PROCEEDINGS

of the Union of Scientists - Ruse

Book 5

Mathematics, Informatics and Physics

Volume 11, 2014

RUSE

PROCEEDINGS
OF THE UNION OF SCIENTISTS - RUSE

Union of Scientists - Ruse
16, Konstantin Irechek Street
7000 Ruse
BULGARIA
Phone: (++359 82) 828 135,
(++359 82) 841 634
E-mail: suruse@uni-ruse.bg
web: suruse.uni-ruse.bg

Contacts with Editor
Phone: (++359 82) 888 738
E-mail: zzdravkova@uni-ruse.bg

PROCEEDINGS
of the Union of Scientists – Ruse

ISSN 1314-3077

ISSN 1314-3077

Proceedings

of the Union of Scientists– Ruse

Contains five books:

1. Technical Sciences
2. Medicine and Ecology
3. Agrarian and Veterinary Medical Sciences
4. Social Sciences
5. Mathematics, Informatics and Physics

The Ruse Branch of the Union of Scientists in Bulgariawas foundedin 1956. Its first Chairman was Prof. StoyanPetrov. He was followed by Prof. TrifonGeorgiev, Prof. KolyoVasilev, Prof. Georgi Popov, Prof. MityoKanev, Assoc. Prof. Boris Borisov, Prof. Emil Marinov, Prof. HristoBeloev. The individual members number nearly 300 recognized scientists from Ruse, organized in 13 scientific sections. There are several collective members too– organizations and companies from Ruse, known for their success in the field of science and higher education, or their applied research activities. The activities of the Union of Scientists – Ruse are numerous: scientific, educational and other humanitarian events directly related to hot issues in the development of Ruse region, including its infrastructure, environment, history and future development; commitment to the development of the scientific organizations in Ruse, the professional development and growth of the scientists and the protection of their individual rights.

The Union of Scientists – Ruse (US – Ruse) organizes publishing of scientific and popular informative literature, and since 1998 – the “Proceedings of the Union of Scientists- Ruse".

BOOK 5

"MATHEMATICS, INFORMATICS AND PHYSICS"

VOLUME 11

CONTENTS

BOOK 5

"MATHEMATICS, INFORMATICS AND PHYSICS"

VOLUME 11

Physics

web: suruse.uni-ruse.bg

CONTRIBUTIONS OF FOLDING, CLUSTER AND INTERFERENCE TERMS TO THE CHARGE FORM FACTOR OF ^{6}Li NUCLEUS

Galina Krumova

Angel Kanchev University of Ruse

Abstract: *The contributions of the folding, cluster and interference terms to the formation of the charge form factor of ^{6}Li nucleus are investigated. The theoretical basis of this approach is described in the previous article. The obtained results are successfully compared with the available experimental data for the charge form factor of ^{6}Li.*
Keywords: *Form factor, cluster structure, interference.*

As described in the previous article here the squared nuclear charge form factor of the ^{6}Li nucleus

$$\left|F^{ch}_{^6\mathrm{Li}}(q)\right|^2 = A + B + C$$

is represented as a sum of three terms A, B and C of the following form:

$$A = c_1^2\left|F^{ch}_{^4He}(q)\right|^2\left|F^{ch}_{d}(q)\right|^2 e^{\frac{q^2}{2A^{2/3}}},$$

$$B = \frac{c_2^2}{9}\left[4\left|F^{ch}_{^4He}(q)\right|^2 + \left|F^{ch}_{d}(q)\right|^2 + 4\left|F^{ch}_{^4He}(q)\right|\left|F^{ch}_{d}(q)\right|\right] e^{\frac{q^2}{2A^{2/3}}},$$

$$C = \frac{2}{3}c_1c_2\left|F^{ch}_{^4He}(q)\right|\left|F^{ch}_{d}(q)\right|\left[2\left|F^{ch}_{^4He}(q)\right| + \left|F^{ch}_{d}(q)\right|\right] e^{\frac{q^2}{2A^{2/3}}}.$$

They correspond to the folding, cluster structure and interference contributions to the charge density, respectively.

