REVIEW

of the official reviewer of the dissertation work

Yernazarov Tursynbek Izmukhanovich on the topic “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”, submitted for the degree of Doctor of Philosophy (PhD) in the specialty 8D05306 – Physics

№	Criteria	Compliance with the criteria (underline one of the answer options)	Justification of the official reviewer's position (comments should be highlighted in italics))
1.	The topic of the dissertation (as of the date of its approval) corresponds to the directions of scientific development and/or state programs	1.1 Compliance with priority areas of scientific development or state programs:	The dissertation was prepared in alignment with the plans for fundamental scientific research projects.
		1) the dissertation was completed within the framework of a project or target program financed from the state budget (indicate the name and number of the project or program); 2) the dissertation was completed within the framework of another state program (indicate the name of the program); 3) the dissertation corresponds to the priority direction of scientific development approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the direction).	The dissertation topic is aligned with the priority scientific research area "Research in Natural Sciences" within the framework of project AP22686542, titled "Numerical Study of Ray Deflection on Magnetars Considering Dark Matter," as well as project AP14869524, titled "Effects of Nonlinear Vacuum Electrodynamics and General Relativity on Magnetars."
2.	Importance for Science	The work makes/does not make a significant contribution to science, and its importance is/is not well explained.	The dissertation on the topic "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" describes an important phenomenon in astrophysics, which has a significant impact on science, and whose significance is well disclosed.

3.	The principle of independence	Level of independence: 1) high; 2) average; 3) short; 4) there is no independence.	The author's level of independence in conducting research is high. The author independently completed all aspects of the dissertation work, including the development of the methodology, solving the assigned tasks, as well as performing analytical and numerical calculations.
4.	The principle of internal unity	4.1 Justification of the relevance of the dissertation: 1) justified; 2) partially justified; 3) not substantiated.	Research in the field of nonlinear electrodynamics and nonlinear optics is extremely relevant in the field of their application to the study of magnetars
		4.2 The content of the dissertation reflects the topic of the dissertation: 1) reflects; 2) partially reflects; 3) does not reflect.	The content of the dissertation fully reflects the research topic. The dissertation work is presented as a completed work.
		4.3. The goal and objective correspondence is the topic of the dissertation: 1) correspond; 2) partially match; 3) do not correspond.	The goals and objectives of the study, the provisions submitted for defense demonstrate mutual agreement and correspond to the topic of the dissertation.
		4.4 All sections and provisions of the dissertation are logically interconnected: 1) completely interconnected; 2) partial relationship; 3) there is no connection.	All sections of the dissertation are logically interconnected. The work consists of an introduction, two chapters, a conclusion and a list of references. The introduction substantiates the relevance of the study, presents the goal, objectives, object, subject and method of the dissertation. The scientific novelty, theoretical and practical significance of the study, as well as the main provisions submitted for defense are formulated. Each of the sections is logically interconnected. The conclusion presents the main findings of the study.

		4.5 The new solutions (principles, methods) proposed by the author are substantiated and evaluated in comparison with known solutions: 1) there is a critical analysis; 2) partial analysis; 3) The analysis does not represent personal opinions, but quotes from other authors; 4) analysis missing.	In the dissertation the author has shown detailed review of previous works of other authors confirmed by references.
5.	The principle of scientific novelty	5.1 Are the scientific results and provisions new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new).	The scientific results and provisions obtained in the course of the work are completely new. The author of the dissertation provides qualitative and quantitative estimates of the deflection of light in ultra strong magnetic field of a magnetar
		5.2 Are the findings of the dissertation new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new).	All conclusions are based on significant scientific evidence and are correctly substantiated. The work was tested at international conferences in Kazakhstan and abroad. Based on the research results, 6 scientific papers were published, including one article in a top-rated scientific journal indexed by the Scopus database (percentile - 80), and five articles in journals included in the list of Science and Higher Education Quality Assurance Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan.
		5.3 Technical, technological, economic or managerial decisions are new and justified: 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new).	The solutions obtained by the doctoral student are completely new. It is confirmed by recent articles in peer-reviewed journals.
6.	Validity of the main conclusions	All key findings are based/not based on sound scientific evidence or are reasonably well supported (for qualitative research and arts and humanities majors).	The theoretical research conducted by the dissertation has led to results that demonstrate both scientific and practical innovativeness. The main conclusions are confirmed and proven, since the author relies on previously analyzed scientific documentation and factual data confirmed by methods and theories.

