

JRA  
TARGET

JRA  
AMaSCa

NA  
QUANTIFY

JRA  
OptION

PRISMAS-MAP meeting 2019.09.19, CERN

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# TARGET

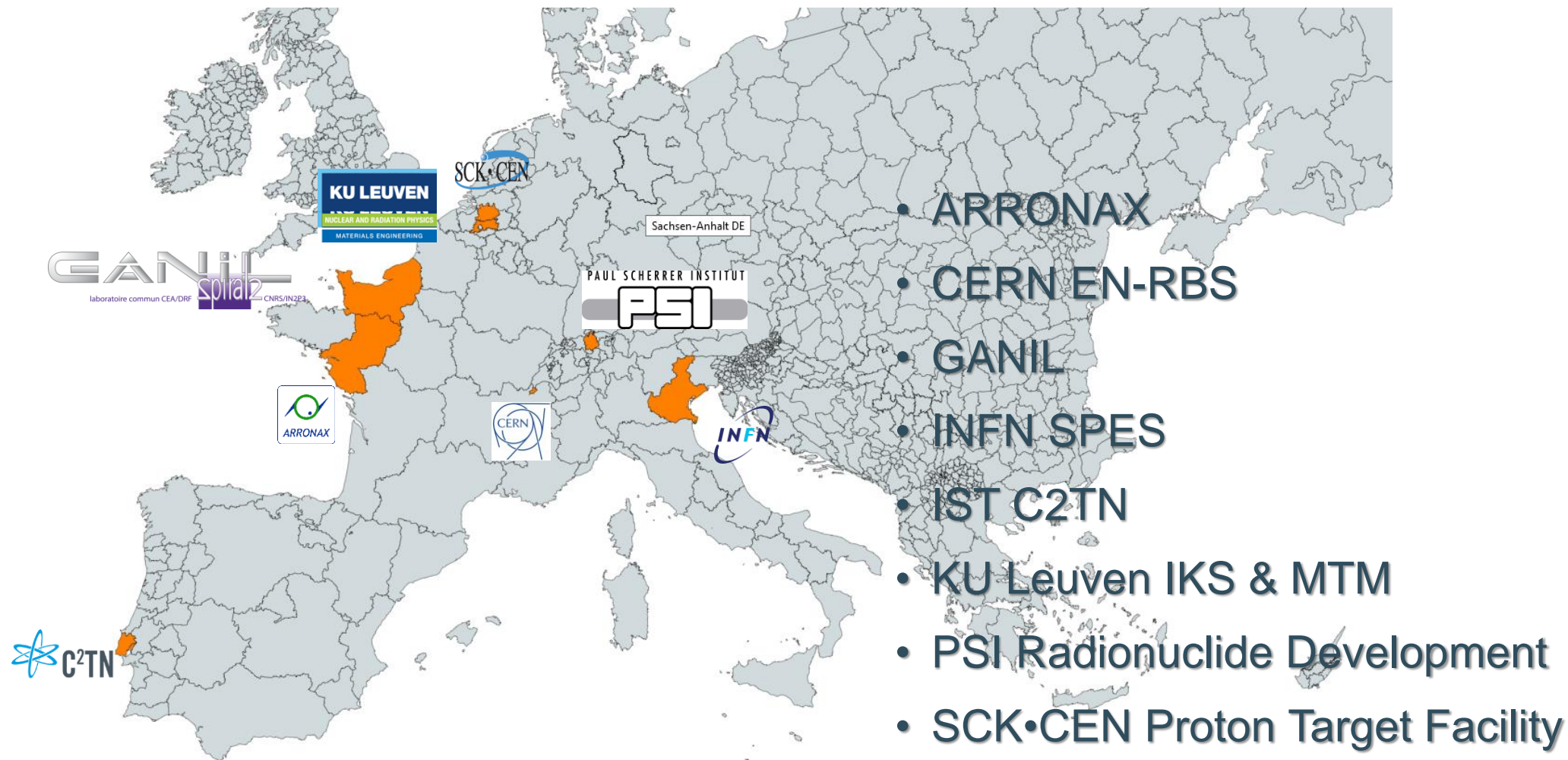
## Concept

- The target is at the heart of the production of radioisotopes.
- Aims:
  - Producing radioisotopes with ‘long’ half-lives by ISOL standards
  - Requires a different perspective aiming for **EFFICIENCY** and **PURITY**

