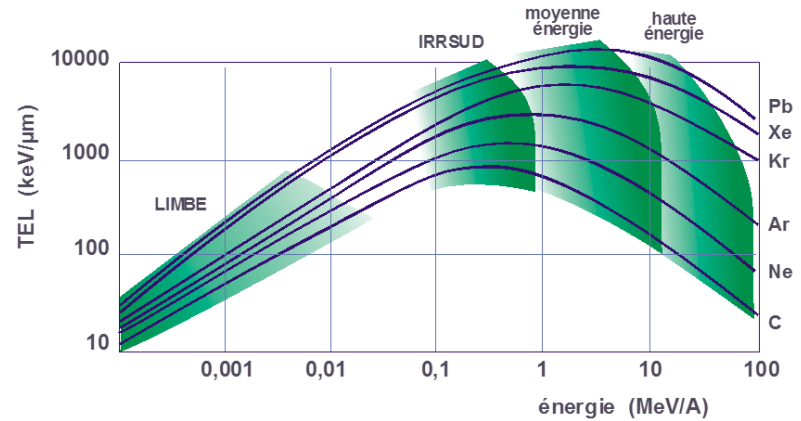
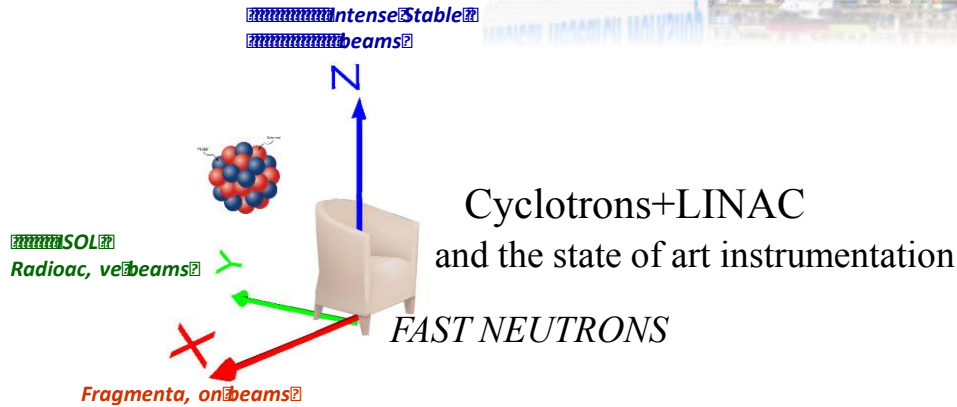


A glimpse of the beauty of femtoscience from the microscopes @ GANIL

A. Navin

Grand Accélérateur National d'Ions Lourds, Caen, France



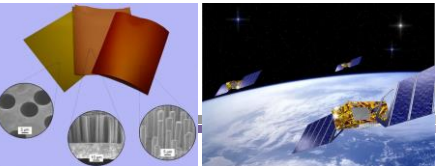
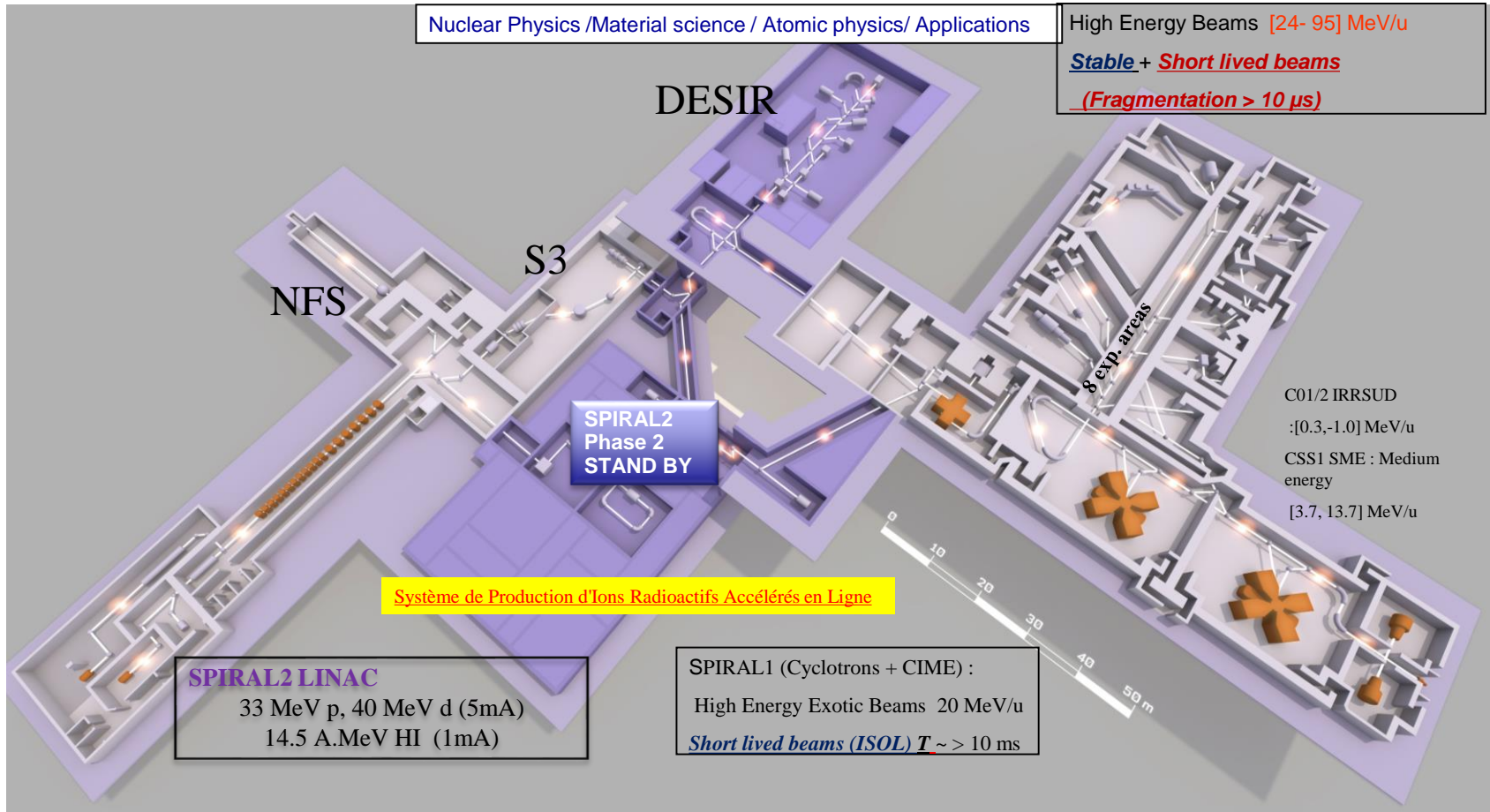
Explorations physics at the infinitely small to understanding physics of the infinitely large

