2.110E-03	33.18	3.306E-03	1.347E-04
31.77	4.589E-03	2.006E-04	4.37	6.877E-02	3.007E-03	33.71	4.129E-03	1.805E-04
32.27	5.021E-03	1.037E-04	2.07	7.996E-02	1.651E-03	34.23	4.520E-03	9.334E-05
32.77	5.530E-03	1.421E-04	2.57	9.349E-02	2.402E-03	34.76	4.981E-03	1.280E-04
33.27	5.069E-03	1.123E-04	2.22	9.090E-02	2.014E-03	35.29	4.569E-03	1.012E-04
33.77	4.570E-03	1.498E-04	3.28	8.684E-02	2.846E-03	35.81	4.121E-03	1.351E-04
34.27	3.926E-03	1.824E-04	4.65	7.900E-02	3.670E-03	36.34	3.543E-03	1.646E-04
34.77	3.523E-03	1.546E-04	4.39	7.498E-02	3.289E-03	36.87	3.181E-03	1.396E-04
35.27	2.822E-03	1.507E-04	5.34	6.348E-02	3.390E-03	37.39	2.550E-03	1.362E-04
35.77	2.045E-03	1.584E-04	7.75	4.857E-02	3.762E-03	37.92	1.849E-03	1.432E-04
36.27	1.632E-03	1.267E-04	7.76	4.090E-02	3.176E-03	38.44	1.476E-03	1.146E-04
36.77	1.277E-03	1.066E-04	8.35	3.374E-02	2.816E-03	38.97	1.156E-03	9.647E-05
37.27	1.315E-03	4.781E-05	3.64	3.661E-02	1.331E-03	39.50	1.191E-03	4.331E-05
37.77	1.363E-03	4.810E-05	3.53	3.995E-02	1.409E-03	40.02	1.236E-03	4.360E-05
38.27	1.267E-03	5.098E-05	4.02	3.907E-02	1.572E-03	40.55	1.149E-03	4.624E-05
38.77	1.334E-03	4.589E-05	3.44	4.325E-02	1.487E-03	41.07	1.211E-03	4.165E-05
39.27	1.286E-03	4.550E-05	3.54	4.379E-02	1.549E-03	41.60	1.168E-03	4.133E-05
39.77	1.190E-03	3.706E-05	3.11	4.254E-02	1.324E-03	42.12	1.082E-03	3.368E-05
40.27	1.114E-03	4.061E-05	3.65	4.175E-02	1.523E-03	42.65	1.013E-03	3.694E-05
40.77	1.006E-03	3.677E-05	3.65	3.962E-02	1.445E-03	43.17	9.175E-04	3.347E-05
41.27	7.440E-04	3.043E-05	4.09	3.064E-02	1.253E-03	43.69	6.777E-04	2.772E-05
41.77	7.037E-04	3.744E-05	5.32	3.035E-02	1.615E-03	44.22	6.415E-04	3.413E-05
42.27	5.654E-04	2.573E-05	4.55	2.552E-02	1.161E-03	44.74	5.158E-04	2.347E-05
42.77	5.040E-04	2.448E-05	4.86	2.379E-02	1.156E-03	45.27	4.601E-04	2.235E-05
43.27	4.733E-04	2.410E-05	5.09	2.335E-02	1.189E-03	45.79	4.324E-04	2.201E-05
43.77	3.638E-04	1.958E-05	5.38	1.876E-02	1.010E-03	46.31	3.327E-04	1.791E-05
44.27	2.438E-04	7.325E-06	3.00	1.312E-02	3.942E-04	46.84	2.231E-04	6.702E-06
44.77	2.832E-04	8.947E-06	3.16	1.591E-02	5.026E-04	47.36	2.593E-04	8.193E-06
45.77	3.437E-04	1.056E-05	3.07	2.099E-02	6.449E-04	48.40	3.152E-04	9.685E-06
46.77	3.427E-04	8.266E-06	2.41	2.271E-02	5.478E-04	49.45	3.148E-04	7.593E-06
47.77	2.880E-04	9.475E-06	3.29	2.067E-02	6.801E-04	50.49	2.650E-04	8.718E-06
48.77	2.726E-04	6.384E-06	2.34	2.116E-02	4.954E-04	51.53	2.513E-04	5.883E-06
49.77	2.659E-04	7.440E-06	2.80	2.227E-02	6.230E-04	52.58	2.455E-04	6.868E-06

