# Q- DEPENDENCE OF THE QUASIFREE PEAK MAXIMUM POSITION IN $^{2}$H(e,e')- REACTION

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The problem of the quasifree peak position of energy spectra at scattering electrons in inclusive $^{2}$H(e,e′)- reaction is discussed. ε(q) dependence of the lightest deuterium nucleus is investigated. The fitting experimental points are realized by a 6-th power polynomial. It is proposed the new method of finding maxima of energy spectra and its errors at the polynomial fitting.
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## INTRODUCTION

At large momentum transfer q, dominant feature in the inclusive spectrum of electrons inelastically scattered by nuclei is a wide so-called quasielastic or quasifree peak (QFP) resulting from elastic scattering from individual nucleons. Previous experiments have shown that (see for example [1, 2]) the location of the QFP $\omega_{max}$ on light, middle weight and heavy nuclei differs from that of a free nucleon $\omega_{eN}$ and shifted to the higher energy loss $\omega_{max} > \omega_{eN}$ side at a certain value of ε.

The shift value is a specific function of the kinematical conditions of measurement and cannot be explained by the introducing an average nucleon separation energy that must be supplied to knock the nucleon out of the nucleus. The ε(q)- dependence has a minimum in the momentum near the nuclear Fermi momentum and don't predict saturation at the large values of q. Consequently this shift cannot be directly related to the average nucleon separation energy. There were difficulties in describing the experimental ε (q)- dependences for A ≥ 3 by the different theoretical models.

So a logical step toward understanding the observed differences between calculations and actual behavior of the ε(q)- dependences is the investigation of the quasielastic $^{2}$H(e,e′) cross section over the same kinematical region in which problems exist in explaining results found for heavier nuclei. First of all the deuteron is the simplest nuclear system consisting of two nucleons. Estimates of a nuclear density show deuteron is a friable formation enough. Therefore, influence of residual interaction effects and dynamical short-range NN- correlations that grow with increasing nuclear density must be minimum. Besides, weak nucleons couple in deuterium allows considering their as free particles in a certain approximation, which facilitates the theoretical interpretation of the experimental data.

## RESULTS AND DISCUSSIONS

In this work the experimental data are analyzed and the transfer momentum dependence is obtained for the shift of the quasifree peak maximum position on the $^{2}$H nucleus relatively elastic eN- peak location. The energy spectra were taken at the Bates Linear Accelerator Center [3, 4]. The inclusive differential cross section was measured with high accuracy for different initial electron energies and scattering angles of $60^{0}$ and 134,5° . All data presented have been corrected for radiative effects. We have analyzed five energy spectra inelastically scattered electrons from the deuteron in the quasifree peak region at initial energies $E_i$ = (292,8±0,4; 366,0±0,6; 465,3±0,7; 510,2±0,8; 596,8±0,9) MeV and scattering angle 60°.

The shift value of the QFP maximum position in $^{2}$H(e,e′)- reaction relative to the point corresponding to free eN- kinematics is determined as

$$\varepsilon = \omega_{max} - \omega_{eN}.$$

As the peak on a free proton wasn't measured in the experiments [2, 3] and the initial electron energy is determined independently, the kinetic energy $\omega_{eN}$ of a recoil nucleon with its error $d\omega_{eN}$ for every concrete spectrum are calculated as

$$\omega_{eN} = E_i - E_H,$$

where $E_H = E_i/(1+2E_i/M\,\mathrm{Sin}^2(\theta/2))$, M is a nucleon mass, at the given value of the initial energy ($E_i \pm dE_i$) and the scattering angle θ. The most value of the absolute error $\pm d\varepsilon$ is calculated by the standard procedure of finding errors.

To increase precision of finding transferred energy in QFP maximum and to decrease a fit error that, in particular, is determined by a number of the points for fitting and a fit function form the points are taken only in vicinity of the spectrum maximum. Beforehand, the control of a finished result dependence on the fit function form was fulfilled. On Fig.1, it is shown the fitting ought to the polynomial of 6-th power for one of the spectra. It is seen that the plot describes well the spectrum in the QFP maximum region.

It is proposed a new method for the maximum and its error to be found in the fitting by a 6-th power polynomial. The method can be shortly described by the following way. As the polynomial coefficients are determined with their errors, it is possible to draw the polynomial curves very much through experimental points. So the control experimental points $(x_i, y_i)$ with their errors $dy_i$ are taken for limiting the 6-th power polynomial set. We select only the polynomials values of which must be equal $y_i \pm dy_i$ in point $x_i$. The maximums of different polynomials with the coefficients within the errors of the initial polynomial are found. The polynomial coefficients are picked up at random. The more a number of the polynomials, the more accurate the result we get. Among the maxima of these random polynomials, we select two ones: one with the most low maximum value $x_{1max}$ and another with the highest value $x_{2max}$. The required maximum $x_{max}$ is the arithmetical mean of these two numbers. The absolute value of difference of $x_{max}$ and $x_{1max}$ (or $x_{max}$ and $x_{2max}$) is taken as the error of $x_{max}$. The polynomial maxima are found by the method of half dividing.

