REPORT

on the PhD thesis entitled

"The effects of nonlinear vacuum electrodynamics and general relativity for the passage of the front of electromagnetic waves through the magnetic field of the magnetar"

by

YERNAZAROV TURSYNBEK IZMUKHANOVICH

The thesis presented by Yernazarov Tursynbek Izmukhanovich investigates the interaction between electromagnetic waves and the magnetic field of a magnetar within the frameworks of nonlinear vacuum electrodynamics and general relativity. Magnetars, known for their extremely strong magnetic fields, provide an ideal setting for studying the behavior of electromagnetic waves influenced by intense magnetic fields, revealing insights into fundamental physics phenomena.

The main objective of Tursynbek's research is to understand how electromagnetic wavefronts propagate through the highly magnetized environment surrounding a magnetar. By applying nonlinear electrodynamics and general relativistic principles, the thesis aims to determine the alterations in the wavefront characteristics as they interact with the magnetic field. This includes analyzing the bending of light, modifications in wave speed, and the overall influence of the magnetar's magnetic environment.

To achieve the research objectives, Tursynbek developed analytical models incorporating nonlinear electrodynamics theories, such as the Born-Infeld theory, combined with the equations of general relativity. He applied these models to simulate the electromagnetic wave propagation in a magnetar's magnetic field. The models were further refined using computational simulations to analyze the bending and deformation of wavefronts in various scenarios.

The thesis also integrates observational data from relevant astronomical sources and considers different configurations of magnetar magnetic fields to provide a comprehensive analysis of how these fields affect electromagnetic wave propagation. This methodology ensures a robust understanding of both theoretical and observable aspects of the phenomenon.

Tursynbek's research provides significant insights into the nonlinear interactions between electromagnetic waves and magnetar magnetic fields. The thesis demonstrates that the intense magnetic field of a magnetar alters the wavefront's structure, bending and slowing down the propagation of electromagnetic waves in a manner consistent with predictions from nonlinear electrodynamics. Furthermore, his findings show that the effects of the magnetar's magnetic field extend beyond what linear electrodynamics predicts, highlighting the necessity of considering nonlinear theories in such extreme environments.

Dissertation Thesis of Yernazarov Tursynbek Izmukhanovich by title "The effects of nonlinear vacuum electrodynamics and general relativity for the passage of the front of electromagnetic waves through the magnetic field of the magnetar" performed at a high scientific level, is a complete scientific research, meets the requirements for an independent scientific qualifying work, and recommended to the defense in the Dissertation Council at Al-Farabi KazNU to award the scientific degree of Doctor of Philosophy in Physics.

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