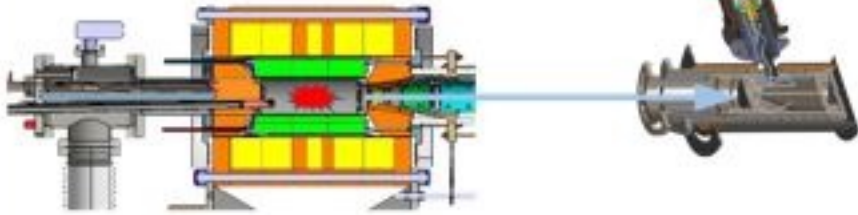


Workshop

Targets – Ions Sources



Tomorrow's technological challenges and associated skills

GANIL, 6-8 september 2023

Stéphane Grévy
LP2i Bordeaux
(Laboratoire des 2 infinis Bordeaux)

Reaching for the infinities – Nuclear Physics – Low Energy

1- What is « Low Energy » at GANIL today ?

2- Which kind of experiment are we talking about ?

Which developments do we need ?

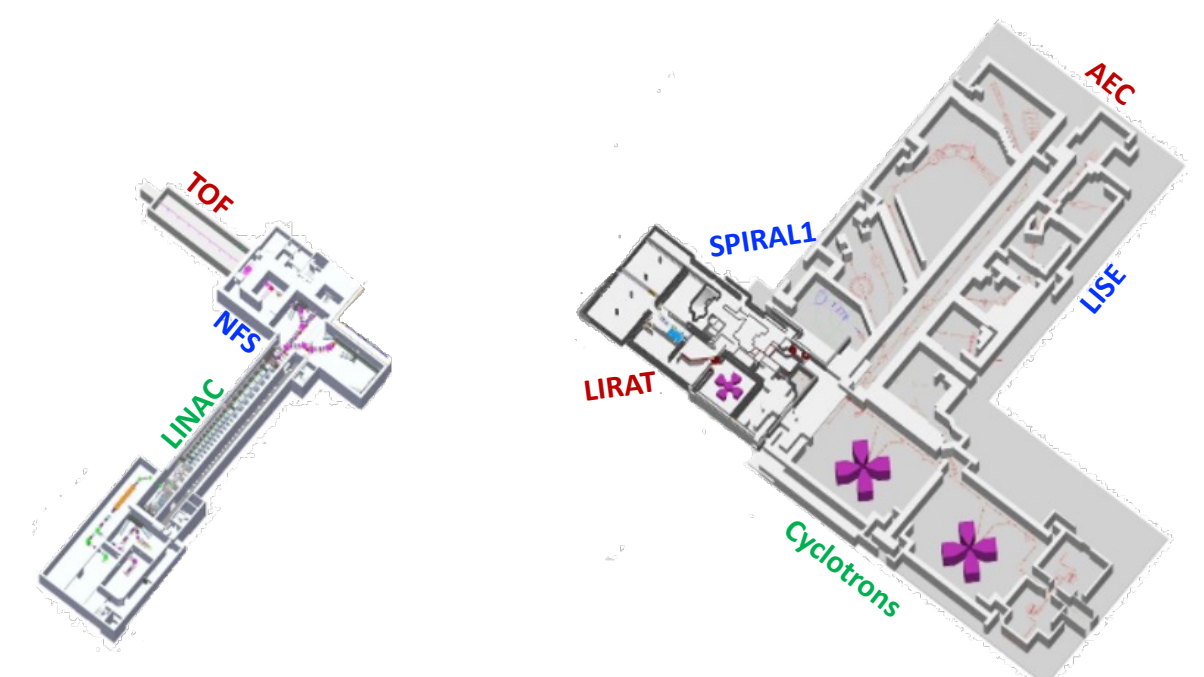
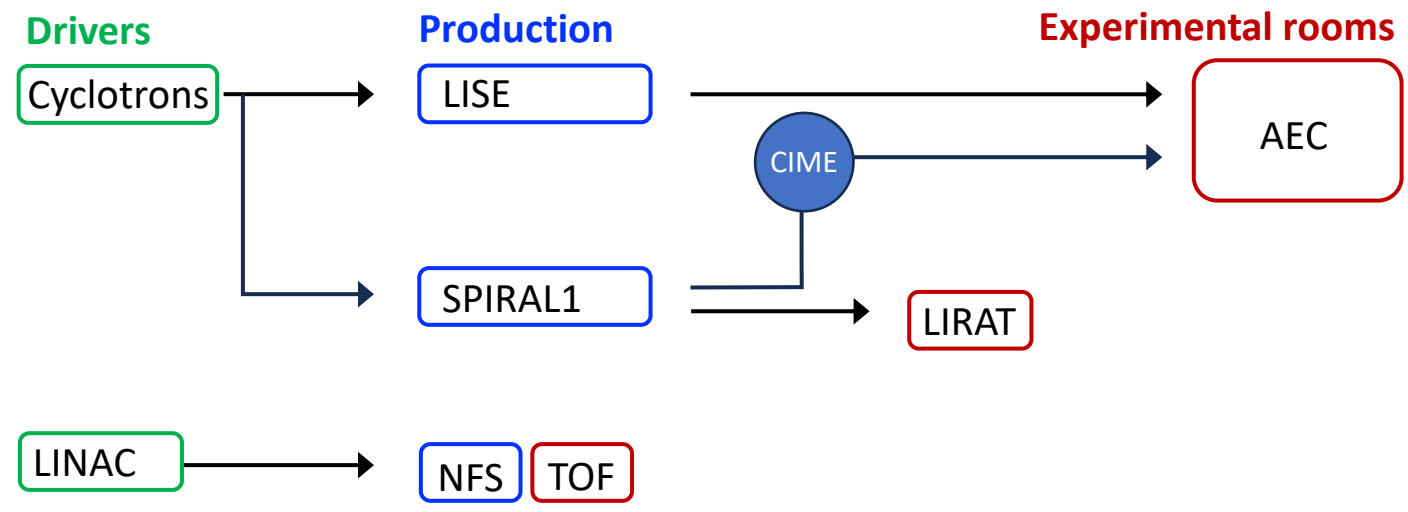
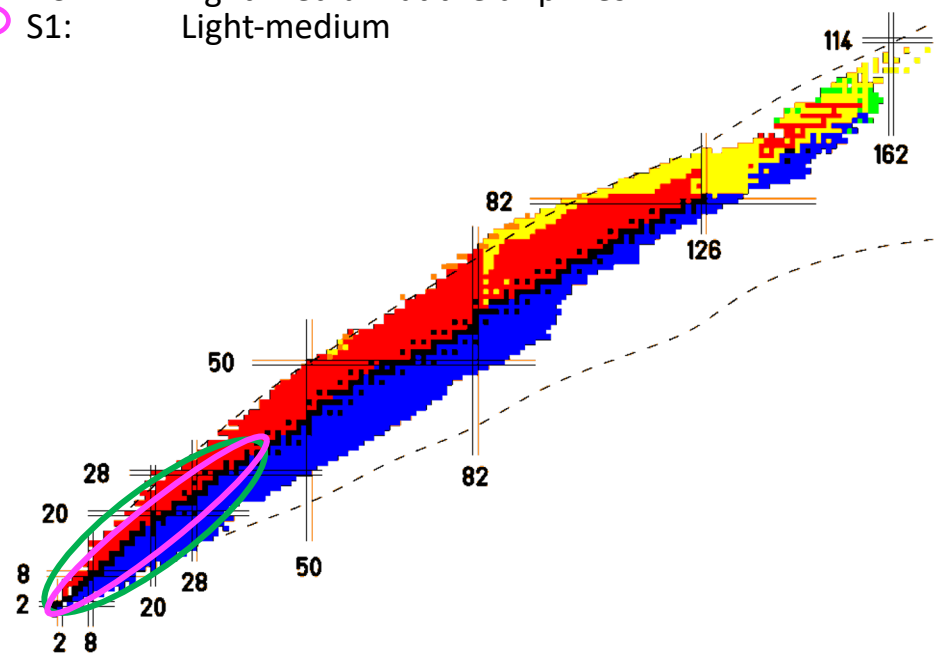
3- What will be « Low Energy » at GANIL tomorrow / after tomorrow

Which developments will be needed ?