## Concrete research lines

- MAX-phase-based material:
  - TiC for **Sc**
  - TaC for **Tb**
- NiAl alloy target for **Fe**
- $\text{GdF}_3$  &  $\text{GdB}_6$  for **Tb**
- O-doped BN target for  $^{11}\text{C}$  production
- Fiber targets – applies to all
- Liquid targets
  - Bi for **At** / **Rn**
- Target enrichment

# TARGET: partners



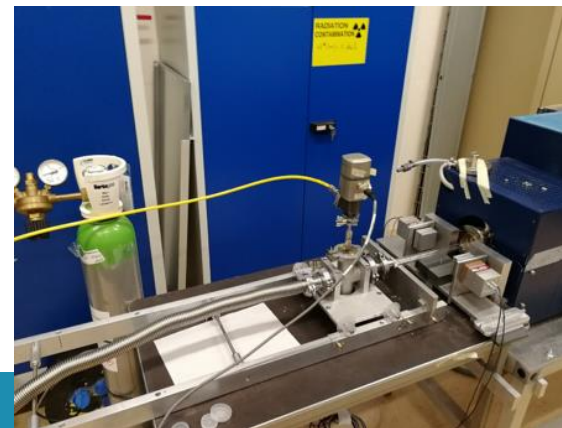
# TARGET

## Approach

- Synthesize new materials with advanced metallurgical processing
  - Melting, milling, mixing, ...
  - SPS, hot pressing, vacuum sintering, electroplating, co-deposition, ...
  - Electrospinning
- Characterize those materials structurally and for radioisotope production
  - Production simulations (FLUKA)
  - TGA-MS, BET, gas pycnometer, heat test, MEB, DRX, PIXE, ...
- Irradiation tests
  - In-target production tests
  - Release fraction studies
  - Real condition studies

## Facilities

- Cold synthesis facilities: C2TN, MTM
- Cold testing facilities: CERN, SPES, C2TN, IKS, SCK
- Irradiation facilities: ARRONAX, GANIL, CERN, PSI, **KU Leuven**
- Post-irradiation tests: ARRONAX, CERN, IKS, PSI