Very select examples

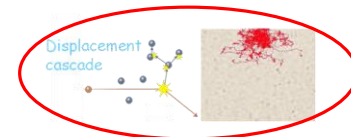
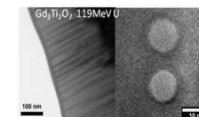
Discovery potential

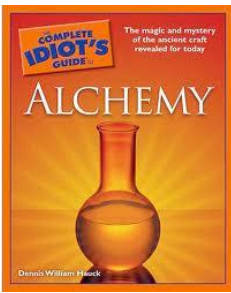
GANIL-Czech Republic a strong connection LIA NuAG, SPIRAL2-CZ

GANIL-a bird's eye view



Radiochemistry Material Science





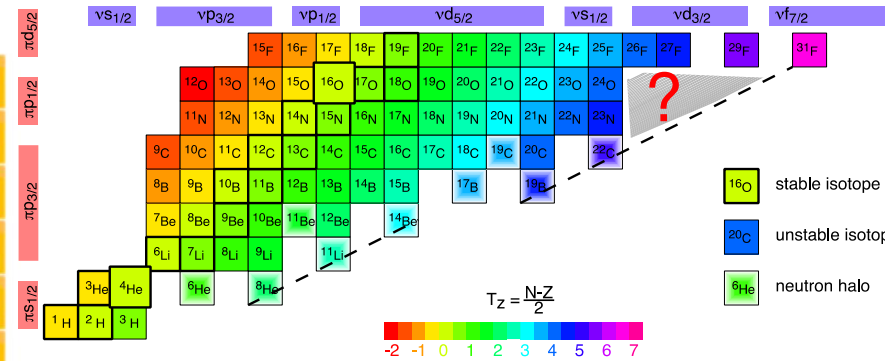
Modern Alchemists are not anymore chemists

but Nuclear Physicists

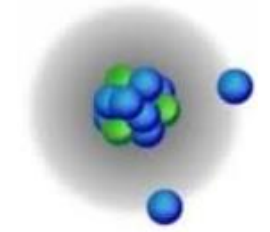
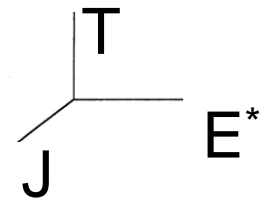
Extending Mendeleev's Periodic table of *ELEMENTS*

are their properties different ?

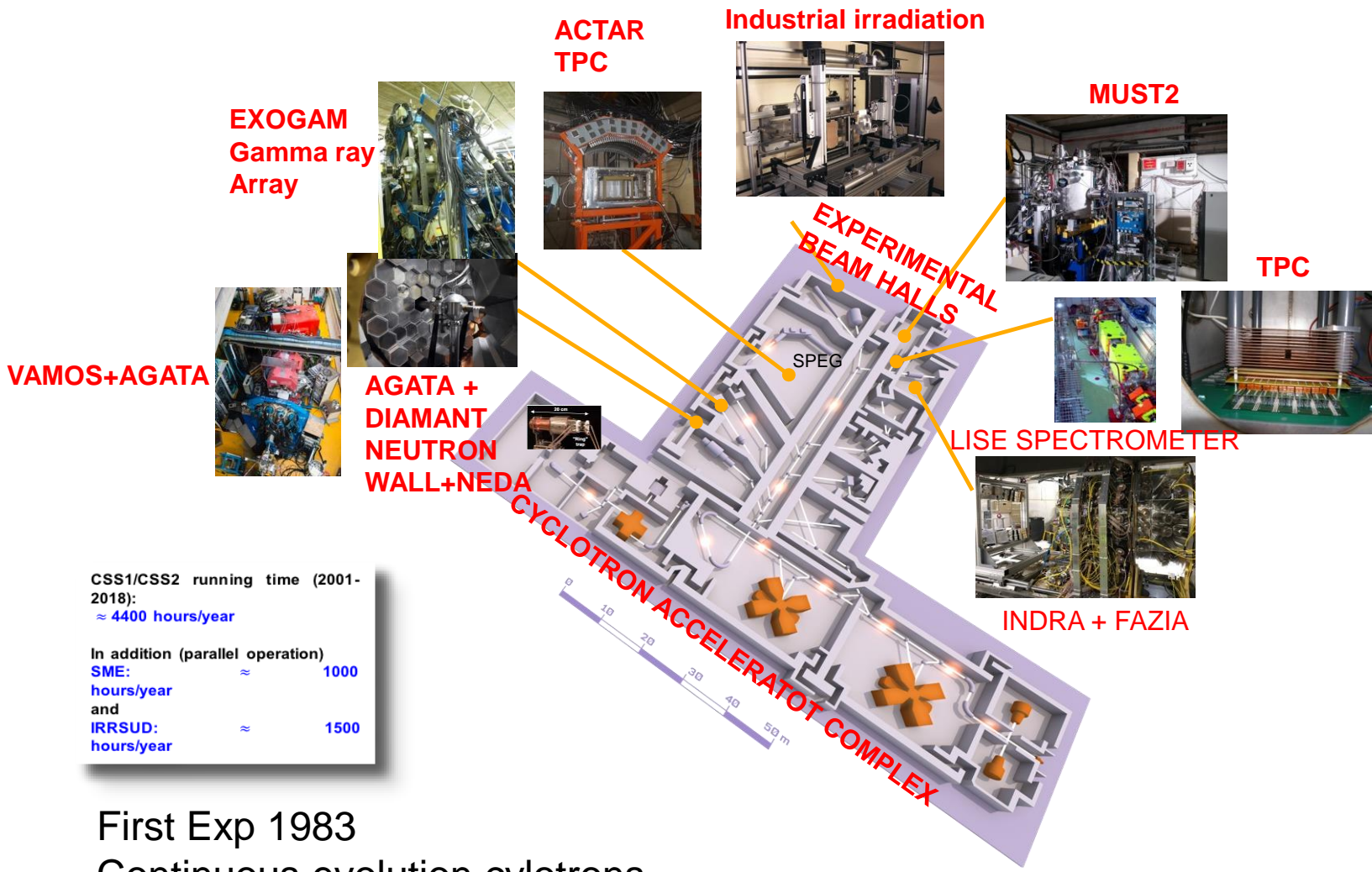
150 years of the periodic table
Periodic Table of the Elements