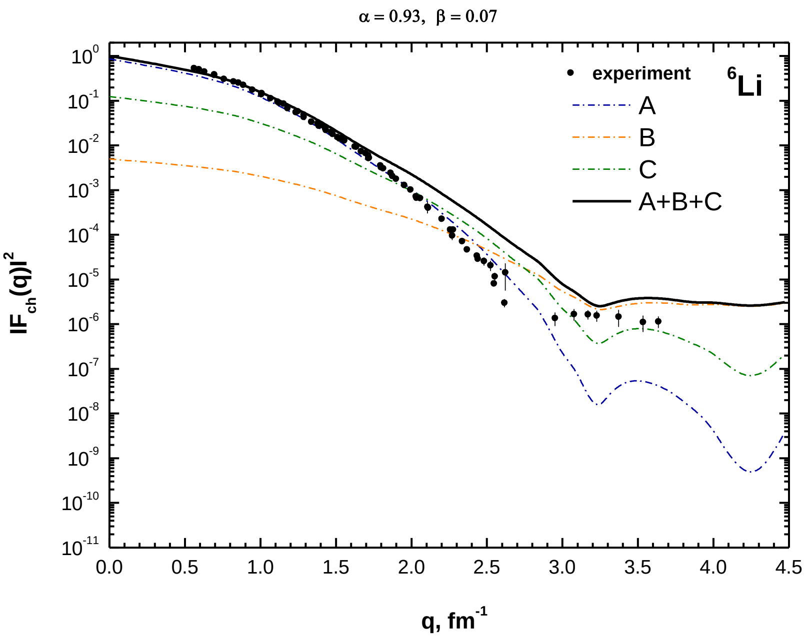

Fig. 1: The charge form factor of ^{6}Li calculated for c_1=0.93, c_2=0.07 in comparison with the experimental data. The contributions of A, B and C terms are presented.

An investigation of the sensitivity of the charge form factor to the values of the coefficients c_1 and c_2, $c_1+c_2=1$, shows interesting results, displayed in **Figs. 1-10**.

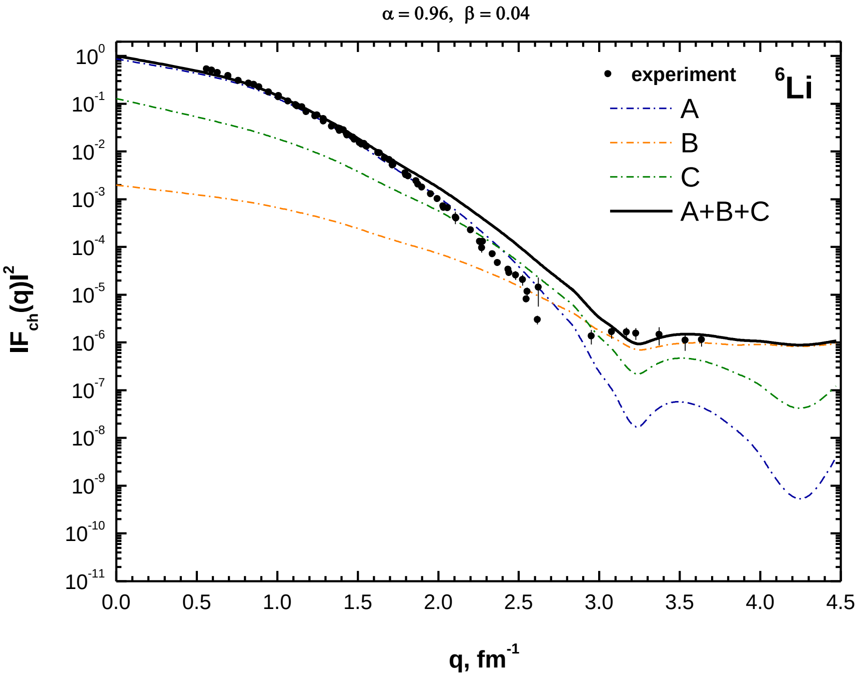

Fig. 2: The same as in **Fig. 1**, but for c_1=0.96, c_2=0.04.