4- Few words about the future of GANIL in general

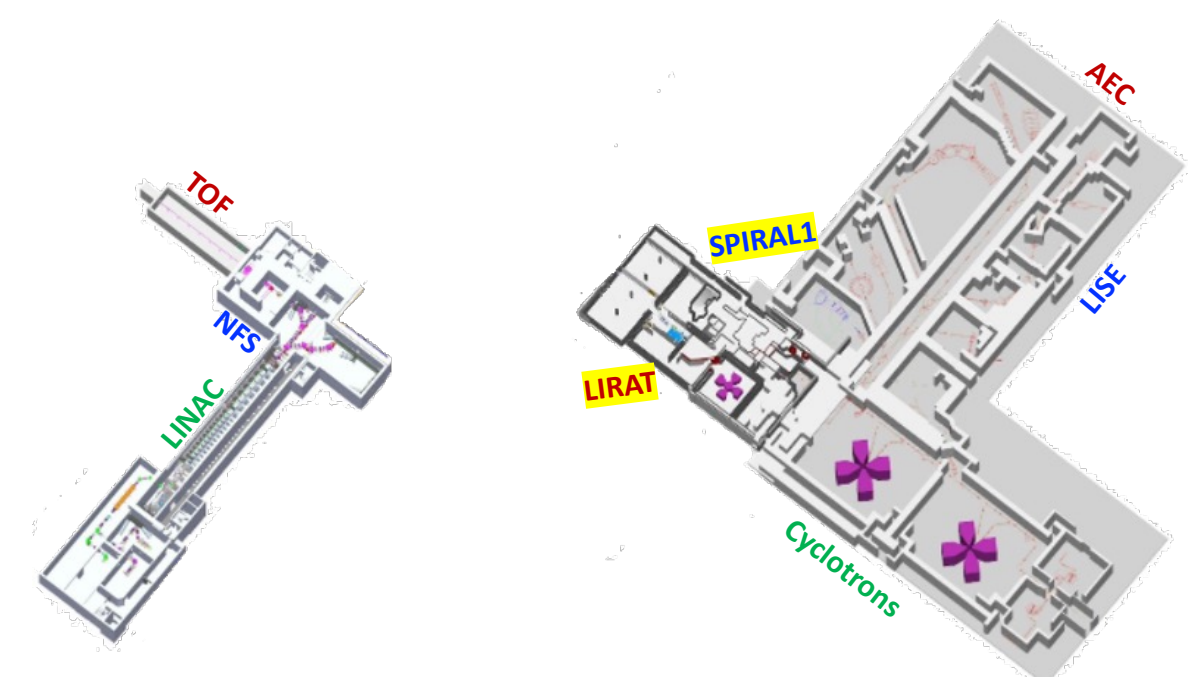
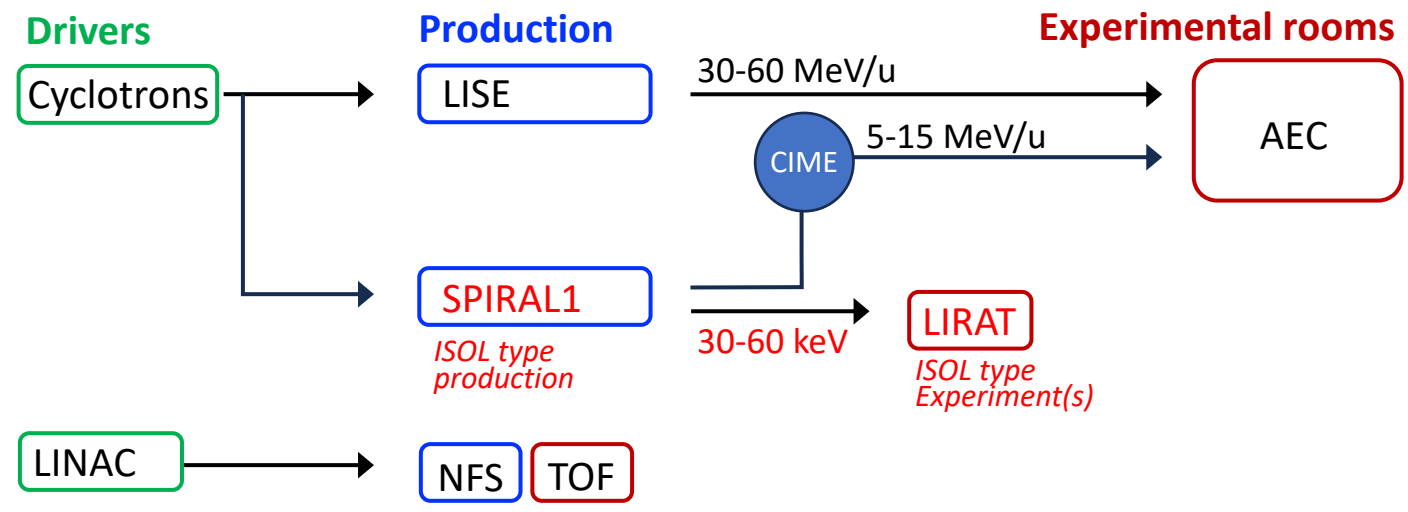
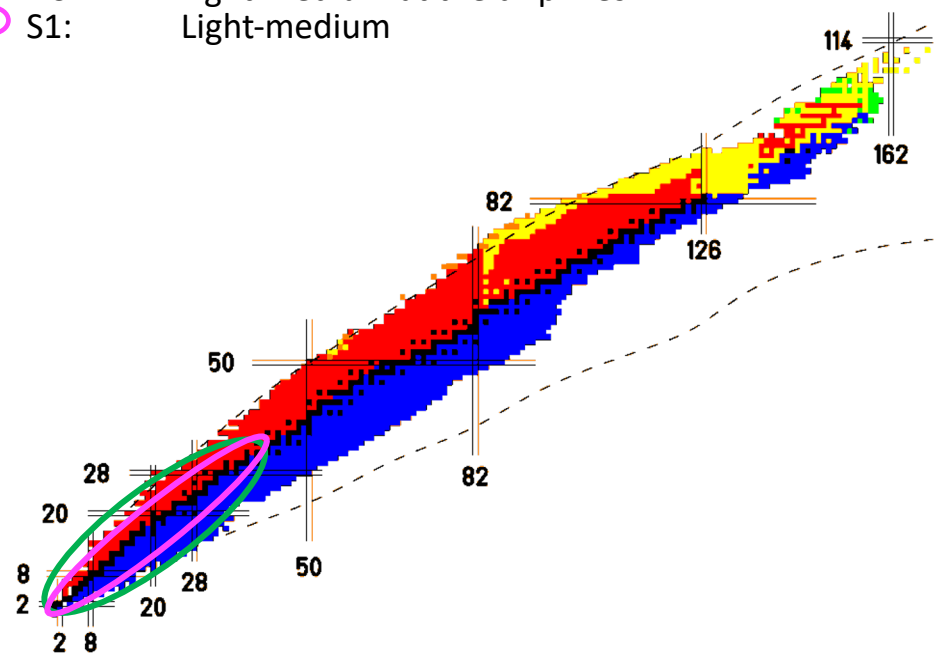
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○ S1: Light-medium



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2- Which kind of experiment are we talking about ?

With the ISOL method, exotic nuclei are produced at very low energy (30-60 keV)

→ No reactions

→ Measurement of fundamental properties of the nuclei

➤ Beta decay measurements

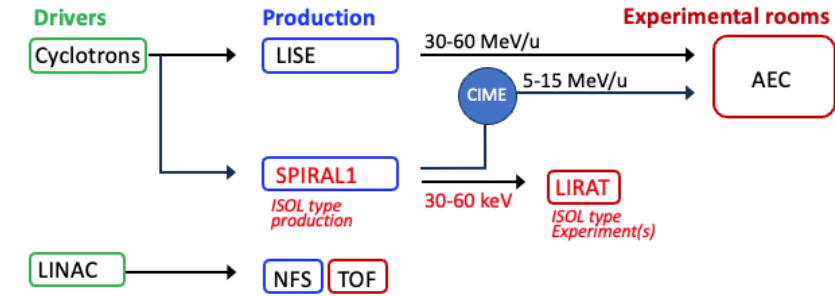
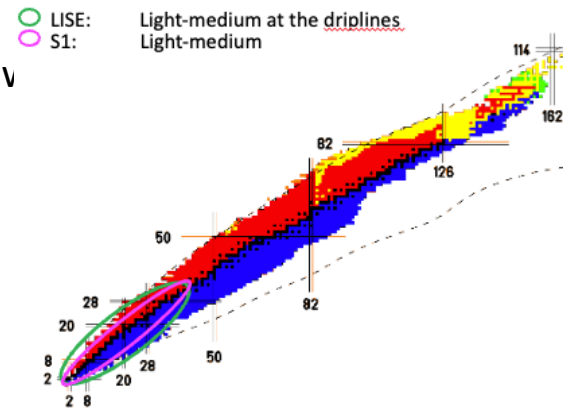
Half-lives, decay schemes, spin-parities...