Q How many isotopes are "possible"



C 12 98.93	C 13 1.07
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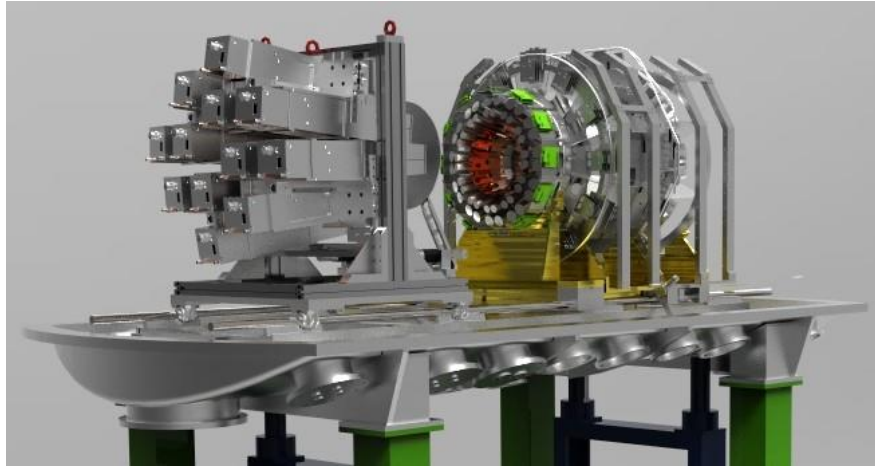


CSS1/CSS2 running time (2001-2018):
 ≈ 4400 hours/year

In addition (parallel operation)
 SME: ≈ 1000 hours/year
 and
 IRRSUD: ≈ 1500 hours/year

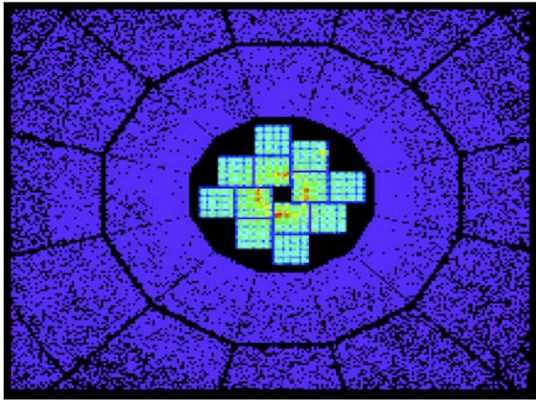
First Exp 1983
 Continuous evolution cyclotrons

Nuclear equation of state



The nuclear symmetry energy determines the energy cost in changing neutrons into protons and vice versa. As such, the symmetry energy — and in particular its density dependence — impacts the dynamics of neutron-rich matter.

Despite a mismatch in length scales of 18 orders of magnitude, the slope of the symmetry energy at saturation density controls both the thickness of the neutron skin and the radius of a neutron star.

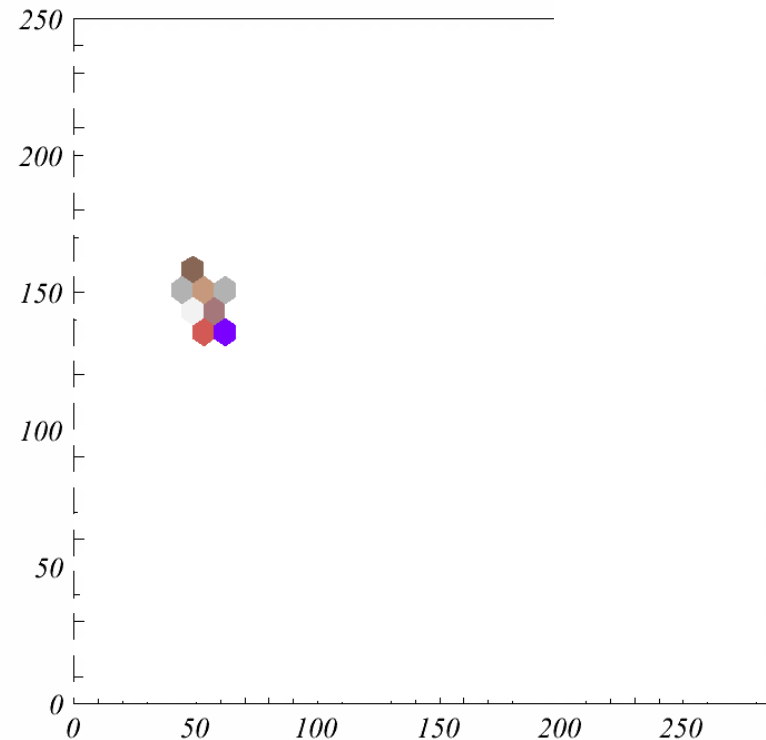
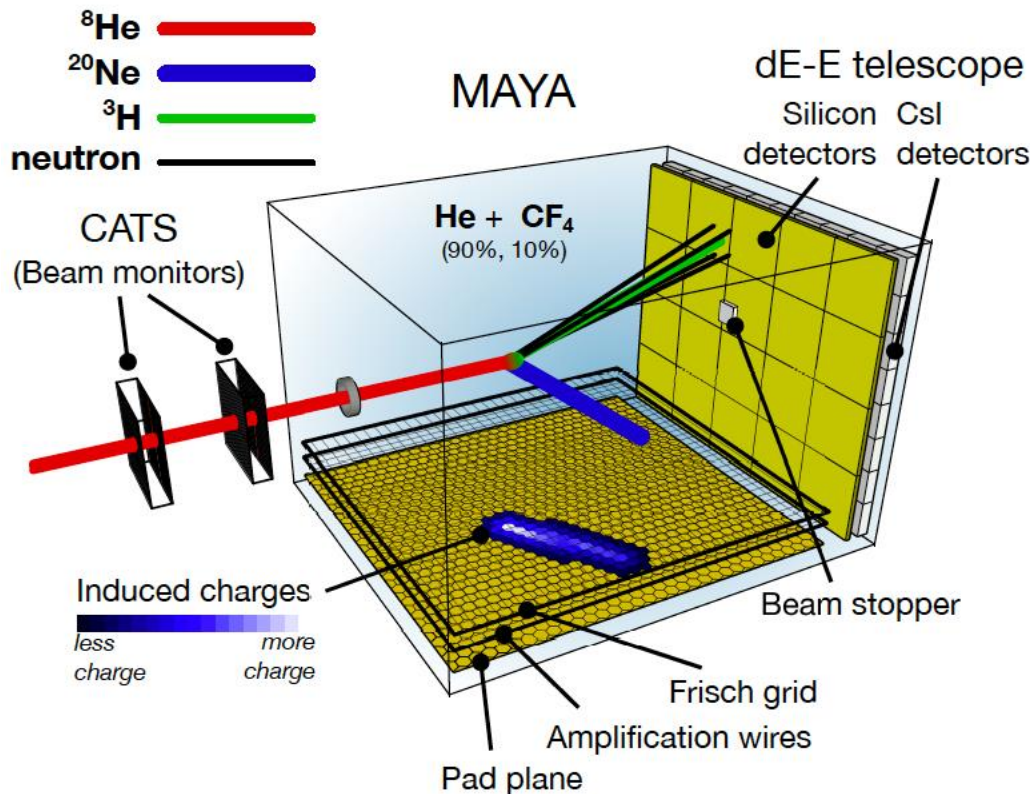
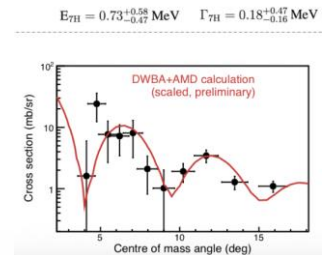