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 90 ZR

ECM = 99.573 MEV   K = 4.27236 PRO FERMI   ETA = 2.47120

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
4.72	2.161E 02	2.875E 01	13.30	8.124E-01	1.081E-01	4.94	1.977E 02	2.630E 01
5.28	1.366E 02	1.972E 01	14.44	8.037E-01	1.160E-01	5.52	1.250E 02	1.804E 01
5.72	9.101E 01	9.401E 00	10.33	7.374E-01	7.617E-02	5.98	8.327E 01	8.602E 00
6.28	4.991E 01	5.096E 00	10.21	5.874E-01	5.997E-02	6.57	4.567E 01	4.663E 00
6.72	3.042E 01	4.163E 00	13.69	4.691E-01	6.422E-02	7.03	2.783E 01	3.810E 00
7.28	1.857E 01	2.654E 00	14.29	3.944E-01	5.637E-02	7.61	1.700E 01	2.429E 00
7.72	1.358E 01	1.604E 00	11.81	3.646E-01	4.305E-02	8.07	1.243E 01	1.468E 00
8.28	1.064E 01	1.098E 00	10.32	3.779E-01	3.899E-02	8.66	9.742E 00	1.005E 00
8.72	9.685E 00	1.011E 00	10.44	4.229E-01	4.415E-02	9.12	8.867E 00	9.258E-01
9.28	7.687E 00	8.611E-01	11.20	4.303E-01	4.820E-02	9.70	7.038E 00	7.885E-01
9.72	6.257E 00	7.315E-01	11.69	4.214E-01	4.927E-02	10.16	5.730E 00	6.699E-01
10.28	4.219E 00	5.080E-01	12.04	3.553E-01	4.278E-02	10.75	3.864E 00	4.653E-01
10.72	2.765E 00	4.313E-01	15.60	2.752E-01	4.293E-02	11.21	2.533E 00	3.951E-01
11.72	6.857E-01	6.873E-02	10.02	9.740E-02	9.763E-03	12.25	6.283E-01	6.298E-02
12.72	5.625E-01	5.688E-02	10.11	1.107E-01	1.120E-02	13.30	5.156E-01	5.214E-02
13.72	6.889E-01	3.492E-02	5.07	1.833E-01	9.291E-03	14.34	6.317E-01	3.202E-02
14.72	6.565E-01	1.849E-02	2.82	2.311E-01	6.508E-03	15.38	6.022E-01	1.696E-02
15.72	2.955E-01	2.891E-02	9.79	1.351E-01	1.322E-02	16.43	2.711E-01	2.653E-02
16.22	1.422E-01	3.531E-02	24.83	7.363E-02	1.828E-02	16.95	1.305E-01	3.241E-02
16.72	3.942E-02	9.796E-03	24.85	2.303E-02	5.722E-03	17.47	3.619E-02	8.993E-03
17.22	1.793E-02	2.180E-03	12.16	1.178E-02	1.432E-03	17.99	1.647E-02	2.002E-03
17.72	4.108E-02	6.028E-03	14.67	3.022E-02	4.434E-03	18.52	3.773E-02	5.536E-03
18.22	6.683E-02	5.625E-03	8.42	5.490E-02	4.621E-03	19.04	6.140E-02	5.168E-03
18.72	1.067E-01	5.767E-03	5.41	9.754E-02	5.275E-03	19.56	9.800E-02	5.300E-03
19.22	1.240E-01	3.871E-03	3.12	1.259E-01	3.930E-03	20.08	1.140E-01	3.558E-03
19.72	1.256E-01	3.350E-03	2.67	1.412E-01	3.765E-03	20.60	1.155E-01	3.080E-03
20.22	1.086E-01	5.459E-03	5.03	1.348E-01	6.776E-03	21.12	9.990E-02	5.020E-03
20.72	8.058E-02	6.541E-03	8.12	1.102E-01	8.943E-03	21.65	7.413E-02	6.017E-03
21.22	4.693E-02	5.459E-03	11.63	7.050E-02	8.201E-03	22.17	4.318E-02	5.023E-03
21.72	1.746E-02	3.926E-03	22.49	2.876E-02	6.468E-03	22.69	1.607E-02	3.614E-03
22.22	4.598E-03	1.185E-03	25.77	8.286E-03	2.136E-03	23.21	4.233E-03	1.091E-03
22.72	1.533E-03	5.530E-04	36.08	3.016E-03	1.088E-03	23.73	1.411E-03	5.093E-04
23.22	5.972E-03	5.988E-04	10.03	1.281E-02	1.284E-03	24.25	5.502E-03	5.517E-04
23.72	1.311E-02	1.675E-03	12.77	3.059E-02	3.906E-03	24.77	1.209E-02	1.543E-03
24.22	2.141E-02	1.627E-03	7.60	5.421E-02	4.121E-03	25.29	1.974E-02	1.500E-03
24.72	2.733E-02	1.390E-03	5.09	7.501E-02	3.816E-03	25.81	2.521E-02	1.282E-03
25.22	2.978E-02	1.003E-03	3.37	8.844E-02	2.979E-03	26.33	2.747E-02	9.255E-04
25.72	2.504E-02	1.390E-03	5.55	8.033E-02	4.460E-03	26.85	2.311E-02	1.283E-03
26.22	1.801E-02	2.054E-03	11.40	6.232E-02	7.107E-03	27.38	1.663E-02	1.896E-03
26.72	1.288E-02	1.288E-03	10.00	4.799E-02	4.799E-03	27.90	1.189E-02	1.189E-03
27.22	5.739E-03	1.027E-03	17.91	2.299E-02	4.116E-03	28.42	5.298E-03	9.487E-04
27.72	2.386E-03	3.602E-04	15.10	1.027E-02	1.551E-03	28.94	2.205E-03	3.329E-04
28.22	1.809E-03	1.896E-04	10.48	8.353E-03	8.754E-04	29.46	1.672E-03	1.753E-04
28.72	1.904E-03	3.097E-04	16.27	9.417E-03	1.532E-03	29.98	1.761E-03	2.864E-04
29.22	4.458E-03	7.347E-04	16.49	2.358E-02	3.888E-03	30.50	4.122E-03	6.797E-04
29.72	6.257E-03	5.254E-04	8.40	3.538E-02	2.971E-03	31.02	5.790E-03	4.862E-04
30.22	8.635E-03	3.792E-04	4.39	5.212E-02	2.289E-03	31.54	7.994E-03	3.511E-04
30.72	8.690E-03	4.266E-04	4.91	5.592E-02	2.745E-03	32.06	8.048E-03	3.951E-04
31.22	8.011E-03	4.866E-04	6.07	5.490E-02	3.335E-03	32.58	7.422E-03	4.509E-04
31.72	7.244E-03	4.227E-04	5.83	5.282E-02	3.082E-03	33.09	6.715E-03	3.918E-04
32.22	5.159E-03	3.492E-04	6.77	3.998E-02	2.706E-03	33.61	4.784E-03	3.238E-04
32.72	3.539E-03	2.876E-04	8.13	2.912E-02	2.366E-03	34.13	3.283E-03	2.668E-04