## Advancement of Mass Separation Capabilities

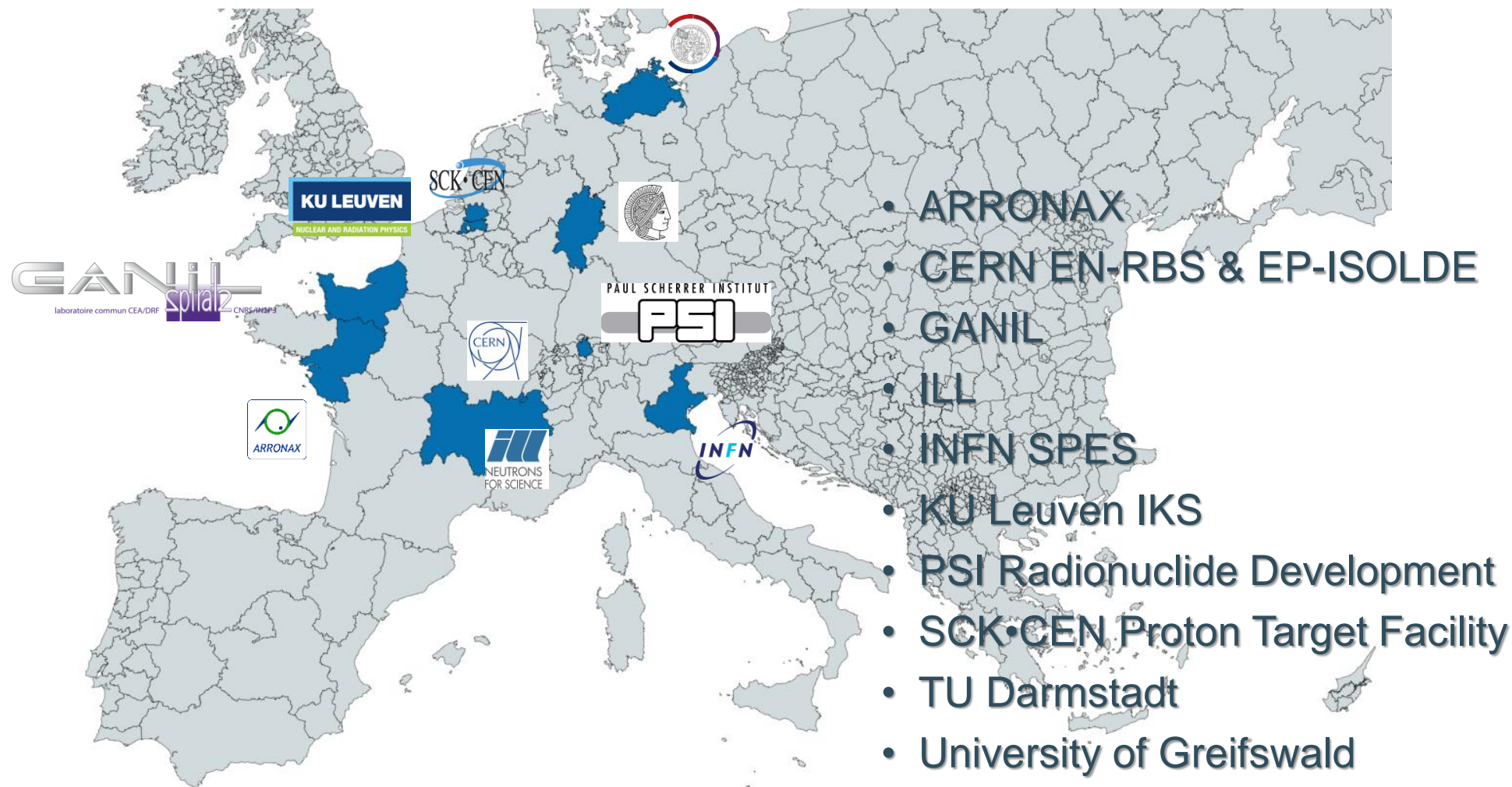
### Concept

- Mass separation is at the heart of the project
- Not all facilities have access to mass separation
- Improve the overall efficiency with multiple-user extraction to maximize the collection of radioisotopes
- Consider mass separators for enrichment of precious target material

### Concrete research lines

- Multiple-beam collection at MEDICIS
- Design of a multi-stage separator at ISOL@MYRRHA to collect fission fragments and near-target isotopes at the same time
- Design a turn-key, small-scale mass separator of implantation at partner institutions
- Study the efficiency of stable element enrichment at existing separators

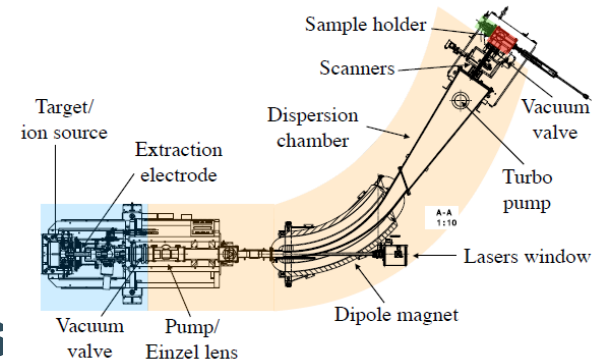
# AMaSCa: partners



## Approach

- Simulate existing and new facilities
  - Ion-beam transport
  - From extraction to implantation
  - Efficiency optimization
- Design new facilities
  - From simulations to mechanical solutions
- Validate models and choices in existing facilities