➤ Trap-assisted spectroscopy

Masses, angular correlations (decay)...

➤ Laser-assisted spectroscopy

Isotope shifts, charge radii, spins, nuclear moments...



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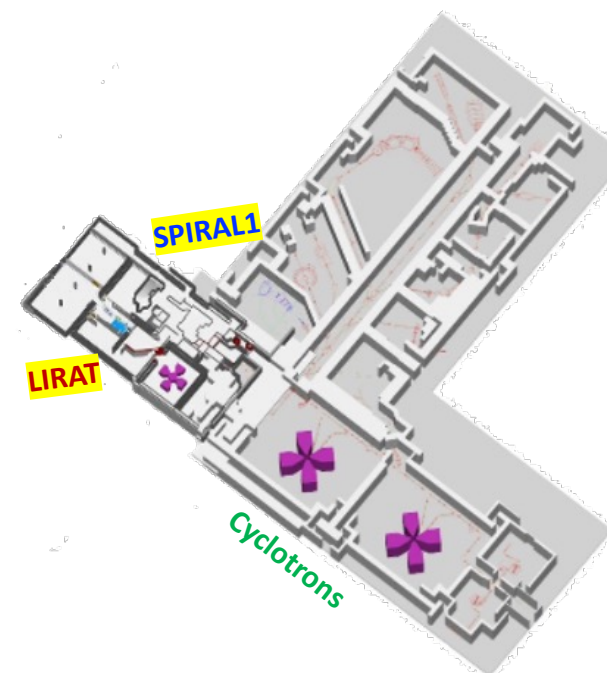
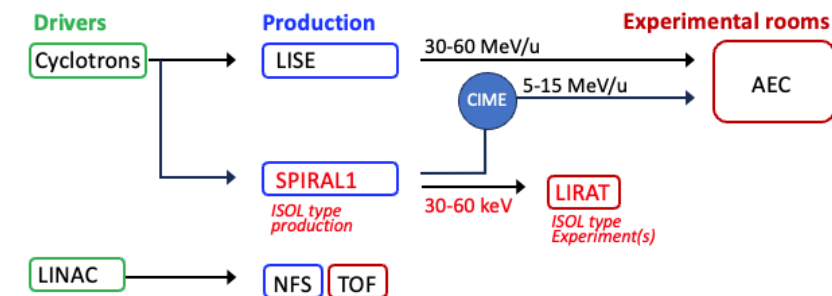
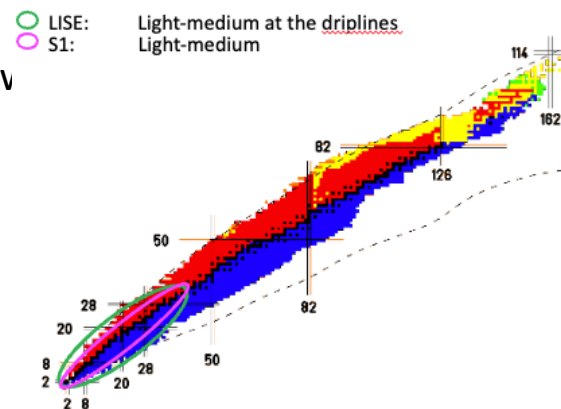
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Isotope shifts, charge radii, spins, nuclear moments...

➤ At GANIL (today), very limited program

- Limited « low energy community » at GANIL
- No real experimental areas (LIRAT corridor...
The « salle au piliers » has never been equipped with beam lines)
- Few experimental devices
- Concurrence of dedicated facilities : ISOLDE...



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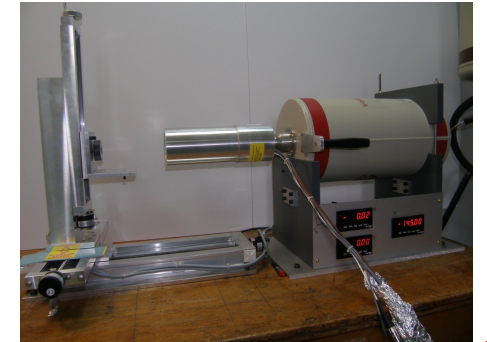
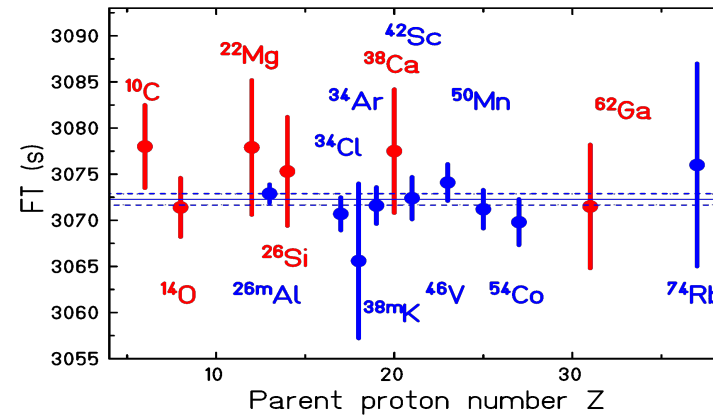
☐ Beta-decay experiment

- $0^+ \rightarrow 0^+$ transition : half lives and branching ratio measurements for testing the standard model

Test of the of the CVC hypothesis of the standard model and CKM matrix

Pure Fermi transitions $0^+ \rightarrow 0^+$:

determination of Ft values from Q-value , $T_{1/2}$, branching ratios



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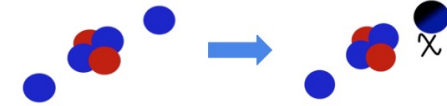
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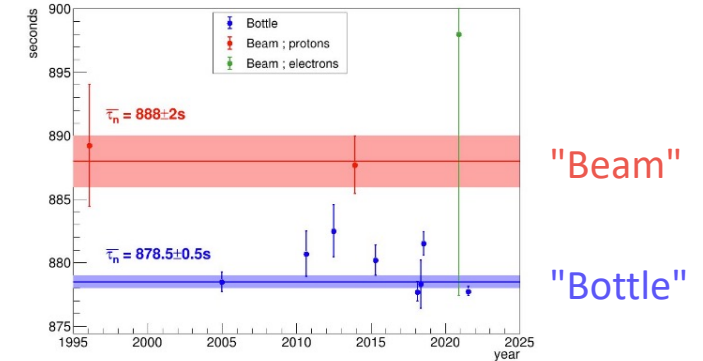
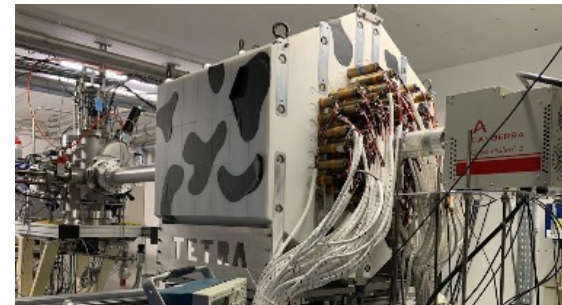
Is there a dark decay of neutrons in ${}^6\text{He}$?

