sck cen

Belgian Nuclear Research Centre

MYRRHA phase 1 implementation

MINERVA

Ion Source Developments at SCK CEN

Kim Rijpstra

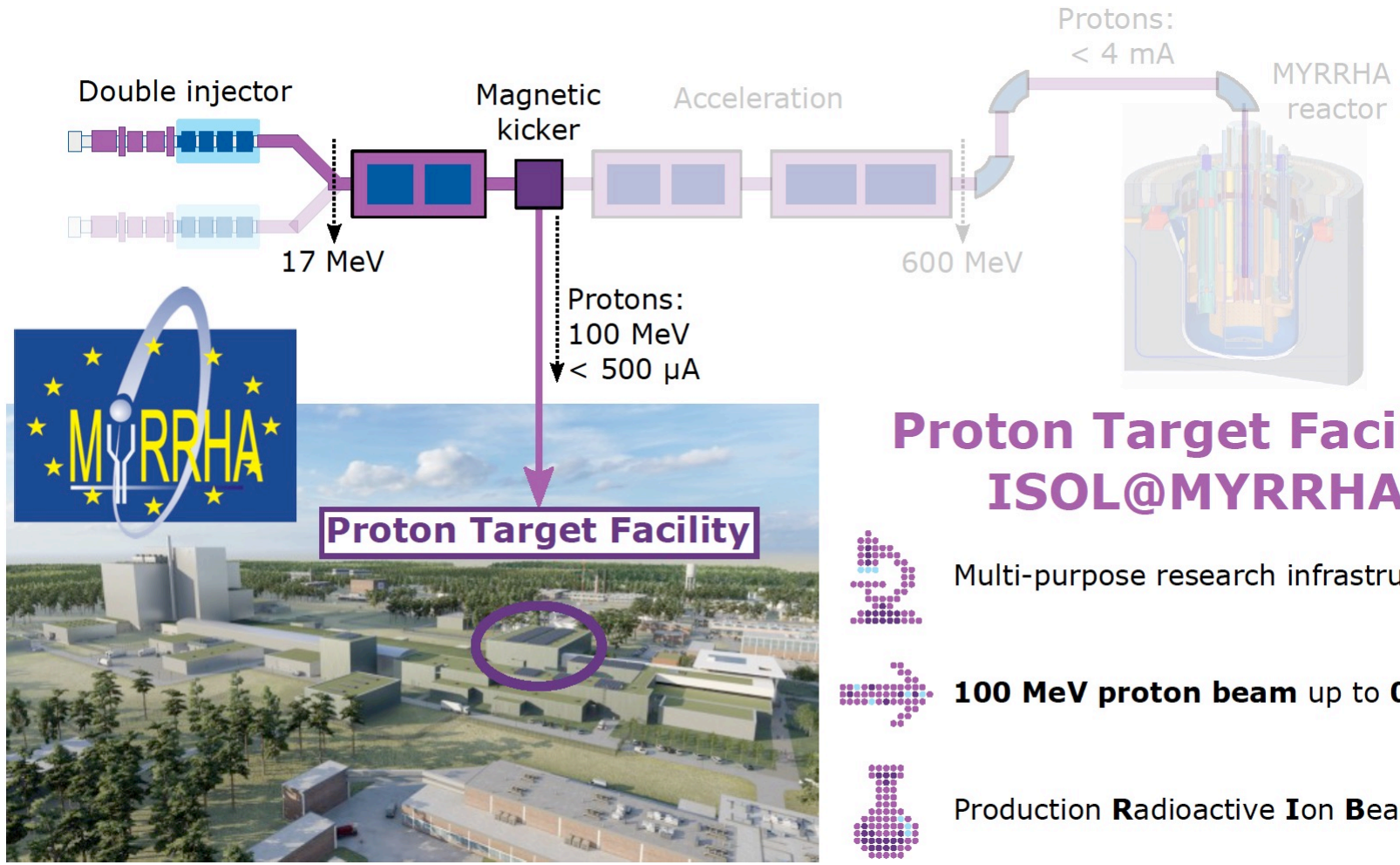
22/11/22

Overview

- ISOL@MYRRHA ion source challenges
- Ion source services
- Initial ion sources
- Hot Cavity
- IMRILS
- Conclusions

ISOL@MYRRHA ion source challenges

- 10 kW proton energy in target-ion source
- 1 order higher yield throughput than ISOLDE
- 4 weeks of stable operation



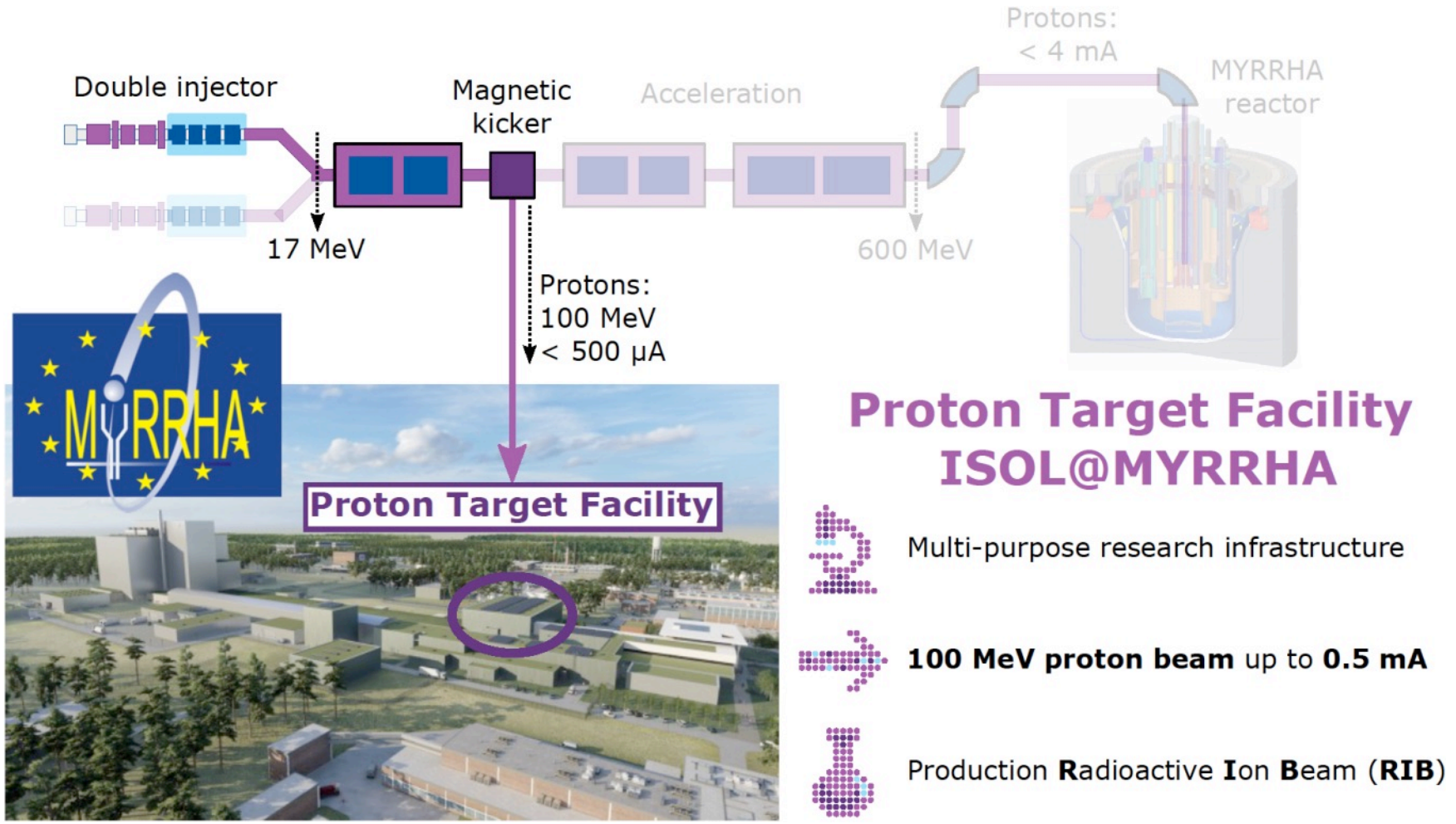
Proton Target Facility ISOL@MYRRHA

Multi-purpose research infrastructure

100 MeV proton beam up to **0.5 mA**

Production **R**adioactive **I**on **B**eam (**RIB**)