Nuclear Camera

Production of Superheavy Hydrogen (^7H compared to triton) Using ^8He beams which live only for 120 milliseconds



M. Caamano et al



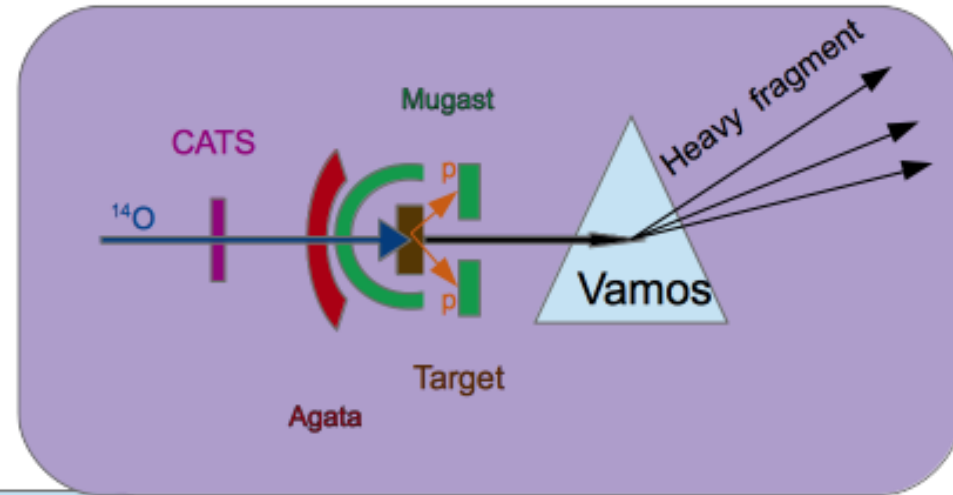
Above-barrier narrow resonances in ^{15}F

- (I) Other 2p states in ^{15}F
- (II) 2p decay from states above 1/2-
- (III) Gamma branching ratio of the 1/2- state

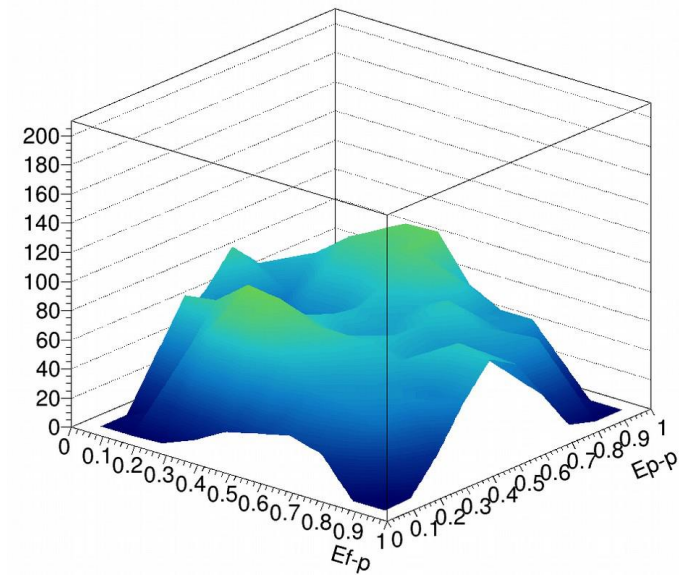
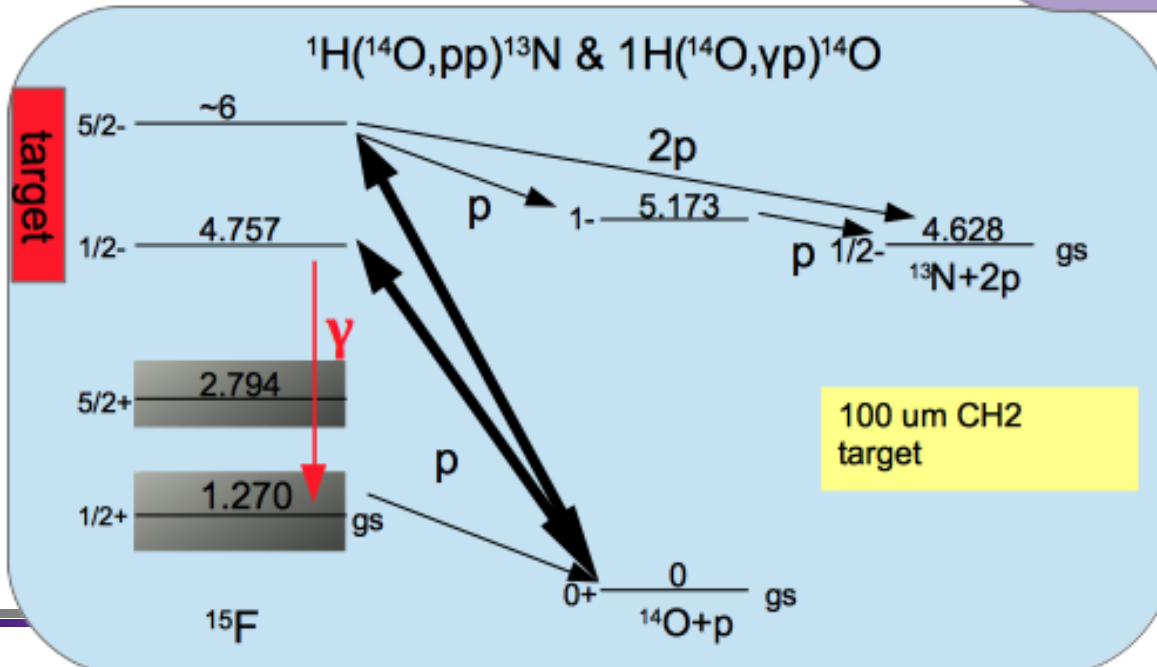
Seen in 2018 run by $^1\text{H}(^{14}\text{O},p)$ resonant elastic reaction