- Look at the possible decay of a low lying neutron into Dark Matter - upper limit : $\text{Br}(\chi) = 1.2 \cdot 10^{-5}$



- Signature : excess of neutron with lifetime of ${}^6\text{He}$ "

- Beam from SPIRAL1 – detection of neutrons with TETRA
 $n + {}^3\text{He} \rightarrow t + p + 765\text{keV}$



GANIL
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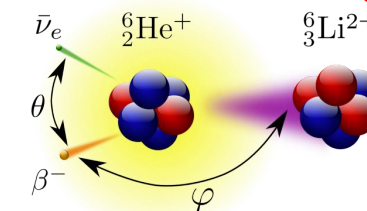
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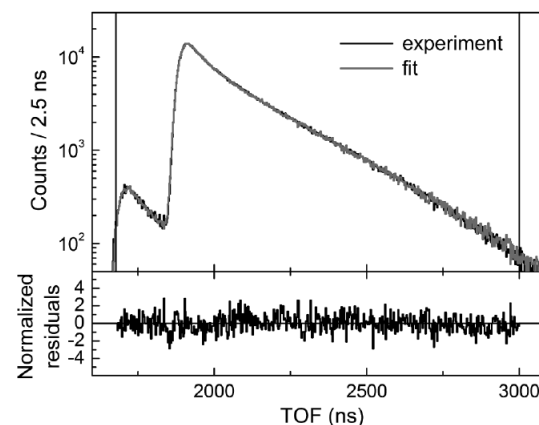
- Beta-neutrino angular correlation for testing the standard model

Measurements of β -v correlation coefficient in nuclear β decays using LPCTrap

Precision measurements in nuclear beta decay to search for exotic currents in the weak interaction

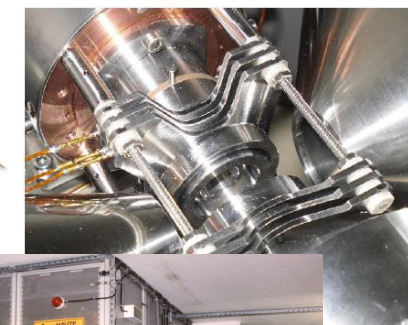


➤ ${}^6\text{He}^+ \rightarrow {}^6\text{Li}^{2+/3+}$



➤ ${}^{35}\text{Ar}^+ \rightarrow {}^{35}\text{Cl}$

➤ ${}^{19}\text{Ne}^+ \rightarrow {}^{19}\text{F}$



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Masses, half-lives, spin/parities, nuclear moments...

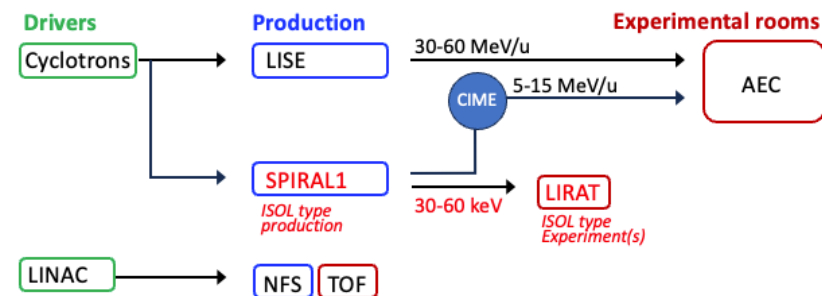
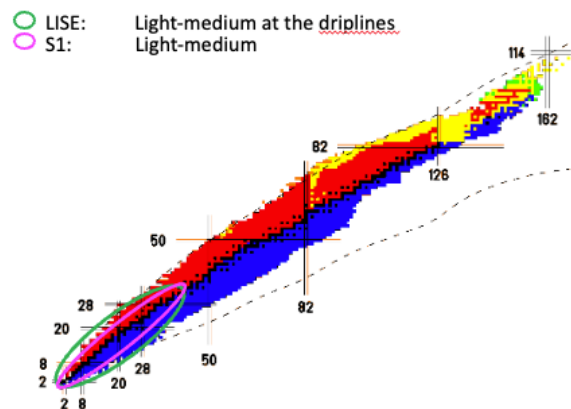
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Beta-decay experiment

Trap assisted spectroscopy



High precision measurements require

→ high intensity

→ High purity (at the target, after the target...)

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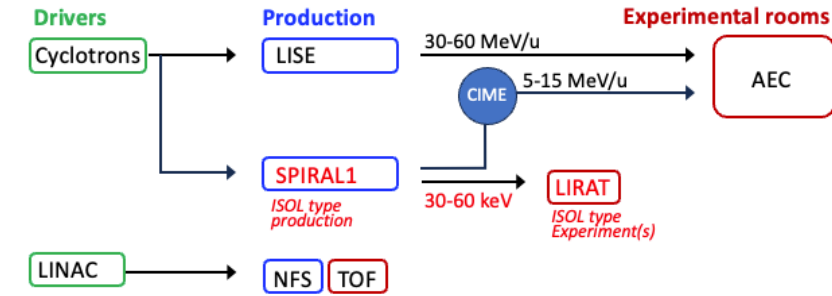
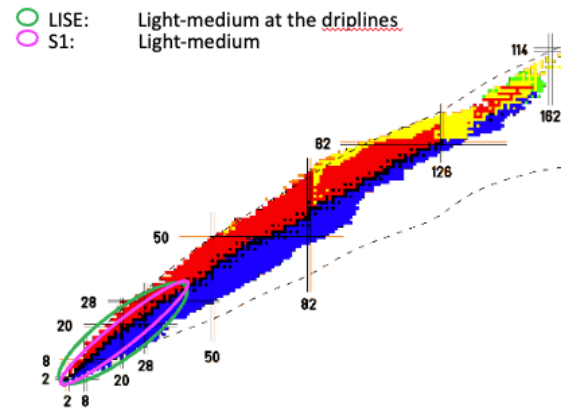
Which developments do we need ?

➤ production of (new) exotic nuclei

➤ Intensity

➤ purity

- Reliability and intensity of cyclotron beams
- Development of SPIRAL1 TIS



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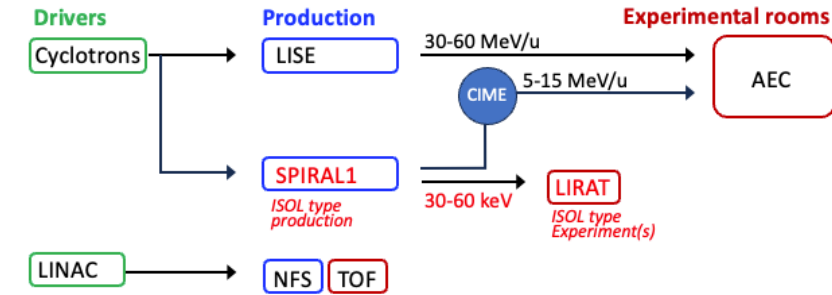
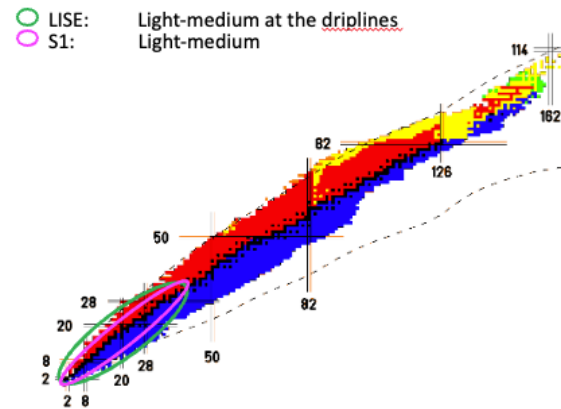
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In the context of the futur of GANIL, question to you :

Would be a test bunch (« SIRA revival ») useless/useful/mandatory ?

If yes, which characteristics ?