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33.22	2.449E-03	2.338E-04
33.72	1.864E-03	1.620E-04
34.22	1.533E-03	1.082E-04
34.72	2.236E-03	1.604E-04
35.22	2.473E-03	1.493E-04
35.72	2.955E-03	1.793E-04
36.22	3.184E-03	1.477E-04
36.72	3.516E-03	1.469E-04
37.22	3.026E-03	1.667E-04
37.72	2.749E-03	1.620E-04
38.22	2.362E-03	1.572E-04
38.72	1.722E-03	1.343E-04
39.22	1.430E-03	9.085E-05
39.72	1.169E-03	7.276E-05
40.22	1.122E-03	7.110E-05
40.72	1.098E-03	7.110E-05
41.72	1.122E-03	7.110E-05
42.72	1.122E-03	8.532E-05
43.72	8.374E-04	6.834E-05
45.72	4.400E-04	3.302E-05
46.72	3.255E-04	3.294E-05
47.72	2.623E-04	2.844E-05
48.72	3.049E-04	3.160E-05
49.72	2.623E-04	2.884E-05

9.55	2.138E-02	2.041E-03
8.69	1.725E-02	1.498E-03
7.06	1.501E-02	1.060E-03
7.17	2.316E-02	1.662E-03
6.04	2.708E-02	1.635E-03
6.07	3.417E-02	2.074E-03
4.64	3.886E-02	1.803E-03
4.18	4.524E-02	1.891E-03
5.51	4.102E-02	2.260E-03
5.89	3.924E-02	2.312E-03
6.66	3.547E-02	2.361E-03
7.80	2.719E-02	2.120E-03
6.35	2.372E-02	1.507E-03
6.22	2.036E-02	1.267E-03
6.34	2.049E-02	1.299E-03
6.47	2.103E-02	1.362E-03
6.34	2.358E-02	1.494E-03
7.61	2.581E-02	1.963E-03
8.16	2.104E-02	1.717E-03
7.50	1.310E-02	9.833E-04
10.12	1.052E-02	1.065E-03
10.84	9.180E-03	9.954E-04
10.36	1.154E-02	1.196E-03
10.99	1.071E-02	1.178E-03

34.65	2.273E-03	2.170E-04
35.17	1.731E-03	1.504E-04
35.69	1.424E-03	1.005E-04
36.21	2.078E-03	1.490E-04
36.73	2.299E-03	1.388E-04
37.25	2.748E-03	1.668E-04
37.77	2.963E-03	1.375E-04
38.28	3.273E-03	1.368E-04
38.80	2.818E-03	1.553E-04
39.32	2.562E-03	1.509E-04
39.84	2.202E-03	1.466E-04
40.36	1.606E-03	1.253E-04
40.87	1.334E-03	8.479E-05
41.39	1.092E-03	6.794E-05
41.91	1.048E-03	6.642E-05
42.43	1.026E-03	6.645E-05
43.46	1.050E-03	6.652E-05
44.49	1.051E-03	7.991E-05
45.53	7.852E-04	6.407E-05
47.59	4.135E-04	3.103E-05
48.62	3.062E-04	3.099E-05
49.65	2.470E-04	2.679E-05
50.68	2.875E-04	2.980E-05
51.71	2.476E-04	2.722E-05