Hinted in 2018 measurement

$^1\text{H}(^{14}\text{O},p)$
7.5 MeV/u ^{14}O Spiral1 beam



Reactions to be studied



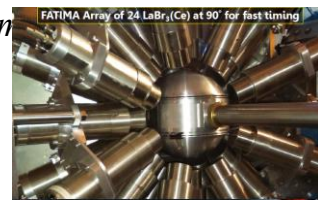
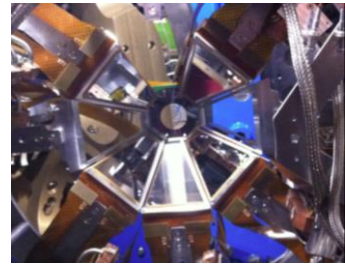
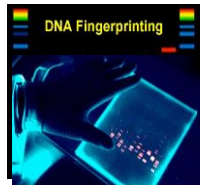
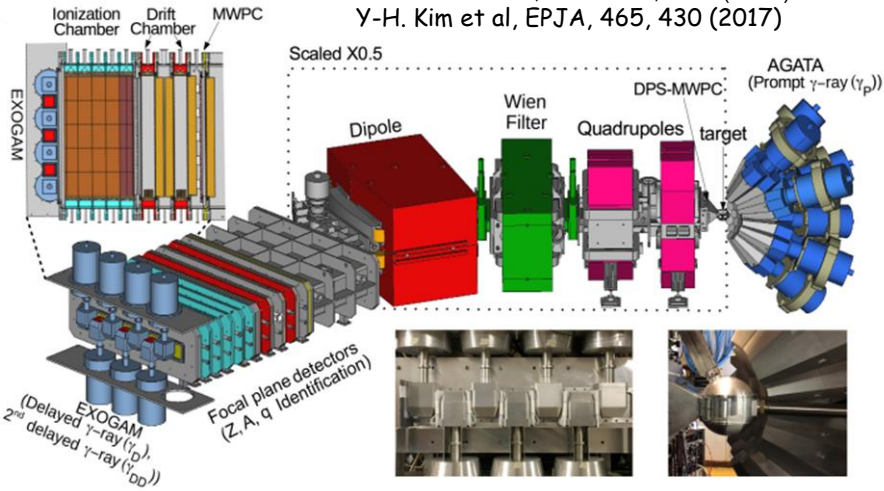
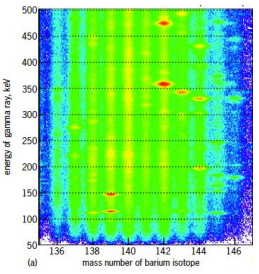
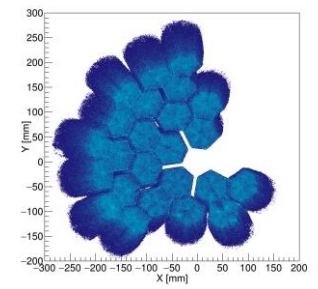
DNA fingerprinting of the nucleus

Under new conditions Fast rotating exotoxic nuclei

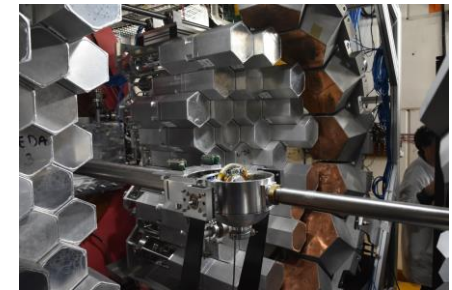
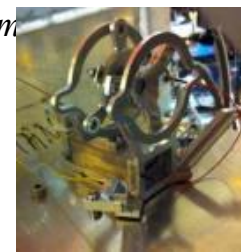
AGATA, VAMOS++ EXOGAM,..... @ GANIL: Today and tomorrow and beyond

Prompt spectroscopy, Prompt-Delayed spectroscopy in the time range of 100 ns - 200 μ s
lifetime measurements from fs to few ns and 100 ns to 200 ms

