REVIEW

of the official reviewer for dissertation work (series of articles)

by Gabitova Ilfa Azamatovna on the topic «Structure and evolution of circumstellar matter in Be stars» presented for the degree of Doctor of Philosophy (PhD) in the educational program 8D05307 – Physics and Astronomy.

№	Criteria	Eligibility (one of the options must be checked)	Justification of the position of the official reviewer
1.	The topic of the thesis (as of the date of its approval) corresponds to the directions of development of science and/or state programs	1.1 Compliance with priority areas of science development or government programs: 1) The thesis 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 thesis was completed within the framework of another state program (indicate the name of the program) 3) The dissertation corresponds to the priority direction of the development of science, approved by the Higher Scientific and Technical Commission under the Government of the Republic of Kazakhstan (indicate the direction)	Gabitova Ilfa's dissertation work (series of articles) entitled «Structure and evolution of circumstellar matter in Be stars» was prepared in alignment with the plans for fundamental scientific research projects. The dissertation topic is aligned with the plans of fundamental research works of the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan «Grant financing of scientific research» within the framework of project AP23484898 – «Development of a modern technique for determining the fundamental parameters of Galactic hot supergiants».
2.	Importance for science	The work makes/does not make a significant contribution to science, and its importance is well disclosed/not disclosed	In short the presented dissertation work (series of scientific publications) does make a significant contribution to astrophysics and its importance is well disclosed. The dissertation "Structure and evolution of circumstellar matter in Be stars" meticulously examines a pivotal astrophysical phenomenon. It underscores the profound scientific implications of this subject and comprehensively elucidates its significance.
3.	The principle of independence	Self-reliance level: 1) High; 2) Medium;	The author exhibits quite high degree of self-reliance in conducting research, successfully completing all facets of the research independently, including the

		3) Low; 4) No independence	formulation of the methodology, the resolution of the assigned objectives, and the execution of both analytical inferences and numerical calculations.
4.	The principle of inner unity	4.1 Justification of the relevance of the thesis: 1) Justified; 2) Partially justified; 3) Not justified.	The chosen thesis topic is highly relevant because the phenomenon explored in this dissertation is central to understanding several aspects of stellar evolution, binary star physics, and decretion processes.
		4.2 The content of the thesis reflects the topic of the thesis: 1) Reflects; 2) Partially reflects; 3) Does not reflect	The dissertation's content as reflected in several publications, comprehensively addresses the research topic. The work is presented as a complete and cohesive scholarly works reflecting the selected topic.
		4.3. The purpose and objectives correspond to the topic of the thesis: 1) correspond; 2) partially correspond; 3) do not correspond	The goals and objectives of the study, as well as the statements presented for defense, are fully consistent and correspond to the dissertation topic.
		4.4 All sections and provisions of the thesis are logically interconnected: 1) completely interconnected; 2) the interconnection is partial; 3) there is no interconnection	The presented dissertation is structured as a series of logically interconnected publications, maintaining a clear logical flow and including introductions, conclusions, and a comprehensive list of references. The introduction establishes the relevance of the study and defines the goal, objectives, and methodology of the research. Furthermore, it articulates the scientific novelty and the theoretical and practical significance of the investigation.
		4.5 The new solutions (principles, methods) proposed by the author are reasoned and evaluated in comparison with the known solutions: 1) there is a critical analysis; 2) partial analysis; 3) the analysis does not represent one's own opinions,	The dissertation includes a comprehensive review of previous research, which the author has substantiated with appropriate references.