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 124 SN

ECM = 100.749 MEV K = 4.32282 PRO FERMI ETA = 3.08900

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
4.77	3.760E 02	2.770E 01	7.37	9.428E-01	6.946E-02	4.93	3.523E 02	2.596E 01
5.23	2.565E 02	1.782E 01	6.95	9.293E-01	6.456E-02	5.40	2.404E 02	1.670E 01
5.27	2.540E 02	1.782E 01	7.02	9.487E-01	6.656E-02	5.44	2.380E 02	1.670E 01
5.77	1.530E 02	1.585E 01	10.36	8.210E-01	8.505E-02	5.96	1.434E 02	1.485E 01
6.23	9.670E 01	9.900E 00	10.24	7.050E-01	7.218E-02	6.44	9.063E 01	9.279E 00
6.27	9.300E 01	9.900E 00	10.65	6.956E-01	7.405E-02	6.48	8.716E 01	9.279E 00
6.77	5.240E 01	3.960E 00	7.56	5.325E-01	4.024E-02	6.99	4.911E 01	3.712E 00
7.23	3.860E 01	2.490E 00	6.45	5.101E-01	3.291E-02	7.47	3.618E 01	2.334E 00
7.27	3.680E 01	2.490E 00	6.77	4.972E-01	3.364E-02	7.51	3.450E 01	2.334E 00
7.77	2.805E 01	1.395E 00	4.97	4.943E-01	2.458E-02	8.03	2.630E 01	1.308E 00
8.23	2.340E 01	9.950E-01	4.25	5.188E-01	2.206E-02	8.50	2.194E 01	9.328E-01
8.27	2.260E 01	9.950E-01	4.40	5.108E-01	2.249E-02	8.54	2.119E 01	9.328E-01
8.77	1.805E 01	8.950E-01	4.96	5.158E-01	2.557E-02	9.06	1.692E 01	8.391E-01
9.23	1.401E 01	1.090E 00	7.78	4.909E-01	3.820E-02	9.53	1.314E 01	1.022E 00
9.27	1.280E 01	1.090E 00	8.52	4.564E-01	3.886E-02	9.58	1.200E 01	1.022E 00
9.77	8.950E 00	5.960E-01	6.66	3.935E-01	2.621E-02	10.09	8.393E 00	5.589E-01
10.23	6.020E 00	4.970E-01	8.26	3.180E-01	2.626E-02	10.57	5.646E 00	4.661E-01
10.27	5.610E 00	4.950E-01	8.82	3.010E-01	2.656E-02	10.61	5.261E 00	4.642E-01
10.77	3.380E 00	3.990E-01	11.80	2.192E-01	2.588E-02	11.12	3.170E 00	3.742E-01
11.27	2.190E 00	1.590E-01	7.26	1.702E-01	1.236E-02	11.64	2.054E 00	1.492E-01
11.77	1.710E 00	6.030E-02	3.53	1.580E-01	5.572E-03	12.16	1.604E 00	5.657E-02
12.27	1.670E 00	1.010E-02	0.60	1.822E-01	1.102E-03	12.67	1.567E 00	9.477E-03
12.77	1.688E 00	9.980E-03	0.59	2.159E-01	1.276E-03	13.19	1.584E 00	9.365E-03
13.27	1.450E 00	4.980E-02	3.43	2.161E-01	7.422E-03	13.71	1.361E 00	4.674E-02
13.77	1.260E 00	4.970E-02	3.94	2.176E-01	8.582E-03	14.22	1.183E 00	4.665E-02
14.27	9.360E-01	5.170E-02	5.52	1.863E-01	1.029E-02	14.74	8.787E-01	4.853E-02
14.77	6.250E-01	3.980E-02	6.37	1.426E-01	9.084E-03	15.25	5.868E-01	3.737E-02
15.27	3.590E-01	4.950E-02	13.79	9.353E-02	1.290E-02	15.77	3.371E-01	4.648E-02
15.77	2.110E-01	1.990E-02	9.43	6.249E-02	5.893E-03	16.29	1.982E-01	1.869E-02
16.27	1.568E-01	1.525E-02	9.73	5.257E-02	5.113E-03	16.80	1.473E-01	1.432E-02
16.77	1.711E-01	1.000E-02	5.84	6.469E-02	3.781E-03	17.32	1.607E-01	9.395E-03
17.27	2.030E-01	7.100E-03	3.50	8.625E-02	3.017E-03	17.83	1.907E-01	6.671E-03
17.77	2.260E-01	2.540E-03	1.12	1.075E-01	1.209E-03	18.35	2.124E-01	2.387E-03
18.27	2.210E-01	2.510E-03	1.14	1.174E-01	1.333E-03	18.87	2.077E-01	2.359E-03
18.77	1.835E-01	1.000E-02	5.45	1.085E-01	5.912E-03	19.38	1.725E-01	9.401E-03
19.27	1.320E-01	1.000E-02	7.58	8.661E-02	6.561E-03	19.90	1.241E-01	9.403E-03
19.77	8.340E-02	9.980E-03	11.97	6.057E-02	7.248E-03	20.41	7.844E-02	9.386E-03
20.27	4.170E-02	1.140E-02	27.34	3.343E-02	9.139E-03	20.93	3.923E-02	1.072E-02
20.77	3.340E-03	1.040E-03	31.14	2.949E-03	9.182E-04	21.44	3.142E-03	9.785E-04
21.27	2.700E-03	6.580E-04	24.37	2.619E-03	6.382E-04	21.96	2.541E-03	6.192E-04
21.77	1.262E-02	3.050E-03	24.17	1.342E-02	3.243E-03	22.47	1.188E-02	2.871E-03
22.27	2.925E-02	2.060E-03	7.04	3.402E-02	2.396E-03	22.99	2.754E-02	1.939E-03
22.77	4.090E-02	1.080E-03	2.64	5.193E-02	1.371E-03	23.50	3.851E-02	1.017E-03
23.27	4.230E-02	4.600E-04	1.09	5.851E-02	6.363E-04	24.02	3.984E-02	4.333E-04
23.77	4.130E-02	1.080E-03	2.62	6.212E-02	1.625E-03	24.54	3.891E-02	1.017E-03
24.27	3.110E-02	2.010E-03	6.46	5.078E-02	3.282E-03	25.05	2.931E-02	1.894E-03
24.77	1.917E-02	2.590E-03	13.51	3.392E-02	4.583E-03	25.57	1.807E-02	2.441E-03
25.27	9.140E-03	1.690E-03	18.49	1.750E-02	3.235E-03	26.08	8.617E-03	1.593E-03
25.77	1.890E-03	6.050E-04	32.01	3.908E-03	1.251E-03	26.60	1.782E-03	5.705E-04
26.27	1.510E-04	5.500E-05	36.42	3.367E-04	1.226E-04	27.11	1.424E-04	5.188E-05
26.77	8.400E-04	2.160E-04	25.71	2.017E-03	5.187E-04	27.63	7.925E-04	2.038E-04
27.27	3.580E-03	5.170E-04	14.44	9.244E-03	1.335E-03	28.14	3.378E-03	4.879E-04