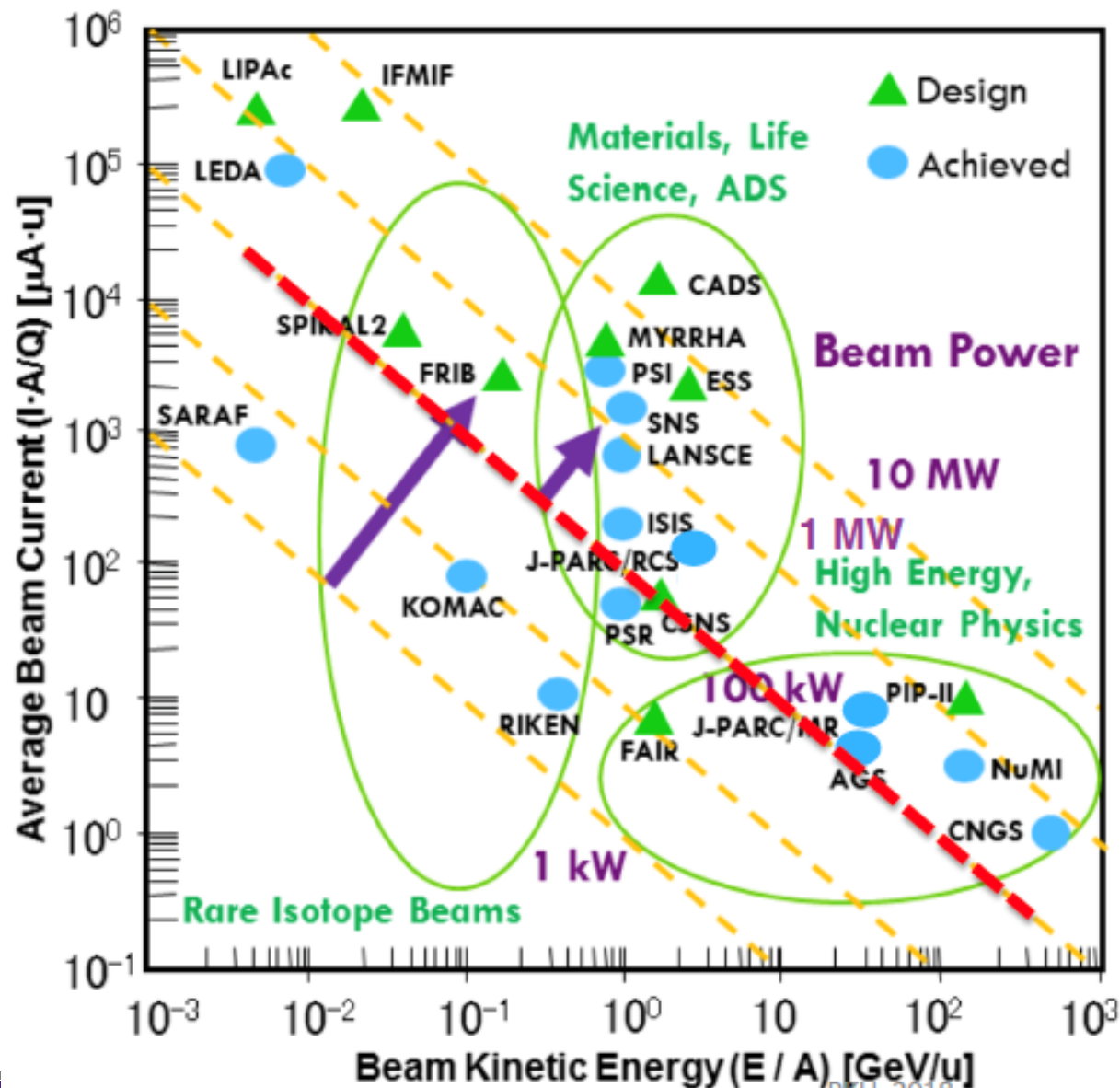
E. Clément et al., NIMA 855, 1-12 (2017)
Y-H. Kim et al, EPJA, 465, 430 (2017)



cs detectors And m



A Quest for High Intensity



High Intensity



High Statistics

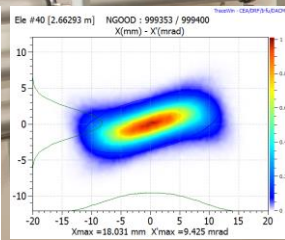
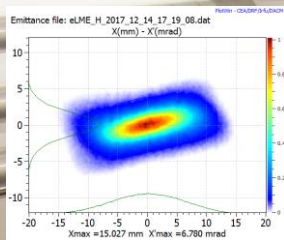
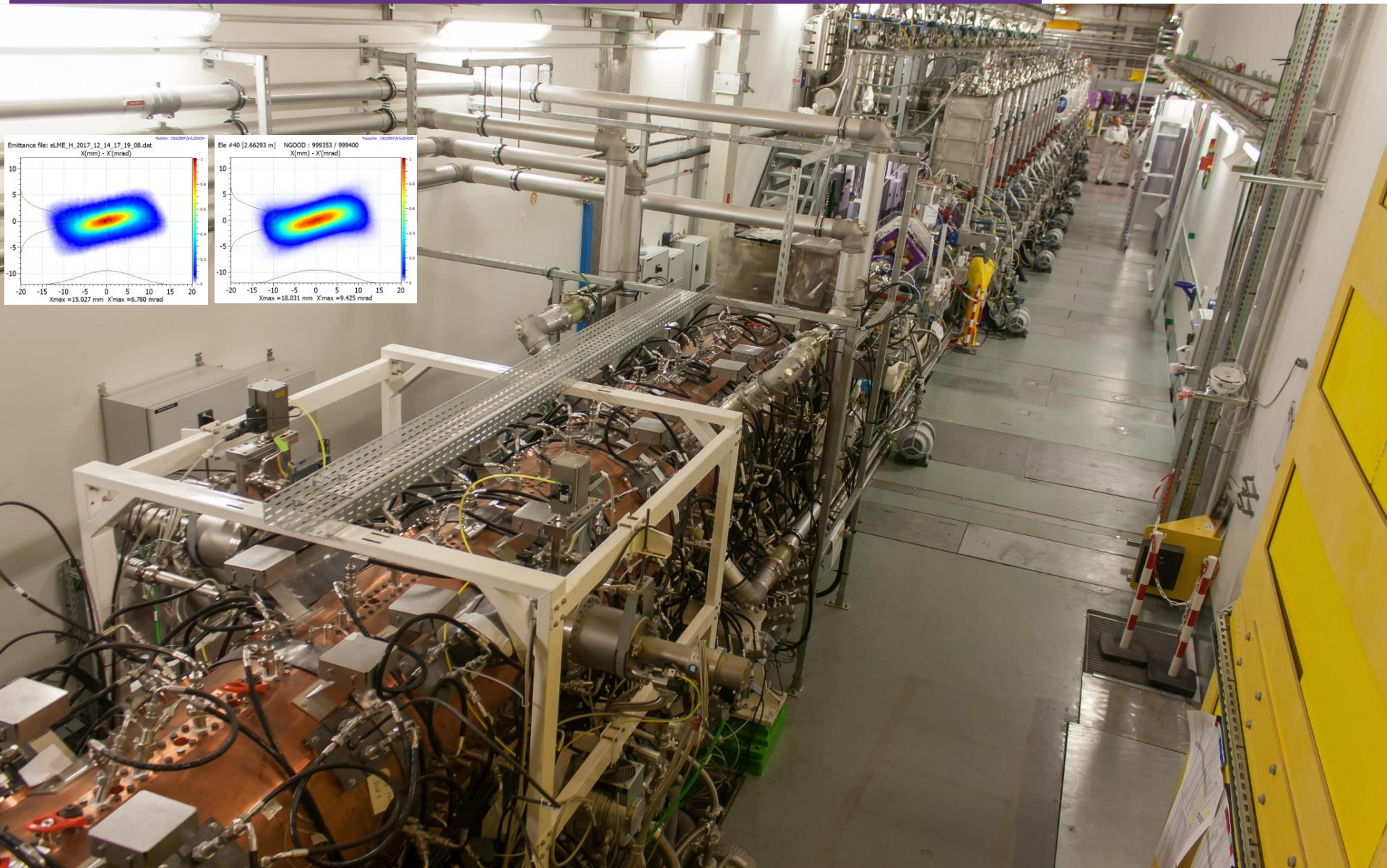


