

Posudek práce

předložené na Matematicko-fyzikální fakultě
Univerzity Karlovy

- posudek vedoucího posudek oponenta
 bakalářské práce diplomové práce

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Název práce: Studies of the K-shell double vacancy production in the electron capture decays of ^{55}Fe , ^{54}Mn and ^{65}Zn using hybrid pixel detectors
Studijní program a obor: Fyzika, Jaderná a subjaderná fyzika (FJF)
Rok odevzdání: 2023

Jméno a tituly oponenta: Mgr. Stanislav Valenta, Ph.D.
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Odborná úroveň práce:

- vynikající velmi dobrá průměrná podprůměrná nevyhovující

Věcné chyby:

- téměř žádné vzhledem k rozsahu přiměřený počet méně podstatné četné závažné

Výsledky:

- originální původní i převzaté netriviální kompilace citované z literatury opsané

Rozsah práce:

- veliký standardní dostatečný nedostatečný

Grafická, jazyková a formální úroveň:

- vynikající velmi dobrá průměrná podprůměrná nevyhovující

Tiskové chyby:

- téměř žádné vzhledem k rozsahu a tématu přiměřený počet četné

Celková úroveň práce:

- vynikající velmi dobrá průměrná podprůměrná nevyhovující

Slovní vyjádření, komentáře a připomínky oponenta:

In the present diploma thesis, the author describes their measurement of the K-shell double vacancy production probability, P_{KK} , for radioisotopes ^{55}Fe , ^{54}Mn , and ^{65}Zn using a pair of Timepix3 detectors.

The Introduction and Chap. 1 read well. However, I have a few - to some extent subjective - remarks. While I have no principled objections against citing the supervisor's thesis, I would like the author to assure it is the original work on the issue. Moreover, when a specific experiment and its resulting P_{KK} are mentioned, I would expect a mention of the isotope under study. Furthermore, there seems to be a mismatch between the text, Fig. 1, and Fig. 2 – from the text I got the impression that Intemann's work (Ref. [9] in the thesis) is a review, while from Fig. 1 it is not clear if that is the case or if said work is an extensive experimental one. Fig. 2 again hints towards a review character of Intemann's work, only after reading the work I understood it is a theoretical one. In Fig. 1, I do not understand the selectivity when plotting the green points, which are taken from various experiments as compiled by Intemann. Lastly, I would expect at least a short comment on different theoretical predictions presented in Fig. 2 (taken from Intemann's work), it is not clear why the author refers only to the Primakoff-Porter prediction.

In the following Chapter, the author describes the Timepix3 detector, its working principle, and the used software. I have some formal remarks, in particular, that the listing of configuration files should not appear in the text but as an appendix. The dominant part of the thesis is presented in Chap. 3. As in the case of the previous Chapter I have some (formal) remarks, but more importantly several questions, see below.

At the end of Chap. 3, the author provides the groundwork for the analysis of the ^{65}Zn measurement. Therein and in Conclusion, the possibility to use a triple coincidence setup to improve the measurements of ^{54}Mn and ^{65}Zn is also mentioned. The two main results – P_{KK} for ^{55}Fe and ^{54}Mn – are given in Conclusion, in comparison to the preceding experimental ones. I was expecting to see their comparison to the aforementioned theoretical prediction, not only to other experimental results, perhaps in form of Fig. 1. Considering the above and assuming satisfactory answers during thesis defense, I propose the grade “velmi dobře”.

Případné otázky při obhajobě a náměty do diskuze:

- In Sec. 3.1 the author describes that “Noisy pixels were masked manually by spotting them in a 2D histogram of pixel hits.” and “Masks of noisy pixels are then utilized in subsequent analysis in which clusters hitting masked pixels are considered as noise and are removed from the analysis.”, without providing further information in the thesis, perhaps with the exception of visual information in Fig. 3.1. How many pixels were masked? Is this number stable during the experimental campaign? How many clusters were removed from the analysis? What is the distribution of the cluster's size? A reader could ask if this approach is adequate or too conservative, if the data loss is negligible or not.
- While the message that the ToA bug is corrected for, presented in Sec. 3.1 by Fig. 3.3, is clear, the description of the bug and the procedure are not. Please clarify what is ΔToA , what quantities are plotted in Figs. 3.2 and 3.3, and if my impression that the shift is always sharp ± 25 ns is correct. Does the author have an explanation of the ToA bug?
- How do the fitted coefficients, presented in captions of Figs. 3.5, 3.14, and 3.23, compare to tabulated values?

- In Sec. 3.2.1 the author says “We have to also consider **major** background processes.” and continues with naming (i) random coincidence of K-line X-rays, (ii) K-line X-ray and IB photon, and (iii) processes involving shake-off electron. What are the other background process(es) and what is the estimated contribution(s)?
- In Sec. 3.2.4 the author compares their result to Bergmann et al. [5]. Are there other measurements and/or predictions to compare to? If so, how do they compare?
- Why is the full energy peak in Fig. 3.13 shifted to ≈ 750 keV?
- Last but not least, I would appreciate it if the author could specify their contribution to the experimental campaign, the data analysis, and perhaps the development of the involved software.

Práci:

- doporučuji
 nedoporučuji
uznat jako diplomovou.

Navrhuji hodnocení stupněm:

- výborně velmi dobře dobře neprospěl

Místo, datum a podpis oponenta:

Praha, 30. ledna 2023

Mgr. Stanislav Valenta, Ph.D.