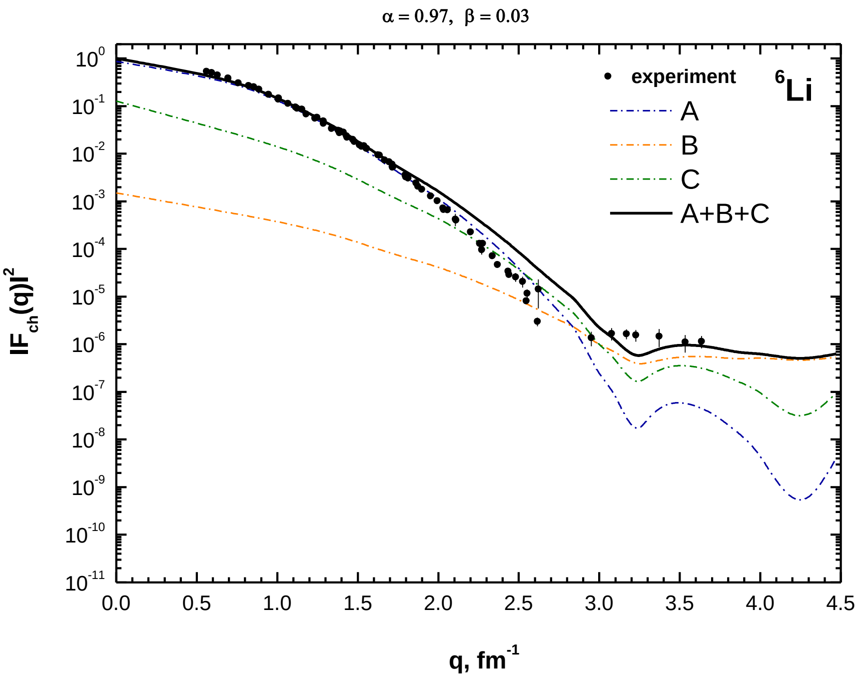

Fig. 3: The same as in **Fig. 1**, but for c_1=0.97, c_2=0.03.

The most convenient results obtained by different sets of values of the weight coefficients c_1 and c_2 are displayed. The same figures reveal the contributions of A, B and C terms to the squared charge form factor of ^{6}Li nucleus.

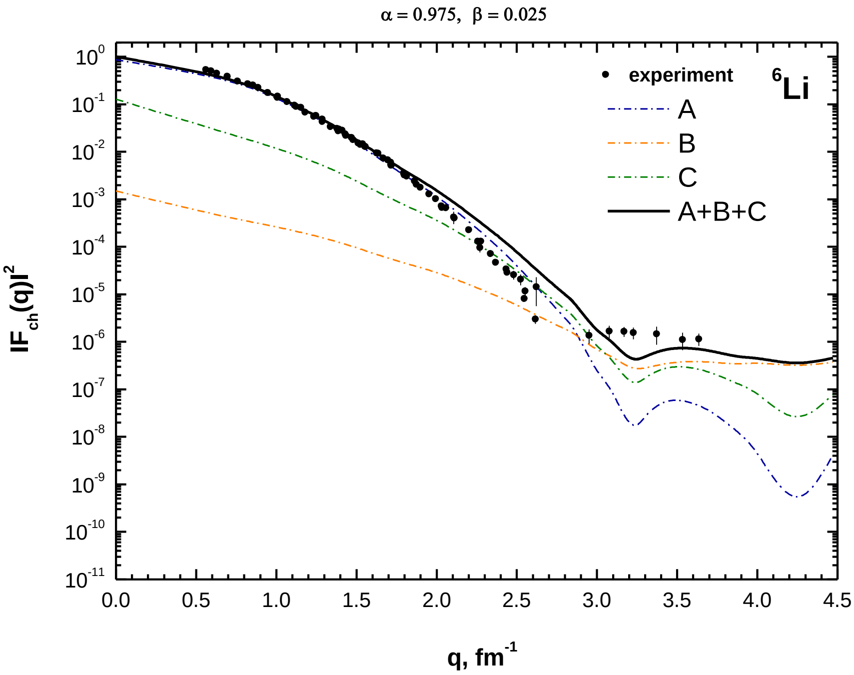

Fig. 4: The same as in **Fig. 1**, but for c_1=0.975, c_2=0.025.

