

High-precision ground- and isomeric-state spectroscopy at FAIR

D. T. Yordanov for the collaborations

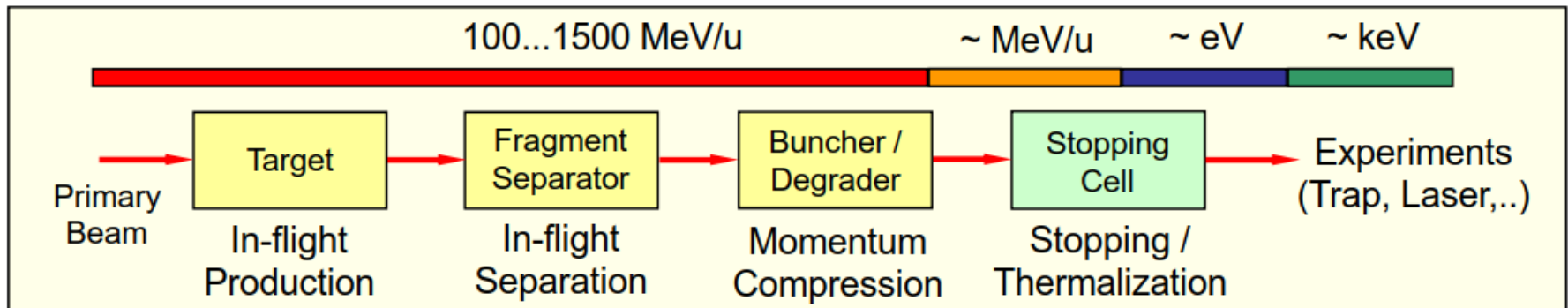
Outline

- ***Low-energy branch @ FAIR***
 - ***Stopping cell***
 - ***Infrastructure***
 - ***MATS & LaSpec***
- ***Connecting beamline***
 - ***Motivation***

Low-Energy Branch (LEB) of the Super-FRS at FAIR

LEB: High-precision experiments with in-flight separated exotic nuclei almost at rest, (production by projectile fragmentation / fission)

- universal and fast production, high selectivity
- cooled exotic nuclei



MATS (Precision Measurements of very short-lived nuclei using an Advanced Trapping System)

- High accuracy mass measurements
- In-trap conversion electron and alpha spectroscopy
- Trap assisted decay spectroscopy

