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Review for the dissertation of Mikhail Padniuk

Dear Prof. Jacek Golak

It is my distinct pleasure to provide a highly favorable review of the PhD thesis entitled "Wide-frequency-range Atomic Comagnetometry to Search for Spin-dependent Interactions Beyond the Standard Model," authored by Mikhail Padniuk. This thesis constitutes a significant advancement in the field of beyond Standard-Model searches, showcasing both comprehensive theoretical insights and rigorous experimental work. My critical comments are limited to minor corrections, which will be communicated directly to the candidate.

Comprehensive Theoretical Coverage

The theoretical exposition presented in this thesis is exemplary. The candidate has meticulously reviewed the relevant literature and theoretical frameworks, demonstrating a profound understanding of the current research landscape pertaining to the detection of spin-dependent beyond-Standard-Model interactions. Notably, the theoretical description was extended to encompass oscillating spin couplings, further expanding the applications of the theoretical framework. The theoretical foundation is articulated with exceptional clarity, elucidating complex concepts in a manner that is both thorough and accessible. This comprehensive theoretical coverage reflects the candidate's deep engagement with the subject matter and his ability to synthesize and critically evaluate existing knowledge.

Thorough Experimental Results

The experimental component of this thesis is equally commendable. The candidate has provided a meticulous account of the experimental setup, methodologies, and results. The well-established method of noble-gas-alkali comagnetometers is extended to oscillating spin couplings. The theoretical and experimental consequences are described with precision and detail, and the candidate convincingly demonstrates the system's sensitivity to these couplings. The experimental results are



presented systematically, with rigorous analysis and interpretation, underscoring the robustness and reliability of the findings.

Structure and Organization

The thesis is exceptionally well-structured, guiding the reader logically through the progression of the research. Each chapter builds cohesively upon the previous one, creating a coherent narrative that enhances the reader's comprehension of the research topic. The organization of the thesis reflects the candidate's ability to present complex information in a systematic and coherent manner, rendering the document not only informative but also engaging.

Conclusion

In conclusion, Mikhail Padniuk has produced a PhD thesis that is distinguished by its comprehensive theoretical coverage, thorough experimental results, and excellent structure. The work convincingly demonstrates the sensitivity of the comagnetometer system in general, and the Krakow system in particular, to oscillating spin couplings beyond the Standard Model. I commend the candidate for his outstanding research and recommend this thesis for acceptance without reservation.

Recommendation

In light of the quality and significance of the research presented, I strongly recommend that Mikhail Padniuk be awarded the PhD degree. This thesis stands as a testament to the candidate's diligence, dedication, and exceptional research capabilities in the field of experimental physics. Moreover, the very well-structured description of complex theoretical and experimental findings demonstrates a scientific maturity that is rare to find in PhD candidates. I therefore also strongly recommend that the thesis should receive a special distinction. The quality of the presented work is exemplary, and the thesis will stand as a scientific reference work as well as an immensely valuable guide for researchers in the field.

Yours sincerely

Georg Bison