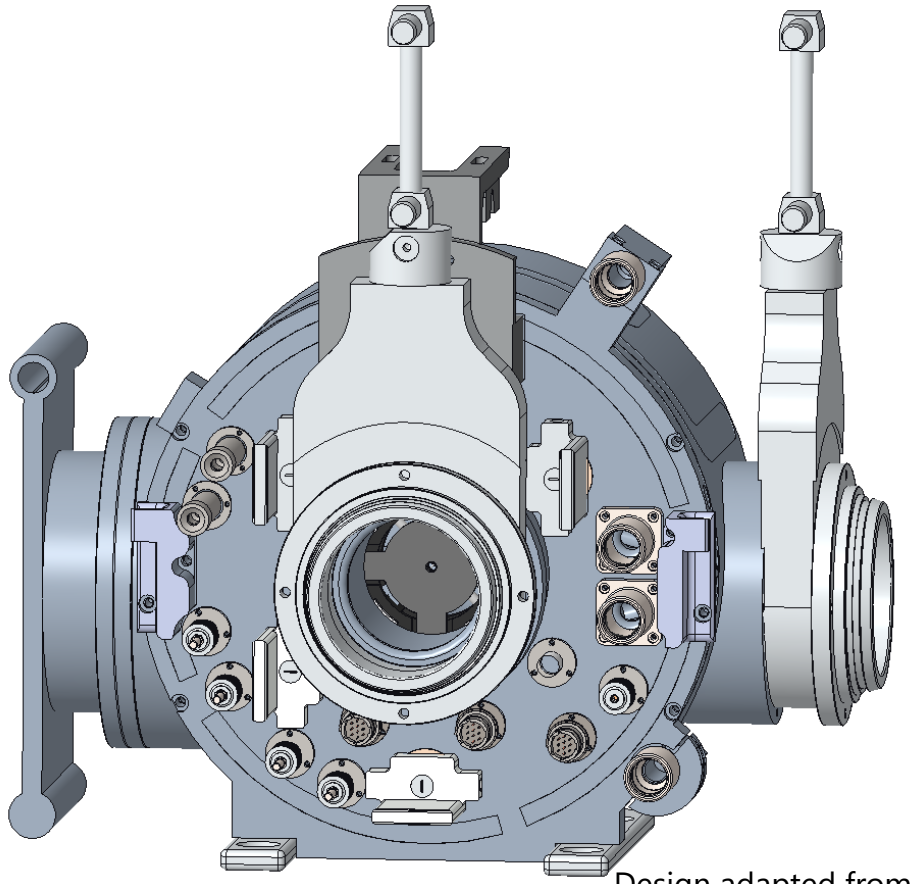
ISOL@MYRRHA ion source challenges



- Produce all RIB's known
- Serve different applications
- Develop towards high efficiencies

Ion source services

- Target ion sources in a ‘casserole’
- Services for at least:
  - (isolated) hot cavity (SIS/RILIS)
    1-2 HP connections
  - FEBIAD/VADLIS
    1-2 HP connections, 2 LP/multipin connections,
    1 magnet connection, 1 gas leak
  - LIST/IGLIS
    1-2 HP connections, 2-3 LP or multipin connections
    2 RF connections (LP or multipin)
  - Auxillaries
    Mass markers (up to 4 LP connectors), Gas leaks (up to 2), thermocouples (multipin)



Design adapted from ARIEL

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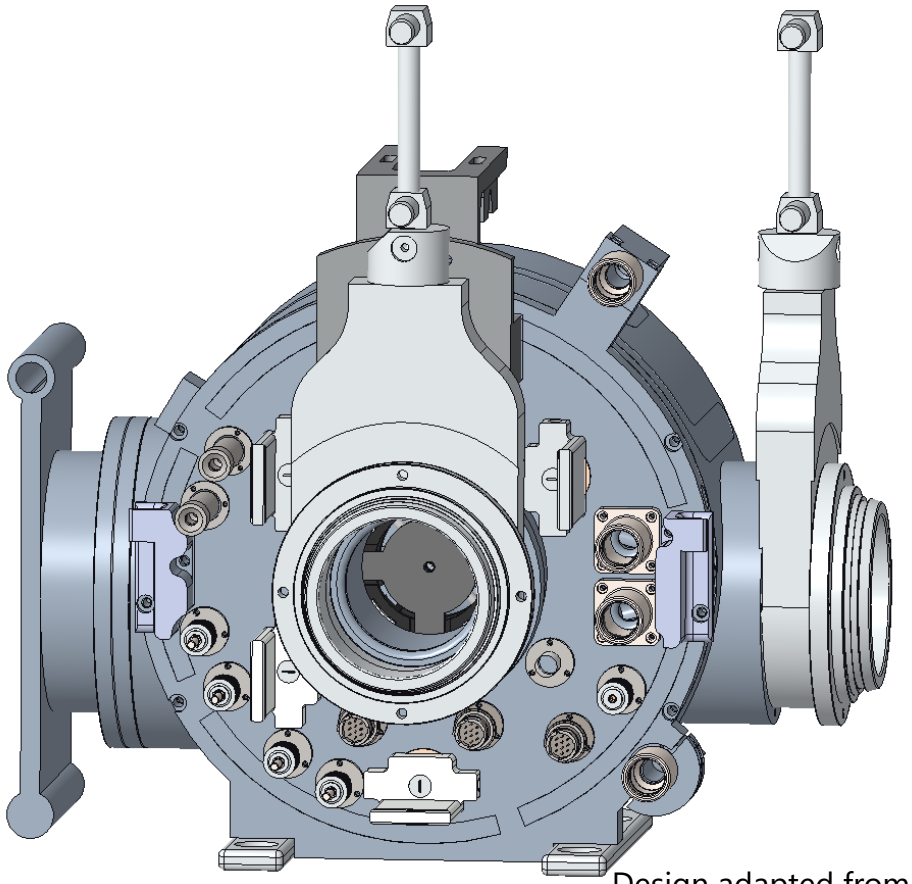