7.	The main provisions submitted for defense	The following questions must be answered for each provision separately: 7.1 Has the position been proven? 1) proven; 2) rather proven; 3) rather not proven; 4) not proven; 5) In the current formulation, it is impossible to verify the proof of the position.	All provisions shown in dissertation are proven. Author of dissertation did show parameters and estimates of deflection of rays caused by both the gravitational and dipole magnetic field, deformation of the wavefront of electromagnetic radiation caused by the gravitational and dipole magnetic fields of the magnetar and application to gamma-ray burst GRB 091006360
		7.2 Is it trivial? 1) Yes; 2) No; 3) in the current formulation it is impossible to verify the triviality of the position.	Provisions are not trivial. This fact confirms complicated numerical calculations shown in dissertation.
		7.3 Is it new? 1) Yes; 2) No; 3) In the current formulation it is impossible to verify the novelty of the provision.	All provision s and results shown in dissertation are new. It is confirmed by recent articles in peer-reviewed journals.
		7.4 Level to use: 1) narrow; 2) average; 3) wide; 4) In its current formulation, it is not possible to verify the level of application of the provision.	The provisions submitted for defense are proven, new, and non-trivial. The scope of their application is quite wide, confirmed in publications.
		7.5 Is it proven in the article? 1) Yes; 2) No; 3) in the current wording it is impossible to verify the proof of the position in the article	All results in dissertation are proven and confirmed by articles in peer-reviewed journals.
8.	The principle of reliability. Reliability of sources and information provided.	8.1 The choice of methodology is justified or the methodology is described in sufficient detail: 1) Yes; 2) No;	The choice of methodology in this study is carefully justified and described in detail.
		8.2 The results of the dissertation work were obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies: 1) Yes; 2) No;	The results of the dissertation work were obtained through the integration of well-known analytical studies with modern computer computing technologies.

		8.3 Theoretical conclusions, models, identified relationships and patterns are proven and confirmed by experimental research (for areas of training in pedagogical sciences, the results are proven on the basis of a pedagogical experiment): 1) Yes; 2) No;	The theoretical justifications, created models, discovered relationships and patterns are confirmed by precise mathematical proofs. Computational experiments have been conducted that confirm the validity of theoretical conclusions.
		8.4 Important claims are supported/partially supported/not supported by references to relevant and reliable scientific literature.	All important statements presented in the dissertation are supported by references to relevant and reliable scientific literature. A thorough analysis of modern research has been conducted, and the main findings have been compared with the results of other scientists. Articles from peer-reviewed scientific journals, data from authoritative databases and monographs have been used, which guarantees high reliability and relevance of the sources.
		8.5 The literature sources used are sufficient/not sufficient for a literature review.	The literature review presents both classical works that laid the foundation for the theory and modern research that reflects the latest achievements and discoveries. The literature sources used are sufficient to conduct a quality literature review. Including diverse, authoritative and relevant sources allows for a comprehensive analysis and reliability of the dissertation conclusions.
9.	The principle of practical value	9.1 The dissertation has theoretical significance: 1) Yes; 2) No.	A theoretical significance of the dissertation is quantitative and qualitative assessments of magnetic lensing.
		9.2 The dissertation has practical significance and there is a high probability of applying the obtained results in practice: 1) Yes; 2) No.	Practical significance is shown in dissertation on application to highly magnetized neutron stars (magnetars).
		9.3 The suggestions for practice are new: 1) completely new; 2) partially new (25-75% are new);	All suggestions in dissertation are completely new, it is confirmed by new articles in peer-reviewed journals.

		3) not new (less than 25% are new).	
10.	Quality of writing and design	Quality of academic writing: 1) high; 2) average; 3) below average; 4) low.	The dissertation is distinguished by the high quality of academic writing, which is manifested in the clarity and accuracy of presentation, logical structure, argumentation and evidence, as well as compliance with scientific style and language.
11.	Notes on a thesis		
12.	Scientific level of the doctoral student's articles on the topic of research (in case of defense of the dissertation in the form of a series of articles, the official reviewers comment on the scientific level of each article of the doctoral student on the topic of research)		
13.	Decision of the official reviewer (pursuant to paragraph 28 of the present Model Regulations)	The dissertation by Yernazarov T.I., titled "The effects of nonlinear vacuum electrodynamics and general relativity on the passage of the front of electromagnetic waves through the magnetic field of the magnetar," meets all the standards established by the Committee for Quality Assurance in Science and Higher Education for PhD dissertations. Tursynbek Izmukhanovich Yernazarov is fully deserving of being awarded the academic degree of Doctor of Philosophy (PhD) in the educational program "8D05306 - Physics."	

PhD, Senior Researcher
Laboratory of Theoretical Nuclear Physics, Institute of Nuclear Physics, Almaty, Kazakhstan Fedosimova A. I.

Signature certification: PhD, Deputy Director General for Science, Institute of Nuclear Physics Saduyev N.O.