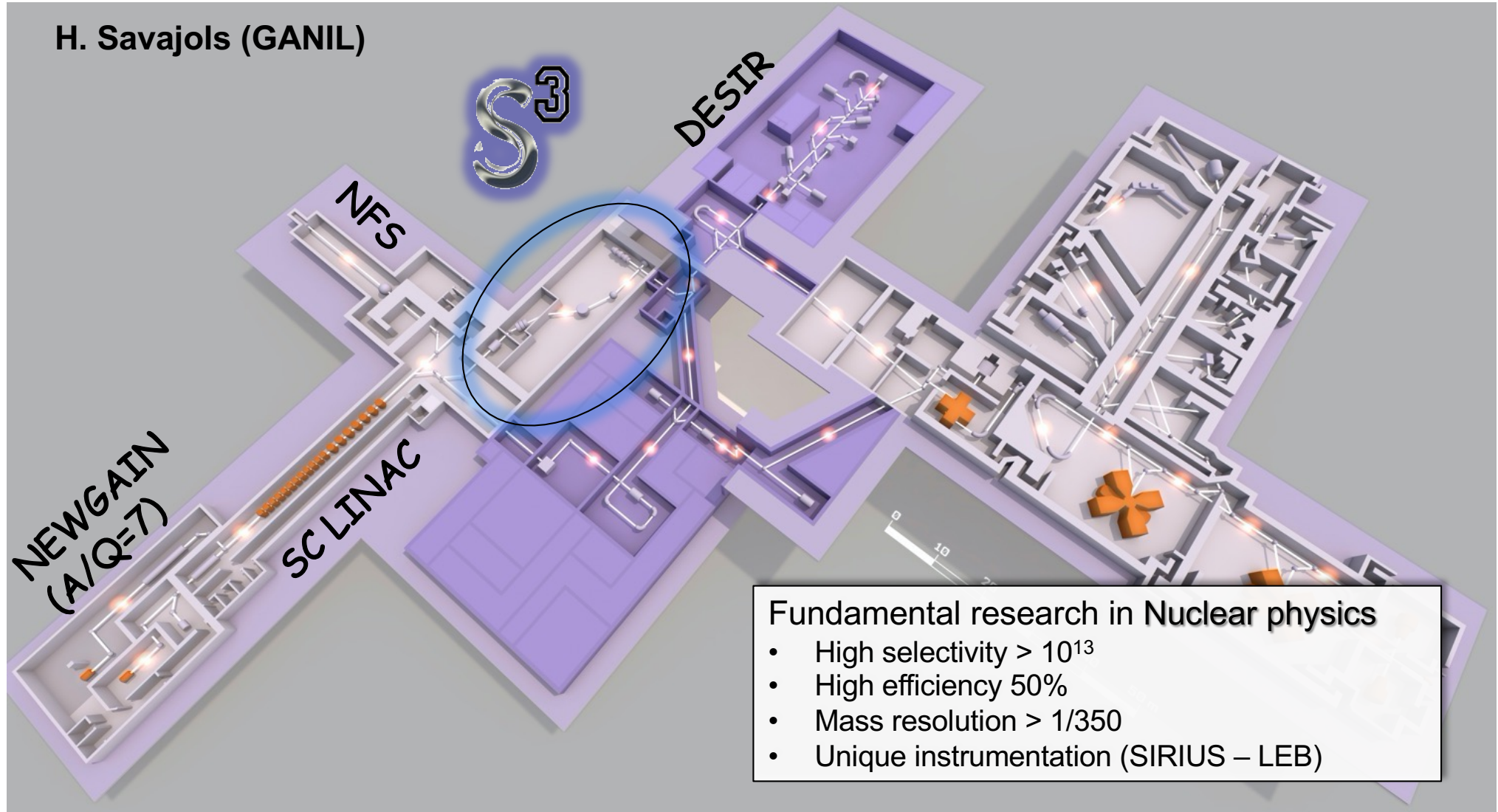


Super Separator Spectrometer

H. Savajols (GANIL)

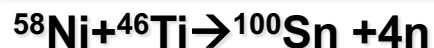


S3 Physics goals

Study of rare events in nuclear and atomic physics

Proton Dripline & N=Z nuclei

Shell correction effects
Study the role of π - ν correlations
Deformation – shape coexistence
Exotic decay
Astrophysics rp-process
Fundamental interaction