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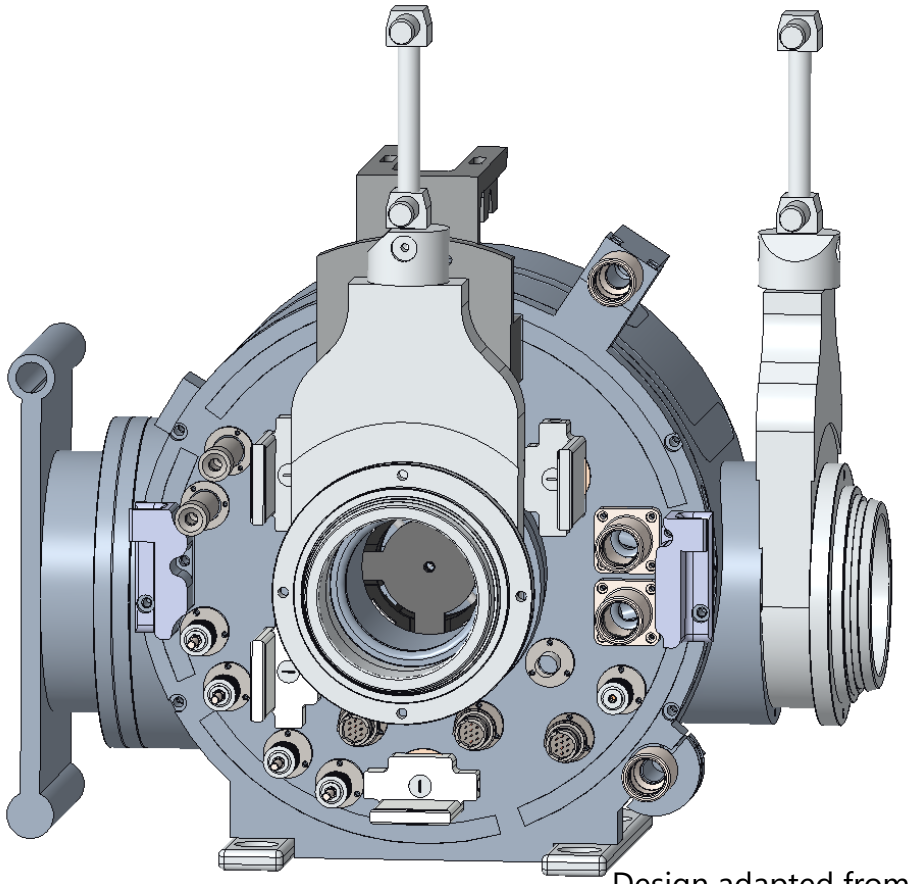

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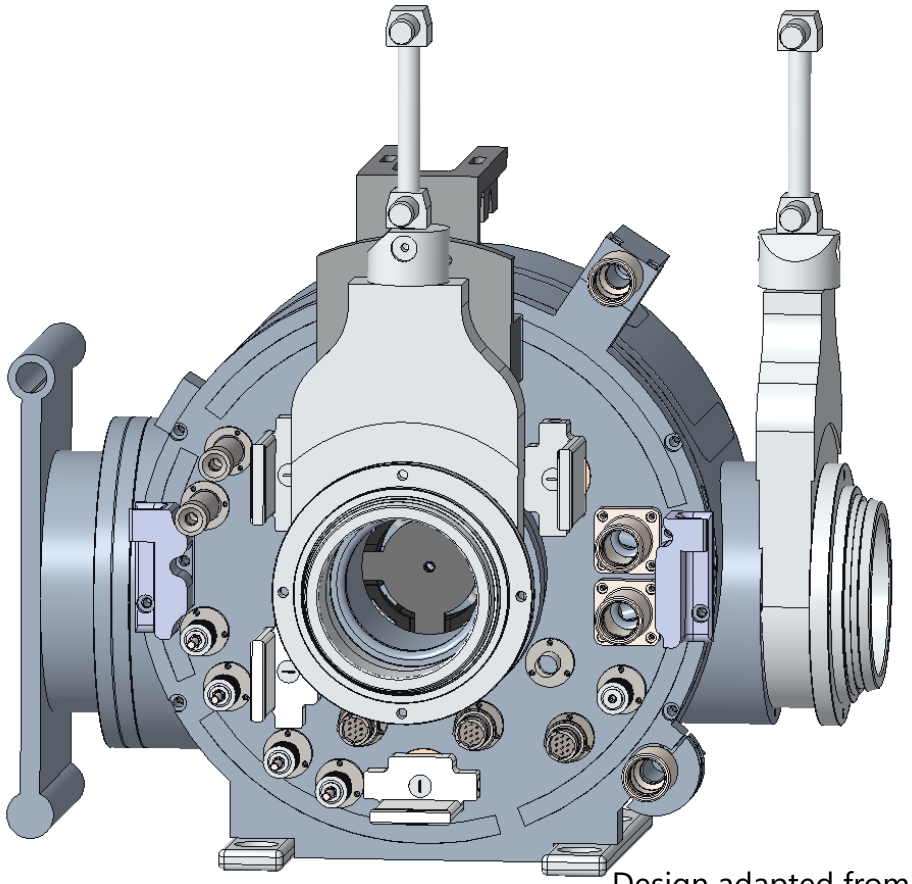

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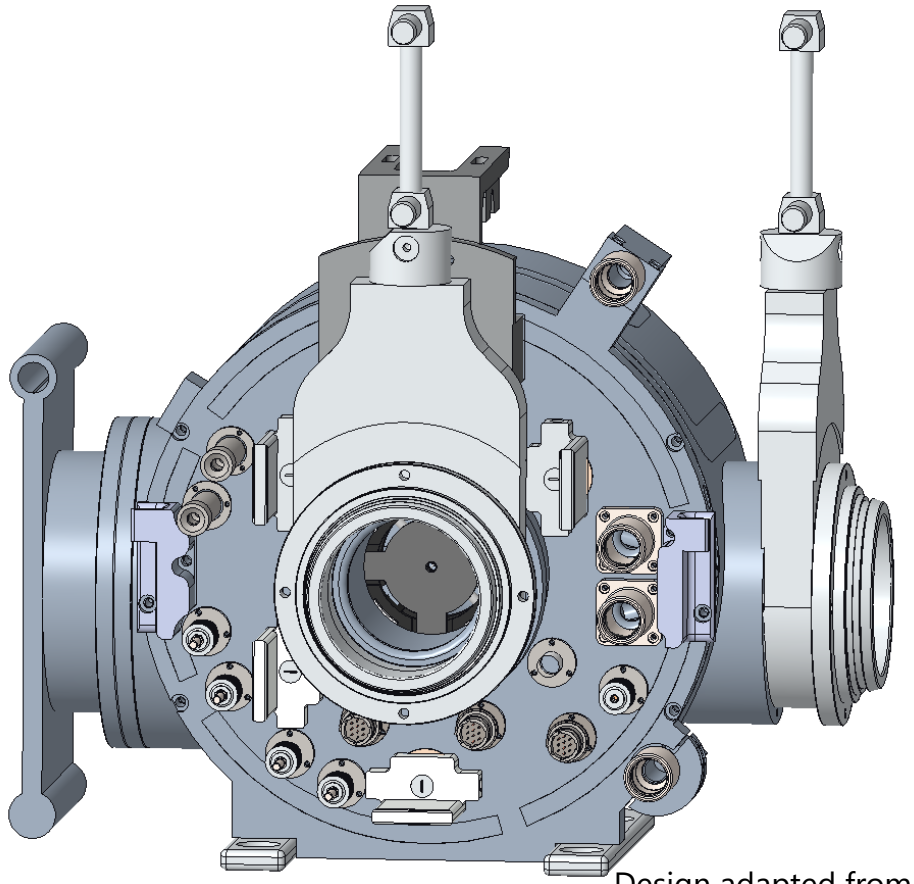

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Initial ion sources

- Day-1 ion source:
  - Lower proton currents
  - RIB still to be chosen
  - Little experience

⇒Hot Cavity

- Reliable, robust
- Simple in operation
- Versatile

- Surface ionization
- Laser ionization

- Improvements on efficiency/saturation?
- Reproducible manufacturing?
- Other potential developments?