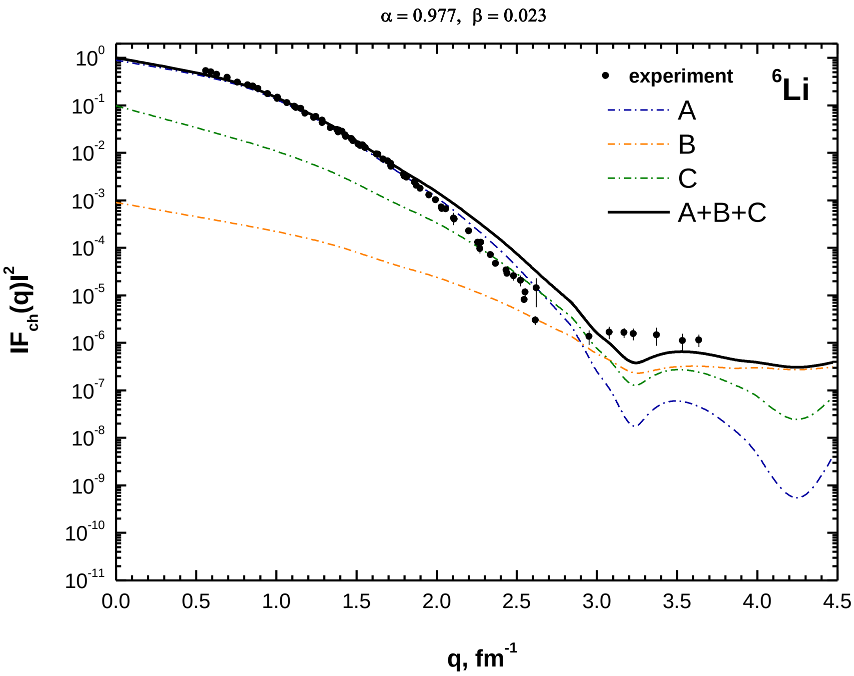

Fig. 5: The same as in **Fig. 1**, but for c_1=0.977, c_2=0.023.

It is obvious that in the interval of values of c_1=0.975÷0.985 and, correspondingly, of c_2=0.025÷0.015, the obtained results reasonably agree with the experimental data within the limits of the experimental errors. This fact has a clear physical meaning concerning the clusterization represented by c_2 coefficient in the charge density distribution of this nucleus.

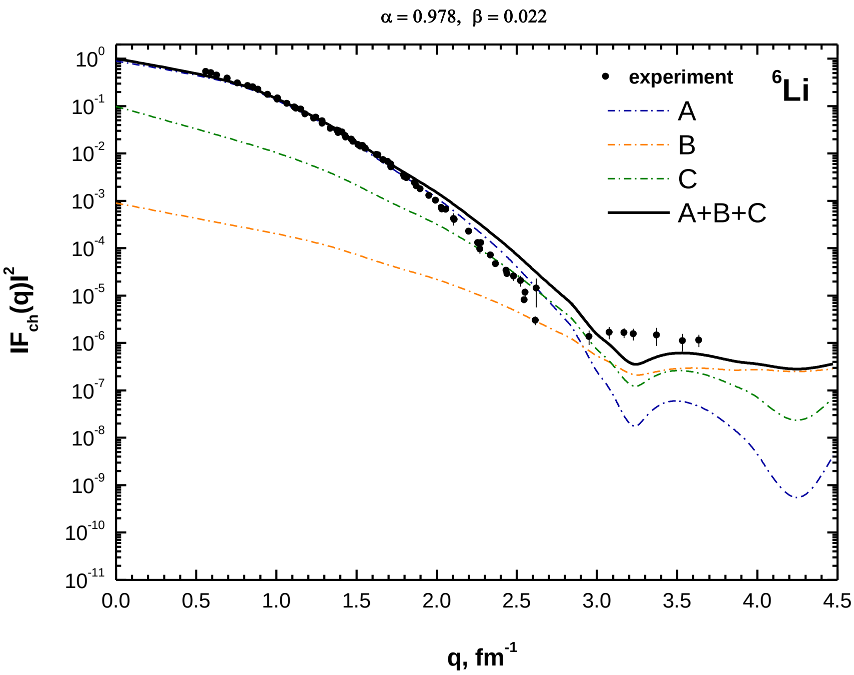

Fig. 6: The same as in **Fig. 1**, but for c_1=0.978, c_2=0.022.

