

# High Resolution Laser Spectroscopy of Actinide Elements within the LISA Network

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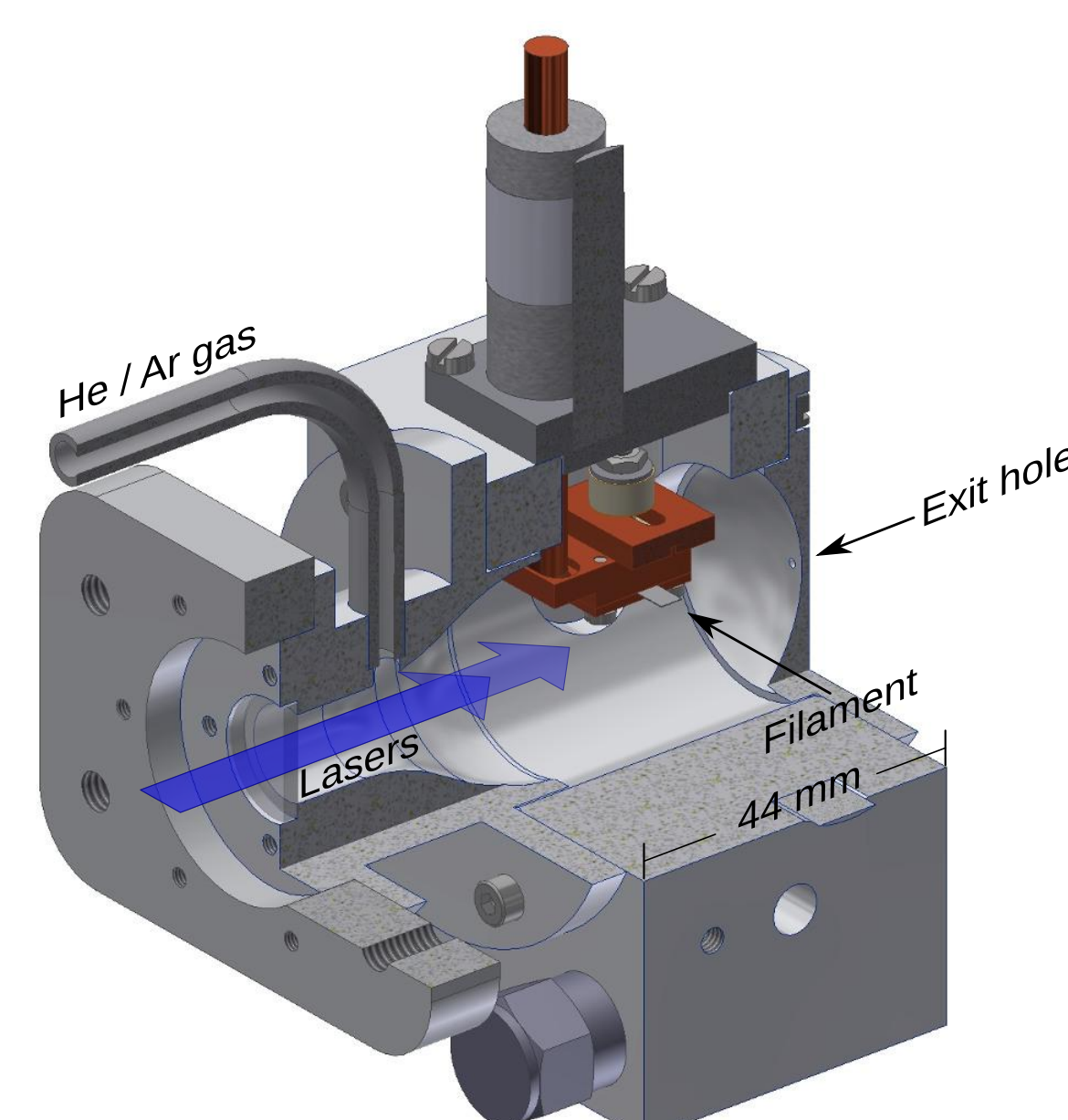
## LISA

### Laser Ionization and Spectroscopy of Actinides

The project aims to develop and push the limits of current knowledge in the actinide region by joining the expertise and capabilities coming from academic research institutions as well as industrial partners.