$I=10\mu\text{A} \rightarrow 1/\text{s}$

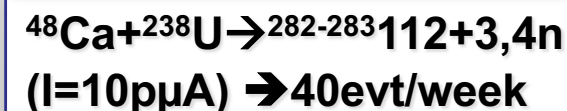
RIBF (today) : 0.003/s

FAIR : 2/s & FRIB : 8/s

*Nuclei produced by
Fusion-Evaporation
(with refractory elements)*

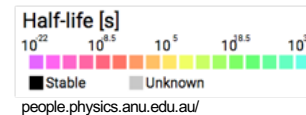
Heavy and Superheavy Elements

Limit of the nuclear existence
Shell correction effects
Reaction mechanisms
Atomic properties



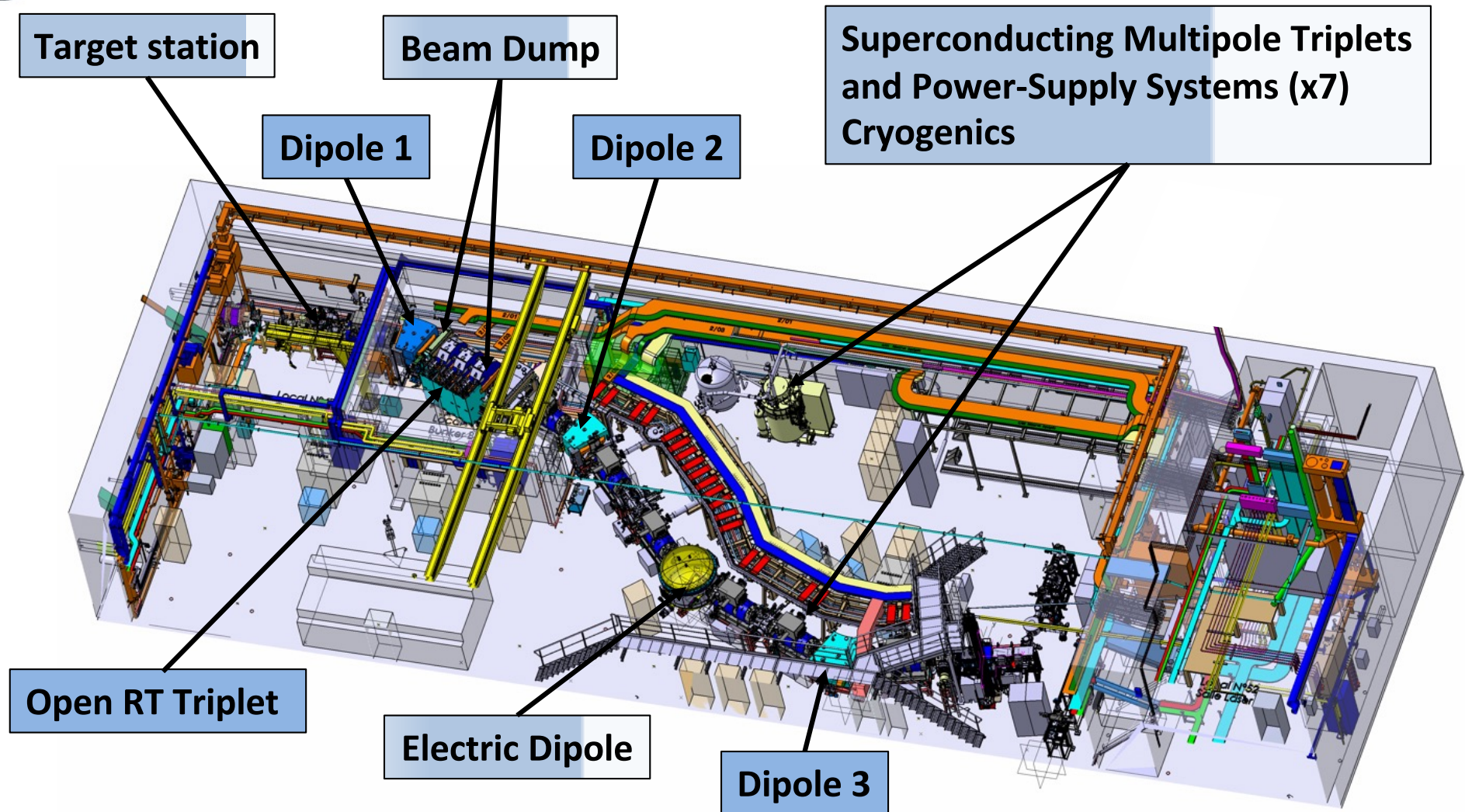
→ test nuclear and atomic models and guide new theoretical development