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27.77	6.66CE-03	2.580E-04	3.87	1.847E-02	7.154E-04	28.65	6.287E-03	2.435E-04
28.27	8.350E-03	2.580E-04	3.09	2.483E-02	7.672E-04	29.17	7.884E-03	2.436E-04
28.77	9.87CE-03	1.780E-04	1.80	3.144E-02	5.670E-04	29.68	9.322E-03	1.681E-04
29.27	8.51CE-03	2.530E-04	2.97	2.900E-02	8.621E-04	30.20	8.040E-03	2.390E-04
29.77	6.05CE-03	2.770E-04	4.58	2.203E-02	1.009E-03	30.71	5.717E-03	2.618E-04
30.27	3.580E-03	6.000E-04	16.76	1.391E-02	2.331E-03	31.23	3.384E-03	5.672E-04
30.77	1.19CE-03	2.540E-04	21.34	4.929E-03	1.052E-03	31.74	1.125E-03	2.402E-04
31.27	3.70CE-04	1.010E-04	27.30	1.632E-03	4.455E-04	32.26	3.500E-04	9.553E-05
31.77	2.680E-04	5.700E-05	21.27	1.258E-03	2.675E-04	32.77	2.536E-04	5.393E-05
32.27	7.85CE-04	6.590E-05	8.39	3.915E-03	3.286E-04	33.28	7.429E-04	6.237E-05
32.77	1.54CE-03	1.080E-04	7.01	8.154E-03	5.718E-04	33.80	1.458E-03	1.022E-04
33.27	2.08CE-03	1.210E-04	5.82	1.168E-02	6.795E-04	34.31	1.970E-03	1.146E-04
33.77	2.31CE-03	9.180E-05	3.97	1.375E-02	5.463E-04	34.83	2.188E-03	8.696E-05
34.27	2.39CE-03	7.040E-05	2.95	1.506E-02	4.435E-04	35.34	2.265E-03	6.671E-05
34.77	1.99CE-03	1.497E-04	7.52	1.326E-02	9.976E-04	35.85	1.886E-03	1.419E-04
35.27	1.58CE-03	1.120E-04	7.09	1.113E-02	7.889E-04	36.37	1.498E-03	1.062E-04
35.77	9.73CE-04	1.070E-04	11.00	7.237E-03	7.958E-04	36.88	9.229E-04	1.015E-04
36.27	5.07CE-04	1.035E-04	20.41	3.979E-03	8.123E-04	37.39	4.811E-04	9.820E-05
36.77	2.87CE-04	2.240E-05	7.80	2.375E-03	1.853E-04	37.91	2.724E-04	2.126E-05
37.27	5.04CE-04	6.100E-05	12.10	4.393E-03	5.318E-04	38.42	4.785E-04	5.792E-05
37.77	6.17CE-04	5.650E-05	9.16	5.662E-03	5.185E-04	38.93	5.860E-04	5.366E-05
38.27	9.040E-04	6.340E-05	7.01	8.727E-03	6.120E-04	39.45	8.589E-04	6.024E-05
38.77	1.08CE-03	5.450E-05	5.05	1.096E-02	5.531E-04	39.96	1.027E-03	5.180E-05
39.27	1.29CE-03	5.600E-05	4.34	1.375E-02	5.970E-04	40.47	1.227E-03	5.325E-05
39.77	1.22CE-03	6.060E-05	4.97	1.365E-02	6.782E-04	40.98	1.160E-03	5.764E-05
40.27	9.84CE-04	4.220E-05	4.29	1.155E-02	4.955E-04	41.50	9.363E-04	4.015E-05
40.77	7.37CE-04	4.100E-05	5.56	9.072E-03	5.047E-04	42.01	7.015E-04	3.903E-05
41.27	5.500E-04	3.720E-05	6.76	7.094E-03	4.798E-04	42.52	5.237E-04	3.542E-05
41.77	4.03CE-04	3.280E-05	8.14	5.443E-03	4.430E-04	43.03	3.839E-04	3.124E-05
42.27	3.13CE-04	2.140E-05	6.84	4.424E-03	3.024E-04	43.55	2.983E-04	2.039E-05
42.77	3.360E-04	2.510E-05	7.47	4.967E-03	3.710E-04	44.06	3.203E-04	2.393E-05
43.27	3.78CE-04	2.660E-05	7.04	5.840E-03	4.110E-04	44.57	3.605E-04	2.537E-05