- More Precision
- More Rare Searches
- More Materials



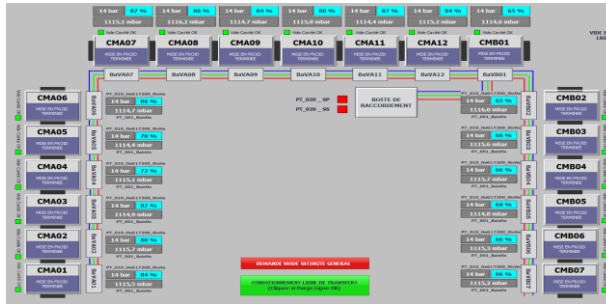
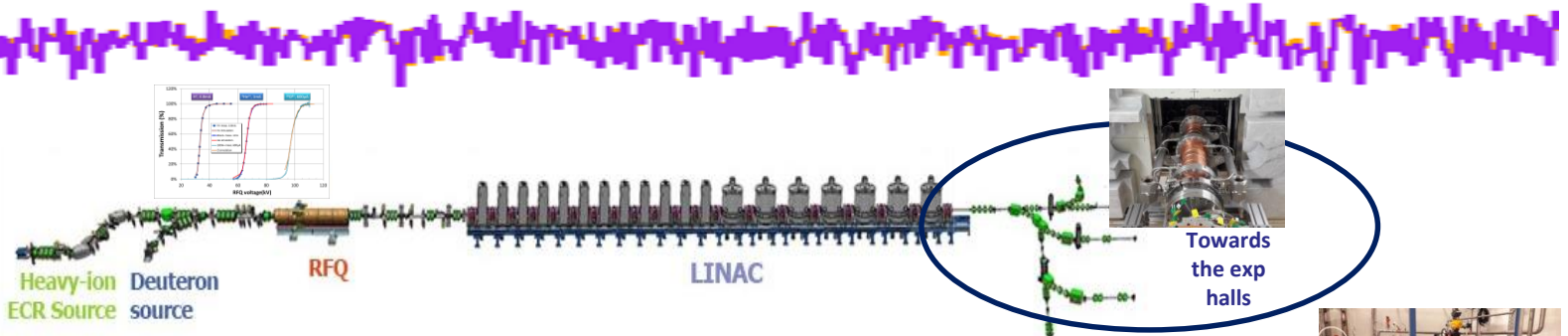
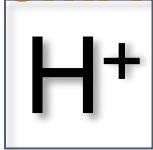
Discovery!

SPIRAL2



5mA Out

5mA In



Ready to go

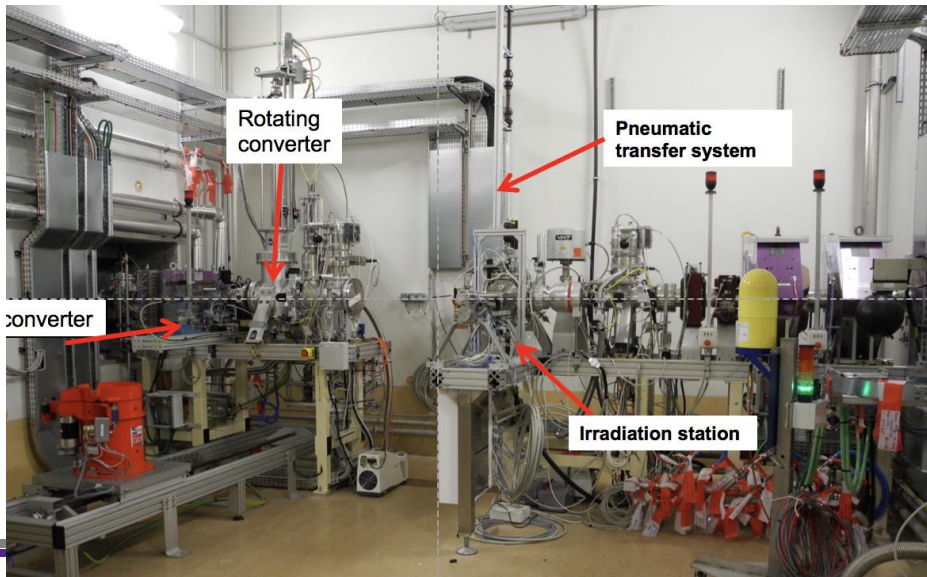
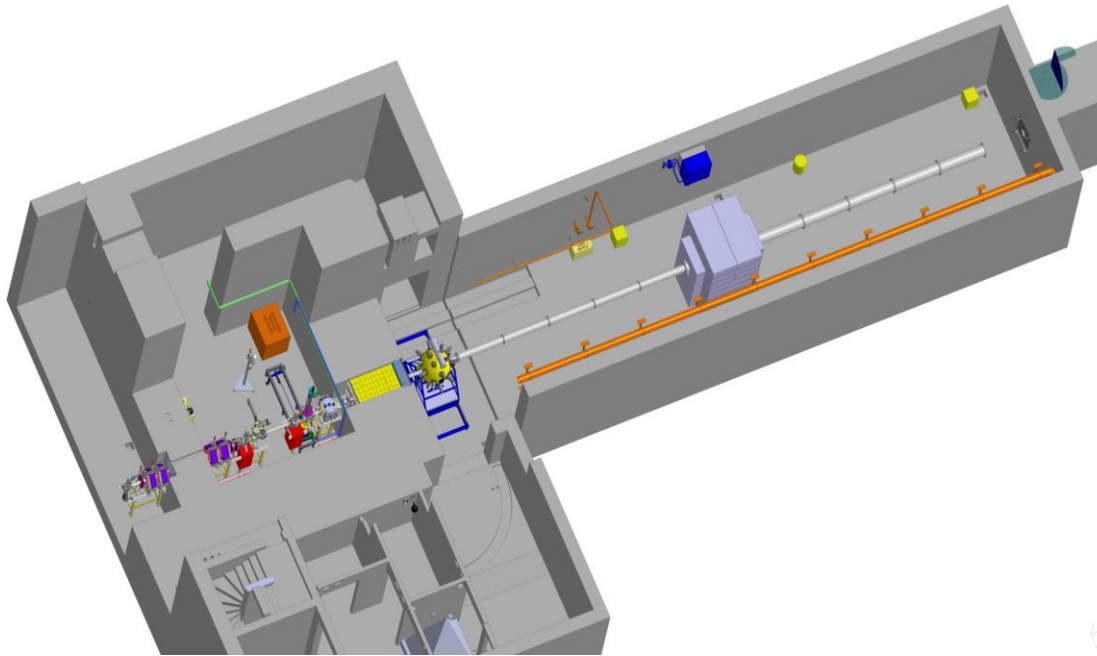
Waiting for Safety clearance for the LAST STEP (ASN to the college planned for 14th May 2019)