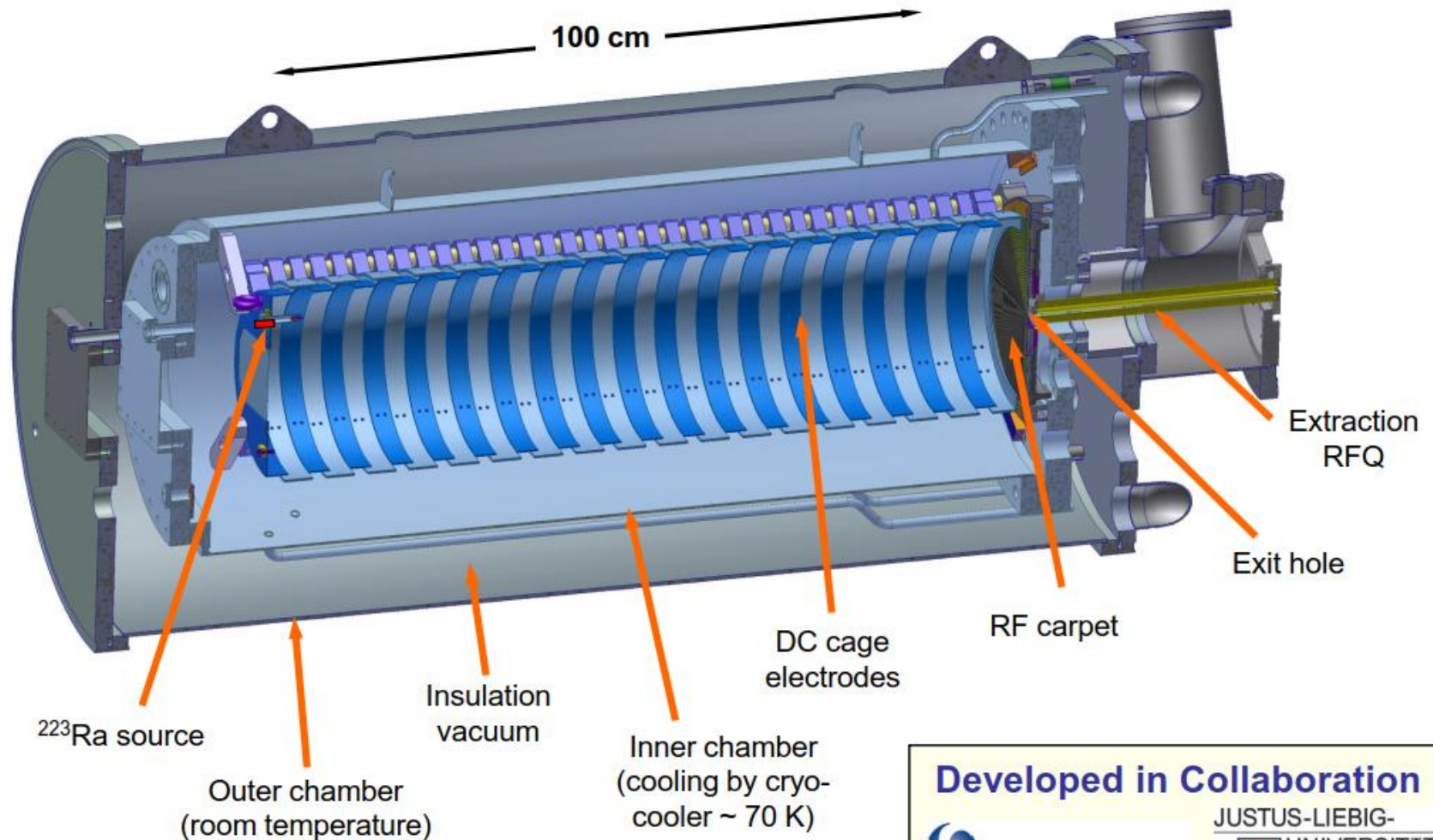
→ Masses,
Decay properties

LaSpec (Laser Spectroscopy)

- Collinear laser spectroscopy of ions and atoms
- β -NMR
- Resonance ionization spectroscopy

→ Charge radii,
Nuclear moments,
Nuclear spin

Prototype of the Cryogenic Stopping Cell (CSC) for the LEB



M. Ranjan et al., Europhys. Lett. 96 (2011) 52001.
 W.R. Plaß et al., Nucl. Instrum. Methods B 317 (2013) 457.
 M. Ranjan et al., Nucl. Instrum. Methods A 770 (2015) 87.