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 208 PB

ECM = 102.037 MEV K = 4.37809 PRO FERMI ETA = 5.06596

LABOR DATEN			RUTHERFORD			CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
4.66	1.039E 03	5.823E 01	5.60	8.821E-01	4.942E-02	4.75	9.996E 02	5.600E 01
5.16	7.653E 02	3.521E 01	4.60	9.762E-01	4.492E-02	5.26	7.360E 02	3.387E 01
5.34	7.040E 02	3.498E 01	4.97	1.030E 00	5.118E-02	5.45	6.771E 02	3.364E 01
5.66	6.103E 02	2.370E 01	3.88	1.127E 00	4.376E-02	5.77	5.869E 02	2.280E 01
6.16	4.475E 02	2.048E 01	4.58	1.159E 00	5.304E-02	6.28	4.305E 02	1.970E 01
6.66	3.391E 02	1.749E 01	5.16	1.199E 00	6.186E-02	6.79	3.262E 02	1.682E 01
7.16	2.309E 02	8.228E 00	3.56	1.090E 00	3.886E-02	7.30	2.221E 02	7.914E 00
7.66	1.704E 02	6.018E 00	3.53	1.054E 00	3.722E-02	7.81	1.639E 02	5.789E 00
8.16	1.372E 02	4.189E 00	3.05	1.093E 00	3.335E-02	8.32	1.320E 02	4.029E 00
8.66	1.088E 02	4.764E 00	4.38	1.098E 00	4.809E-02	8.83	1.047E 02	4.583E 00
9.16	8.366E 01	3.314E 00	3.96	1.057E 00	4.186E-02	9.34	8.048E 01	3.188E 00
9.66	6.081E 01	4.649E 00	7.64	9.496E-01	7.259E-02	9.85	5.851E 01	4.473E 00
10.16	4.361E 01	2.060E 00	4.72	8.329E-01	3.934E-02	10.36	4.196E 01	1.982E 00
10.66	3.194E 01	2.336E 00	7.31	7.389E-01	5.404E-02	10.87	3.074E 01	2.248E 00
11.16	2.313E 01	1.185E 00	5.12	6.423E-01	3.292E-02	11.38	2.226E 01	1.141E 00
11.66	1.839E 01	5.029E-01	2.73	6.082E-01	1.663E-02	11.89	1.770E 01	4.839E-01
12.16	1.487E 01	3.797E-01	2.55	5.813E-01	1.485E-02	12.40	1.431E 01	3.655E-01
12.66	1.225E 01	3.728E-01	3.04	5.626E-01	1.712E-02	12.91	1.180E 01	3.589E-01
13.16	9.482E 00	4.764E-01	5.02	5.079E-01	2.552E-02	13.42	9.127E 00	4.586E-01
13.66	7.169E 00	5.823E-01	8.12	4.455E-01	3.618E-02	13.93	6.901E 00	5.605E-01
14.16	5.190E 00	3.510E-01	6.76	3.721E-01	2.516E-02	14.44	4.996E 00	3.379E-01
14.66	3.682E 00	2.370E-01	6.44	3.031E-01	1.951E-02	14.95	3.545E 00	2.282E-01
15.16	2.578E 00	1.634E-01	6.34	2.425E-01	1.537E-02	15.46	2.482E 00	1.573E-01
15.66	2.278E 00	3.636E-02	1.60	2.438E-01	3.891E-03	15.97	2.194E 00	3.502E-02
16.16	2.083E 00	5.305E-02	2.55	2.525E-01	6.432E-03	16.48	2.006E 00	5.109E-02
16.66	1.853E 00	7.284E-02	3.93	2.535E-01	9.969E-03	16.98	1.784E 00	7.016E-02
17.16	1.565E 00	9.436E-02	6.03	2.409E-01	1.452E-02	17.49	1.508E 00	9.089E-02
17.66	1.220E 00	7.134E-02	5.85	2.104E-01	1.231E-02	18.00	1.175E 00	6.873E-02
18.16	8.400E-01	6.973E-02	8.30	1.619E-01	1.344E-02	18.51	8.093E-01	6.719E-02
18.66	5.915E-01	6.973E-02	11.79	1.269E-01	1.497E-02	19.02	5.699E-01	6.719E-02
19.16	3.889E-01	2.382E-02	6.12	9.269E-02	5.677E-03	19.53	3.748E-01	2.295E-02
19.66	3.395E-01	1.277E-02	3.76	8.959E-02	3.371E-03	20.04	3.272E-01	1.231E-02
20.16	3.199E-01	4.614E-03	1.44	9.326E-02	1.345E-03	20.55	3.084E-01	4.448E-03
20.66	3.337E-01	3.832E-03	1.15	1.072E-01	1.231E-03	21.06	3.217E-01	3.694E-03
21.16	3.187E-01	3.153E-03	0.99	1.125E-01	1.113E-03	21.57	3.073E-01	3.040E-03
21.66	3.337E-01	9.091E-03	2.72	1.292E-01	3.520E-03	22.08	3.218E-01	8.766E-03
22.16	2.842E-01	1.204E-02	4.23	1.204E-01	5.101E-03	22.59	2.741E-01	1.161E-02
22.66	2.785E-01	1.185E-02	4.26	1.289E-01	5.485E-03	23.10	2.686E-01	1.143E-02
23.16	1.553E-01	1.749E-02	11.26	7.836E-02	8.823E-03	23.61	1.499E-01	1.687E-02
23.66	1.005E-01	7.111E-03	7.08	5.513E-02	3.903E-03	24.11	9.692E-02	6.861E-03
24.16	6.801E-02	3.613E-03	5.31	4.053E-02	2.153E-03	24.62	6.562E-02	3.486E-03
24.66	5.328E-02	9.551E-04	1.79	3.442E-02	6.170E-04	25.13	5.142E-02	9.217E-04
25.16	5.903E-02	2.486E-03	4.21	4.127E-02	1.738E-03	25.64	5.698E-02	2.399E-03
25.66	6.467E-02	2.509E-03	3.88	4.885E-02	1.895E-03	26.15	6.243E-02	2.422E-03
26.17	6.939E-02	1.001E-03	1.44	5.663E-02	8.171E-04	26.67	6.699E-02	9.666E-04
26.66	6.375E-02	2.497E-03	3.92	5.596E-02	2.192E-03	27.17	6.156E-02	2.411E-03
27.20	4.913E-02	3.556E-03	7.24	4.667E-02	3.377E-03	27.72	4.745E-02	3.434E-03
27.66	3.452E-02	2.416E-03	7.00	3.502E-02	2.451E-03	28.19	3.334E-02	2.334E-03
28.16	2.060E-02	3.498E-03	16.98	2.241E-02	3.807E-03	28.69	1.990E-02	3.379E-03
28.66	1.146E-02	1.001E-03	8.73	1.336E-02	1.167E-03	29.20	1.107E-02	9.673E-04
30.66	1.761E-02	3.567E-04	2.03	2.672E-02	5.414E-04	31.24	1.702E-02	3.449E-04
31.16	1.553E-02	8.055E-04	5.19	2.511E-02	1.302E-03	31.75	1.502E-02	7.790E-04

