

The review of the doctoral thesis  
“Experimental Studies of Runaway Electrons in Tokamaks“

written by Ing. Ondřej Ficker

Reviewer: Prof. RNDr. Pavel Kubeš, CSc.

In presented thesis, the extensive experimental knowledges about energetic electrons produced and registered in the tokamak fusion plasma are summarized. The author applied experiences obtained at the experiments on European facilities COMPASS, TCV, ASDEX and JET with a view utilize them in buildup COMPASS U and later ITER. The presented overview of basic characteristics, used diagnostics, methods of signal acquisition, and presentation of results from experiments provided at the author presence was fulfilled by the extensive bibliography of 189 references and 41 own publications in reviewed papers and conferential proceedings.

The work is divided into 8 chapters and 4 appendixes. In the first Introduction, the importance of the nuclear fusion is mentioned with the leading role of tokamaks together with aims of author thesis – the use of suitable diagnostics, conduction and analyze of experiments of fast electrons on COMPASS and participation in campaigns on other tokamaks. The second chapter describes the basic characteristics of the fast electron physics. The third part discusses the diagnostics, signals processing, and it includes the author contribution to the diagnostic applied on the COMPASS. The fourth chapter contains description of measurements provided on COMPASS and compare results with other tokamaks. Chapter five summarizes results obtained by the generation of fast electrons and their losses during their existence, and it describes influence of the electron density, impurities, instabilities, and position of magnetic islands on parameters of fast electrons. In Chapter 6, the most important part of thesis is presented, possibility to influence the energy of fast electrons. Final chapter 7 contains the application of the presented diagnostics and new acknowledgements on the COMPASS U and ITER. The work is supplemented by a list of 7 publications, 4 in refereed journals and 3 presented in conferences, in 5 cases as the first and corresponding author.

Doctoral thesis is written logic and clearly presents the knowledge of described problematics and ability to formulate new results and ideas. It shows the erudition in experiments realized in wide international teams as domestic, as abroad. The depth of knowledges is also admirable. As the pivotal and original results of this thesis and benefits of author work, it is the effort to influence the negative consequences of fast electrons to influence their evolution. It is based on the description of the equilibrium using the change of electron density, external magnetic field, and admixtures.

I have next question to the author for discussion:

In the thesis, the generation of magnetic structures and magnetic reconnection as model for their evolution is mentioned. In solar flares, where the coronal model of plasma is used as in tokamak, the fast magnetic reconnection is used as the model for acceleration of fast electrons and ions with energy range above hundreds keV. What is it known about possibility of the acceleration of fast electrons due to magnetic reconnection in tokamak?

At the magnetic reconnection in solar flares, acceleration of electrons is accompanied by acceleration of the ions. Does exist this possibility also in tokamak plasma?

The equilibrium conditions in the work were estimated for constant energy of fast electrons. Which influence on the dynamic of the real electron beam can have the real wide spectrum of electrons?

Ing. Ondřej Ficker demonstrated a broad and deep knowledge of the presented ideas, the ability to cooperate in international teams, and presence of the results in refereed journals. He proved advanced creative independence. The presented study summarizes new own findings and demonstrates the author's creative presentation of the achieved results at top forums in the field. I recommend to the committee defend this thesis. If there is an examination option, I suggest excellent results.

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