## Facilities

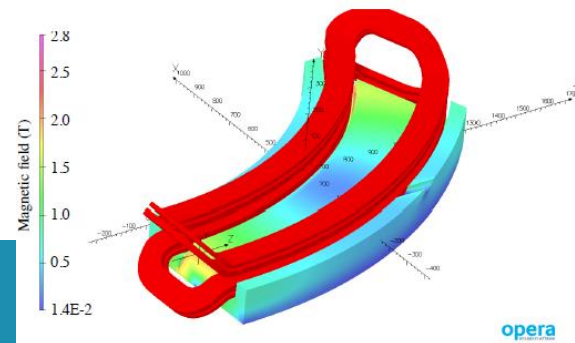


- Existing separators:

- CERN: ISOLDE GPS & HRS, MEDICIS, Offline 1, [Offline 2](#)
- [Leuven Isotope Separator](#)
- [SIDONIE](#)

- Future facilities

- SCK•CEN Proton Target Facility



# OptION – Optimizing ion sources for Medical applications

## Concept

- Ion sources at ISOL facilities were developed for optimal efficiency for **short-lived (ms) isotopes** with **low ion throughput (~nA)**.
- For medical applications we need **long-lived isotopes (hours→days)** with **high ion throughput (~uA)**
- Aims:
  - Optimize the ion sources for medical applications by prioritizing ion throughput and efficiency.
  - Develop new **laser, surface** and **plasma** ion sources dedicated to medical applications.

- Proposed Partner institutes: ARRONAX, MedAustron, CERN EN-RBS / LP, GANIL, INFN SPES, SCK•CEN, KU Leuven IKS , PNPI IRIS (Gatchina)
- Possible industrial partners: PANTECHNIK, RHP Technology

## Concrete research lines

- Laser ion source development
  - Develop simple and **selective** 2-step ionization schemes for the Lanthanides
  - Optimize the ion source material, electrical fields and geometry for high efficiency approaching uA ion rates.
- Surface ion source
  - Investigate single crystal W ionizers for medium-IP elements.
  - Optimize the SIS geometry for long-lived species
- High-current plasma ion source for intense <sup>11</sup>C production
  - Investigate EBIS / FEBIAD options.
- Versatile Laser/plasma ion source for multiple applications.
  - Investigate the optimal VADLIS ion source configuration for a multi-purpose ion source