#### In-gas-cell laser ionization

- Gas Phase Chemistry [1]
- Development of a grating Ti:Sapphire Laser [2]
- Investigation of Ionization schemes



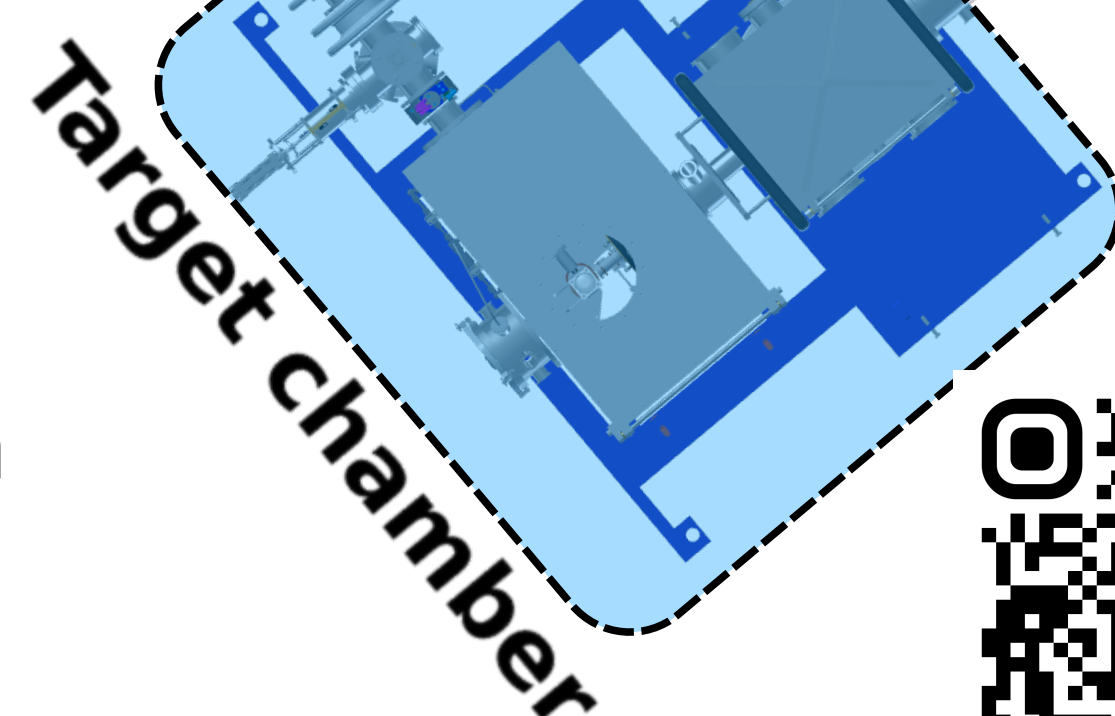
**Fig.1:** Cross-sectional view of the gas-cell in use for heavy element studies [1]

