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REVIEWER'S REPORT

Manuscript No.: IJAR-56164

Title: Modified Atomic Orbital Theory Applied to the Study of (3d94s 3D3,2,1)np and the (3d94s 1D2)np Rydberg series of Cu-like Zn+

Recommendation:

Accept as it is .....
✓ Accept after minor revision.....
Accept after major revision .....
Do not accept (*Reasons below*) .....

Rating	Excel.	Good	Fair	Poor
Originality		✓		
Techn. Quality		✓		
Clarity	✓			
Significance	✓			

Reviewer Name: Dr S. K. Nath **Date:** 12.02.26

Detailed Reviewer's Report

Strengths of the Study

- **Originality:** The application of the Modified Atomic Orbital Theory (MAOT) to high-lying Rydberg series of Zn+ ions represents a significant extension and demonstrates innovative use of semi-empirical modeling in atomic physics.
- **Relevance:** The work addresses important questions related to resonance energies integral to astrophysical plasma diagnostics and spectral interpretations of trans-iron elements.
- **Methodology:** The combination of MAOT with quantum defect theory, supplemented by comparison with advanced computational methods (DARC) and experimental data, provides robust and comprehensive analysis.
- **Data Quality:** The resonance energies predicted by MAOT align closely with high-resolution ALS measurements and other theoretical methods, indicating high reliability and precision.
- **Contribution to the Field:** The dataset of high-lying resonance energies (n = 16–45) can serve as valuable benchmarks and enrich the NIST database for astrophysical applications.

Weaknesses of the Study

- **Methodological Limitations:** The semi-empirical nature of MAOT, while effective, may lack the predictive rigor of fully ab initio methods, which could limit accuracy in less well-characterized systems.
- **Limited Scope:** The study is focused solely on Zn+ ions; broader validation across different elements or ions could strengthen claims of general applicability.
- **Absence of Statistical Analysis:** While deviations are discussed, a formal statistical treatment (e.g., uncertainty quantification) of the resonance energies is missing.
- **Clarity in Presentation:** Some tables (e.g., resonance energies and quantum defects) can benefit from clearer structuring to enhance readability.
- **Graphical Data:** Lack of figures or plots comparing experimental data and theoretical predictions limits immediate interpretability.

Reviewer Comments

- The **title clearly indicates the scope**, but could be slightly more descriptive, emphasizing the novel application of MAOT to high-lying Rydberg series.

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- The **abstract** succinctly summarizes objectives, methodology, and conclusions, though inclusion of the significance of findings could strengthen it.
- The **introduction** provides a solid background, but explicitly stating the main research gap and objectives at the end would improve clarity.
- The **methodology section** offers a brief overview of MAOT formalism; adding more details or references for clarity would benefit readers unfamiliar with the technique.
- The **results** are comprehensive; however, detailed discussion on the sources of discrepancies and uncertainties would improve interpretative depth.
- The **conclusion** appropriately highlights the significance of results, but discussing potential limitations and future work would add value.
- **Ethical considerations** are not explicitly addressed; however, as this is a computational and experimental comparison study, formal ethical approval is generally not required.
- The **English language and grammar** are acceptable overall, with minor improvements possible for clarity.
- **Tables and formatting** are functional, yet some could be better formatted for readability, particularly with consistent alignment and more descriptive captions.
- The **references** are adequate and support the content; ensuring consistent citation styles would be beneficial.

Verification of Prior Publication

The manuscript appears to be a recent, original submission and does not show evidence of prior publication on open-access platforms or preprint servers. A comprehensive internet search with key phrases indicates this is novel work, and no duplication or prior dissemination was detected.