ISSN: 2320-5407

International Journal of Advanced Research

Publisher's Name: Jana Publication and Research LLP

www.journalijar.com

REVIEWER'S REPORT

Manuscript No.: IJAR-53816 Date: 14.09.2025

Title: Magnetotransport Impact on Shunt Resistance in Bifacial c-Si Cells: A Near-Short-Circuit Analysis

Recommendation:
Accept as it is ……………………………….
Accept after minor revision………Yes………
Accept after major revision ……………..
Do not accept (*Reasons below*) ………

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

Reviewer Name: Shikhar Pandey **Date:** 14-09-2025

Reviewer's Comment for Publication.

(*To be published with the manuscript in the journal*)

The reviewer is requested to provide a brief comment (3-4 lines) highlighting the significance, strengths, or key insights of the manuscript. This comment will be Displayed in the journal publication alongside with the reviewers name.

The manuscript presents a well-structured and original investigation into the effects of magnetic fields on the shunt resistance of bifacial c-Si solar cells. The use of a three-dimensional modeling framework, alongside parametric extraction methods, provides significant insights into how device geometry, illumination mode, and magnetic perturbations interact. The study's findings on optimizing base thickness and passivation, as well as accounting for magnetic influences in measurement, are highly relevant for both research and practical solar cell design. Minor revisions regarding clarity in the methodology section and presentation of results would further enhance the manuscript.

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Detailed Reviewer's Report

The paper is strongly relevant to the themes and topics of the conference, as it addresses a significant issue in photovoltaic device performance, how magnetic fields, device geometry, and illumination modes impact the shunt resistance in bifacial crystalline silicon solar cells. The research presents high originality, as it applies a 3D modeling framework combined with parametric extraction methods to investigate magnetotransport effects, offering new insights into optimizing device structure and measurement protocols. The methods and analysis are technically excellent, with well-formulated equations, appropriate modeling assumptions, and thorough exploration of the variables involved. The paper is clearly written and logically structured, making the complex concepts accessible while maintaining technical rigor, and the results are highly significant, as they contribute actionable guidelines for improving solar cell efficiency and reliability, which advances the state-of-the-art in photovoltaic research. The related work is adequately cited and discussed, connecting the current study with prior research on passivation, leakage diagnostics, and magnetoconductivity without leaving important gaps. There are no ethical concerns observed in terms of plagiarism or data integrity.

Based on these assessments, my overall recommendation is accepting after minor revision, where improving clarity in specific sections-

The methodology section could be improved by clearly explaining the assumption that surface passivation effects are negligible, including when this holds true and what limitations it introduces. Parameters such as Sg (grain boundary recombination velocity) and Sf (front surface recombination velocity) are introduced without fully explaining their physical meaning, estimation, or role in the model; expanding this would aid comprehension. The boundary conditions applied at grain edges in equations (7) and (8) are mathematically correct but need additional explanation or diagrams to show how they relate to actual device structures. The term "apparent Rsh extracted from the low-voltage slope" is used frequently, but distinguishing between real leakage and measurement artifacts would clarify its meaning. The effects of front, rear, and dual illumination on diffusion, recombination, and leakage paths could be better illustrated with examples or schematics. Several figures would benefit from brief interpretative captions to guide the reader in understanding key trends. Finally, ensuring consistent usage and clear definitions of terms like "apparent Rsh," "photogenerated current density," "low-voltage slope," and "leakage path" at their first mention would enhance clarity throughout the manuscript.