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31.66	1.041E-02	1.174E-03	11.27	1.791E-02	2.019E-03	32.25	1.007E-02	1.135E-03
32.16	6.459E-03	7.077E-04	10.96	1.180E-02	1.294E-03	32.76	6.245E-03	6.846E-04
29.16	8.860E-03	2.532E-04	2.86	1.105E-02	3.158E-04	29.71	8.563E-03	2.446E-04
29.66	1.000E-02	7.434E-04	7.43	1.333E-02	9.911E-04	30.22	9.665E-03	7.185E-04
30.16	1.530E-02	9.746E-04	6.37	2.178E-02	1.387E-03	30.73	1.480E-02	9.422E-04
32.66	3.187E-03	9.286E-04	29.13	6.189E-03	1.803E-03	33.27	3.084E-03	8.985E-04
33.16	1.519E-03	2.129E-04	14.02	3.129E-03	4.385E-04	33.78	1.470E-03	2.060E-04
33.66	1.507E-03	1.174E-04	7.79	3.291E-03	2.562E-04	34.29	1.459E-03	1.136E-04
34.16	3.061E-03	4.166E-04	13.61	7.076E-03	9.630E-04	34.80	2.963E-03	4.033E-04
34.66	4.154E-03	2.739E-04	6.59	1.016E-02	6.699E-04	35.30	4.022E-03	2.652E-04
35.16	4.810E-03	2.221E-04	4.62	1.244E-02	5.742E-04	35.81	4.659E-03	2.151E-04
35.66	4.879E-03	2.382E-04	4.88	1.332E-02	6.505E-04	36.32	4.726E-03	2.307E-04
36.16	3.970E-03	2.854E-04	7.19	1.144E-02	8.224E-04	36.83	3.846E-03	2.765E-04
36.66	2.566E-03	3.498E-04	13.63	7.798E-03	1.063E-03	37.34	2.487E-03	3.390E-04
37.17	1.289E-03	3.498E-04	27.14	4.131E-03	1.121E-03	37.85	1.249E-03	3.391E-04
37.66	3.947E-04	1.174E-04	29.74	1.331E-03	3.957E-04	38.35	3.827E-04	1.138E-04
38.16	1.392E-04	1.277E-05	9.17	4.939E-04	4.531E-05	38.86	1.350E-04	1.239E-05
38.66	3.705E-04	6.801E-05	18.35	1.382E-03	2.536E-04	39.37	3.594E-04	6.596E-05
39.16	8.630E-04	1.208E-04	14.00	3.382E-03	4.735E-04	39.88	8.372E-04	1.172E-04
39.66	1.342E-03	7.272E-05	5.42	5.520E-03	2.992E-04	40.38	1.302E-03	7.057E-05
40.16	1.358E-03	9.585E-05	7.06	5.862E-03	4.138E-04	40.89	1.318E-03	9.303E-05
40.66	1.404E-03	7.721E-05	5.50	6.355E-03	3.495E-04	41.40	1.363E-03	7.495E-05
41.16	1.208E-03	8.734E-05	7.23	5.731E-03	4.143E-04	41.91	1.173E-03	8.480E-05
41.66	7.169E-04	1.047E-04	14.61	3.561E-03	5.202E-04	42.41	6.962E-04	1.017E-04
42.16	3.797E-04	5.236E-05	13.79	1.974E-03	2.722E-04	42.92	3.689E-04	5.086E-05
42.66	1.266E-04	3.636E-05	28.73	6.884E-04	1.978E-04	43.43	1.230E-04	3.533E-05
43.16	3.072E-05	4.971E-06	16.18	1.747E-04	2.826E-05	43.93	2.986E-05	4.831E-06
43.66	1.074E-04	2.566E-05	23.90	6.377E-04	1.524E-04	44.44	1.044E-04	2.494E-05
44.16	2.060E-04	4.327E-05	21.01	1.278E-03	2.684E-04	44.95	2.003E-04	4.207E-05
44.66	3.061E-04	2.635E-05	8.61	1.982E-03	1.706E-04	45.46	2.977E-04	2.563E-05
45.16	3.797E-04	2.647E-05	6.97	2.564E-03	1.787E-04	45.96	3.694E-04	2.575E-05
45.65	4.488E-04	2.877E-05	6.41	3.157E-03	2.024E-04	46.46	4.367E-04	2.799E-05
46.16	3.314E-04	2.002E-05	6.04	2.432E-03	1.469E-04	46.98	3.225E-04	1.949E-05
46.66	1.968E-04	2.716E-05	13.80	1.504E-03	2.075E-04	47.48	1.916E-04	2.644E-05
47.16	9.459E-05	2.313E-05	24.45	7.525E-04	1.840E-04	47.99	9.211E-05	2.252E-05
47.66	4.096E-05	1.208E-05	29.49	3.391E-04	1.000E-04	48.50	3.990E-05	1.177E-05
48.16	1.726E-05	3.843E-06	22.27	1.486E-04	3.309E-05	49.00	1.682E-05	3.744E-06
48.66	2.785E-05	6.628E-06	23.80	2.493E-04	5.933E-05	49.51	2.714E-05	6.459E-06
49.16	9.977E-05	1.415E-05	14.19	9.279E-04	1.316E-04	50.02	9.725E-05	1.380E-05
49.66	1.016E-04	1.381E-05	13.59	9.816E-04	1.334E-04	50.52	9.907E-05	1.346E-05
50.16	1.228E-04	1.098E-05	8.94	1.231E-03	1.101E-04	51.03	1.197E-04	1.071E-05
50.66	1.404E-04	1.530E-05	10.90	1.461E-03	1.593E-04	51.54	1.369E-04	1.493E-05
51.16	1.131E-04	1.427E-05	12.61	1.221E-03	1.541E-04	52.04	1.104E-04	1.392E-05
51.66	6.133E-05	1.185E-05	19.32	6.867E-04	1.327E-04	52.55	5.986E-05	1.157E-05
52.16	4.603E-05	1.064E-05	23.13	5.342E-04	1.235E-04	53.05	4.494E-05	1.039E-05
52.66	1.530E-05	4.741E-06	30.98	1.840E-04	5.700E-05	53.56	1.495E-05	4.630E-06
53.16	1.530E-05	4.649E-06	30.38	1.906E-04	5.789E-05	54.07	1.495E-05	4.541E-06
53.66	2.301E-05	6.386E-06	27.75	2.967E-04	8.234E-05	54.57	2.249E-05	6.240E-06

