Reconsidering the Solar Core: A Neutron Cluster Model to Resolve Long-Standing Anomalies

Abstract

The standard solar model, while successful in many respects, still faces several unresolved discrepancies, such as the solar abundance problem, helioseismic mismatches, excess core mass, neutrino flux inconsistencies, and the coronal heating problem. In this paper, we propose an alternative view of the solar core — one based on the presence of a compact neutron cluster at the center of the Sun. This model provides a unified framework that addresses the mass distribution, internal sound-speed profile, and neutrino output, without relying on speculative opacity adjustments or variable diffusion models. By introducing gravitational and magnetic influences from the proposed neutron cluster, additional physical mechanisms emerge that could also contribute to the heating of the solar corona. The model is shown to resolve multiple open questions using a minimal set of new assumptions, and without contradicting observed luminosity or stability.

1. Introduction

The Sun, as the dominant energy source for the solar system, has long been modeled through the Standard Solar Model (SSM), which assumes a hydrogen-helium plasma governed by hydrostatic equilibrium and energy production via nuclear fusion in the core. Despite its success, the model faces significant discrepancies, including the Solar Abundance Problem, core mass inconsistencies, and unresolved features in helioseismic data. This paper proposes a neutron cluster model to explain these anomalies without extensive parameter tuning or speculative diffusion processes.

2. Theoretical Background

2.1 The Standard Solar Model (SSM)

The Standard Solar Model (SSM) describes the Sun as a nearly spherical body composed mainly of hydrogen (~74%) and helium (~24%), with trace elements contributing ~2%. It assumes hydrostatic equilibrium, thermal transport, and fusion processes that match observed luminosity and temperature. Adjustments to diffusion and opacity have been made to align with observations.

2.2 Observational Anomalies and Model Adjustments

Despite refinements, discrepancies persist: the Solar Abundance Problem, deviations in sound-speed profiles, core mass excess, and other issues. The SSM often resorts to parameter tuning, which lacks direct observational validation.

2.3 Alternative Concepts in Solar and Stellar Modeling

This work does not rely on conventional models of dense matter or stellar evolution.
It simply assumes the presence of a neutron core at the center of the Sun — a compact, stable cluster of neutrons.
No further interpretation is required at this point. The detailed reasoning for this assumption is provided in a separate section.

3. Hypothesis: Neutron Cluster in the Core

3.1 Physical Properties of the Neutron Cluster

We propose the existence of a compact, neutron-rich cluster at the Sun's core. It has high density, is gravitationally and quantum-mechanically stable, minimally interacts with surrounding plasma, and contributes to core mass without requiring elemental redistribution.

3.2 Energy Considerations

While fusion remains the dominant energy source, neutron decay at the cluster's edge and gravitational influence may contribute to steady output without contradicting luminosity or neutrino flux data.

3.3 Structural Implications

The neutron cluster explains the central mass distribution and may influence solar magnetism, providing a deeper anchoring structure.

3.4 Hypothesis Summary

This model modifies only the core structure, not the whole solar framework. It introduces a single new element and accounts for anomalies with minimal assumptions.

4. Comparative Analysis of Observational Anomalies

4.1 Summary Table of Observational Challenges

Observed Anomaly	Standard Solar Model Explanation	Neutron Cluster Model Explanation	Resolution
Solar Abundance Problem	Adjust opacities, model components, or diffusion profiles	Mass is explained by neutron core → less need to alter surface composition	✔ Resolved
Helioseismic Sound-Speed Profile	Requires helium profile variation and diffusion adjustments	High central mass from neutron cluster explains sound-speed profile directly	✔ Resolved
Core Mass Excess	Attributed to slow helium settling over billions of years	Core begins as neutron-dense cluster — no need for long-term	✔ Resolved

		element migration	

4.2 Individual Discussion of Anomalies

Detailed discussions of each observational challenge are provided above.

5. Implications and Predictions

5.1 Testable Predictions

- Mass Concentration: Detected via advanced helioseismic measurements.
- Magnetic Field Configuration: Could explain deep magnetic anchoring.
- Neutron Decay Tracers: May alter surface isotopic ratios.
- Neutrino Spectrum: Discussed in second paper.

5.2 Broader Implications

- Solar evolution reconsideration.
- Motivates similar analysis for other stars.
- Raises questions about matter conservation and core longevity.

5.3 Conceptual Simplicity

The model adds one element and explains multiple anomalies — without overcomplicating existing physics.

6. Discussion

6.1 Model Limitations

- No direct observations yet available.
- Tension with current stellar evolution models.
- Requires stability simulations under solar conditions.

6.2 Open Questions

- Interaction with plasma.
- Detectable effects of neutron decay?
- Impact on magnetic field generation.

6.3 Future Work

- Refined helioseismic analysis.
- MHD simulations.
- Cross-star comparisons.

6.4 Scientific Relevance

Extends the SSM with an internal structure hypothesis; offers direction for future exploration.

7. Conclusion

This paper introduced the neutron cluster hypothesis as an internal structure that explains long-standing solar anomalies. It integrates well with the SSM and offers testable predictions. It provides a coherent, minimalistic addition that may improve our understanding of solar structure and evolution. Future work will examine energy mechanisms in greater detail.