Ruprecht - Karls - Universität Heidelberg
Fakultät für Physik und Astronomie

Im Neuenheimer Feld 227
69120 Heidelberg
Tel.: (06221)54-4124
Fax: (06221)54-9288

To the chairman of the
board of examiners for Master
Subject Physics

Record of Master's thesis

Name: Sendlinger, Christian **Student ID:** 3667390

Thesis Examiner I: PD Dr. Felix Spanier Thesis Examiner II: Prof. Dr. Simon Glover

Title of Thesis: Modelling of the KATRIN Source Plasma using kinetic Pseudo-2d Simulations

Date of submission of MSc Thesis: 10.06.2023

Report:

The current thesis deals with modeling the plasma inside the KATRIN experiment that is generated by energetic beta decay electrons. The main point is the implementation of a 2D representation of the cylindrical geometry which could make parameter studies feasible.
The thesis features a detailed plasma theory chapter that specifically highlights plasmas in cylindrical vessels. The dispersion relations derived here are later used as test cases. Following a description of the KATRIN experiment and the problem setting, Particle-in-Cell codes are described. Starting from the ACRONYM code a pseudo-2D method is implemented. The intricacies of the boundary conditions and the plasma source are described in great detail. The newly developed methods are validated using theoretical plasma dispersion relations.
Finally results for the actual source plasma are shown. The simulations runs are limited by the available time, but could already reproduce full source runs. Here space-charge waves are identified.
The thesis provides new insights and also new tools for modeling and understanding the source plasma of the WGTS. The description of the underlying science is complete and comprehensible. The methods used are well described and provide novel aspects. The simulations are insightful and go beyond the current state of research.

Report:

Grade (Thesis Examiner I): **1,0**

Grade (Thesis Examiner II):

Date / examiner I signature

Date / examiner II signature

Admissible marks: 1.0; 1.3; 1.7; 2.0; 2.3; 2.7; 3.0; 3.3; 3.7; 4.0; 5.0

You can find an electronical version under the following link: https://www.physik.uni-heidelberg.de/studium/master/vorlagen