ELASTISCHE STREUUNG VON 104 MEV ALPHA-TEILCHEN AN 209 BI

ECM = 102.046 MEV   K = 4.37848 PRO FERMI   ETA = 5.12774

LABOR DATEN				RUTHERFORD		CM DATEN		
THETA	SIGMA	DSIGMA	PROZENT	SIGMA/SR	DSIGMA/SR	THETA	SIGMA	DSIGMA
GRAD	B/SR	B/SR				GRAD	B/SR	B/SR
6.55	4.210E 02	2.770E 01	6.58	1.360E 00	8.947E-02	6.68	4.050E 02	2.665E 01
7.55	1.835E 02	1.260E 01	6.87	1.046E 00	7.179E-02	7.70	1.765E 02	1.212E 01
8.55	1.131E 02	5.750E 00	5.08	1.059E 00	5.384E-02	8.72	1.088E 02	5.533E 00
9.55	5.720E 01	5.050E 00	8.83	8.328E-01	7.353E-02	9.74	5.504E 01	4.860E 00
10.55	2.840E 01	1.675E 00	5.90	6.152E-01	3.629E-02	10.76	2.733E 01	1.612E 00
11.50	2.015E 01	1.130E 00	5.61	6.156E-01	3.452E-02	11.72	1.940E 01	1.088E 00
12.55	1.295E 01	7.250E-01	5.60	5.604E-01	3.138E-02	12.79	1.247E 01	6.979E-01
13.55	7.950E 00	5.500E-01	6.92	4.669E-01	3.230E-02	13.81	7.655E 00	5.296E-01
14.55	3.535E 00	1.960E-01	5.54	2.756E-01	1.528E-02	14.83	3.404E 00	1.887E-01
15.55	2.215E 00	1.100E-01	4.97	2.250E-01	1.117E-02	15.85	2.133E 00	1.059E-01
16.55	1.662E 00	5.920E-02	3.56	2.162E-01	7.703E-03	16.87	1.601E 00	5.703E-02
17.55	1.209E 00	6.690E-02	5.53	1.986E-01	1.099E-02	17.89	1.165E 00	6.446E-02
18.55	6.050E-01	7.000E-02	11.57	1.238E-01	1.432E-02	18.91	5.831E-01	6.746E-02
19.55	3.220E-01	1.370E-02	4.25	8.113E-02	3.452E-03	19.93	3.104E-01	1.321E-02
20.55	2.890E-01	8.850E-03	3.06	8.871E-02	2.717E-03	20.95	2.786E-01	8.533E-03
21.55	2.600E-01	1.042E-02	4.01	9.631E-02	3.860E-03	21.96	2.507E-01	1.005E-02
22.55	1.620E-01	1.428E-02	8.81	7.179E-02	6.328E-03	22.98	1.563E-01	1.378E-02
23.45	5.850E-02	4.160E-03	7.11	3.025E-02	2.151E-03	23.90	5.645E-02	4.014E-03
23.55	7.150E-02	5.280E-03	7.38	3.760E-02	2.777E-03	24.00	6.899E-02	5.095E-03
24.45	4.130E-02	2.520E-03	6.10	2.518E-02	1.536E-03	24.92	3.986E-02	2.432E-03
24.55	5.070E-02	1.640E-03	3.23	3.141E-02	1.016E-03	25.02	4.894E-02	1.583E-03
25.45	5.360E-02	1.910E-03	3.56	3.826E-02	1.363E-03	25.93	5.175E-02	1.844E-03
25.55	6.050E-02	1.550E-03	2.56	4.386E-02	1.124E-03	26.04	5.841E-02	1.496E-03
26.45	4.140E-02	2.700E-03	6.52	3.439E-02	2.243E-03	26.95	3.998E-02	2.607E-03
26.55	4.890E-02	2.550E-03	5.21	4.123E-02	2.150E-03	27.05	4.723E-02	2.463E-03
27.45	2.030E-02	2.860E-03	14.09	1.951E-02	2.748E-03	27.97	1.961E-02	2.763E-03
27.55	2.250E-02	3.160E-03	14.04	2.193E-02	3.080E-03	28.07	2.174E-02	3.053E-03
28.45	9.280E-03	3.900E-04	4.20	1.026E-02	4.312E-04	28.99	8.968E-03	3.769E-04
28.55	8.550E-03	5.210E-04	6.09	9.584E-03	5.840E-04	29.09	8.262E-03	5.035E-04
29.45	1.020E-02	8.450E-04	8.28	1.291E-02	1.070E-03	30.00	9.860E-03	8.168E-04
29.55	1.065E-02	7.800E-04	7.32	1.366E-02	1.000E-03	30.11	1.030E-02	7.540E-04
30.45	1.450E-02	6.900E-04	4.76	2.091E-02	9.951E-04	31.02	1.402E-02	6.672E-04
30.55	1.585E-02	5.860E-04	3.70	2.315E-02	8.560E-04	31.12	1.533E-02	5.667E-04
31.55	1.071E-02	8.900E-04	8.31	1.774E-02	1.474E-03	32.14	1.036E-02	8.609E-04
32.55	2.990E-03	4.020E-04	13.44	5.593E-03	7.519E-04	33.16	2.893E-03	3.890E-04
33.55	1.230E-03	1.320E-04	10.73	2.588E-03	2.777E-04	34.17	1.191E-03	1.278E-04
34.55	3.140E-03	3.620E-04	11.53	7.404E-03	8.536E-04	35.19	3.041E-03	3.506E-04
35.55	4.720E-03	2.980E-04	6.31	1.243E-02	7.848E-04	36.21	4.573E-03	2.887E-04
36.55	2.830E-03	3.320E-04	11.73	8.297E-03	9.734E-04	37.22	2.743E-03	3.218E-04
37.55	5.770E-04	1.860E-04	32.24	1.878E-03	6.052E-04	38.24	5.595E-04	1.803E-04
38.55	6.650E-05	1.230E-04	184.96	2.394E-04	4.429E-04	39.25	6.451E-05	1.193E-04