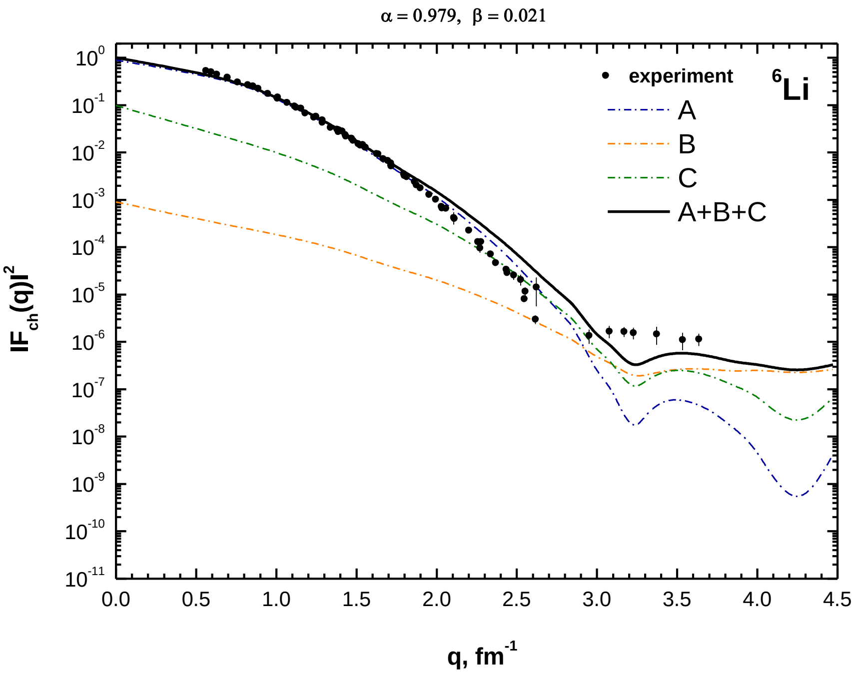

Fig. 7: The same as in **Fig. 1**, but for c_1=0.979, c_2=0.021.

The results presented in **Figs. 1-10** prove that the contribution of the folding density to the charge density of ^{6}Li is about 97.5÷98.5%. This corresponds to the weight of the contribution of the sum of ^{4}He and the deuteron densities of about 2.5÷1.5%. It is seen that the term A describes well the squared charge form factor of ^{6}Li in the interval 0<q≤2.7 fm^{-1}, while the shell-model cluster density (related to the term B) is important for the description

of the charge form factor of ^{6}Li for the large values of q (q≥3 fm^{-1}), related to the central nuclear density. The interference term C has a contribution to the charge form factor of ^{6}Li for q≥3 fm^{-1}. The increase of c_1 within the above interval leads to a better description of the data for q=1.8÷2.9 fm^{-1}, but at the same time to a decrease of the values of the squared ^{6}Li charge form factor for q≥3 fm^{-1}, underestimating the data. The calculations show that most reasonable results are obtained for 97.9% contribution of the folding term that corresponds to 2.1% weight of the contribution of the sum of ^{4}He and the deuteron charge densities to the ^{6}Li charge density.