#### Production techniques Online

- Fusion-evaporation reaction

#### Offline

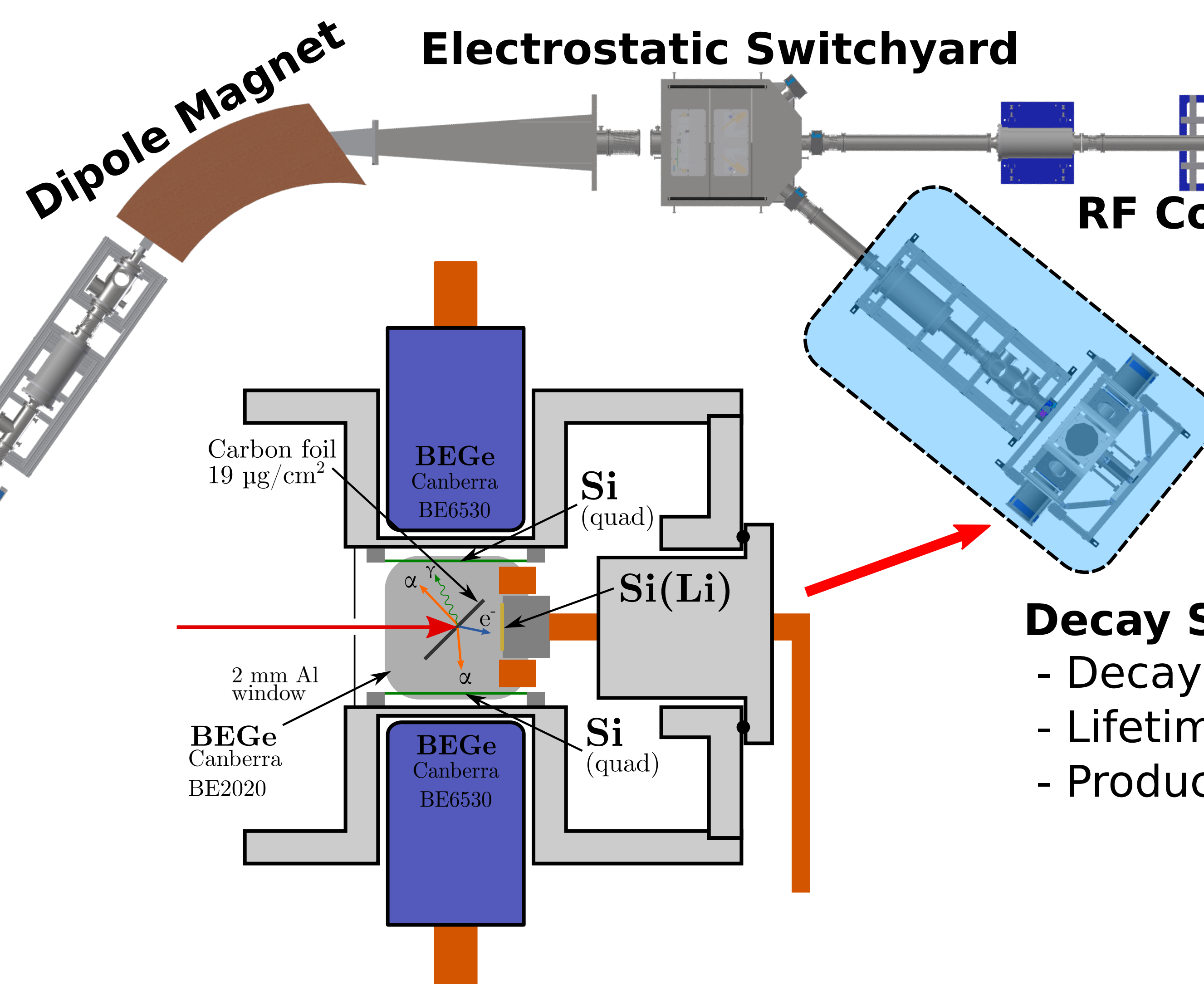
- In-gas-cell alpha-recoil source
- Heated actinides filaments



## IGISOL

### Ion Guide Isotope Separation On Line

The IGISOL facility in the Accelerator Laboratory of the University of Jyväskylä is at the forefront in the application of laser spectroscopy techniques for the extraction of nuclear ground-state properties. In addition to optical spectroscopy, nuclear decay spectroscopy and precision mass measurements are implemented to further investigate the region of interest. The first decay spectroscopy experiment was performed using proton-induced fusion-evaporation on a <sup>232</sup>Th target in July 2020, the analysis of the data is underway.