-  $A/Q=3$  $A/Q=7$



Strong synergies with JINR scientific program

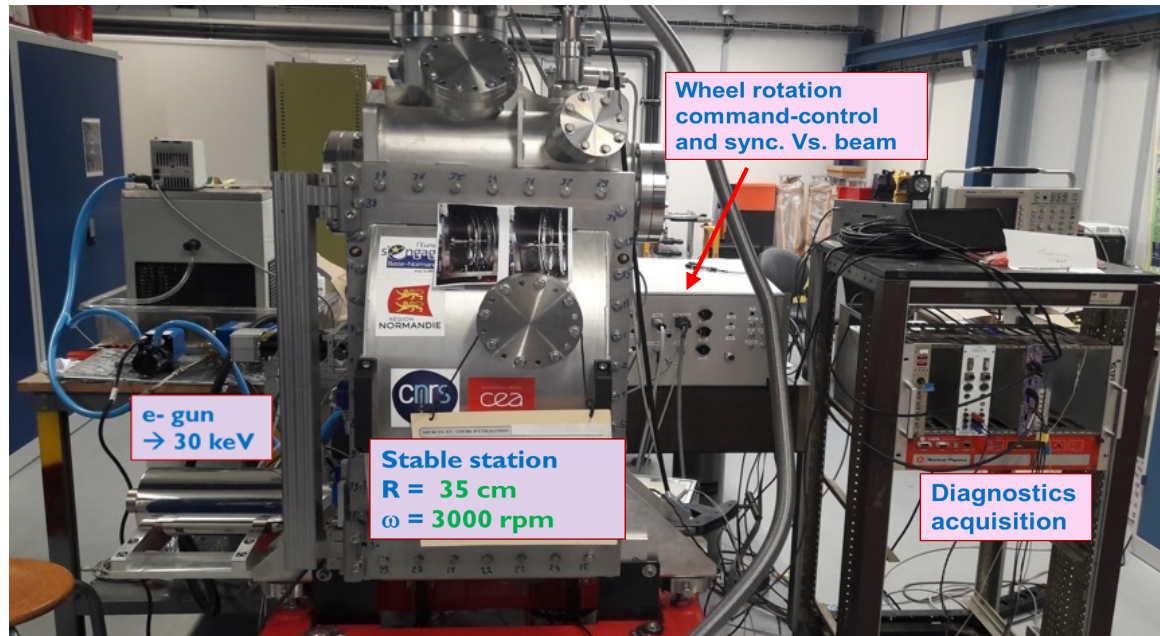
S³ Separator - Spectrometer



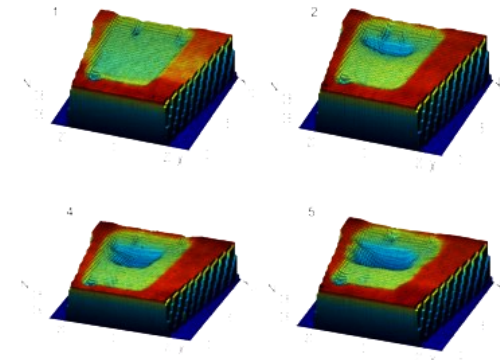
Level of completion

S3 Target stations

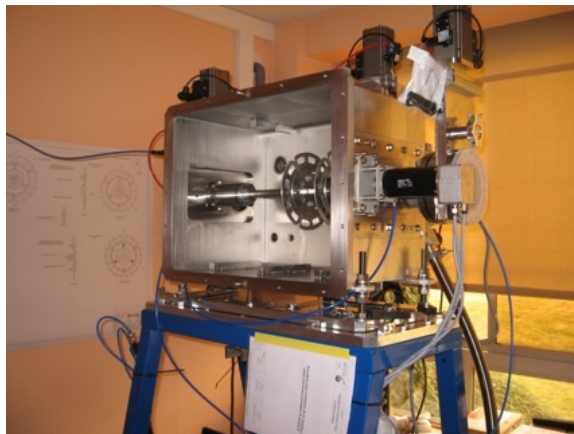
➤ Stable target station (including U and Th)



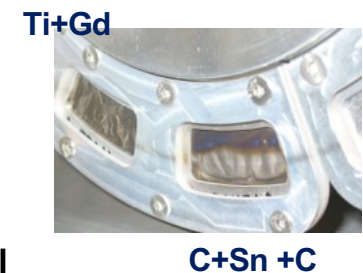
- Designed to handle 5-10 μA
- Targets integrity measurement (ex : Electron gun)



➤ Actinide target station



- Actinide Prototype
 - ✓ R = 8cm and ω = 5000 rpm
 - ✓ Target irradiation tests at GANIL
- Final target station