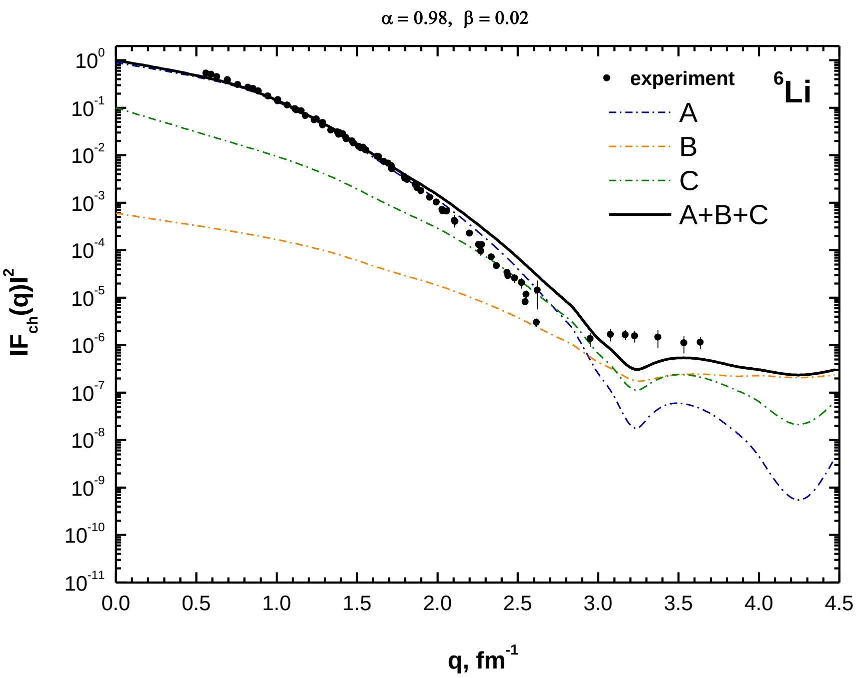

Fig. 8: The same as in **Fig. 1**, but for c_1=0.98, c_2=0.02.

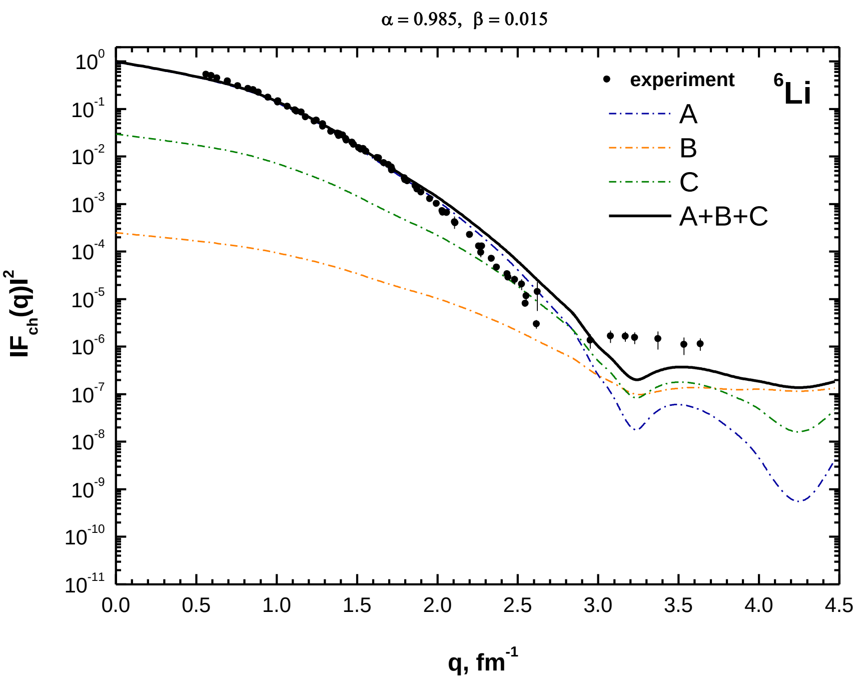

Fig. 9: The same as in **Fig. 1**, but for c_1=0.985, c_2=0.015.