⇒IMRILS (ISOL@MYRRHA Resonant Ionization Laser Source)

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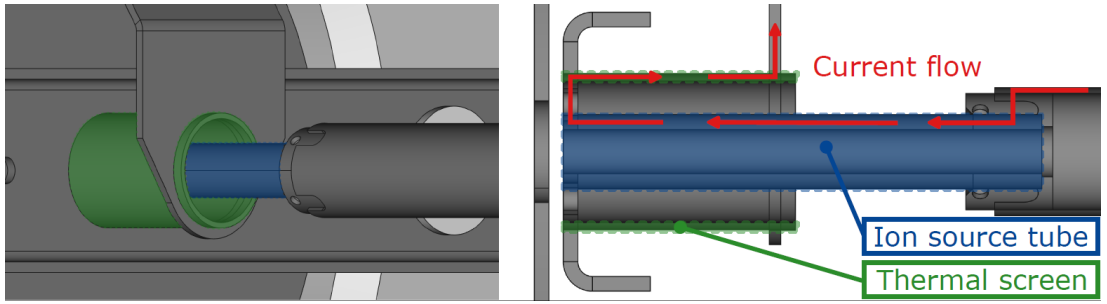
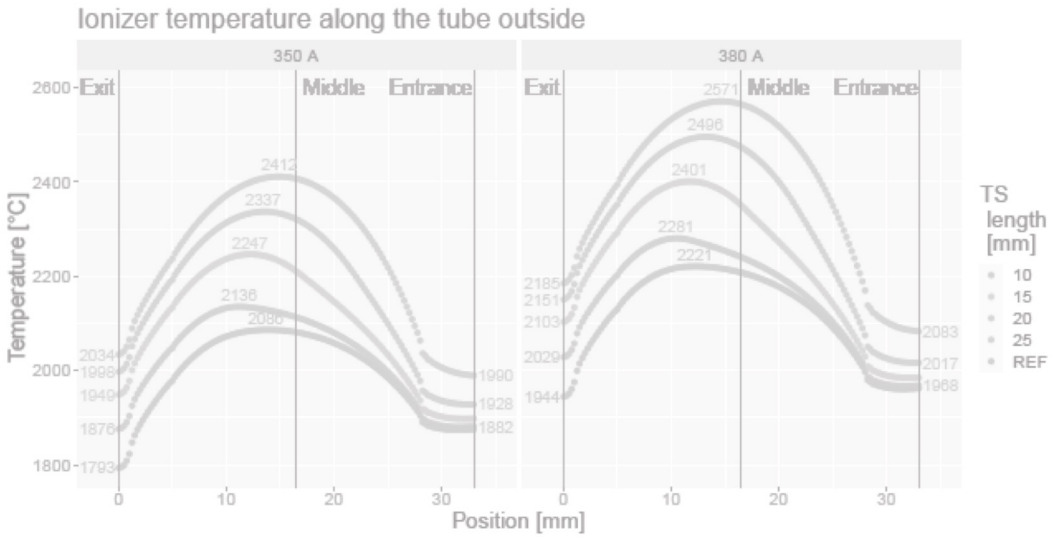
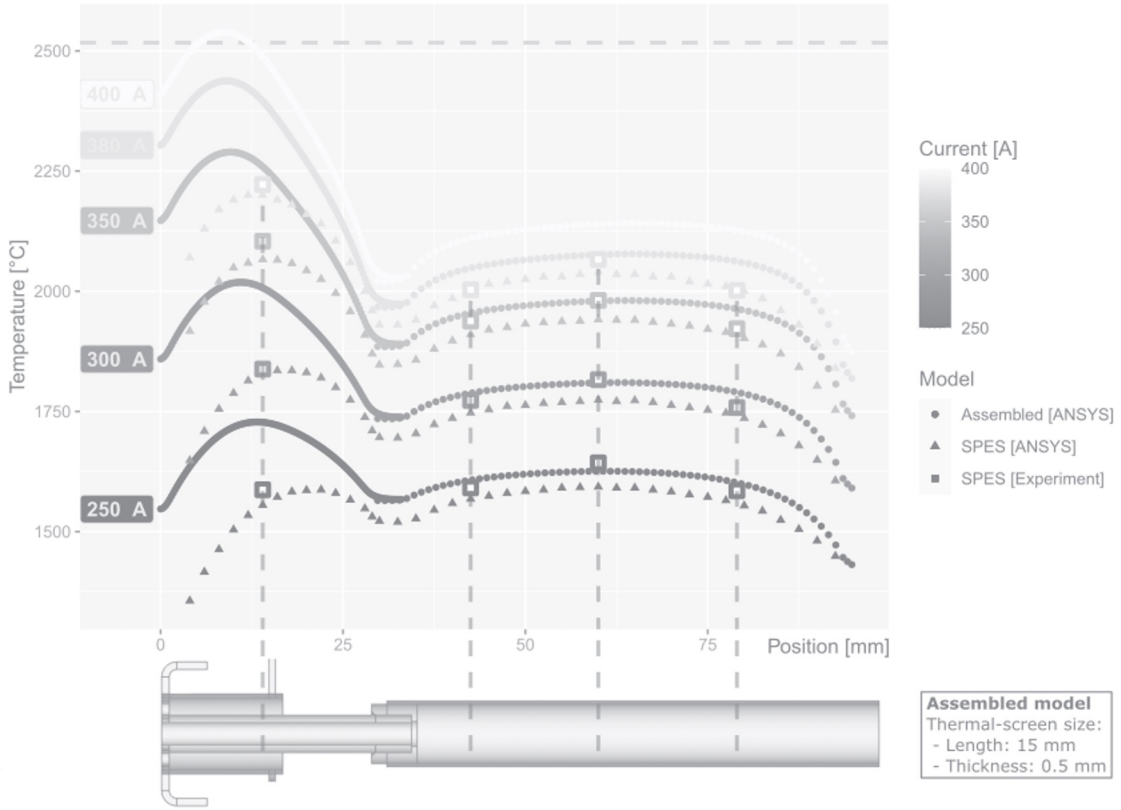
- Active thermal screen (Sophie Hurier)
  - Concept



  - Screen length as parameter



  - Thermoelectric simulation



(reference: SPES SIS, 2017)

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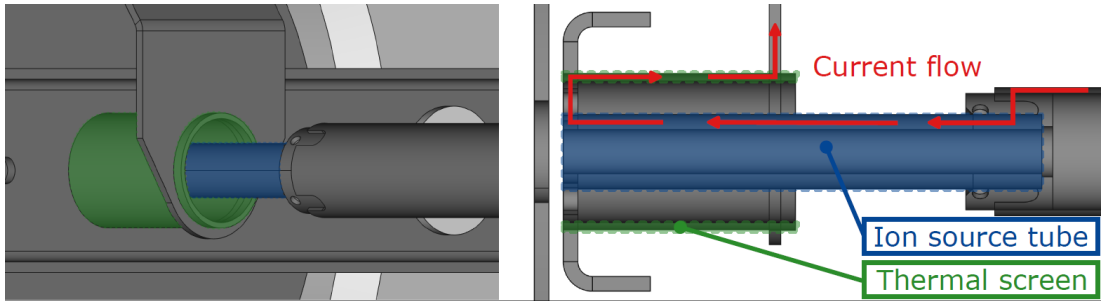

