

Review report on thesis

” Positive ion extraction system design for the U-120M cyclotron”

Author: Tomas Matlocha

The thesis describes the development process of the U-120M cyclotron extraction system starting from measured data for the cyclotron with the original design, and then introducing the computational tools for beam simulations and finally, design of the new extraction elements which have not yet been installed or manufactured. The estimated increase of extraction efficiency with the new elements is remarkable. So briefly we can say that the work was a success.

The first section after the introduction re-postulates essential parts of cyclotron theory which are needed to understand behavior of particle beams in cyclotrons (acceleration, focusing, resonances, extraction methods). This section is clearly written, and the reader can better understand the dependencies of different parameters on the particle beam in a cyclotron.

The next section (Cyclotron U-120M) and its sub-sections describe the structure of the cyclotron and its essential components like the ion source, RF-system, vacuum system and the magnetic structure. Essential part of the cyclotron regarding the extraction process is the set of harmonic coils. Their new design is described in later sections of the thesis. In this section, also the magnetic field mapper is described and how it was refurbished. A new mapping software was also developed.

From the thesis it became clear that before going to the main topic (a new extraction system), many other upgrades and corrections had to be made first. This clearly has made the whole process longer than possibly in the beginning was thought. It must have been a challenge to find and repair the “faulty” structures of the magnet and the vacuum chamber. One good thing of it is that it has deepened author’s knowledge and understanding how different things may affect the beam behavior in a real cyclotron.

The numerical methods were tested, and their accuracy was verified with the existing system. This, as well as the ideas how to proceed with the design and the choice of different extraction elements, was the main contribution by the author. Unfortunately, there has not been enough time to build and assemble all designed elements and then experimentally verify the result. However, the name of the thesis is “Positive ion extraction system **design** for the U-120M cyclotron”. That task has clearly been accomplished with good or satisfactory results. Having said that, I can conclude that the thesis fulfills the requirements for a doctoral thesis.

Jyväskylä, July 20, 2023


Paul Heikkinen

PhD, Docent
University of Jyväskylä, Finland