French Nuclear authorities for putting RF into the cavities July 2019

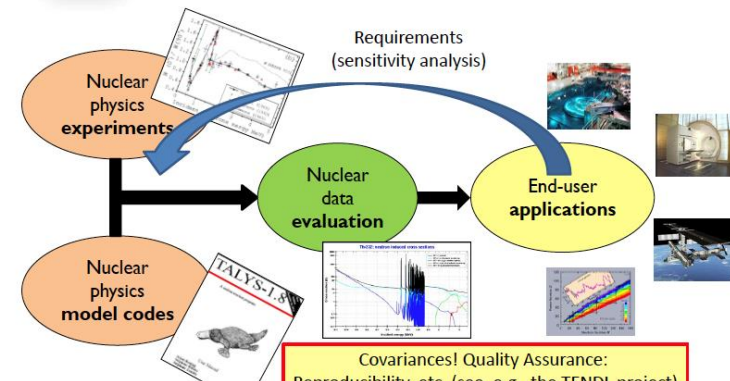
and first proton beams beginning 2020



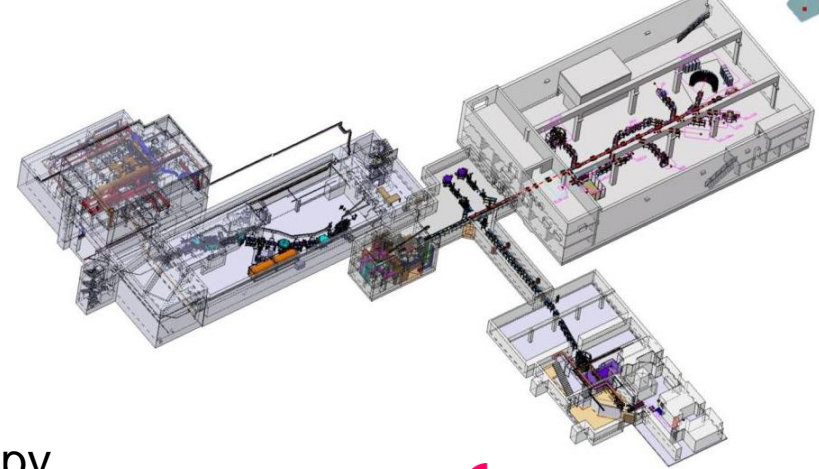
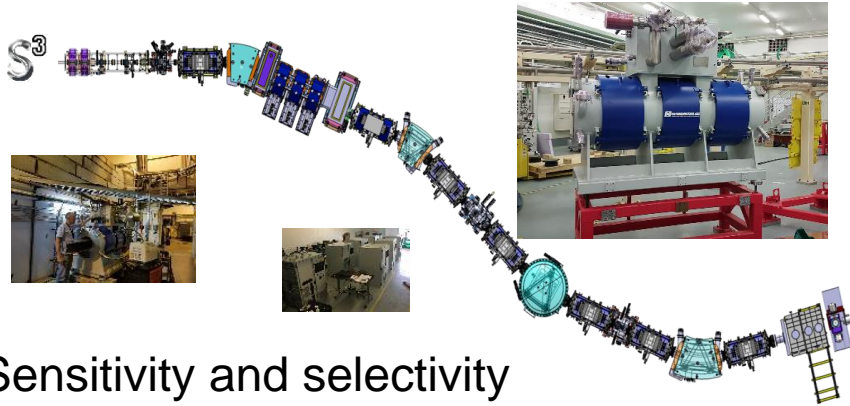
Pure and applied research



- Continuous and quasi-mono-energetic beam
- Flight path from 5 to 30 m
- High flux of fast neutrons



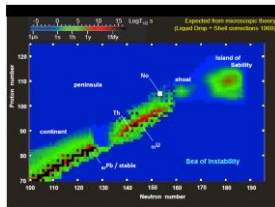
S³@SPIRAL2



Sensitivity and selectivity
N=Z , Spectroscopy VHE , Laser spectroscopy ...

Exotic nuclei ground state properties

High precision techniques

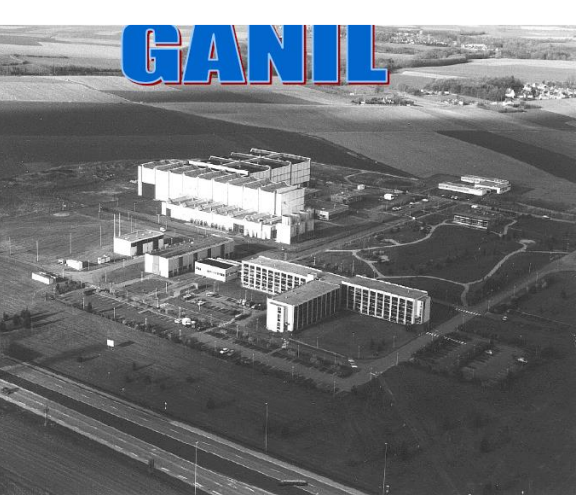


Summary

*Discovery potential and
GANIL continues to grow and provide newer opportunities (with you)*

*Making a GANIL **an international lab** with scientific partners and
to boldly go no man/woman has gone before*

*We are looking forward for the Czech Republic to be a partner
in this endeavor*



*Děkuji
Thank you
Merci*