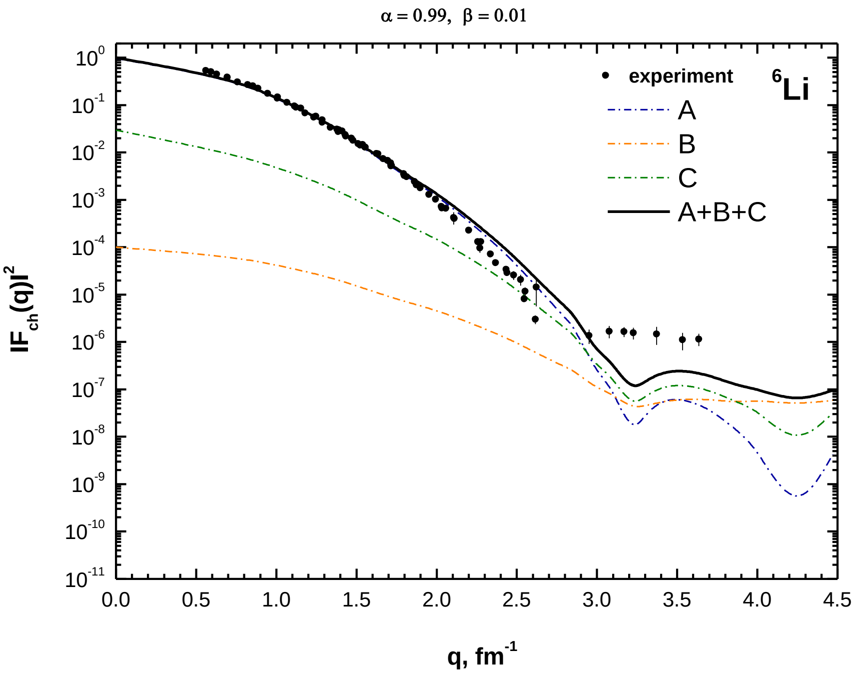

Fig. 10: The same as in **Fig. 1**, but for c_1=0.99, c_2=0.01.

CONCLUSIONS

The obtained results can be summarized as follows:

1) The calculations show a reasonable description of the charge form factor of ^{6}Li on the basis of a superposition of two density distributions:

- A folding density obtained from ^{4}He and the deuteron charge densities. Available experimental data for both densities are used, the calculations show that a good agreement with the data can be obtained when the weight of this contribution is about 97.5÷98.5%;
- A sum of the ^{4}He and deuteron charge densities with a weight of this contribution of about 2.5÷1.5%.

2) The scheme has only one free parameter (c_1 or c_2) - it is the weight of one of the contributions to the charge density of ^{6}Li.

3) The behavior of the charge form factor of ^{6}Li for $0<q\leq 2.7$ fm^{-1} is determined mainly by the folding contribution (of ^{4}He and the deuteron densities) to the charge density of ^{6}Li (its weight is about 97.5÷98.5%).

4) The shell-model α-d cluster density of ^{6}Li (i.e. the sum of ^{4}He and the deuteron charge densities) is important (though with a small weight of about 2.5÷1.5%) in the central nuclear region and, correspondingly, it is responsible for the values of the charge form factor of ^{6}Li at large values of q ($q\geq 3$ fm^{-1}).

5) We would like to pay attention to the following facts:

- The minimum of the experimental charge form factor of the deuteron is at $q\approx 4.2$ fm^{-1};
- The minimum of the experimental charge form factor of ^{4}He is at $q\approx 3.2$ fm^{-1};
- The minimum of the experimental charge form factor of ^{6}Li is at $q\approx 2.9$ fm^{-1}.

In this way our estimations show that the charge form factor of ^{6}Li is determined mainly by the contribution of the charge density and the corresponding form factor of ^{4}He.

We expect that taking into account a possible deformation of ^{6}Li nucleus in future applications of the present approach, e. g. in certain direct reactions will improve the agreement with the empirical data for the form factor in the region of the minimum and for momentum $q > 3\ fm^{-1}$.