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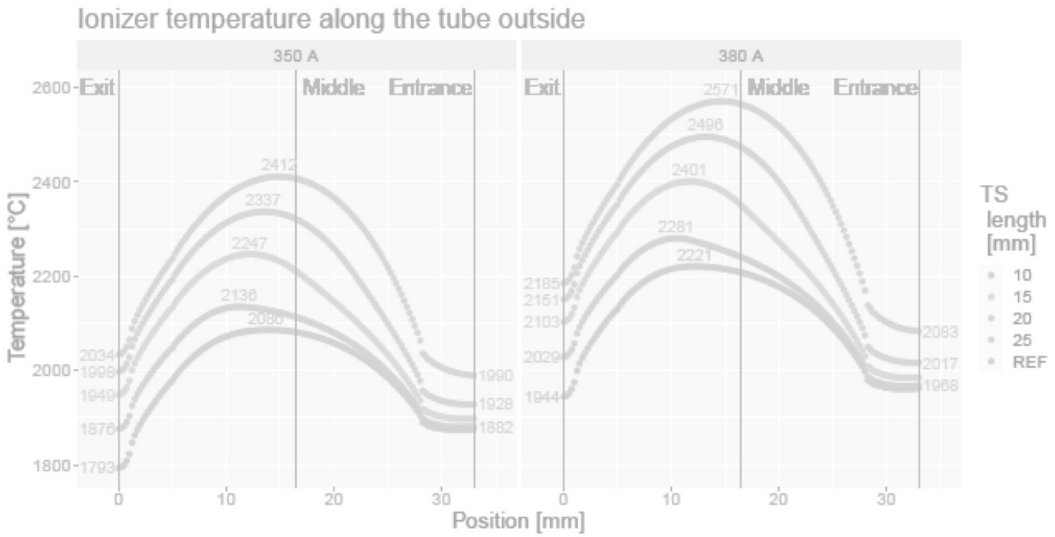

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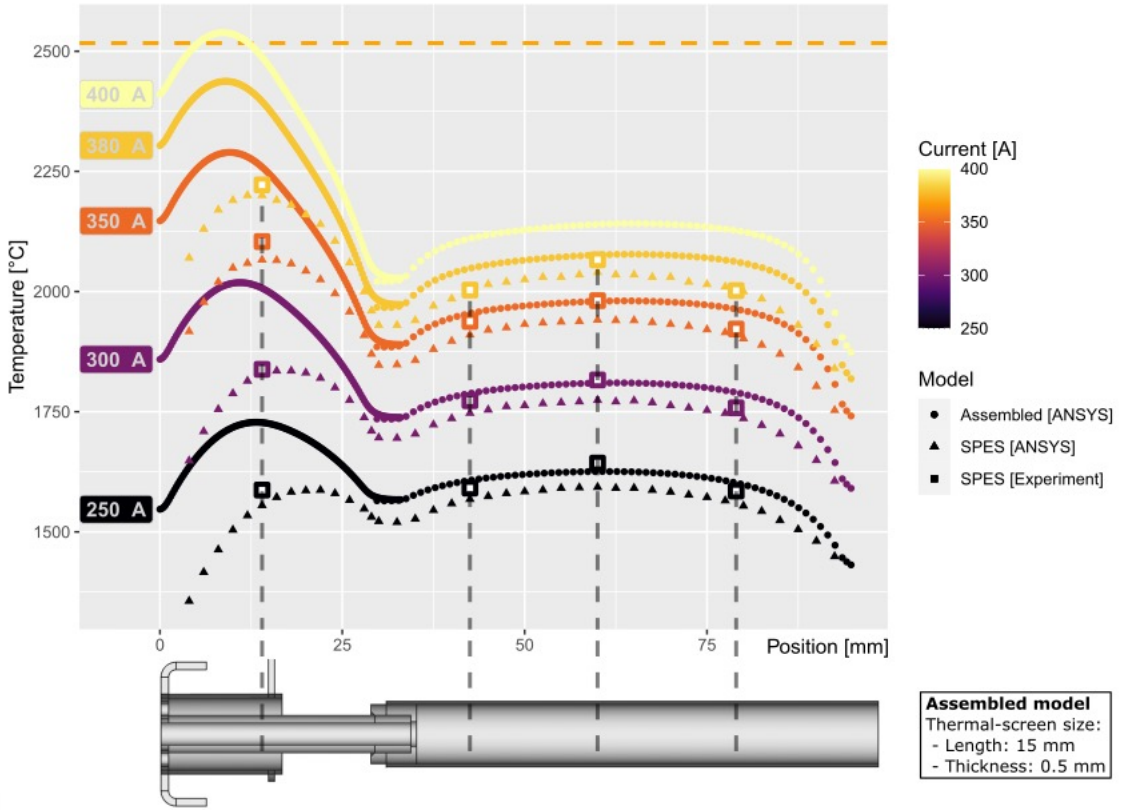

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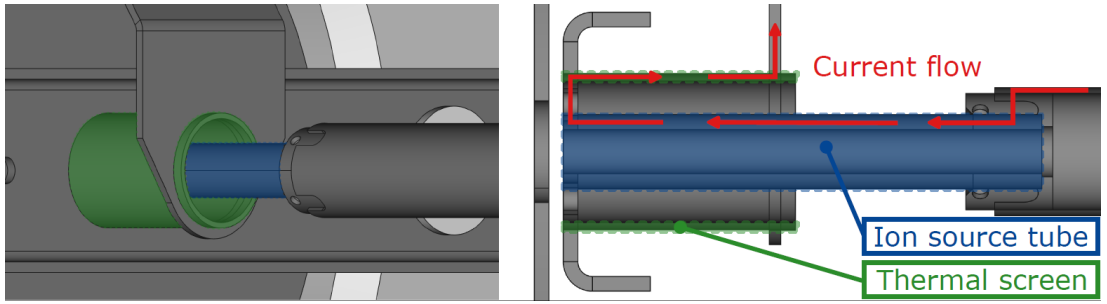

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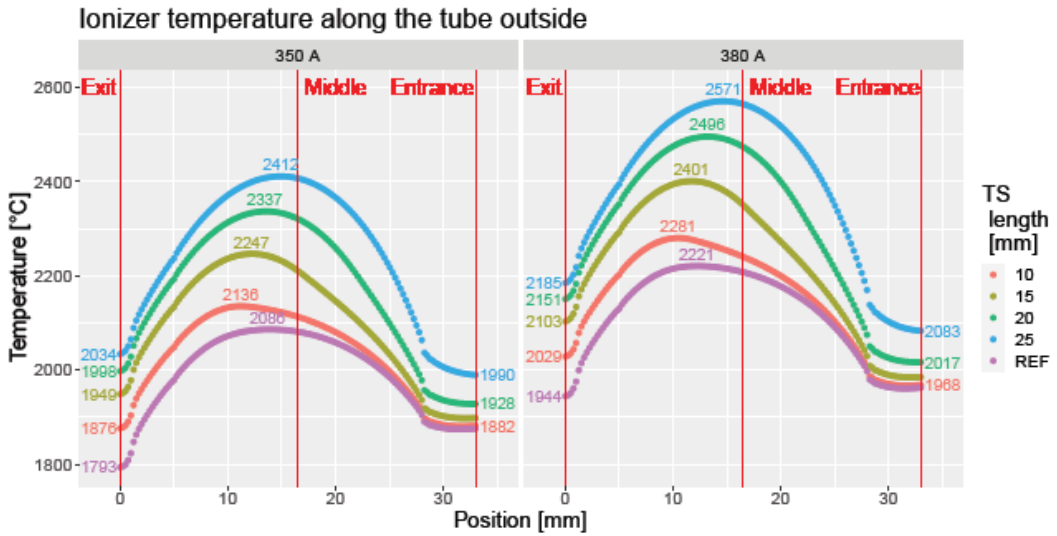

