The study of heavy proton-rich nuclei offers the opportunity to investigate a plethora of physics such as the interaction between protons and neutrons, the coexistence of multiple nuclear shapes in the same nuclear isotope, nuclear structure properties at the extremes and the production of elements in the stellar environment.

The MARAgas project was focused on the study of proton rich nuclei in the vicinity of ^{100}Sn employing the MARA vacuum-mode recoil separator and the development of novel experimental equipment to allow the study of hitherto inaccessible nuclei in the same region.

The MARA separator has been commissioned successfully during 2015 and 2016 using several nuclear reactions. MARA is a unique separator designed and developed in-house at the Accelerator Laboratory of the University of Jyväskylä. The separator is combined with a focal plane detector system which allows the detection and study of fusion evaporation reaction products and their subsequent decays. Both the separator and detector system were extensively tested during these two years and were made available for experimental exploitation during the end of 2016.

The MARAgas project aimed to develop a gas cell to be used for stopping, thermalising and neutralising the reaction products which reached the focal plane of MARA. Upon extraction from the gas cell, the products will be selectively ionised using resonant laser ionisation before being further mass separated and transported to the detector stations. The different steps taken from ion production at the target position of MARA to detection at the experimental stations are shown in the figure.

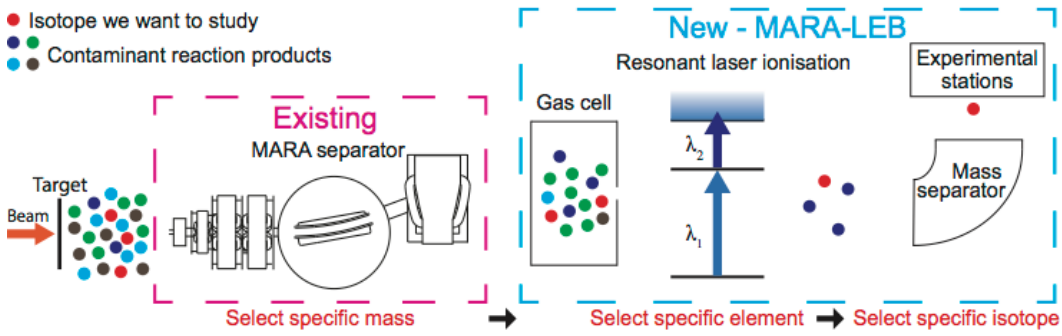

Figure 1: The contaminant nuclei are gradually reduced until only the isotope of interest remains for study at the experimental stations.

The MARAgas project did not include the stages after the gas cell, however, their design and development started in parallel with the gas cell development. Currently the gas cell is in the manufacturing stage and the laser system to be used for laser ionisation and spectroscopy is in the final development stage. Simulations and design of the ion guides is ongoing and the magnetic dipole mass separator will soon be ordered.

The developments and achievements of the MARAgas project form the basis of the MARA Low-Energy Branch (MARA-LEB). The MARA-LEB facility includes not only the gas cell but all the necessary equipment to allow for laser ionisation and spectroscopy, ion transport, mass separation and detection. The completion of the MARA-LEB facility is anticipated in the next few years and will open the way to the study of exotic, currently unreachable nuclei, which will provide a direct inside to exotic nuclear properties.

Project website:

https://www.jyu.fi/fysiikka/en/research/accelerator/nucspec/maralowenergy/mara-leb

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