		but quotes from other authors	
5.	Scientific novelty principle	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 during this research are entirely novel. For the first time, the author of this dissertation provides a qualitative and quantitative description of a complete Be-star disk dissipation event through Doppler tomography of the κDra system, identified and provided kinematic characterization of a narrow Hα emission component co-moving with the companion in HD 698, and established direct, self-consistent constraints on the companion's mass in HD 698. These constraints reject the black-hole scenario previously suggested for this system, instead supporting a stripped bloated companion within quantified uncertainties.
		5.2 Are the dissertation findings new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The findings and its novelty are supported by significant, properly substantiated scientific evidence. This work has been presented and tested at international conferences both in Kazakhstan and abroad. The research has led to the publication of three scientific papers in peer-reviewed journals indexed in the Scopus database.
		5.3 Technical, technological, economic or management decisions are new and reasonable: 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The technical decision presented in the dissertation is new since for the first time provides a qualitative and quantitative description of a complete Be-star disk dissipation event using novel Doppler tomography obtained on spectroscopic observations which were performed on modern instruments using up-to-date data reduction software.
6.	The validity of the main findings	All main conclusions are/are not based on scientifically significant evidence or well-grounded (for qualitative research and areas of training in the arts and humanities)	The scientific significance of these findings is underscored by the robust and multi-faceted evidence supporting the orbital and physical parameters. Reliability is ensured by a comprehensive set of well-grounded evidences, including multi-epoch, multi-

			instrument spectroscopy; the confirmed reproducibility of both RV and V/R measurements; the independent and coherent detection of the same orbital period across both RV and V/R time series; and orbital solutions that align consistently with prior investigations. Furthermore, the geometric and kinematic self-consistency of the mapped structures with the derived binary dynamics provides strong physical validation. The confidence in the conclusions is further strengthened by explicit testing against parameter ranges and alternative scenarios, alongside full documentation of ephemerides, measurement windows, and reconstruction settings, guaranteeing the exact reproducibility of these results.
7.	The main provisions for the defense	It is necessary to answer the following questions for each provision separately: 7.1 Is the provition proven? 1) proven; 2) rather proven; 3) rather not proven; 4) not proven 7.2 Is it trivial? 1) yes; 2) no 7.3 Is it new? 1) yes; 2) no 7.4 Application level: 1) narrow; 2) medium; 3) wide 7.5 Is it proven in the article? 1) yes; 2) no	Each of the provisions is proven. The methods are self-consistent, and the results are backed by existing theoretical models. The provisions are not trivial as each result overturns or extends prior understanding. Application is medium to wide as the approasch an be applied to many Be binaries with sufficient spectroscopic monitoring, and potentially can be applied to other classes of stars with similar characteristics. Each provision is proven in an article. Three articles in which provisions are proven, compose the dissertation work.

8.	The principle of reliability Reliability of sources and information provided	8.1 Choice of methodology - is justified or the methodology is described in sufficient detail 1) yes; 2) no	Yes, the choice of methodology in this study is thoroughly justified and described in detail.
		8.2 The results of the thesis obtained using modern methods of scientific research and methods of processing and interpreting data using computer technologies: 1) yes; 2) no	The dissertation's results were obtained through the use of modern instrumentation, robust algorithms, and up-to-date computational facilities, alongside an advanced data reduction methodology.
		8.3 Theoretical conclusions, models, identified relationships and patterns have been proven and confirmed by experimental research (for areas of training in pedagogical sciences, the results have been proven on the basis of a pedagogical experiment): 1) yes; 2) no	The Dissertation's conclusions and findings are fully substantiated by observational evidence and verified using multiple sources of factual data pertaining to the studied objects.
		8.4 Important statements are confirmed / partially confirmed / not confirmed by references to current and reliable scientific literature	The dissertation's core statements are substantiated and confirmed through references to authoritative and credible scientific literature. A thorough review of current research was conducted, contrasting the principal conclusions with those of other scholars. The reliance on peer-reviewed journal articles guarantees the high relevance and reliability of the sources used to confirm the statements and findings.
		8.5 Used literature sources are sufficient/not sufficient for a literature review	The dissertation features an impressive and extensive bibliography, with over 130 references. This collection is highly comprehensive, incorporating foundational works in the field dating back to the 19th century, alongside very recent publications. Consequently, the sufficiency of the literature sources supports the

