Ion-extraction from the CISe gas catcher

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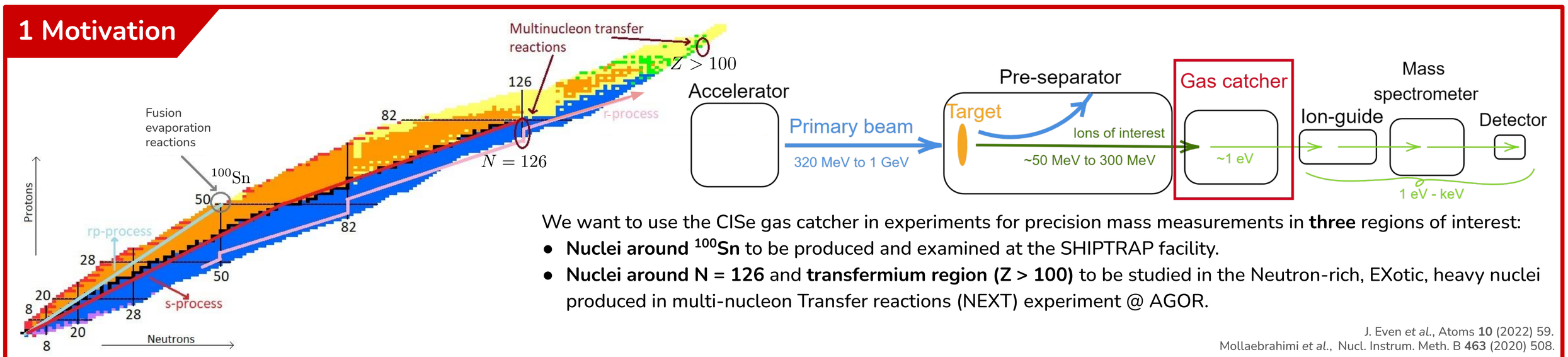
1 Motivation



We want to use the CISe gas catcher in experiments for precision mass measurements in **three** regions of interest:

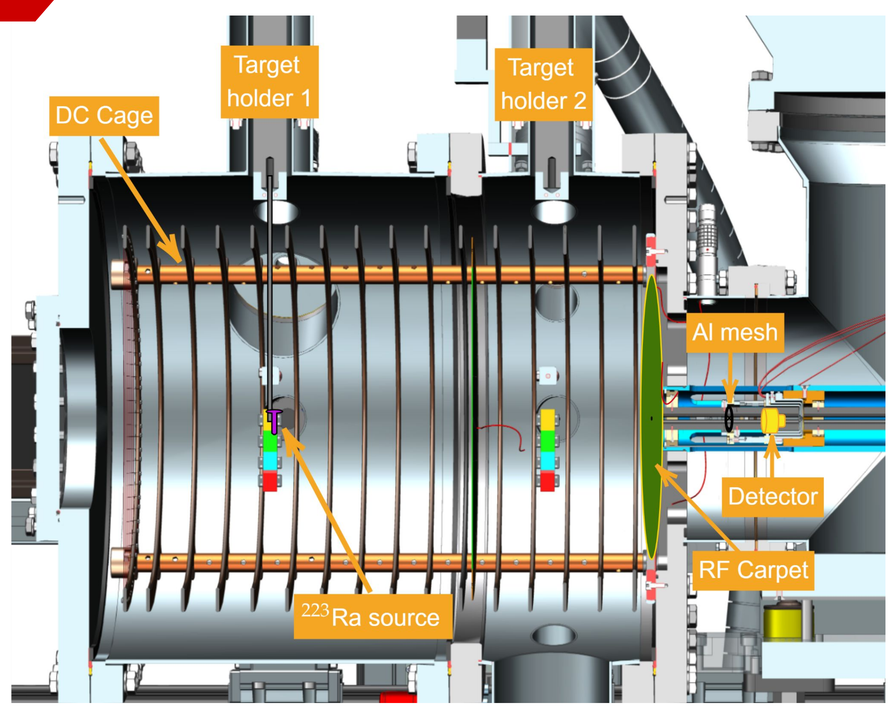
- **Nuclei around ^{100}Sn** to be produced and examined at the SHIPTRAP facility.
- **Nuclei around N = 126** and **transfermium region (Z > 100)** to be studied in the Neutron-rich, EXotic, heavy nuclei produced in multi-nucleon Transfer reactions (NEXT) experiment @ AGOR.