CONTACT ADDRESS
Assoc. Prof. Galina Krumova, PhD
Department of Physics, Faculty of Transport
Angel Kanchev University of Ruse
8 Studentska Str., 7017 Ruse, Bulgaria
Phone: (++359 82) 888 215
E-mail: gal@ uni-ruse.bg

ПРИНОСИТЕ НА СГЪНАТИЯ, КЛЪСТЕРНИЯ И ИНТЕРФЕРЕНЦИОННИЯ ЧЛЕН КЪМ ЗАРЯДОВИЯ ФОРМ ФАКТОР НА ЯДРОТО ^{6}Li

Галина Крумова

Русенски университет „Ангел Кънчев”

Резюме: *Изследвани са приносите на сгънатия, клъстерния и интерференционния член при формирането на зарядовия форм фактор на ядрото ^{6}Li. Теоретичната основа на този подход е описана в предходната статия. Получените резултати са сравнени успешно с наличните експериментални данни за зарядовия форм фактор на ^{6}Li.*
Ключови думи: *Форм фактор, клъстерна структура, интерференция.*

Requirements and guidelines for the authors - "Proceedings of the Union of Scientists - Ruse" Book 5 Mathematics, Informatics and Physics

The Editorial Board accepts for publication annually both scientific, applied research and methodology papers, as well as announcements, reviews, information materials, adds. No honoraria are paid.
The paper scripts submitted to the Board should answer the following requirements:
1. Papers submitted in English are accepted. Their volume should not exceed 8 pages, formatted following the requirements, including reference, tables, figures and abstract.
2. The text should be computer generated (MS Word 2003 for Windows or higher versions) and printed in one copy, possibly on laser printer and on one side of the page. Together with the printed copy the author should submit a disk (or send an e-mail copy to: vkr@ami.uni-ruse.bg).
3. Compulsory requirements on formatting:

- font - Ariel 12;
- paper Size - A4;
- page Setup - Top: 20 mm, Bottom: 15 mm, Left: 20 mm, Right: 20mm;
- Format/Paragraph/Line spacing - Single;
- Format/Paragraph/Special: First Line, By: 1 cm;
- *Leave a blank line under Header - Font Size 14;*
- Title should be short, no abbreviations, no formulas or special symbols - Font Size 14, centered, Bold, All Caps;
- *One blank line - Font Size 14;*
- Name and surname of author(s) - Font Size: 12, centered, Bold;
- *One blank line - Font Size 12*;
- Name of place of work - Font Size: 12, centered;
- *One blank line;*
- abstract – no formulas - Font Size 10, Italic, 5-6 lines ;
- keywords - Font Size 10, Italic, 1-2 lines;
- *one blank line;*
- text - Font Size 12, Justify;
- references;
- contact address - three names of the author(s) scientific title and degree, place of work, telephone number, Email - in the language of the paper.

4. At the end of the paper the authors should write:

- The title of the paper;
- Name and surname of the author(s);
- abstract; keywords.

Note: The parts in item 4 should be in Bulgarian and have to be formatted as in the beginning of the paper.
5. All mathematical signs and other special symbols should be written clearly and legibly so as to avoid ambiguity when read. All formulas, cited in the text, should be numbered on the right.
6. Figures (black and white), made with some of the widespread software, should be integrated in the text.
7. Tables should have numbers and titles above them, centered right.
8. Reference sources cited in the text should be marked by a number in square brackets.
9. Only titles cited in the text should be included in the references, their numbers put in square brackets. The reference items should be arranged in alphabetical order, using the surname of the first author, and written following the standard. If the main text is in Bulgarian or Russian, the titles in Cyrillic come before those in Latin. If the main text is in English, the titles in Latin come before those in Cyrillic. The paper cited should have: for the first author – surname and first name initial; for the second and other authors – first name initial and surname; title of the paper; name of the publishing source; number of volume (in Arabic figures); year; first and last page number of the paper. For a book cited the following must be marked: author(s) – surname and initials, title, city, publishing house, year of publication.
10. **The author(s) and the reviewer, chosen by the Editorial Board, are responsible for the contents of the materials submitted**.

Important for readers, companies and organizations

1. Authors, who are not members of the Union of Scientists - Ruse, should pay for publishing of materials.
2. Advertising and information materials of group members of the Union of Scientists – Ruse are published free of charge.
3. Advertising and information materials of companies and organizations are charged on negotiable (current) prices.

Editorial Board

ISSN 1314-3077

9 771314 307000