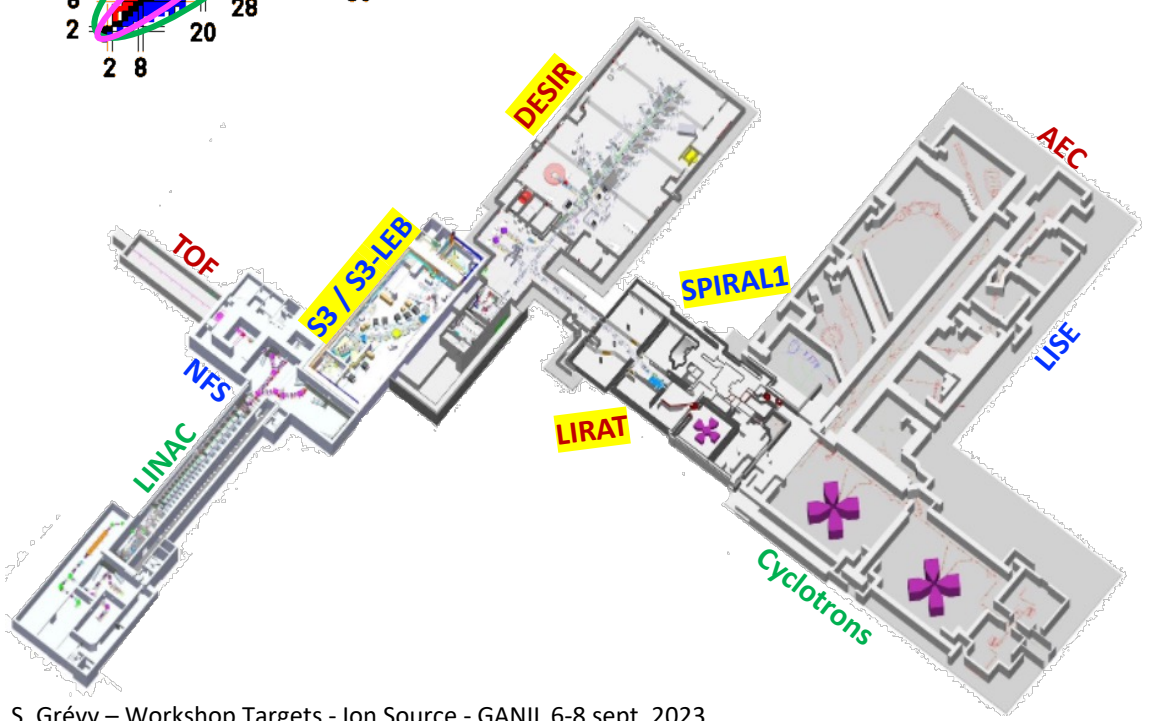
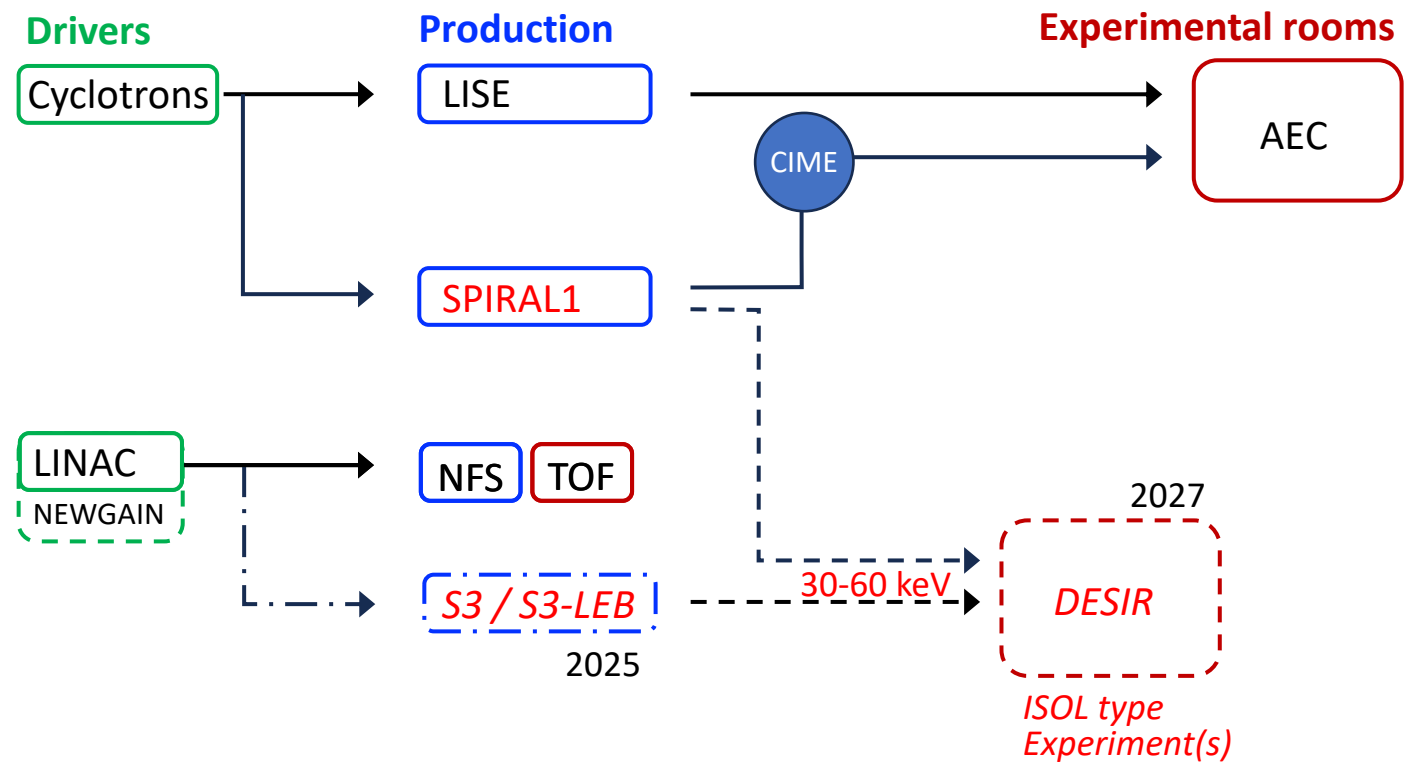
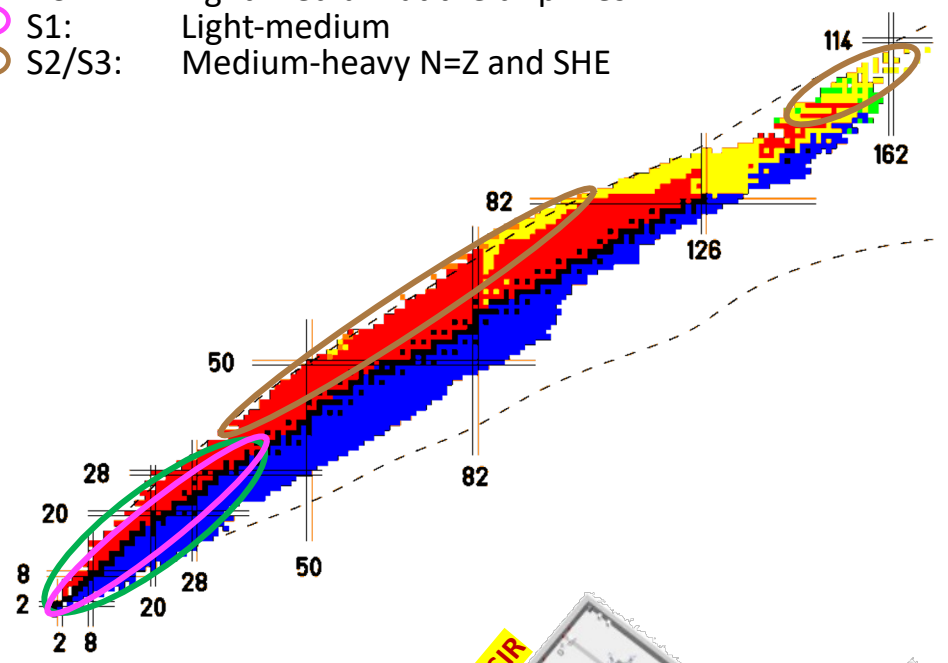
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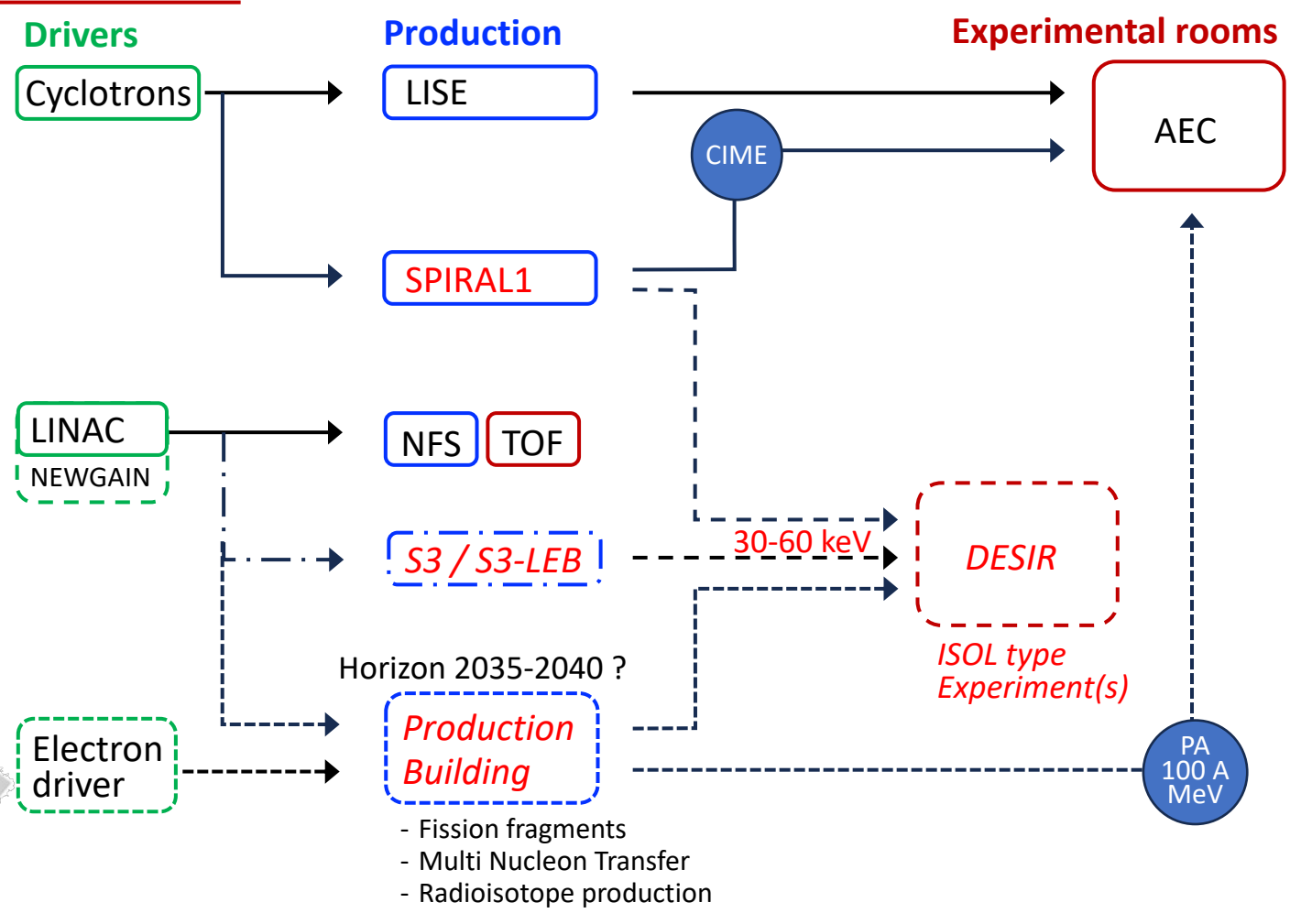
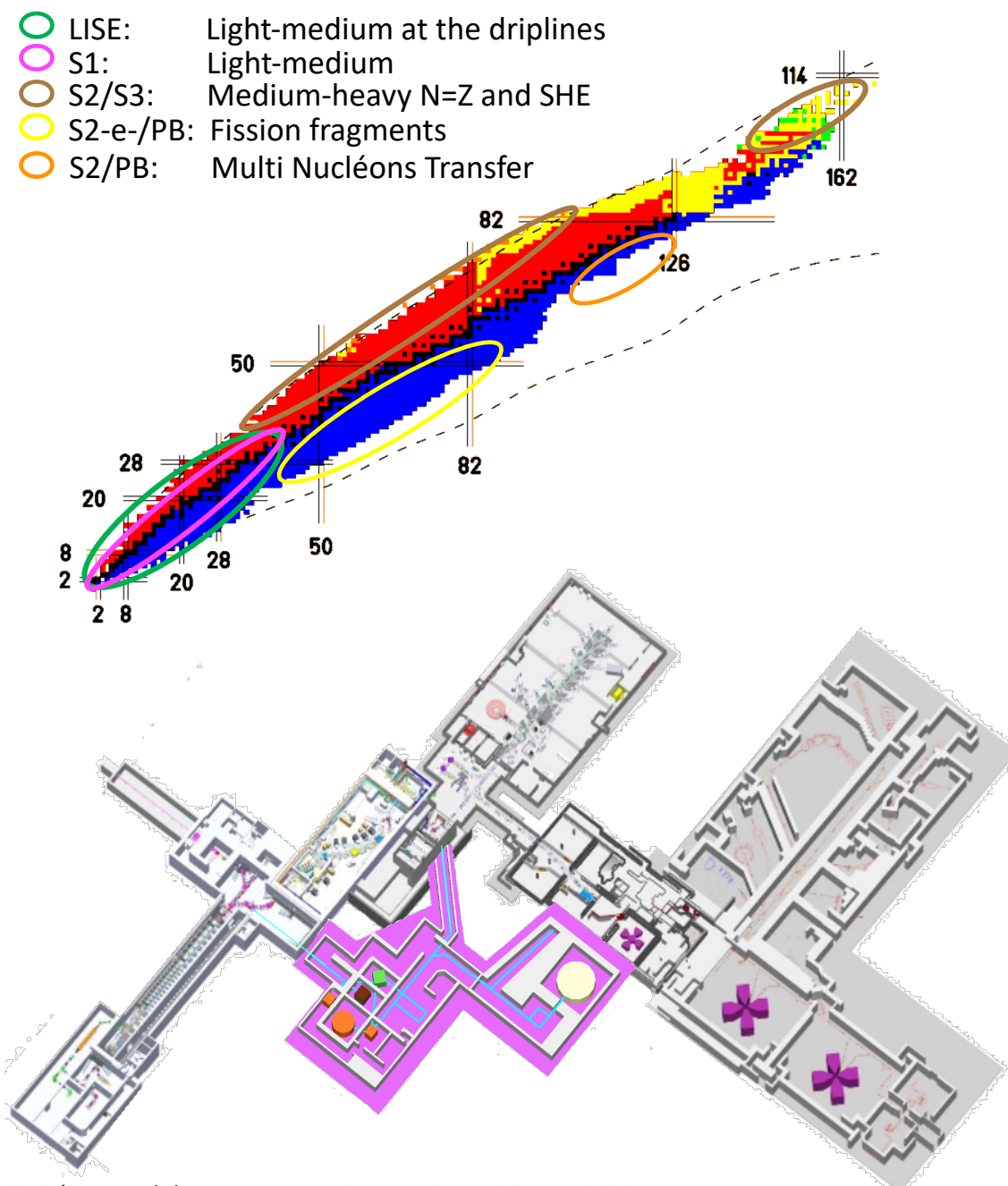
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- S1: Light-medium
- S2/S3: Medium-heavy N=Z and SHE