J. Even *et al.*, Atoms **10** (2022) 59.
Mollaebrahimi *et al.*, Nucl. Instrum. Meth. B **463** (2020) 508.

2 CISe project

Our goal is to develop a new **C**hemical **I**sobaric **Se**paration technique using a gas catcher. Gas catchers are used to slow down high-energy nuclear reaction products by interacting with a buffer gas. The ions lose energy in collisions with the buffer gas atoms through ionization and excitation. As a first step we are optimizing the ion extraction process within the gas catcher by testing different DC and RF settings.

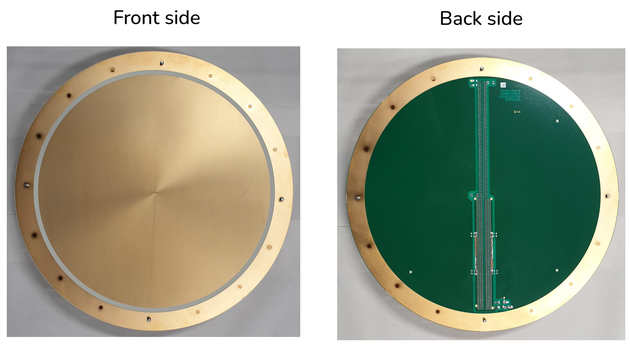
3 CISe gas catcher



To study the extraction of ions we are using:

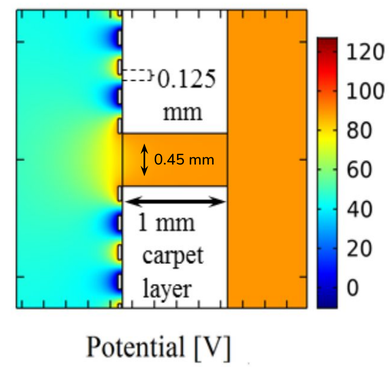
- A gas cell filled with 50 mbar of **Helium**. Helium has the advantage that it has a low density and high ionization potential, reducing the probability of ion neutralization.
- A **^{223}Ra** source that decays into ^{219}Rn. Radon is a noble gas with high ionization potential, making it one of the most challenging elements to extract.
- High electric field gradients to reduce the probability of recombination and to achieve a shorter extraction time.

4 RF carpet



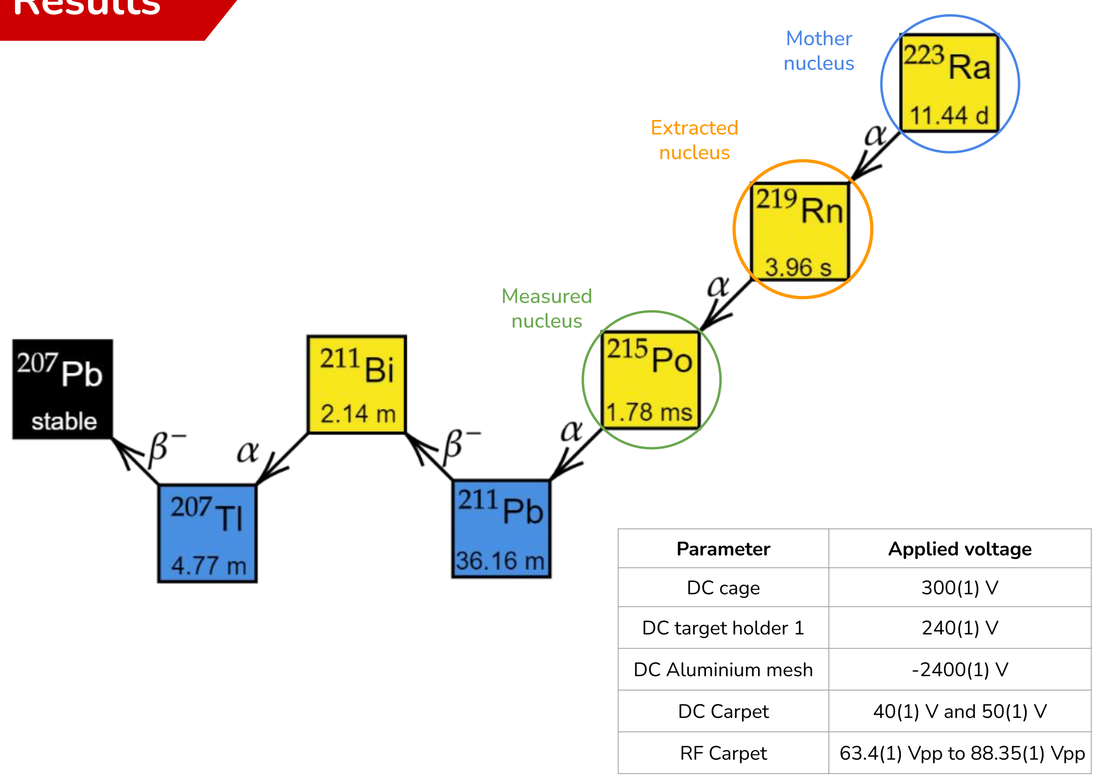
The DC carpet's electric field gradient pushes ions towards the center, while the time-averaged repelling force of the RF voltage makes them hover. Applying a 90° phase difference generates a traveling potential wave, allowing the ions to surf over the carpet towards the exit hole.