# OptION – Optimizing ion sources for Medical applications

## The challenge

Maintain efficiency at high evaporation rates

## The goal

Maximum specific activity BEFORE chemical treatment

## Solutions

High ion capacity and/or Selectivity

Modified VADLIS with variable extraction Voltage

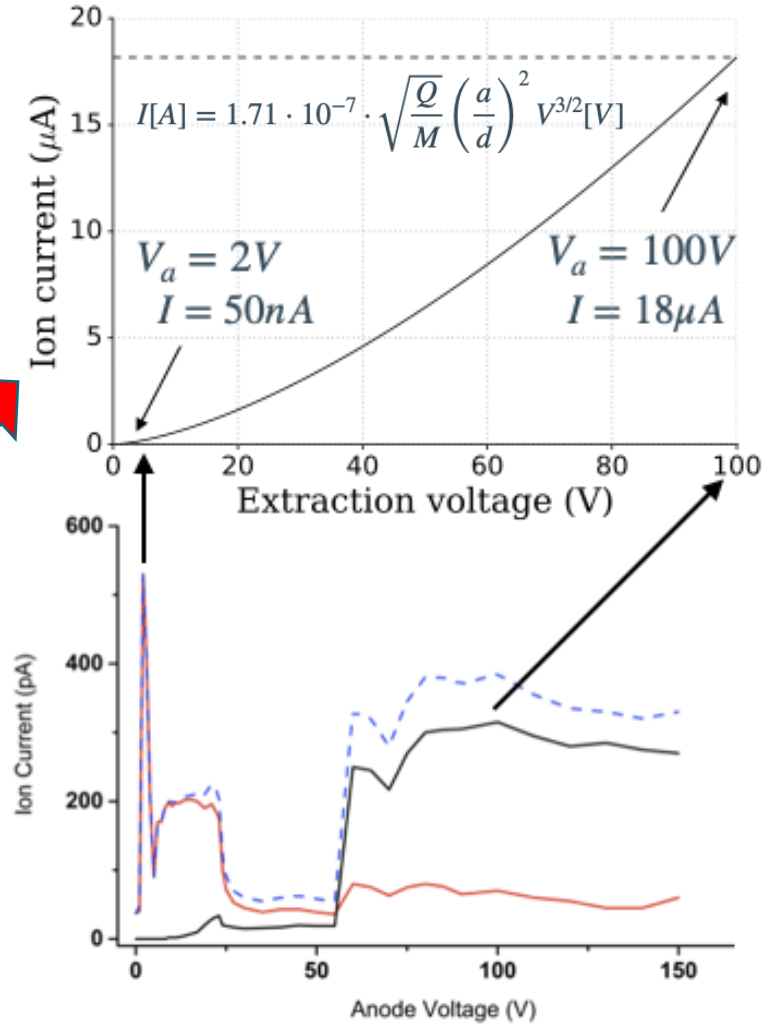
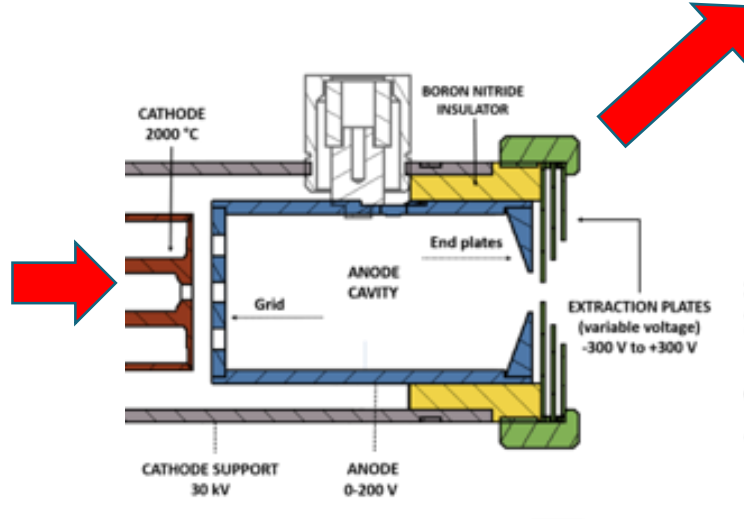
Surface Ion Source  
-new materials  
-optimize geometry

High-voltage laser ion source

FEBIAD/EBIS optimisation

Laser Ionisation schemes

Time-of-flight laser ion source



# SOURCES: partners



## Concept

- Clinical application of novel radioisotopes depends on the application of the principle of **justification and optimization of medical exposure**
- Dose-effect relationships depend on the accuracy of the nuclear data
  - Administered activity
  - Nuclear data for imaging modality
- Quality insurance & quality control
- Quantitative imaging
- Standardization & calibration of medical devices

## Practical activities

- Medical device studies
  - Calibration factors, acquisition & image reconstruction parameters, image processing and quantification techniques, ...
- Experimental approach
  - Phantom studies
  - Multicentre trials with intercomparisons
- Exchange forum
  - Meetings, workshops, round-tables, ...
  - Updating databases with new nuclear data information
  - Online visibility & lobby (website, ...)

# QUANTIFY: partners



# JRA - NA

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