Developed in Collaboration



Kernfysisch Versneller Instituut



university of
groningen

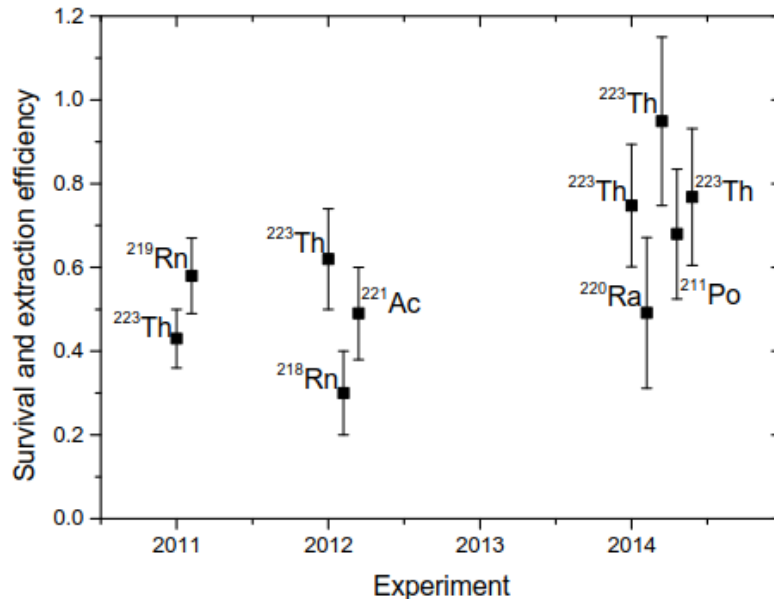
JUSTUS-LIEBIG-



UNIVERSITÄT
GIESSEN

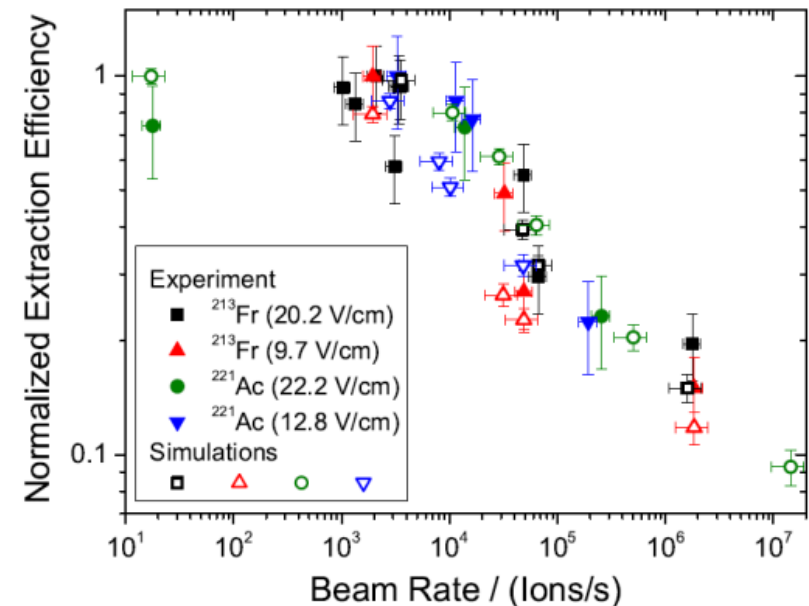
GSI

Performance characteristics of the prototype CSC

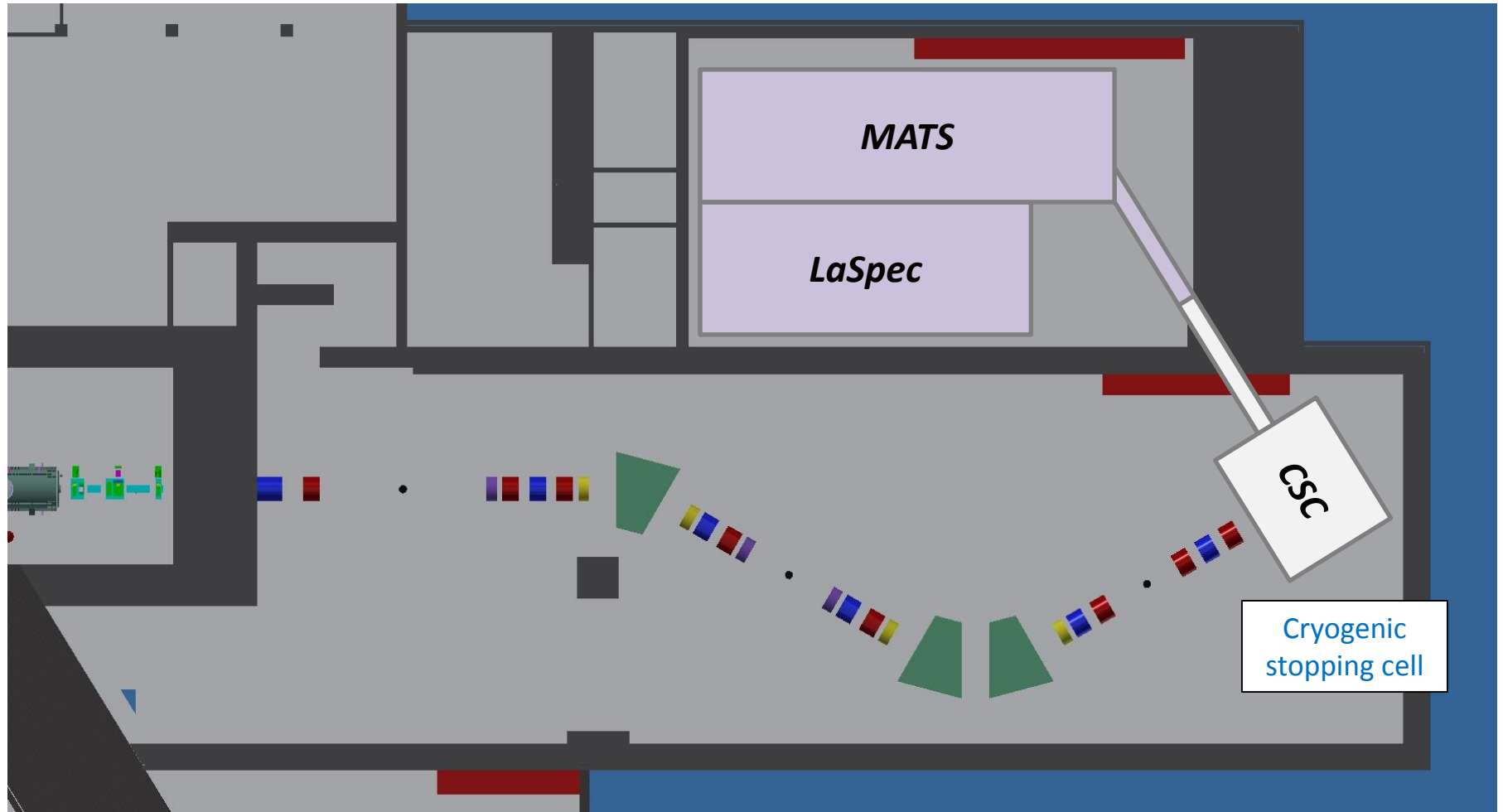


Data for ²³⁸U projectile fragments produced at 1 GeV/u

- Ion survival and extraction efficiency 60%
- Total efficiencies ($\epsilon_{total} = \epsilon_{stop} \times \epsilon_{ext}$) up to 25%
- Extraction times of 25 ms
- Rate capability 10^4 ions/s