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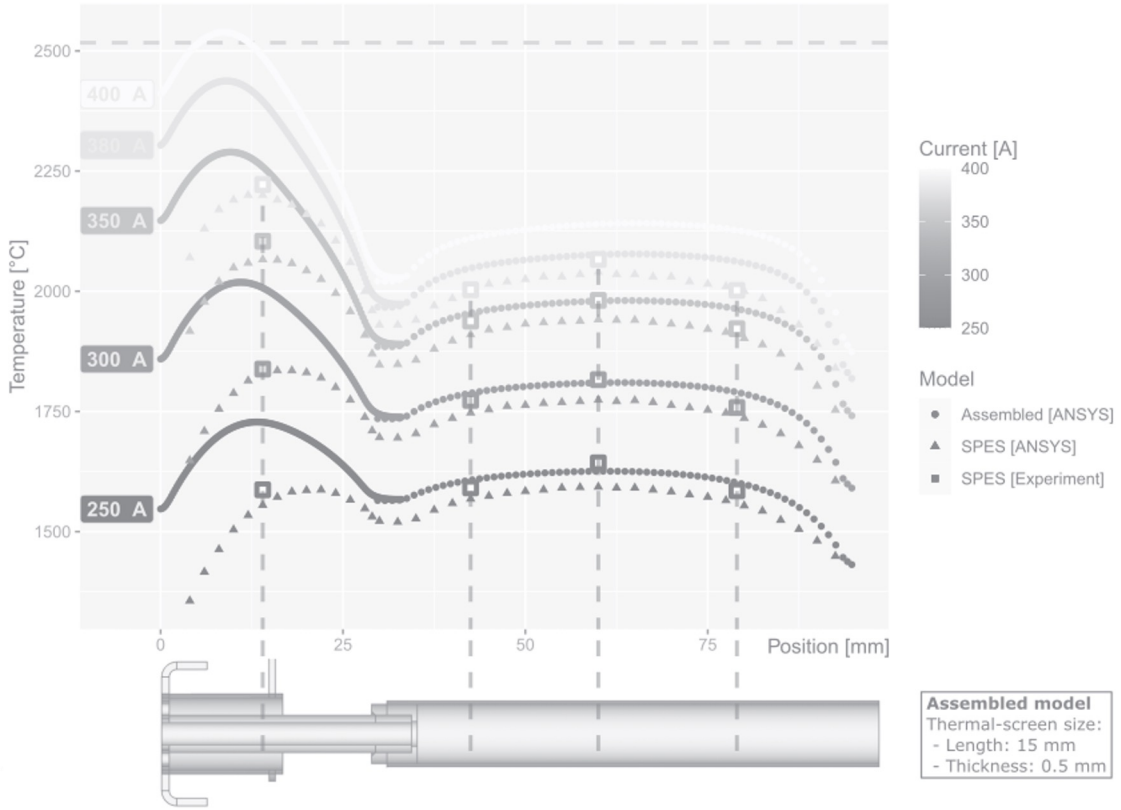

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- Active thermal screen (Sophie Hurier)
  - Two manufacturing methods/materials under evaluation
  - Press-fitted tantalum source

Under construction
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To be tested on
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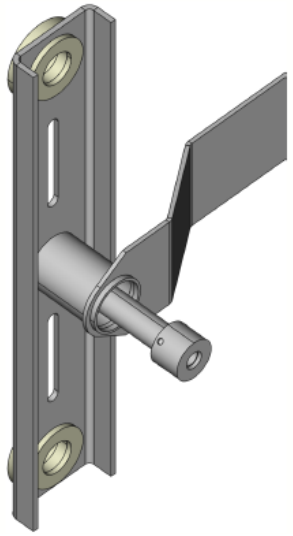

  - 3D-printed tungsten source

Laser Beam Melting on
Powder Bed (LBM-PB)

Technique is still
under development
⇒ Heat treatment?
⇒ Modified design?

  - Alternative: e-beam welding
  - Alternative: Ta-wire 3D printing?

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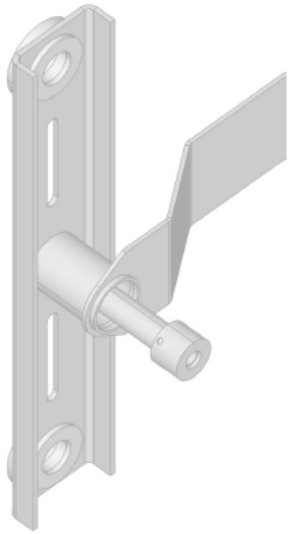

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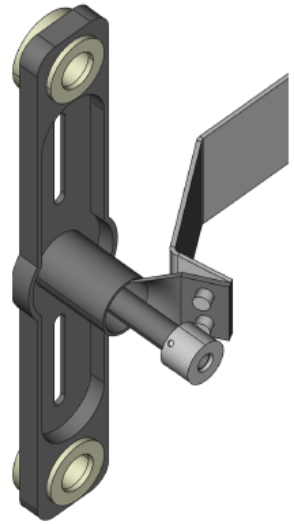

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IMRILS

- ISOL@MYRRHA's laser source
  - Hybrid laser system: 2 dye lasers, 2-3 Ti:Sa lasers, dedicated non-resonant laser
  - Cleanroom with tight temperature control
  - Dye circulators in dedicated adjacent space
  - Dog-leg laser beam transport

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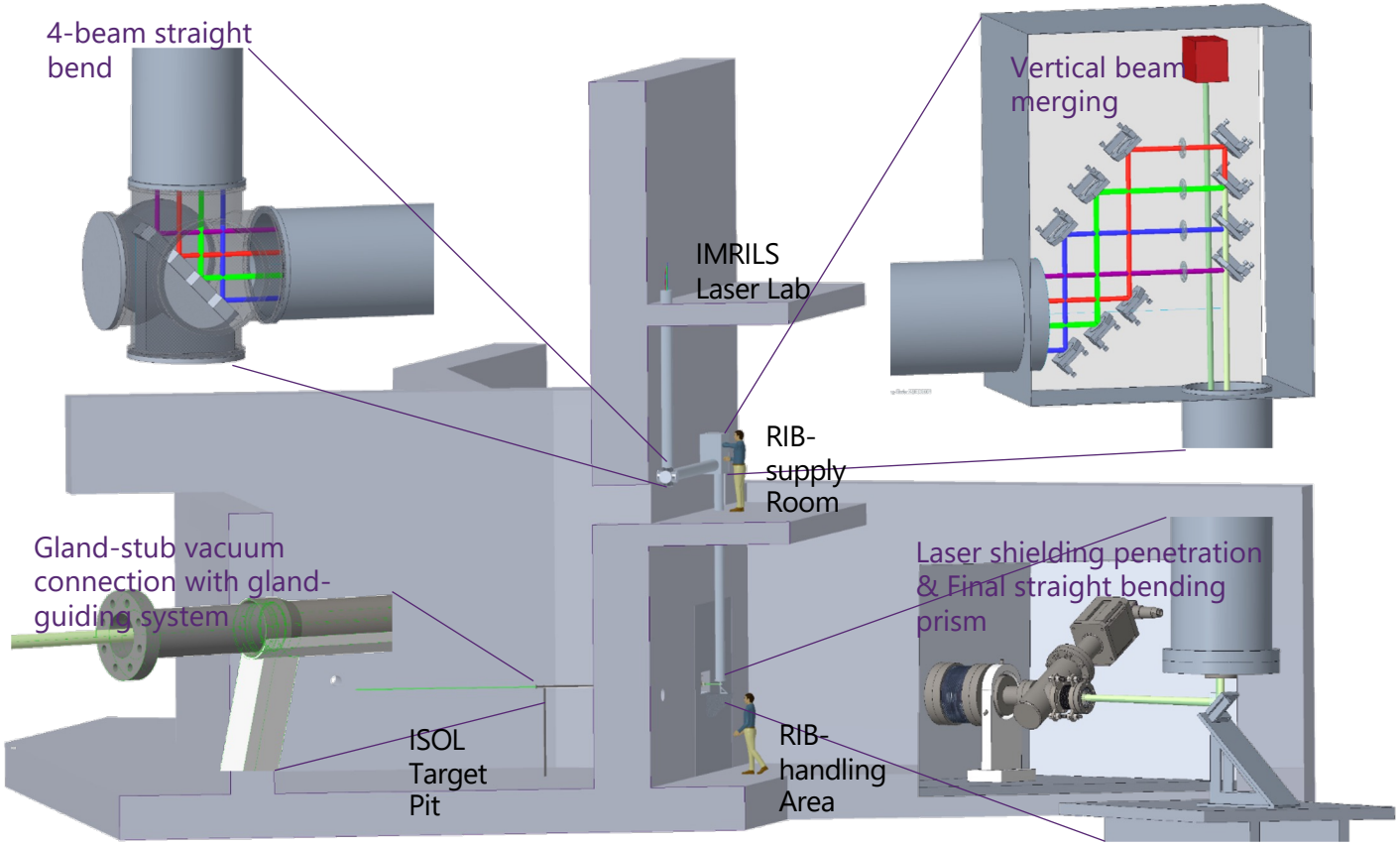