 - ✓ Design to be done
 - ✓ Actinide material suppliers & target makers



Strengthen collaboration with JINR



SMT's, PSS and Cryogenics

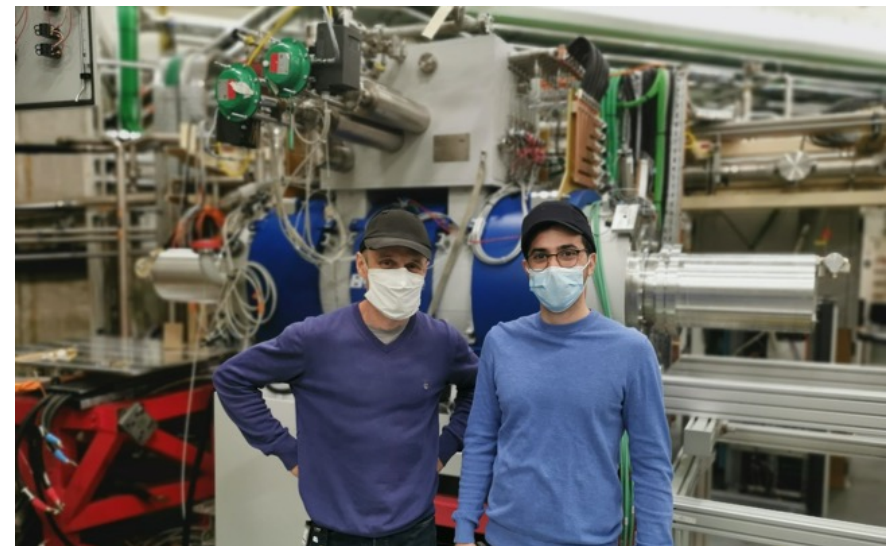
3 SMT tested end 2020



4 SMT installed in the cave end 2020



- All 7 Power Supplies Systems (PSS) installed on the beam line
- Magnetic field measurement & alignment with 3D mapper in May 2021
- All SMT delivery by end 2021 and tested in 2022



S³ Electric dipole

- Dipole horizontal gap 20 cm
- Radius of curvature $\rho = 4$ m
- Bend angle $\theta = 22$ degrees
- Vertical acceptance 25 cm