LEB infrastructure



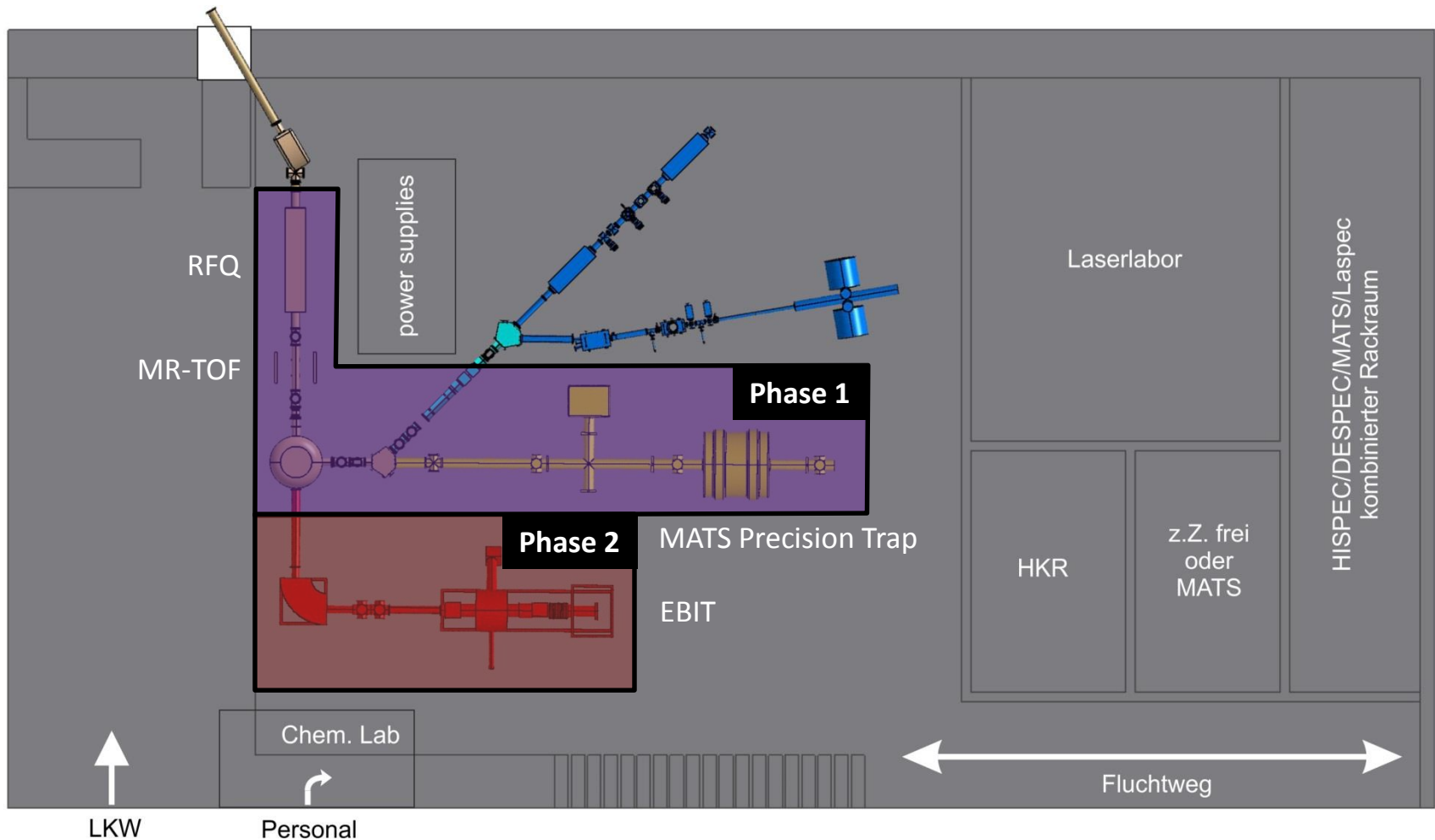
MATS @ FAIR



MATS

Precision Measurements of very short-lived nuclei
using an Advanced Trapping System