IMRILS

- Offline ISOL Laser Laboratory
  - 2 Liop-Tec dye lasers (incl. SHG), pumped with 2 EdgeWave (532 and 355 nm)
  - Laser lab design and realization
  - Reference cell ABU, adaption from KULeuven design
  - Will be coupled to offline ISOL system
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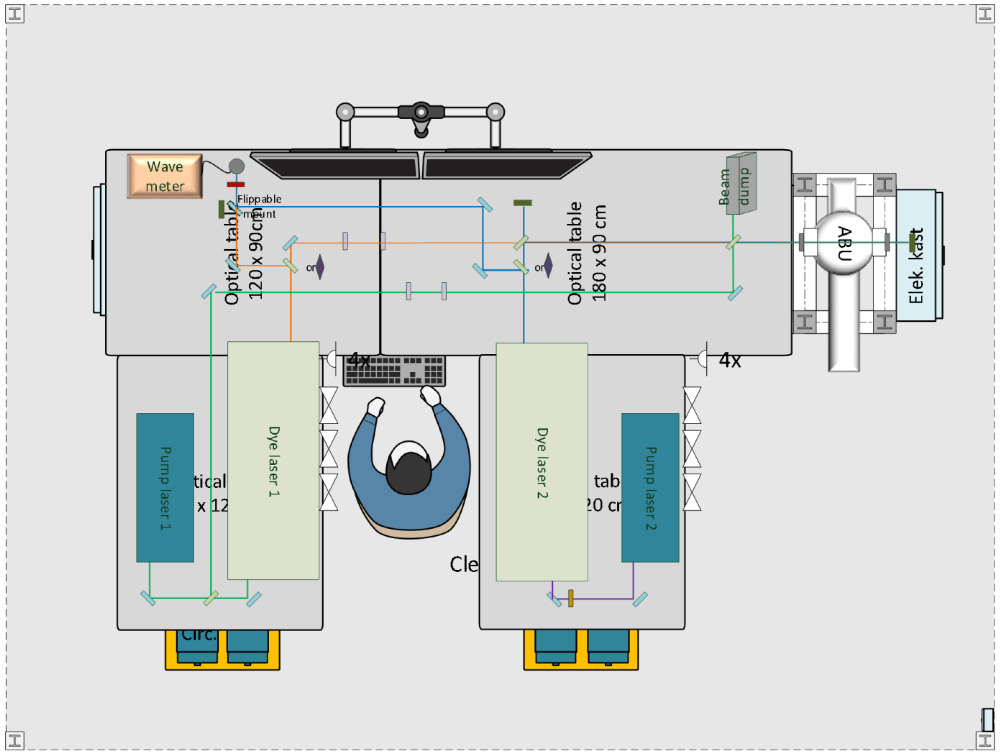

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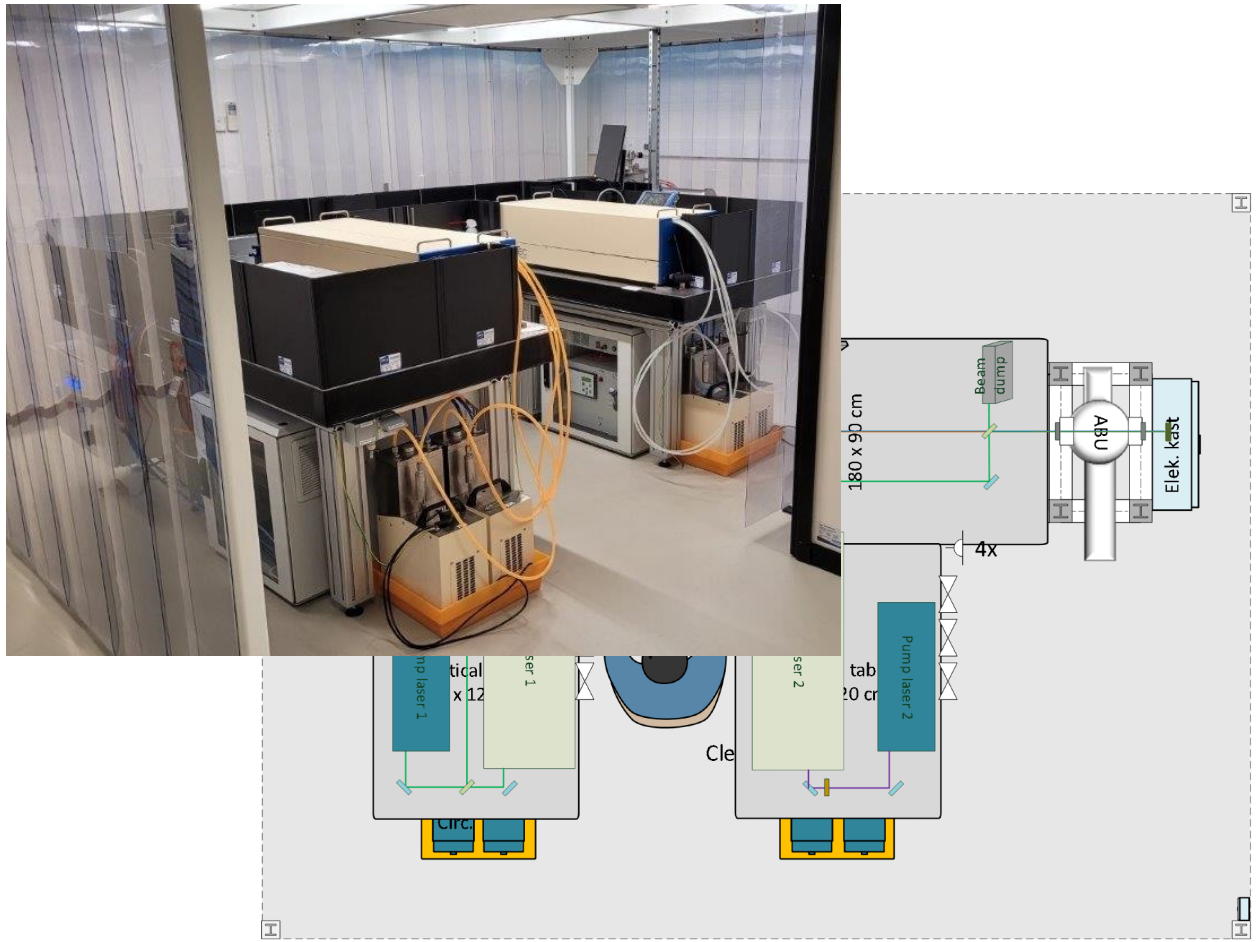

