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**To Whom It May Concern**

**Subject**: Review of PhD thesis summary of Krasymyr Tretiak
**Affiliation**: V.N. Karazin Kharkiv National University
**Supervisor**: Prof. D.L. Grekov
**Title of the thesis**: High-frequency short wavelength plasma heating and diagnostics in toroidal traps

**Relevance.** The author of the PhD thesis studies analytically and numerically two topics aimed on application in the magnetic traps with high plasma inhomogeneity: (1) Radio Frequency (RF) plasma heating in the ICRF band in the stellarator URAGAN-3M and (2) Development of dual-polarization microwave reflectometry based on the simultaneous use of the ordinary (O-) and extra-ordinary (X-) modes for plasma diagnosis in the stellarator URAGAN-2M. Both topics are very actual and high demanded in research of the International Fusion Community due to the strong need to develop (i) scenarios of the RF plasma initiation and heating using ICRF power and (ii) alternative efficient diagnostic for analysis of the plasma density profiles in the present and future stellarators and tokamaks.
**Originality.** Pioneering contribution of Krasymyr Tretiak to the research fields clearly shows that:
- The plasma three-dimensional inhomogeneity gives an impact on polarization change of the fast Alfven wave in the case of overlapping of the ICR and AR layers, which resulted in strong cyclotron absorption of the fast wave by resonant ions observed in the URAGAN-3M stellarator.
- The slow wave propagates in the plasma edge and not penetrates into the plasma core if electron collisional absorption mechanisms are included into ray-tracing modelling in addition to Landau damping.
- The developed dual-polarization microwave reflectometry expands noticeably the measured plasma density range in the URAGAN-2M stellarator, when both, O-mode and X-mode, are used simultaneously for plasma diagnosis.

**Practical significance.** The obtained analytical and numerical results were used in analysis and proper explanation of the ICRF heating data in the URAGAN-3M stellarator and in development of the dual-polarization microwave diagnostic, which successfully operated in the URAGAN-2M stellarator. The developed numerical tools and diagnostic may be used to support fusion research program on the leading European stellarator W7-X.
**Remarks.**
1. The title of the PhD thesis is formulated in very general manner not explaining the frequency range used for plasma heating study (*ICRF band*) and also for diagnostic development (*microwave band*).
2. The author of the PhD thesis summary did not clear up, which exactly types of the electron collisions play a fundamental role in the peripheral (antenna-near) propagation of the SW.
3. The obtained results have a high importance. To be better known among the International Fusion Community, they should be published in the leading international journals dedicated to fusion research.

**Recommendation.** Ideas and concepts presented in the PhD thesis summary are clear enough and understandable in postulating, discussion and conclusion sections, and written in the clear scientific language. Krasymyr Tretiak made an essential contribution to the field of high demanded research. I recommend awarding him with a PhD degree without any reservation.

Respectfully submitted,

Dr. Anatoli LYSSOIVAN,
Senior Fusion Research Scientist – ICRF Expert of LPP-ERM/KMS (Brussels),
Former European Coordinator of ICRF Plasma Physics Research for ITER ICWC Development