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Attn.: Referee report – S. Rednyk

The doctoral thesis entitled “*Reakce astrofyzikálně důležitých kladných iontů s molekulami a atomy při nízkých teplotách*” authored by Mr. Serhiy Rednyk, under the supervision of prof. Juraj Glosík (co-supervisor doc. Radek Plašil), focuses on experimental studies of fundamental ion-molecule reactions at low temperatures. The topic is relevant within the study programme *Physics of Plasmas and Ionised Media*.

The manuscript is written in Czech language and has one hundred one pages of the original text (excl. TOC, Abbr., Bibliography). It contains fifty nine figures, no tables and eighty eight bibliographic entries. The thesis is supplemented with the complete list of author’s publications, including fourteen peer reviewed publications (with two more in preparation). The work is divided into six chapters and epilogue. The first three chapters (approximately half of the thesis) focus on current knowledge of the topic and general and later detailed description of the experimental setup and techniques. The second half of the thesis is devoted to presentation and interpretation of acquired experimental data.

Although the anti-plagiarism reports from *Theses* and *TurnItIn* sw. found dozens of matches, only handful were higher than 1%. Even then, the higher percentage matches are unwarranted matches to the legal disclosure in the preamble or mostly references/ bibliographic entries. I have not spotted unauthorised/ non referenced text block copies. Figures that were adopted, mainly while describing the experiment, are appropriately marked. Photographs authorship is also properly revealed, where relevant. Author cites extensively publications of his own, of the experimental group and of all the others. References and external resources are used appropriately, while maintaining the writing original.

The language component of the thesis is beyond my qualification, nonetheless I would like to focus on two points, namely decimal separators (figures use

“.”, while text uses “;”) and absolute lack of font style/ weight distinction for citations, figure captions, emphases in the text. The second issue only makes the text less navigable and readable yet the first issue causes a lot of trouble in teams with nationals from around the world. I would also strongly recommend use of DOIs in the bibliography (as in author’s publications).

Author has conducted numerous ion-molecule reaction experiments at different temperatures for the systems of N^+ , NH^+ , NH_2^+ , and, NH_3^+ with H_2 and to lesser extent an experimentally difficult investigation reaction of $N^+ + H$ involving effusive beam of atomic hydrogen and reaction of doubly charged ion C^{2+} with H_2 . The temperature dependent behaviour of these reactions, reaction rates as well as exothermic/ endothermic nature are discussed and summarised. The acquired novel data can be used to fine-tune Nitrogen containing complex astrochemical networks, where low temperature is of importance.

Dear committee, I recommend the acceptance of the doctoral thesis.

Discussion points for the author:

- p. 15.: Fig. 2.1.1.: Why no “22 pole every time”, if the potential is the flattest?
- p. 32.: Fig. 2.3.9.: What is the shape of the rods? Is it important?
- p. 18.: Langevin (Eq.), what are the units used in this Eq.?
- p. 37.: 27 MHz in the trap: How were the different rf frequencies in the trap achieved?
- p. 57.: What is the fitting procedure used? Are the rates really determined from slopes, like shown in Fig. 4.1.2. for all the temperatures? Or are the k -s determined from differential equations being fitted in Fig. 4.2.2. etc.? How big are the uncertainties of the fits?
- p. 65.: paragraph in the middle. Could this “*mass discrimination*” calibration be shown in more detail? Particularly, what is the (e. g. relative) uncertainty of the calibration factor?
- On a similar note, the number density determination (especially at very low T) is extremely important for accurate reaction rate determination. I haven’t found how this was done anywhere in the thesis, except a mention of a spinning-rotor gauge.
- p. 73.: Fig. 4.3.2.: Does author have any similar figure with $[He]$ on the abscissa? Just as a proof of no He density dependence? On p. 76. (and corr. Fig. 4.3.4.) author mentions: “*we could not extract all the ions from the trap*”. Was this effect dependent on He number density (at higher He densities the ratio is clearly lower (Fig. 4.3.4.)), or a singular event at low hydrogen densities?

Yours faithfully,

Pavol Jusko