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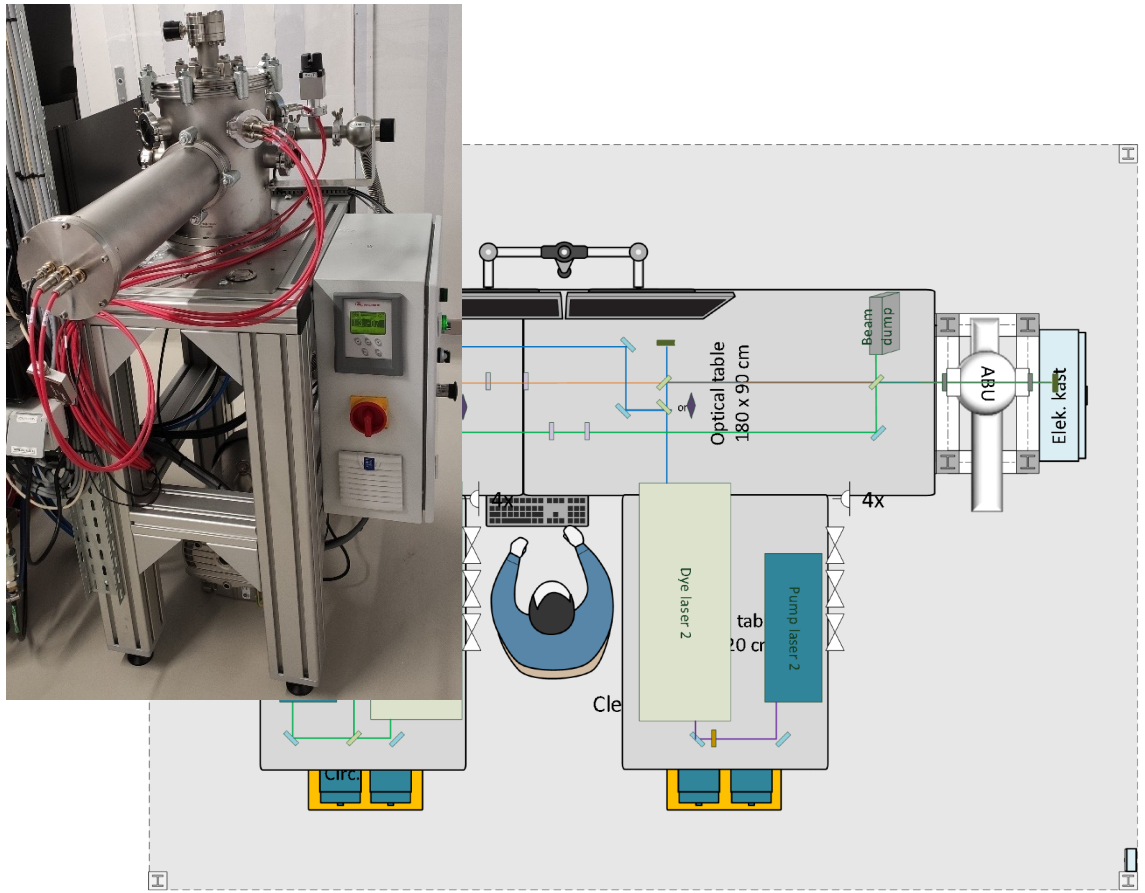

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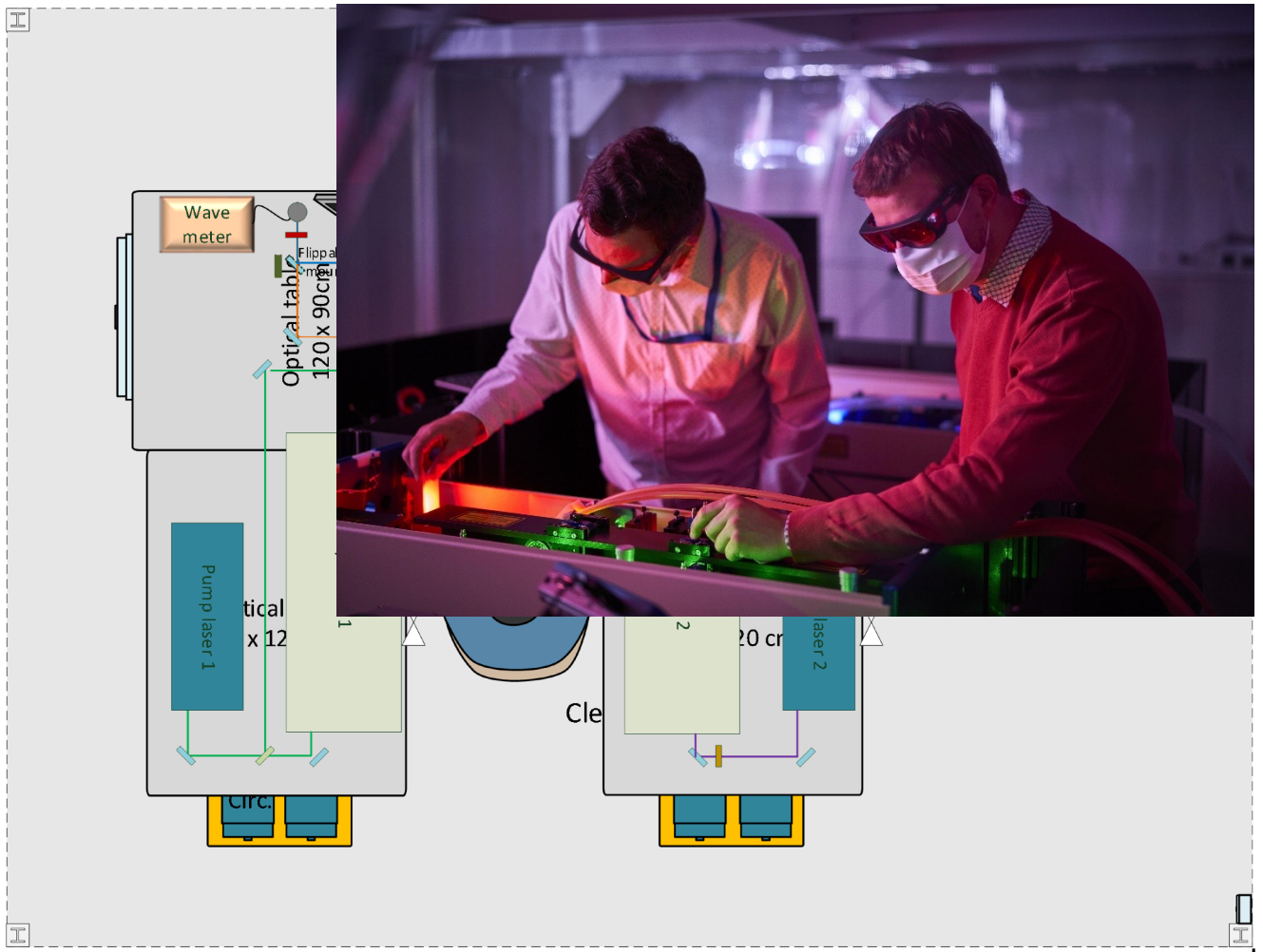

Conclusions

- ISOL@MYRRHA infrastructure is foreseen for state-of-the-art ion sources today, as well as future source
- In-house development focuses on the hot cavity: thermo-electric engineering, manufacturing and understanding
- Laser laboratory and transport design as input for the facility building, the offline laser laboratory aids in this.

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