Phase 0: TRIGA facility, Mainz



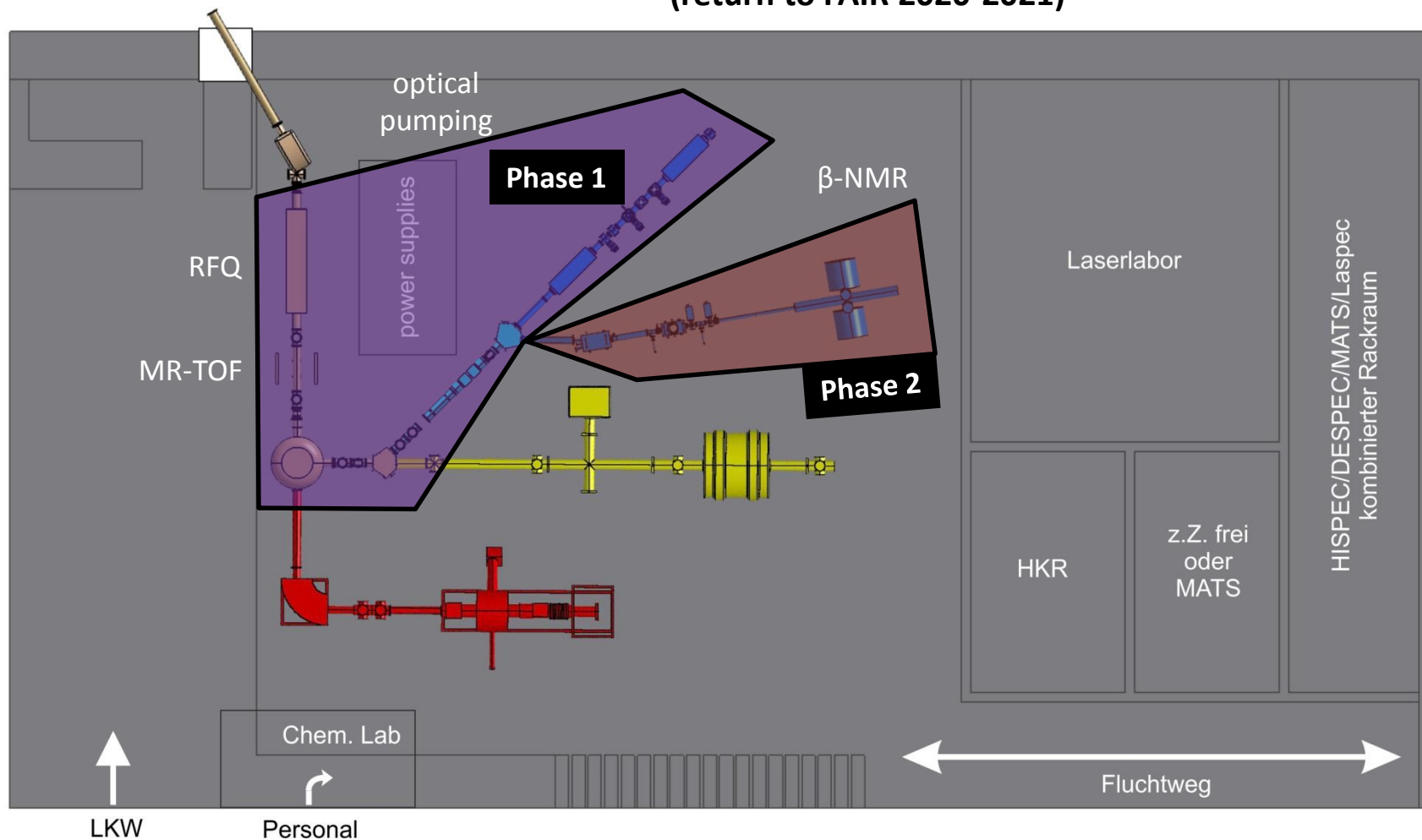
LaSpec @ FAIR

LaSpec
© FAIR