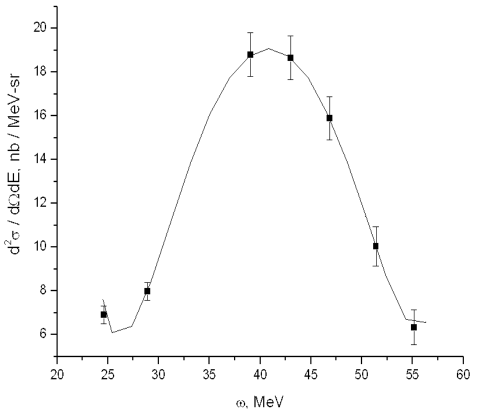


*Fig. 1. The dependence of $^2H(e,e')$- reaction cross section on transferred energy. ■ is experimental points for $E_i$ = 292,8 MeV, $\theta$ = 60°. The plot is fitting by the 6-th power polynomial*

The analysis results of the experimental data at the angle 60° are represented on Fig. 2 and in the table. The

*Kinematical conditions and results of analysis*

| $E_i$, MeV | $\omega_{max}$, MeV | $\omega_{eN}$, MeV | ε, MeV | q, $Fm^{-1}$ |
|---|---|---|---|---|
| 292,8±0,4 | 40,9±0,5 | 39,5±0,5 | 1,37±0,71 | 1,39 |
| 366,0±0,5 | 60,6±0,2 | 59,7±0,7 | 0,86±0,70 | 1,72 |
| 465,3±0,7 | 94,5±0,3 | 92,5±0,8 | 2,01±0,87 | 2,16 |
| 510,2±0,8 | 111,9±0,4 | 109,1±0,9 | 2,83±0,97 | 2,35 |
| 596,8±0,9 | 146,9±1,0 | 144,0±1,0 | 2,93±1,47 | 2,73 |

error of the quantity ε takes into account the measurement error of the initial energy, the fitting error and the error of finding the quantity $\omega_{eN}$. From Fig. 2, it is seen well dynamics of the QFP maximum shift in $^2H(e,e')$- reaction relative to the peak of the elastic eN-scattering in dependence on the kinematical conditions of measurement. As seen from Fig. 2, polynomial fitting experimental data points out that the shift quantity ε increases from the value 1,37 up to 2,93 MeV with increasing transferred momentum in the interval 1,39-2,73 $Fm^{-1}$. No obvious anomaly like a minimum appears at low energy loss. Nevertheless, the final result is considered not to be completely determined because of a low number of the investigated spectra and the relatively high experimental errors. The available data are failed for conclusion to be reliable on behaving the investigated dependence on the kinematical conditions of measurement.

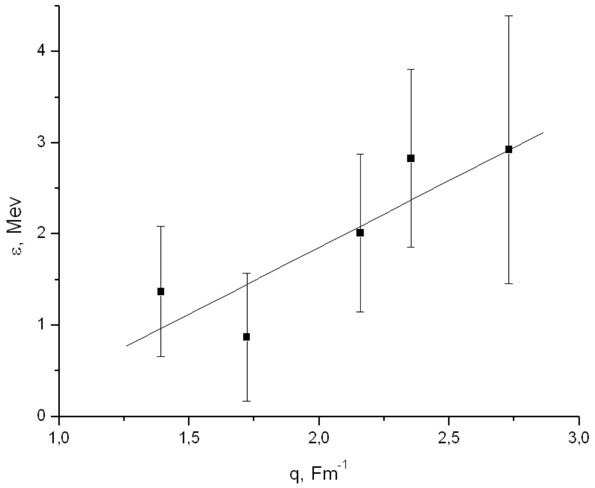


*Fig. 2. The QFP maximum shift dependence for $^2H$ nucleus relative to the peak of the elastic eN- scattering on transferred 3- momentum. The scattering angle is $\theta$ = 60°. ■ is the experimental points at fitting QFP by the 6-th polynomial. The straight line is the result of the linear fitting*

## CONCLUSIONS

The shift of the QFP maximum relatively elastic eN-kinematic increases from the value 1,37 up to 2,93 MeV with increasing transferred momentum in the interval 1,39-2,73 $Fm^{-1}$. The shift cannot be directly related to the average nucleon separation energy.

Specific behavior of the ε(q)- dependence for deuterium may indicate that another process is competing with the single nucleon knockout process and altering the perceived quasielastic peak location.

In order that progress be made in the solution of the problem additional experimental investigations over a large range of momentum transfer and modern theoretical calculations are need.

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