Speeding up gas-phase chemistry to access elements beyond Fl

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Motivation

chemical investigation of elements $Z \geq 104$

Gas-phase chemical techniques:

- access to the influence of relativistic effects on chemical properties
- low limits of detection needed
- first gas chromatography was in the 1960s
Motivation

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• three types of detectors:
  
  • Cryo-Thermochromatographic Separator (CTS)
  
  • Cryo On-Line Detector (COLD)
  
  • Cryo-Online-Multidetector for Physics And Chemistry of Transactinides (COMPACT)

• in previous experiments the properties of Cn and Fl have been determined
transport time ≈ 400 ms
transport time ≈ 400 ms
The Experiment
The Experiment

COMPACT
2 x 32 PIN Diodes
Au covered

neutralisation

gas cell for ion guiding:
• DC-gradient
• RF-funnel

gas flow

The Experiment (Off-line)

Voltage divider

$V_{\text{source}} \approx [70 \text{ V} - 300 \text{ V}]$

$\text{RF} \approx [796 \text{ kHz}; 102 \text{ V}]$

replace the RTC with the new gas stopping cell

advantages:

• faster extraction time
  ➔ accessing short-lived nuclides
The Experiment (Off-line)

- off-line source: $^{219}$Rn recoil ion source ($a_{Rn} \approx 8$ kBq)

- successful stopping and extraction of $^{219}$Rn
- decay in flight
- spectrum from COMPACT-detector
Results

varied variables:
- Funnel RF-amplitude
- cell pressure

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<table>
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<tbody>
<tr>
<td>$D_{C_{\text{Fun}}_{\max}}$</td>
<td>20 V</td>
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<tr>
<td>$D_{C_{\text{Fun}}_{\min}}$</td>
<td>5 V</td>
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<tr>
<td>$D_{C_{\text{Cage}}_{\max}}$</td>
<td>64 V</td>
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<td>$D_{C_{\text{Cage}}_{\min}}$</td>
<td>25 V</td>
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<tr>
<td>$D_{\text{Source}}$</td>
<td>64 V</td>
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Results

varied variable:

- source voltage

- in the considered area, the source has only a small influence on the efficiency

- opens possibility to operate the source in pulsed mode

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Summary and Outlook

achieved:

• ions extracted
• neutralization from wall collision

Open questions

• transport time
• neutralization efficiency

to do:

• determine the transport time using pulsed source operation
• maximize of the total efficiency of the system
• establish in On-line experiments at TASCA
Summary and Outlook