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Tokamak Scenario Development

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To whom it may concern

Subject: Review of Ph.D. thesis summary of Krasymyr Tretiak

Affiliation: V.N. Karazin Kharkiv National University

Scientific consultant: Prof. D.L. Grekov

Title of the thesis: "High-frequency short wavelength plasma heating and diagnostics in toroidal traps"

I have the following comments to Krasymyr Tretiak's Ph.D. thesis summary:

1. Krasymyr Tretiak has applied a multi-sided approach to the problem of description and application of the waves with short wavelength in inhomogeneous plasmas in complex magnetic geometries. This excellent work is very valuable not only from the point of view of applications in torsatrons "Uragan-3M" and "Uragan-2M", but generally for fusion experiments and reactors based on magnetic confinement.

2. Propagation and absorption as well as mode conversion of the fast and of the slow waves in the inhomogeneous plasma in the stellarator magnetic geometry are described theoretically in great detail. Analytical and numerical methods for the description are used on a very high scientific level. Parallels to the existing experimental observations and direct comparisons to the experimental data are made which confirm theoretical findings. This work is novel and unique, and it represents a useful guide for experimental planning as well as for development of the plasma heating schemes in the "Uragan-3M" torsatron.

3. The feasibility study of the dual-mode reflectometry system for "Uragan-2M" along with the development of the numerical algorithms to reconstruct density profiles are of high scientific value. The practical implications of such reflectometry system are described very clearly. Stability analysis of the proposed deconvolution algorithms demonstrates that the reflectometry study is thoroughly thought through, well beyond a basic theoretical study.

4. The application of the dual-mode reflectometry to measure poloidal magnetic field in tokamaks is highly appealing. The example of such application for a small spherical tokamak is presented very well and quality of the assessment is excellent.

5. As one point of minor criticism, I would like to remark is the absence of a discussion about the role of the non-linear processes at the antenna (e.g. RF sheaths) in the near-fields, while discussing excitation of the slow wave from an antenna operating in the ion cyclotron range of frequencies. Such processes are important for ICWC (Ion Cyclotron Wall Conditioning) which is mentioned in the summary. However, this does not affect the evaluation of the overall work quality, because the corresponding part of the current work is focused rather on the description of the slow wave propagation and absorption in the plasma volume.

6. Another point of minor criticism is the absence of explicit declaration of working frequencies when discussing the plasma heating by the slow and the fast wave. However this is not essential in the format of the thesis summary, because the referred publications do specify the frequencies.

Reviewing the thesis summary and the main publications, which are the basis for the present Ph.D. thesis, I can confirm that the obtained results are important and relevant for plasma physics. The scientific results obtained by Krasymyr Tretiak have been delivered to the wide scientific community through presentations at international conferences and workshops as well as publications in leading scientific journals. Summarizing the aforesaid, I would highly recommend to award him a Ph.D. degree.

Sincerely,

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