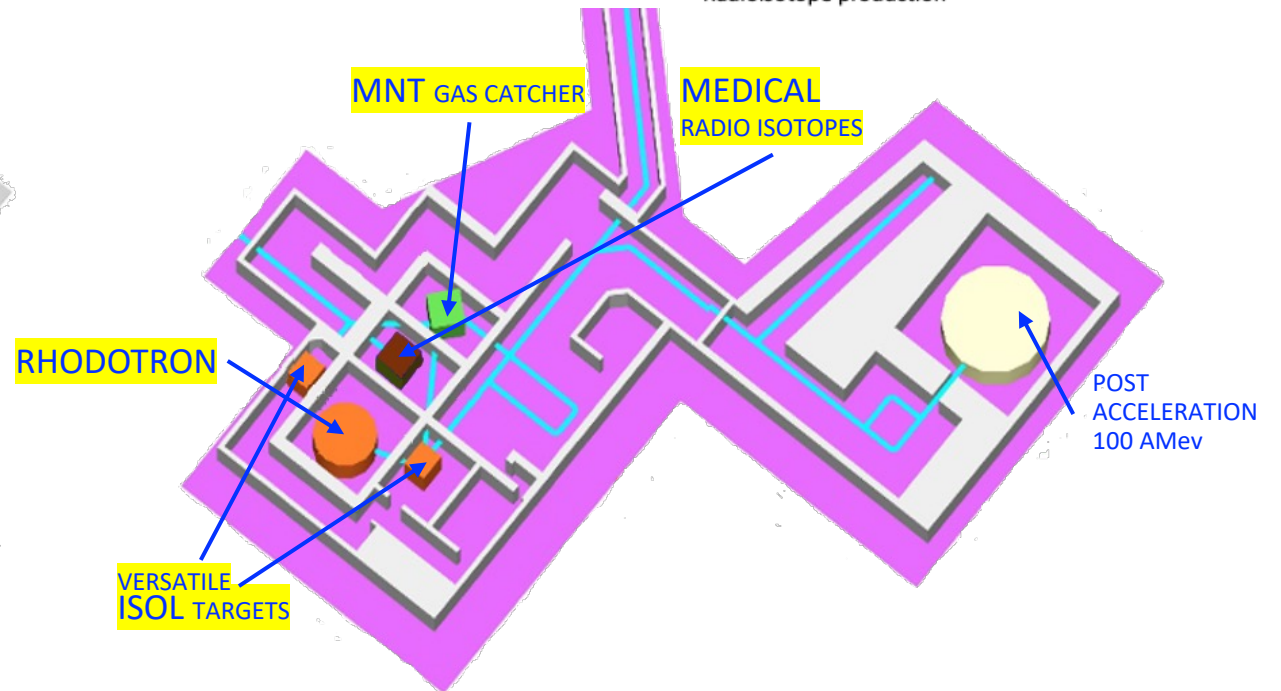
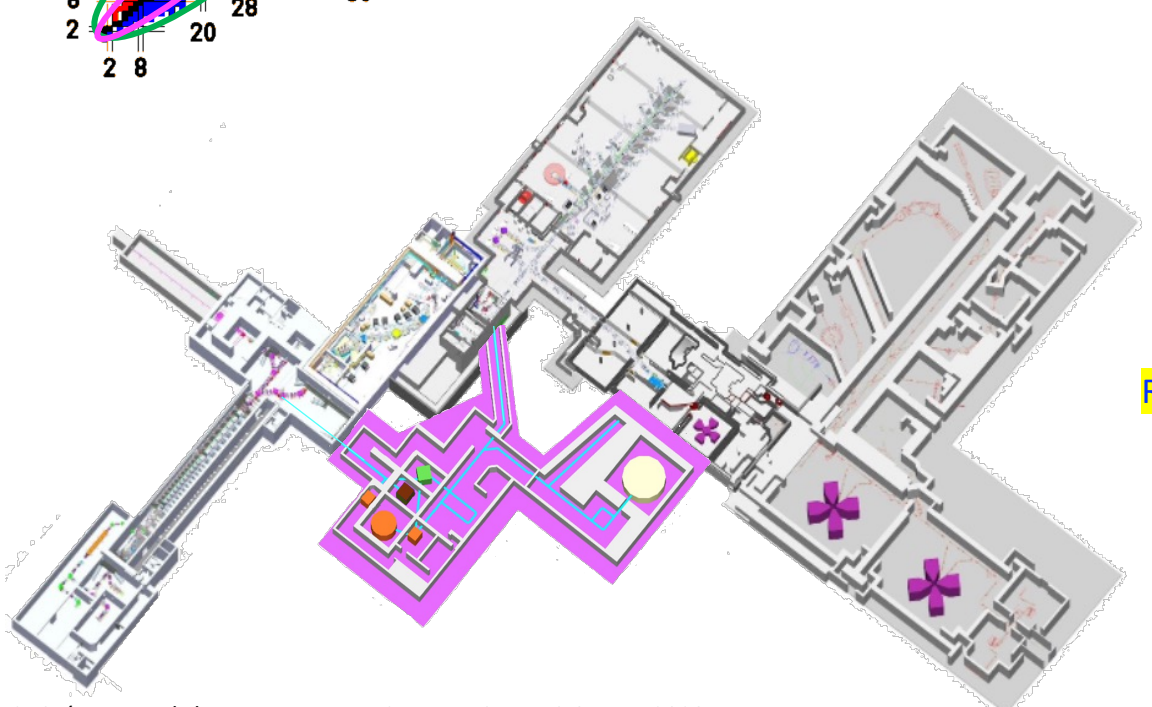
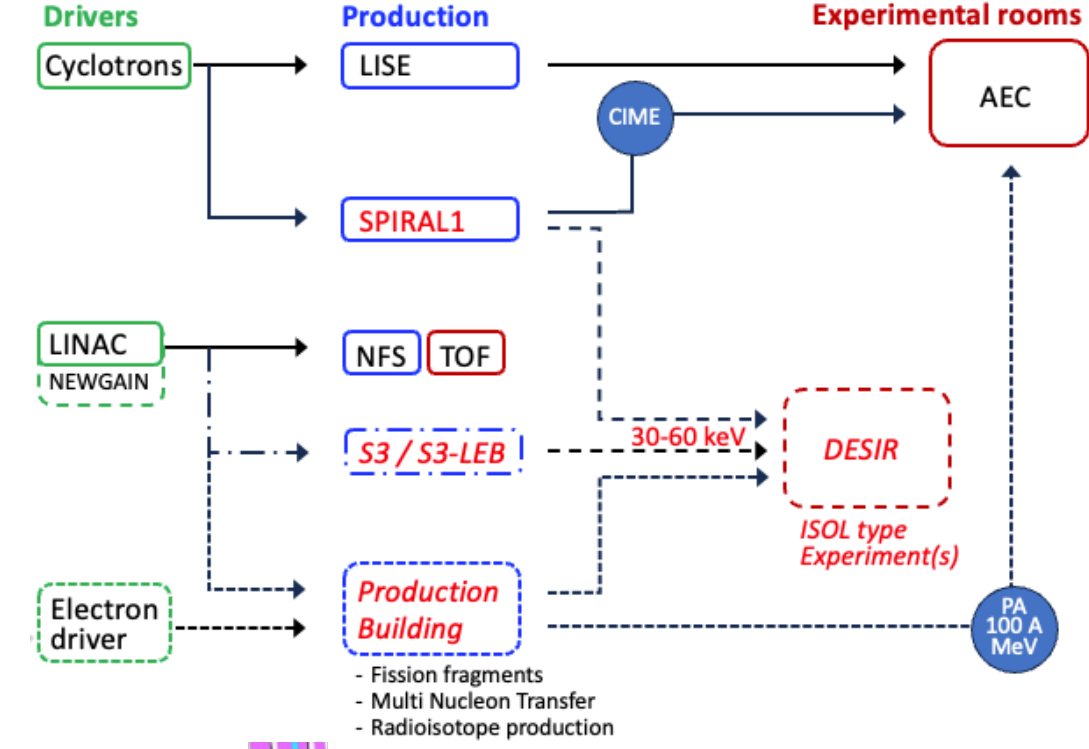
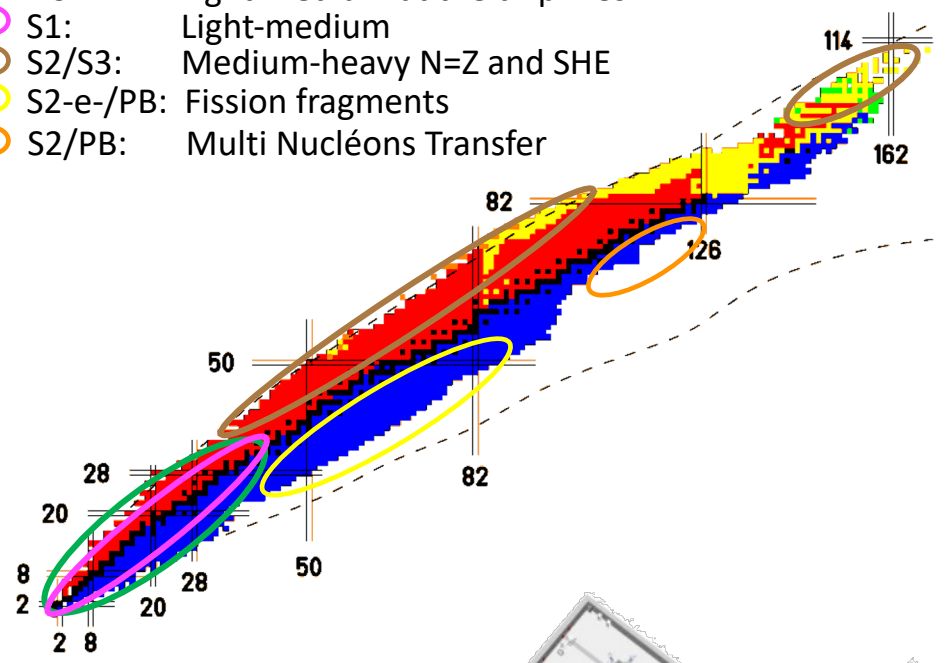