LaSpec

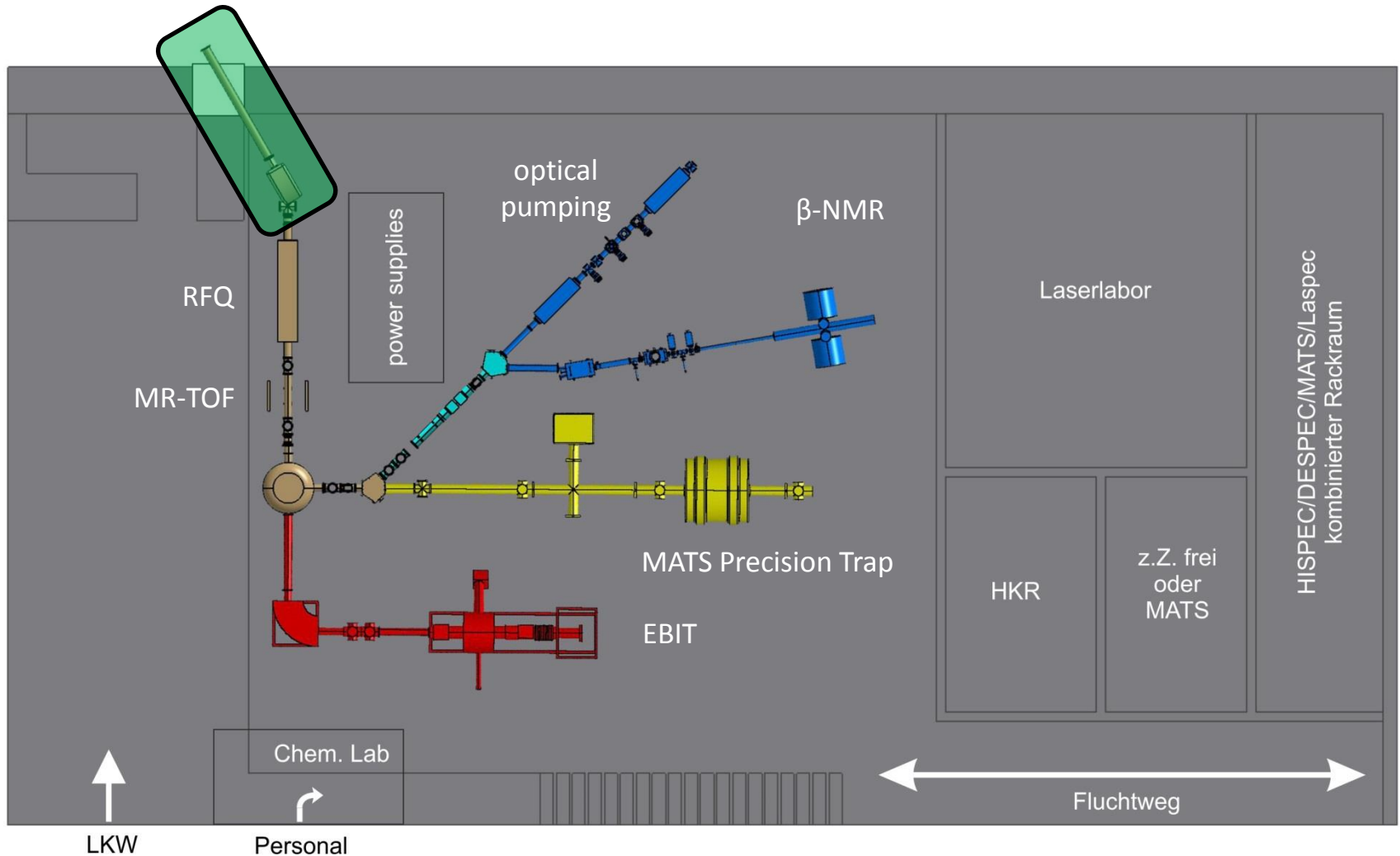
Laser Spectroscopy of short-lived nuclei at FAIR