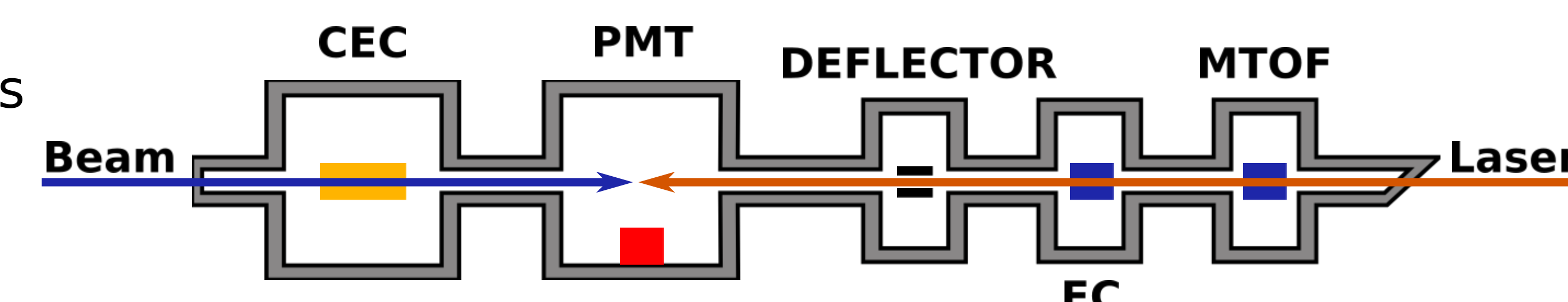


**Fig.2:** Decay station setup mounted at the end of the IGISOL spectroscopy line

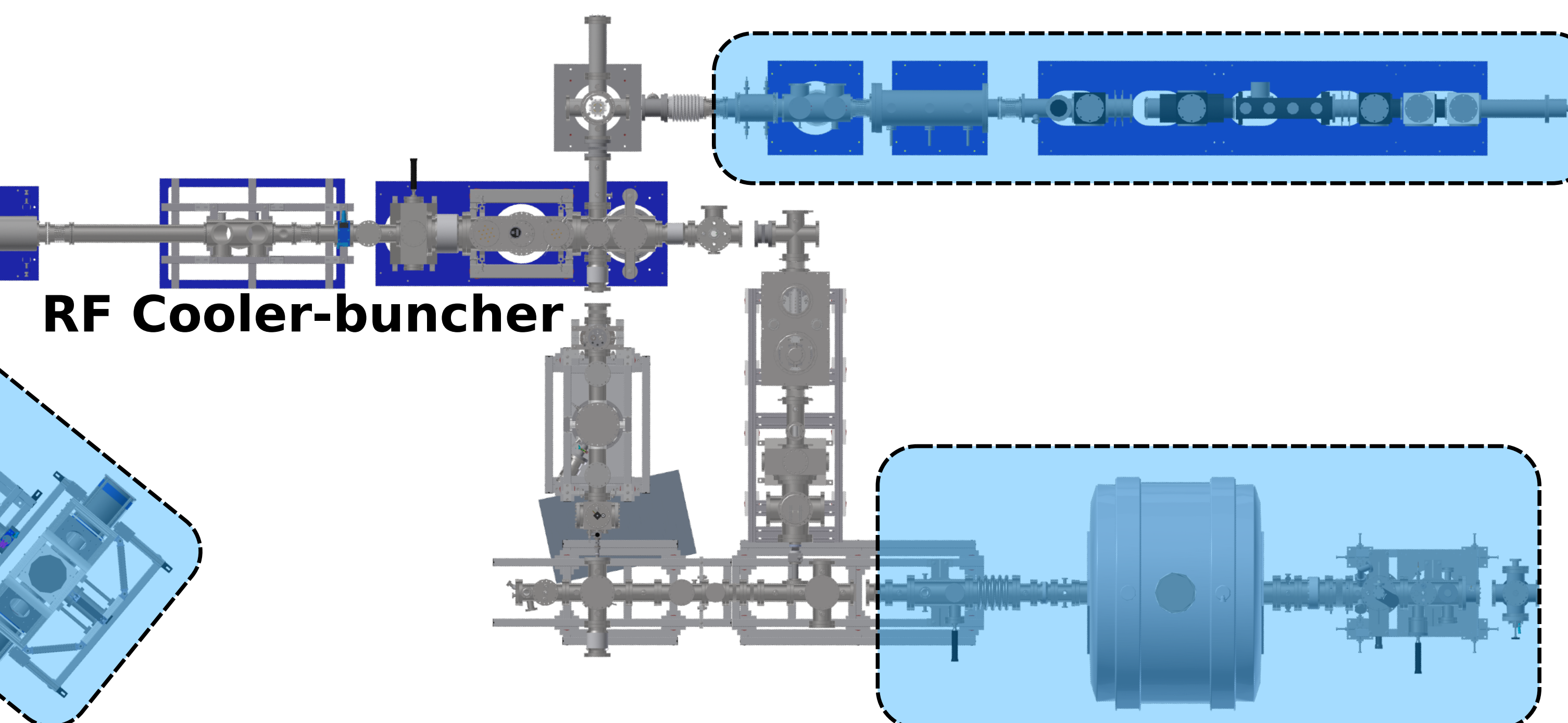
### High resolution collinear laser spectroscopy

Hyperfine structure and isotope shift

- Nuclear spins
- Electromagnetic moments
- Mean-square charge radii



**Fig.3:** Details of the IGISOL collinear line [3]



#### JYFL Penning trap [4]

- High precision mass measurement
- Direct measurement of production yield of <sup>229</sup>Th

#### Decay Spectroscopy

- Decay modes
- Lifetimes
- Production yields

#### References

- [1] Pohjalainen, I. et al., Nucl. Instr. Meth. Phys. Res. Sect. B, 376 (2016) 233-239.
- [2] Tomita, H. et al., Prog. Nucl. Sci. tech., 5 (2018).
- [3] De Groote, R. P. et al. Nucl. Instr. Meth. Phys. Res. Sect. B, 463 (2020) 437-440.
- [4] Eronen, T. et al. Eur. Phys. Jour. A, 48 (4) (2004) 46

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