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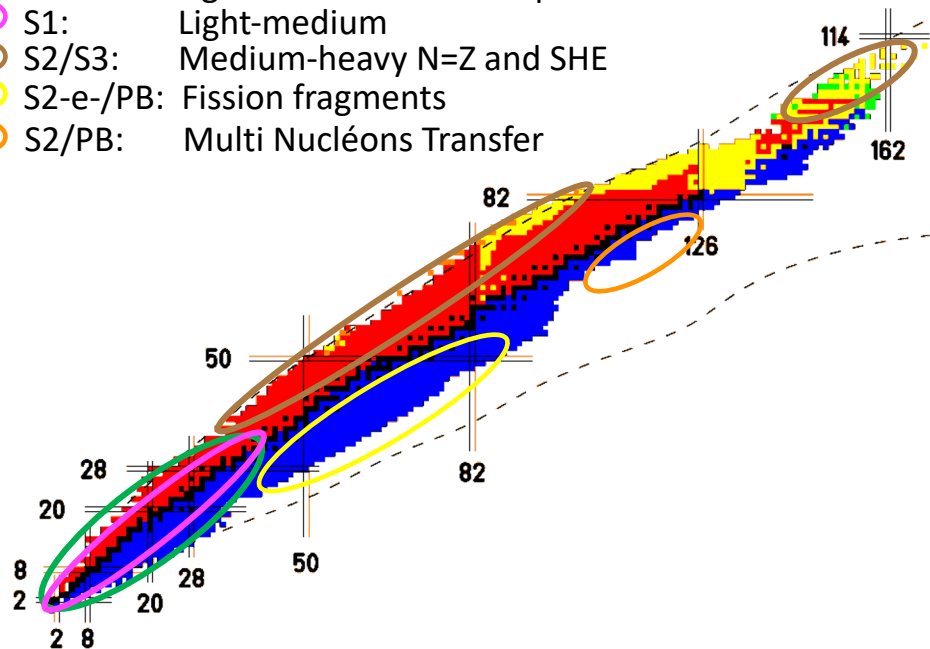
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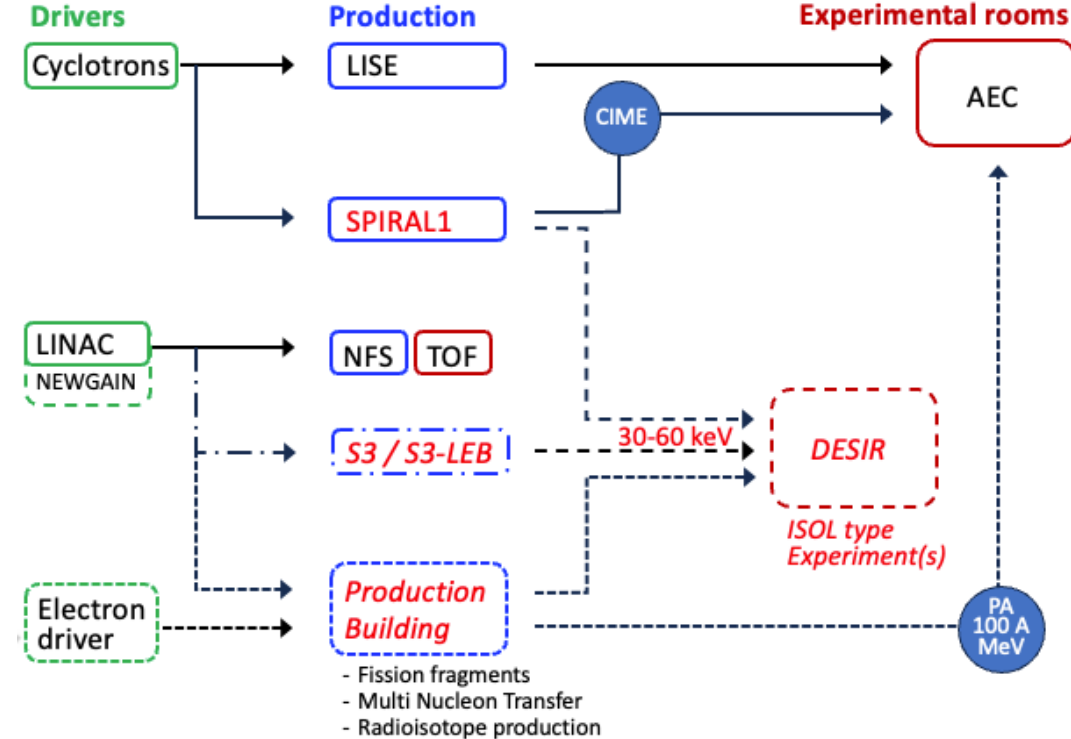
➤ The needs are in the production of (new) exotic nuclei...

