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Peer Review

Review of: "Spatially Modulated Plasma Profile for Turbulence and Instability Mitigation in Fusion Plasma"

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This paper introduces a novel approach to mitigating turbulence and instabilities in fusion plasmas using spatially modulated plasma profiles. Drawing inspiration from phenomena like bandgap formation in solid-state physics and photonic crystals, the study explores how spatial periodicity in plasma parameters can alter wave propagation and suppress turbulence. The mathematical framework, based on the Mathieu equation, provides a robust theoretical foundation for understanding how spatial modulation impacts wave attenuation. The paper also outlines practical pathways for implementing this modulation, such as RF waves, static magnetic field perturbations, and spatially modulated neutral particle beams, making the concept applicable across various magnetic confinement devices.

While the theoretical depth and innovation of the study are commendable, it lacks experimental validation or computational simulations to support its claims. The practical feasibility of the proposed methods, including the challenges of implementation and cost considerations, is not sufficiently addressed. Additionally, the discussion of modulation effects, which can lead to either wave amplification or damping, is intriguing but requires further elaboration. Despite these limitations, the paper presents a compelling alternative to traditional turbulence suppression techniques, offering a versatile framework that could significantly advance the development of stable, high-performance fusion plasmas. Future work should focus on experimental testing and detailed feasibility studies to transition this promising concept from theory to application.

Declarations

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Potential competing interests: No potential competing interests to declare.