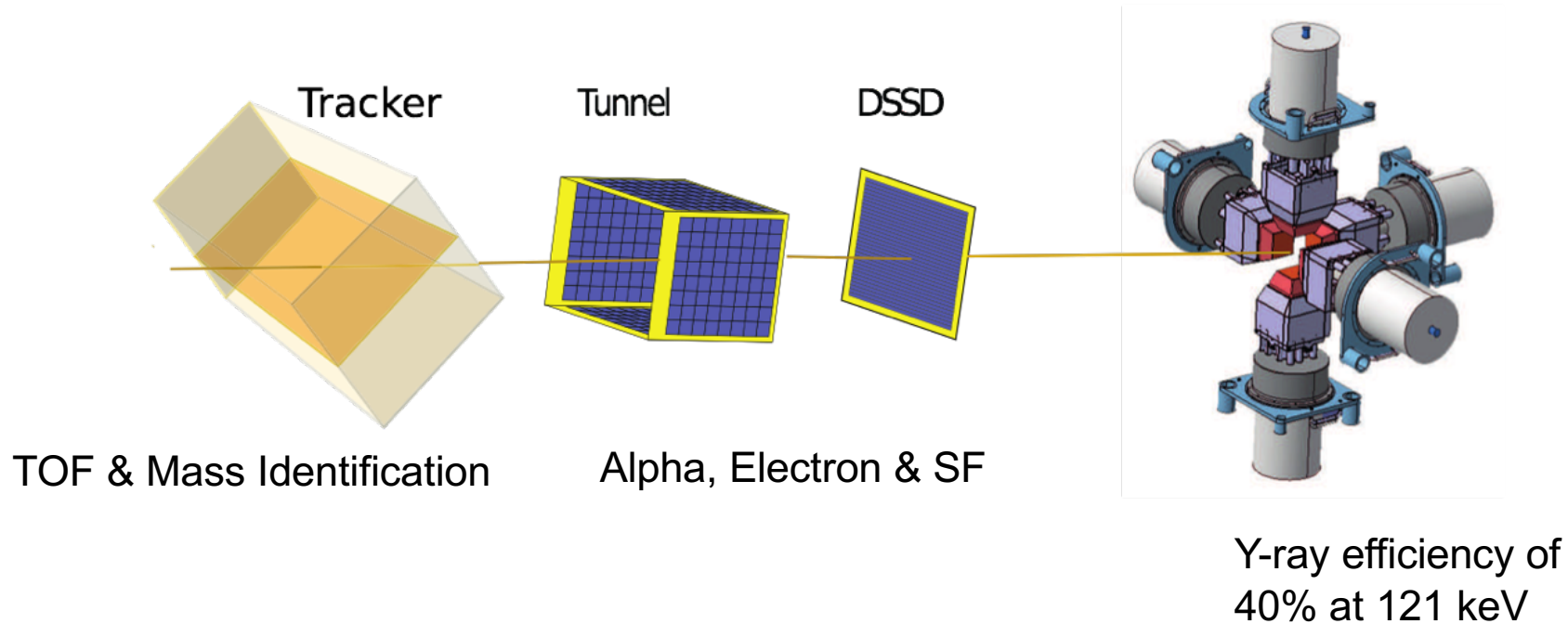


- Chamber, Ti electrodes and all hardware completed at IJCLab
- +/- 300 kV high voltage power supplies ordered
- E-Dipole conditioning beginning 2023