→ development of S3 beams

- LINAC beam intensities for HI → Newgain...
- S3 targets

→ development of « production building » beams

- fission fragments → many developments have been done in the context of the original SPIRA2 project
- MNT : Multi Nucleon Transfer → nothing for the moment



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4- Few words about the future of GANIL in general

Prospective works have been done :

- In 2019-2021 in the framework of the French National prospectives
- In 2020-2021 in the framework of the International Expert Committee (« Mission Spiro »)

⇒ Report « Vision for the future of GANIL »: 3 steps

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- Deliver neutron-rich ions for SPIRAL2 physics program
- Target station for production of medical radio-isotopes
- Interdisciplinary studies



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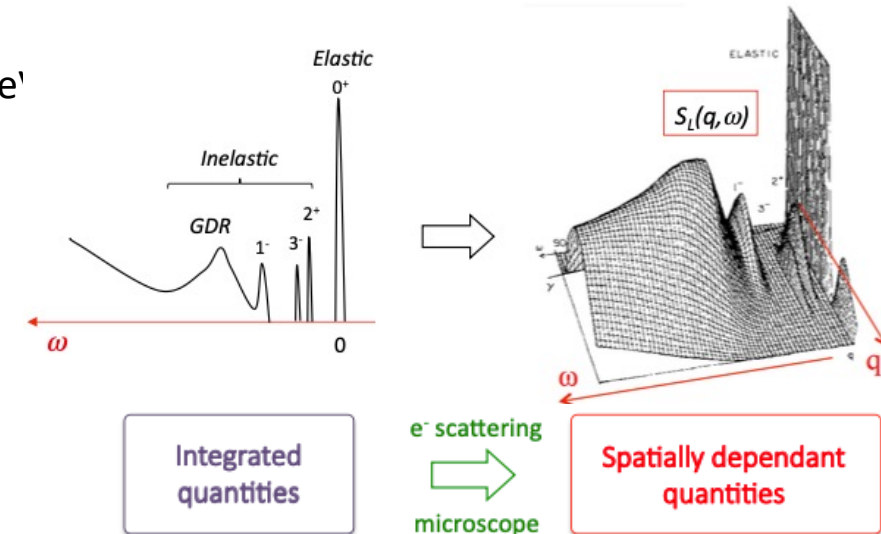
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3- Engage the long-term future

- Develop in-beam studies capabilities : post-acceleration to ~ 100 MeV
- Studies towards an electron-Radioactive Ions collider



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- Define the priorities among the scientific strategies presented by the expert committee
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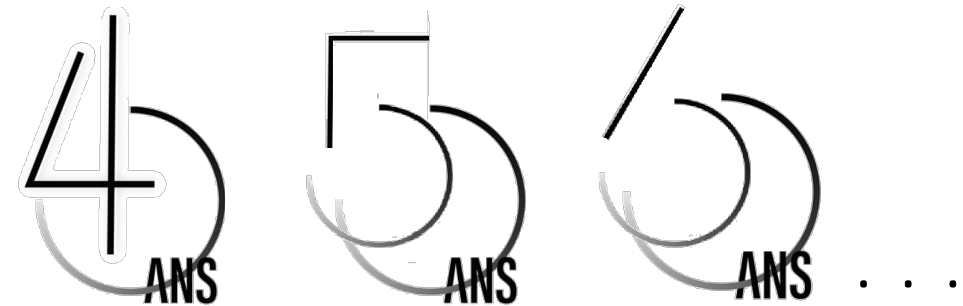
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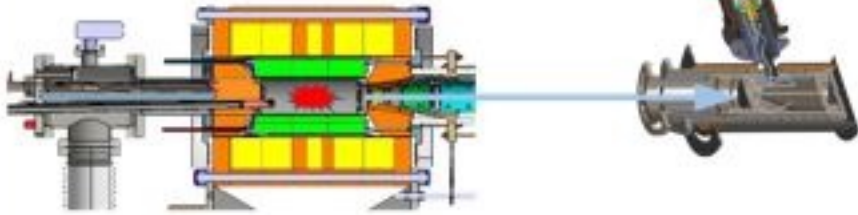
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- **Pre-Project leader** : Hanna Franberg Delahaye
- **Scientific leader** : Stéphane Grévy



Workshop

Targets – Ions Sources



Tomorrow's technological challenges and associated skills

GANIL, 6-8 september 2023

Stéphane Grévy
LP2i Bordeaux
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