Phase 0: collinear beam line from TRIGA
Currently at Argonne, USA, for use at ATLAS and CARIBU
(return to FAIR 2020-2021)

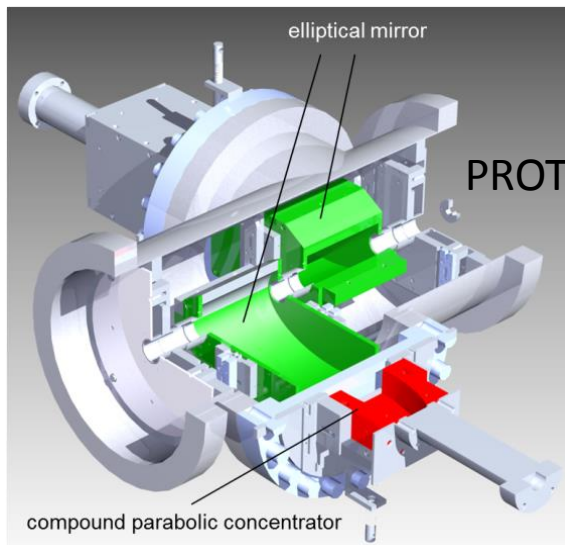
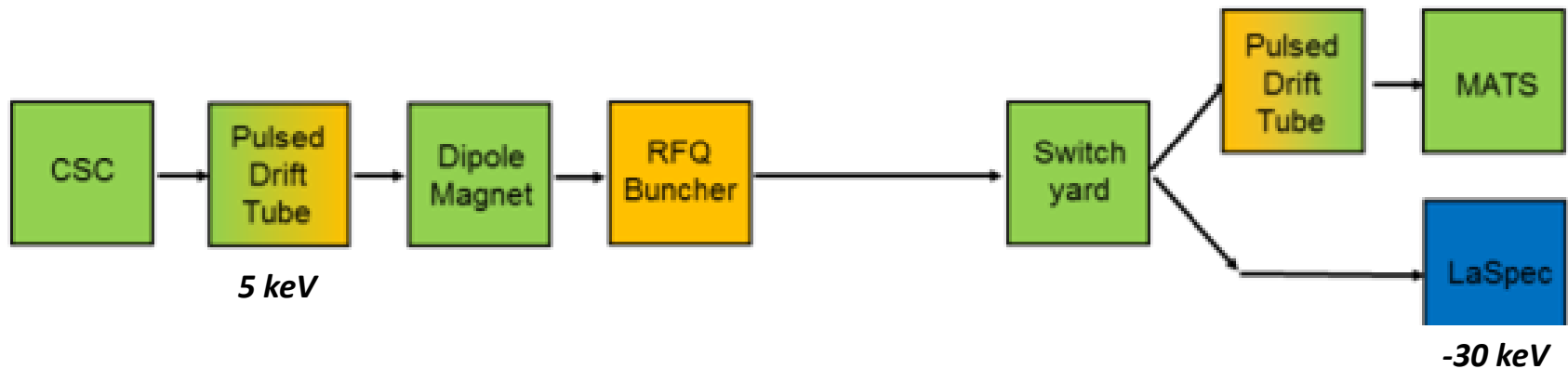


Connecting beamline to the cryogenic stopping cell

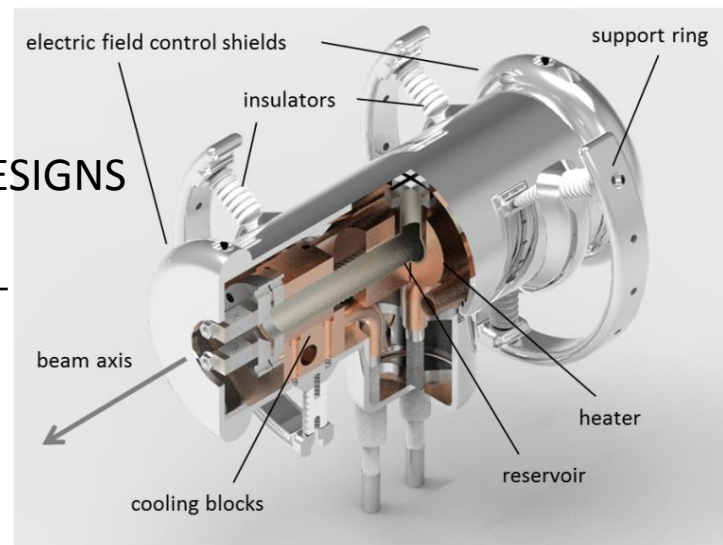
Length: 6-8 m; Height: 1.2 m; Energy: 5 keV; magnetic dipole



