Referee report on doctoral thesis of Petr Hlavenka

„The spectroscopic study of cold ions in plasma and ion trap“

submitted to the Department of Surface and Plasma Physics

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The topic of the doctoral thesis, spectroscopic characterization of cold ions in plasma and ion trap, especially of H_3^+ ions and its deuterated analogues is highly timely. Many recent publications and conferences dedicated to this ion declare this thematic as a "hot topic" in international science.

The absorption spectroscopy of density determination of ionic species in plasmas is a innovative method of studying ion – electron recombination due to specific sensitivity on the selected ion and its internal state. Low density of absorption media requires an experimental setup with very high sensitivity. Within this work the time-resolved cavity ringdown spectroscopy (TR-CRDS) experiment has been build which allows density determination down to $3\times10^8 cm^{-3}$ for H_3^+ ions with a time resolution of ~ 50 μs.

The studies of electron-ion recombination of H_3^+ ions using newly built TR-CRDS confirmed the results obtained in classical way using Langmuir probes. In addition valuable information on kinetic temperatures and internal state distributions of the ion in this study has been delivered. The new spectroscopic lines in vibrational combination bands of H_2D^+ and D_2H^+ ions have been identified. Rotational and ortho / para state populations of H_2D^+ and D_2H^+ ions have been determined during the afterglow.

Another spectroscopic device has been developed for excitation of ions stored in the trap. Due to low density of stored ions the photon absorption has been detected using the laser induced reaction method. The low temperature ion traps are used for synthesis of cold ions which can be injected to the storage ring where the processes of electron-ion recombination can be studied at specific collision energies. The spectroscopic method has been used for determination of H_2D^+ and D_2H^+ temperatures and internal state distributions.

The thesis is written in English and is organized in six chapters. The relevant publications are attached in the appendix. Text and figures are informative and in high quality. The experimental part of the thesis concentrates on the spectroscopic methods and only briefly describes apparatuses which determine the physical properties of spectroscopic objects. Obtained results are compared to other experimental and theoretical results and differences are discussed. The main results are published in prestigious journals and conference proceedings.

Mr. Hlavenka proved by the submitted work the ability of working independent and creative and therefore I highly recommend the submitted thesis for its defense.

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