Simulated DC and RF potential distribution

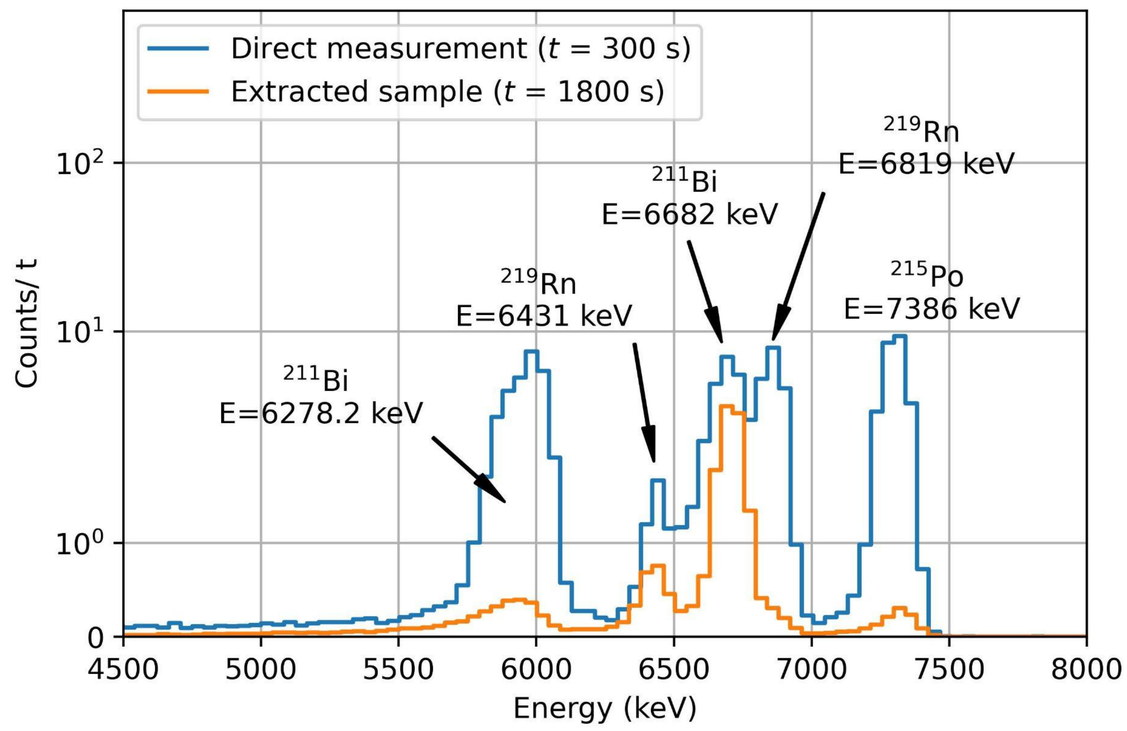


Anđelić, B. (2021). *Direct mass measurements of No, Lr and Rf isotopes with SHIPTRAP and developments for chemical isobaric separation.*

5 Results



Parameter	Applied voltage
DC cage	300(1) V
DC target holder 1	240(1) V
DC Aluminium mesh	-2400(1) V
DC Carpet	40(1) V and 50(1) V
RF Carpet	63.4(1) Vpp to 88.35(1) Vpp



Extraction yields of 10-15% of ^{219}Rn have been achieved.

6 Summary

- In this study, alpha spectroscopy measurements showed that ^{219}Rn$^+$, which has a half-life of 3.96 s, was extracted from the gas catcher.
- The results indicated a maximum extraction efficiency of 15%. Further studies will be conducted to optimize the extraction efficiency and unlock the full potential of this technique.

We thank the accelerator support staff, the mechanical workshop and the electronic workshop at UMCG-PARTREC.
This work is funded by the European Research Council through an ERC Starting Grant (No. 803740) and by the Dutch Research Council through a NWO Natuurkunde Projectruimte grant (No. 68091103) and by the Scholarship Program No. 906 of the Ministry of Science, Technology, and Innovation of Colombia.