Beam-delivery concept

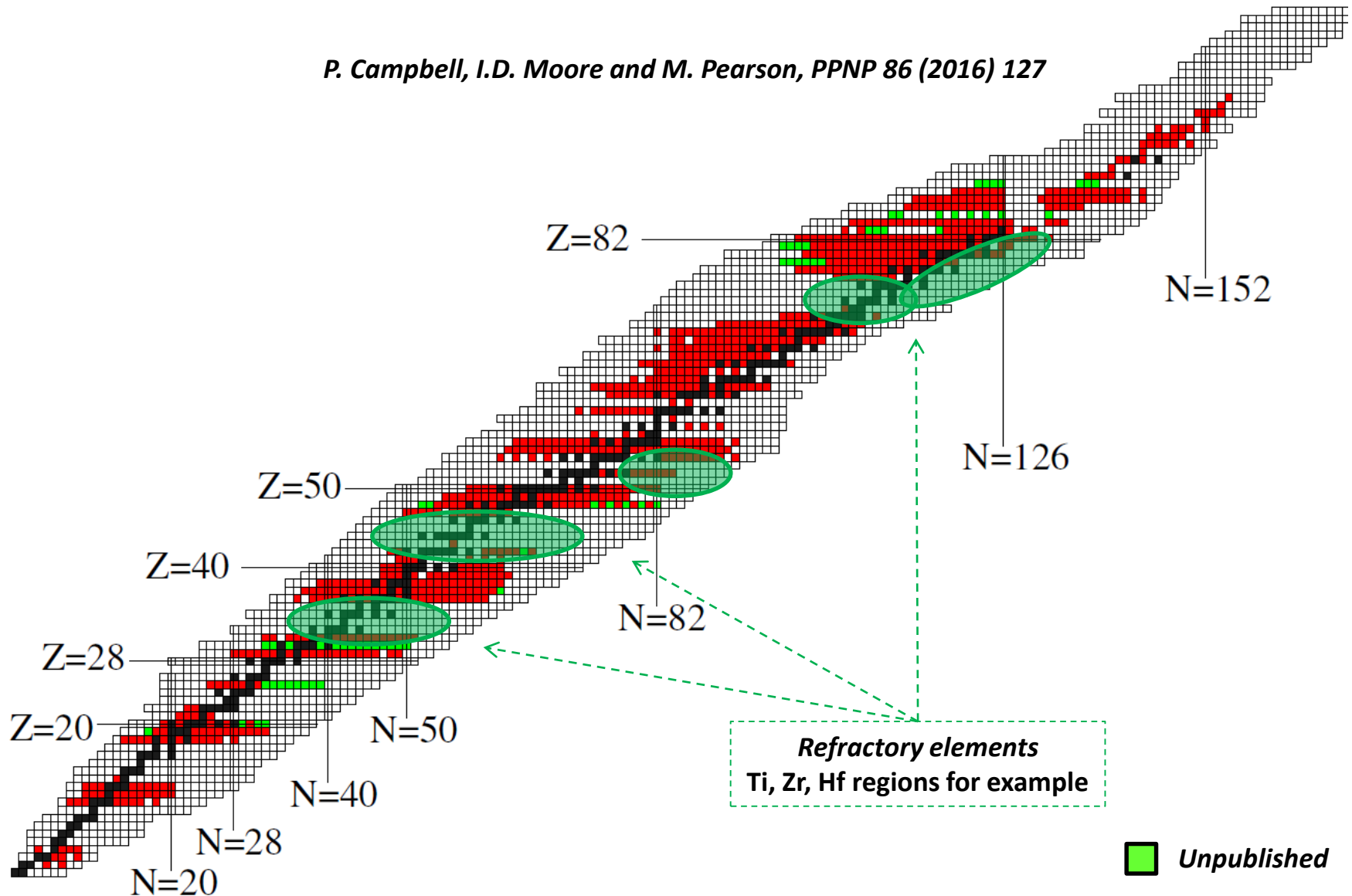


PROTOTYPE DESIGNS



Status of laser spectroscopy landscape

P. Campbell, I.D. Moore and M. Pearson, PNP 86 (2016) 127



Principle layout for β -delayed γ spectroscopy