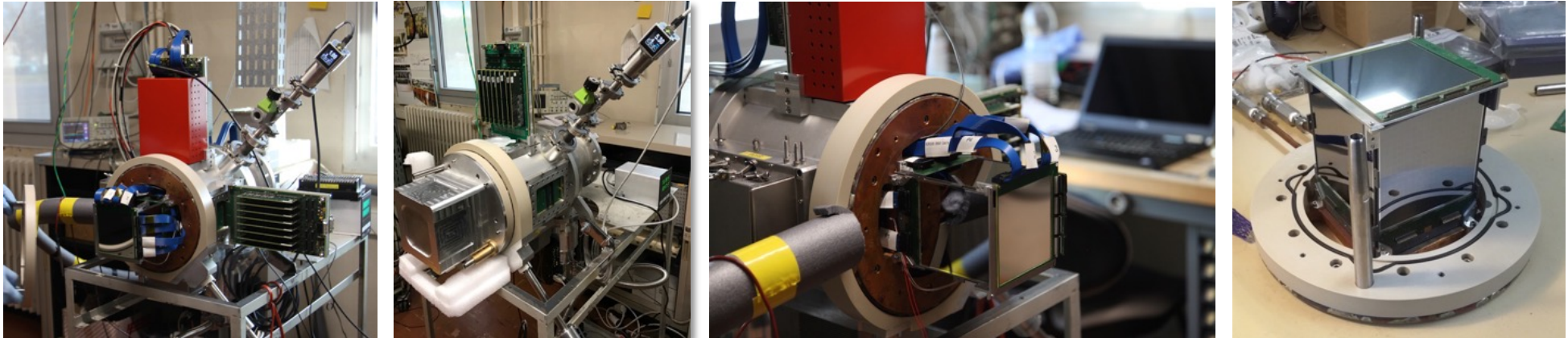
- Installation process ongoing
- Spectrometer ready for beam commissioning by mid 2023

Expertise from JINR

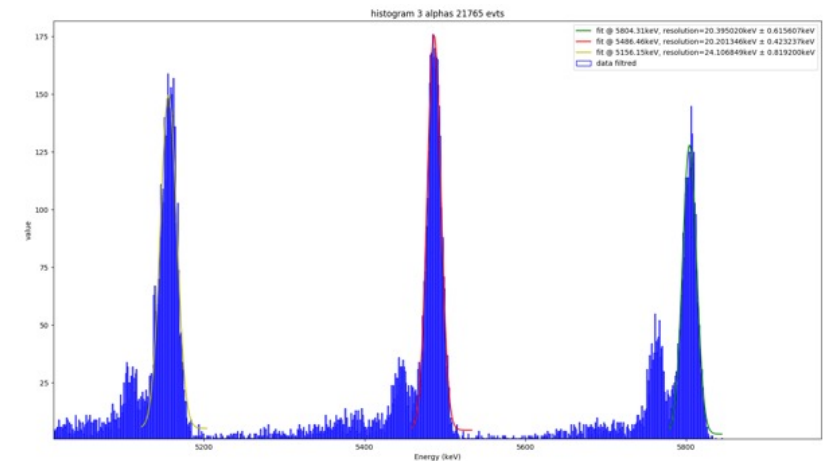
Spectroscopy & Identification of Rare Ions Using S³

Alpha, electron, gamma decay spectroscopy

- Time of flight ($\sigma(t) < 1\text{ns}$) and tracking ($\sigma(x) < 0.5\text{mm}$) of (super)heavy ions
- Implantation decay correlation ($10 \times 10\text{cm}^2$, $128 \times 128\text{ch}$ DSSD)
- Digital electronics for fast decays (dual-gain preamplifiers) $\sigma(E_{\text{alpha}}) < 20\text{keV}$

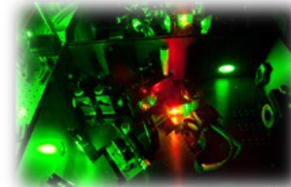
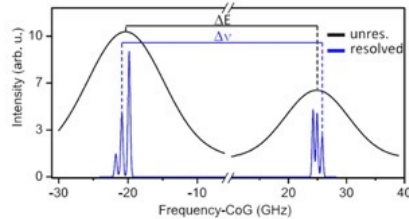


Resolution measurement of the detector installed in the SIRIUS chamber with the final electronics and the complete acquisition system (V6 SIRIUS + V5 and NARVAL acquisition from GANIL). Resolution obtained (20.5 keV) meet the specifications



- SIRIUS installed at GANIL since March 2021 for source commissioning and in-beam tests