8.	The principle of reliability Reliability of sources and information provided	8.1 Choice of methodology - is justified or the methodology is described in sufficient detail 1) yes; 2) no	Yes, the choice of methodology in this study is thoroughly justified and described in detail.
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			execution of high-quality research. The incorporation of such diverse, authoritative, and relevant sources ensures a thorough analysis and significantly enhances the reliability of the dissertation's findings.
9	Practical value principle	9.1 The thesis has theoretical value: 1) yes; 2) no	The theoretical value of this work lies in definitively establishing the binary companion as the mechanism driving non-axisymmetric structure (V/R variability) in Be-star disks, offering critical observational constraints for models of disk truncation, warping, and stream-impact within the Keplerian framework.
		9.2 The thesis is of practical importance and there is a high probability of applying the results obtained in practice: 1) yes; 2) no	The practical value of this work lies in providing a reproducible, end-to-end methodology for analyzing Be binaries—including standardized line measurements, period analysis, and phase-resolved tomography—that is portable and can be directly applied to other Be binary systems to investigate companion-driven disk structures.
		9.3 Are the practice suggestions new? 1) completely new; 2) partially new (25-75% are new); 3) not new (less than 25% are new)	The dissertation's propositions are entirely original, a fact substantiated by recently published articles in peer-reviewed journals.
10.	The quality of writing and design	Academic writing quality: 1) high; 2) average; 3) below average; 4) low.	The dissertation work presented by series of high-quality papers is surely distinguished by the high quality of academic writing characterized by clear and precise presentation, logical structure, strong argumentation and evidence, as well as adherence to scientific style and language.
11.	Notes on a thesis	The work could benefit from spectroscopic data taken in other spectroscopic ranges rather than mainly optical. This is a minor note; the work is complete and scientifically important as it is.	
12.	Scientific level of the doctoral student's articles on the topic of research (in case of defense of	All of the articles are published in a peer-reviwed journal with high scientific metrics as shown below.	

	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)	1. **Gabitova I. A.**, Zharikov S. V., Miroshnichenko A. S., Carciofi A., Khokhlov A. A., Agishev A., and Prendergast P. Doppler Tomography of the Be Star HD 698 //Galaxies. – 2025. – Vol. 13. – № 4. DOI: 10.3390/galaxies13040080. **(Journal Impact Factor – 3.8, WoS – Q2, Scopus – 74)** 2. **Gabitova I. A.**, Miroshnichenko A. S., Zharikov S. V., Amantayeva A., and Khokhlov S. A. Doppler Tomography of the Circumstellar Disk of the Be Star κ Draconis //Galaxies. – 2024. – Vol.12. – №3. DOI: 10.3390/galaxies12030023. **(Journal Impact Factor – 3.8, WoS – Q2, Scopus – 74)** 3. Miroshnichenko A. S., Chari R., Danford S., Prendergast P., Aarnio A. N., Andronov I. L., Chinarova L. L., Lytle A., Amantayeva A., **Gabitova I. A.**, Vaidman N. L., Baktybayev S. S., and Khokhlov S. A. Searching for Phase-Locked Variations of the Emission-Line Profiles in Binary Be Stars //Galaxies. – 2023. – Vol.11. – №4. DOI: 10.3390/galaxies11040083. (**Journal Impact Factor – 3.2, WoS – Q2, Scopus – 66**)
13.	Decision of the official reviewer (pursuant to paragraph 28 of the present Model Regulations)	The dissertation (series of scientific publications) presented by Gabitova Ilfa Azamatovna titled «Structure and evolution of circumstellar matter in Be stars,» satisfies all the requisite standards established by the Committee for Quality Assurance in Science and Higher Education of the Republic of Kazakhstan for the award of the Doctor of Philosophy (PhD) degree. Consequently, Gabitova Ilfa Azamatovna is fully deserving of the academic degree of Doctor of Philosophy (PhD) in the educational program 8D05307 – Physics and Astronomy.

Official Reviewer:

PhD, Head of Department,
Fesenkov Astrophysical Institute,
Almaty, Kazakhstan

(Signature) Serebryanskiy A.V.

Signature certification:

Scientific Secretary, M.Sc.,
Fesenkov Astrophysical Institute,
Almaty, Kazakhstan

(signature) Kokumbaeva R.I.