Qeios

Peer Review

Review of: "The Band-Gap Approach for Turbulence and Instabilities Mitigation in Fusion Plasma"

V. I. Geyko[1]

1. Lawrence Livermore National Laboratory, Livermore, United States

To my mind, this manuscript appears more akin to a draft or a collection of research notes rather than a finalized research article. It lacks a well-structured introduction, a comprehensive literature review, and a clear articulation of the significance of its research findings. Therefore, publication should only be considered following major revisions and substantial improvements to enhance its quality and readability. Below, I provide detailed comments addressing specific issues in the manuscript:

Introduction and Literature Review

The introduction gives the impression that the author has a background in solid-state physics but limited expertise in plasma physics, despite the manuscript being intended for a plasma physics audience. This is evident from the numerous references related to crystal lattice physics, while there is a complete absence of references when plasma physics concepts are introduced. For instance, the author discusses turbulence suppression and confinement improvement via "plasma rotation shear" and "plasma shaping and magnetic field configuration optimization" without providing any supporting references. Statements such as, "Plasma shape and magnetic topology optimization is the subject of another constraints, as improper configurations could lead to new instability modes," are vague—specific modes should be identified and referenced. Additionally, the claim that "the time-averaged spatial scale of plasma parameters in fusion plasmas has typically the scale of the the confinement device," is misleading. For example, the spatial width of the tokamak pedestal depends on various physical properties of the plasma, not solely on the device dimensions (e.g., see https://doi.org/10.1063/1.1518474). I strongly recommend a thorough rewrite of the introduction to align it with professional standards and provide relevant, accurate references to plasma physics literature.

doi.org/10.32388/JC8L9V

Scientific Impact

The primary conclusion of the paper—that parametric resonance can result in wave damping or amplification—is presented as the central finding. However, this result is purely theoretical and disconnected from realistic plasma scenarios, reducing its novelty and impact. The concept of parametric resonance is already well-documented in fundamental texts and resources such as Wikipedia (https://en.wikipedia.org/wiki/Parametric_oscillator#Solution_of_the_transformed_equation). While the author briefly explores potential applications of spatial parametric resonance in plasma setups, these ideas remain underdeveloped, with no detailed analysis or concrete examples provided. This lack of specificity significantly diminishes the manuscript's significance and scientific contribution.

Problem Formulation

The manuscript begins with a standard wave equation (Eq. (1)) for drift waves but fails to derive it from fundamental plasma physics models (e.g., MHD, gyrokinetics, or kinetic Vlasov-Maxwell equations) or reference any prior works where such an equation has been derived or analyzed. Furthermore, the problem lacks a proper description, including assumptions, geometry, parameter ranges, and boundary conditions. As a result, the model equation appears disconnected from any realistic plasma configuration, leaving the reader with an abstract framework devoid of practical relevance.

Cosmetic and Formatting Issues

The manuscript also contains numerous formatting, notation, and grammatical errors, which further detract from its quality:

- Starting with Eq. (7), parentheses are improperly sized (e.g., (\omega/u_p^0) in Eq. (7)). The use of “\left(\right)” in LaTeX can resolve this issue.
- Including images of equations in the Appendix is highly unconventional and unacceptable in a scientific manuscript.
- Inconsistent fonts are used throughout the manuscript. For example, in "have been factored out to isolate the slowly varying amplitudes a(x) and b(x)," the fonts of a(x) and b(x) are inconsistent.
- The bold font used for n(x) is inappropriate, as bold fonts typically denote vector variables, whereas n(x) is clearly a scalar in this context.

- Some grammatical errors are present, such as "spatial modulation created by **an** external current**s**." Processing the manuscript through a language editing tool, such as ChatGPT, could help eliminate these errors and improve the overall readability and clarity.

In conclusion, while the manuscript contains some interesting theoretical elements, it requires significant revisions to meet the standards of a scientific research article. Addressing the above issues will substantially enhance its quality and impact.

Declarations

Potential competing interests: No potential competing interests to declare.