S³ Low Energy Branch



Two lasers
systems:
TiSa and dye

MR ToF MS
($m/\Delta m \sim 10^7$)

bender

Pulse up
(~ 3 kV)

towards DESIR

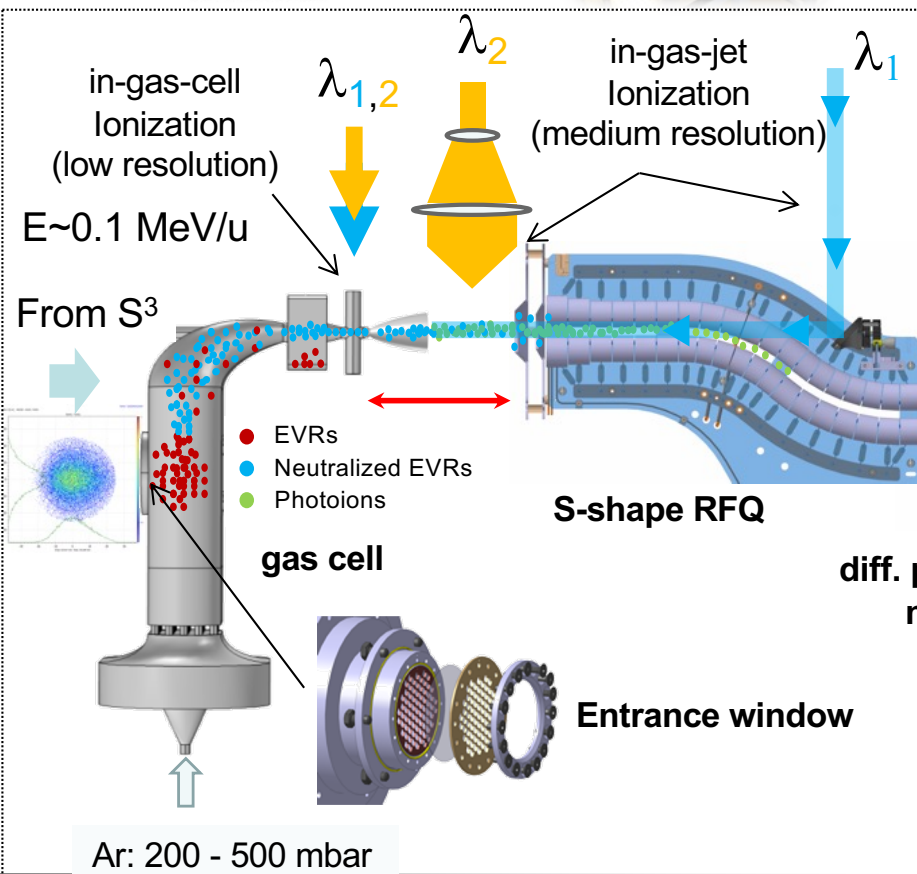
RFQ
buncher

He: $10^{-2} - 10^{-3}$ mbar

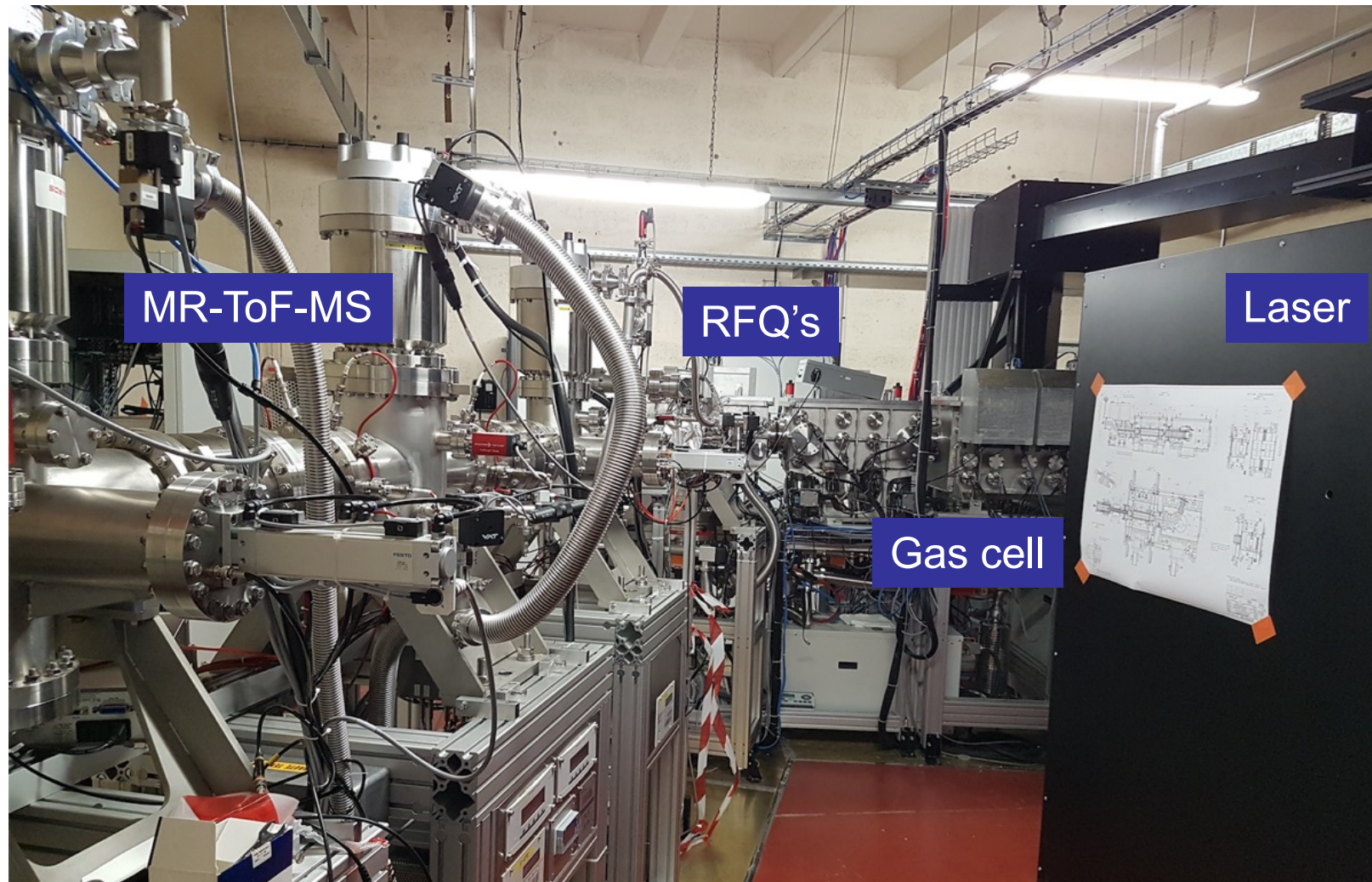
diff. pumping
mRFQ

QMF
($m/\Delta m \sim 100$)

towards Multi Purpose Room - Identification/detection



- Provide pure & low energy beams from S³
- Perform medium resolution mass measurement & laser spectroscopy
(charge radii, spin, magnetic dipole moment, electric quadrupole moment)



Commissioning ongoing at LPC Caen

- PILGRIM (MR-Tof-MS) precision $\delta m/m \approx 10^{-7}$
- Test in gas jet high resolution with Er : End 2021
- Development of efficient ionisation scheme for day one experiment

MoU signed between GANIL & FLNR in 2020

GANIL and FLNR shall jointly :

- Participate in the preparation and the commissioning phase for experiments at SHE factory and at S³
- Participate in experiments aiming at synthesizing heavy and super-heavy isotopes and investigating the properties of heavy nuclei
- Participate in the processing, analysis and interpretation of joined experiments
- Exchange of knowledge on the production and use of high intensity beams. In particular the development of high intensity beams
- Develop heavy-ions detection systems and in particular those based on large surface MCP detector

GANIL shall :

- Explore a possibility to construct for FLNR a MR-ToF system
- Share with FLNR experience in the construction and operation of superconducting heavy-ion linear accelerator (LINAC)

FLNR shall :

- Help in providing of enriched ⁴⁸Ca
- Provide the isotopes of ²⁴³Am and ²⁴²Pu for targets to be used for joint experiments
- Share experience with the GANIL staff on using radioactive targets