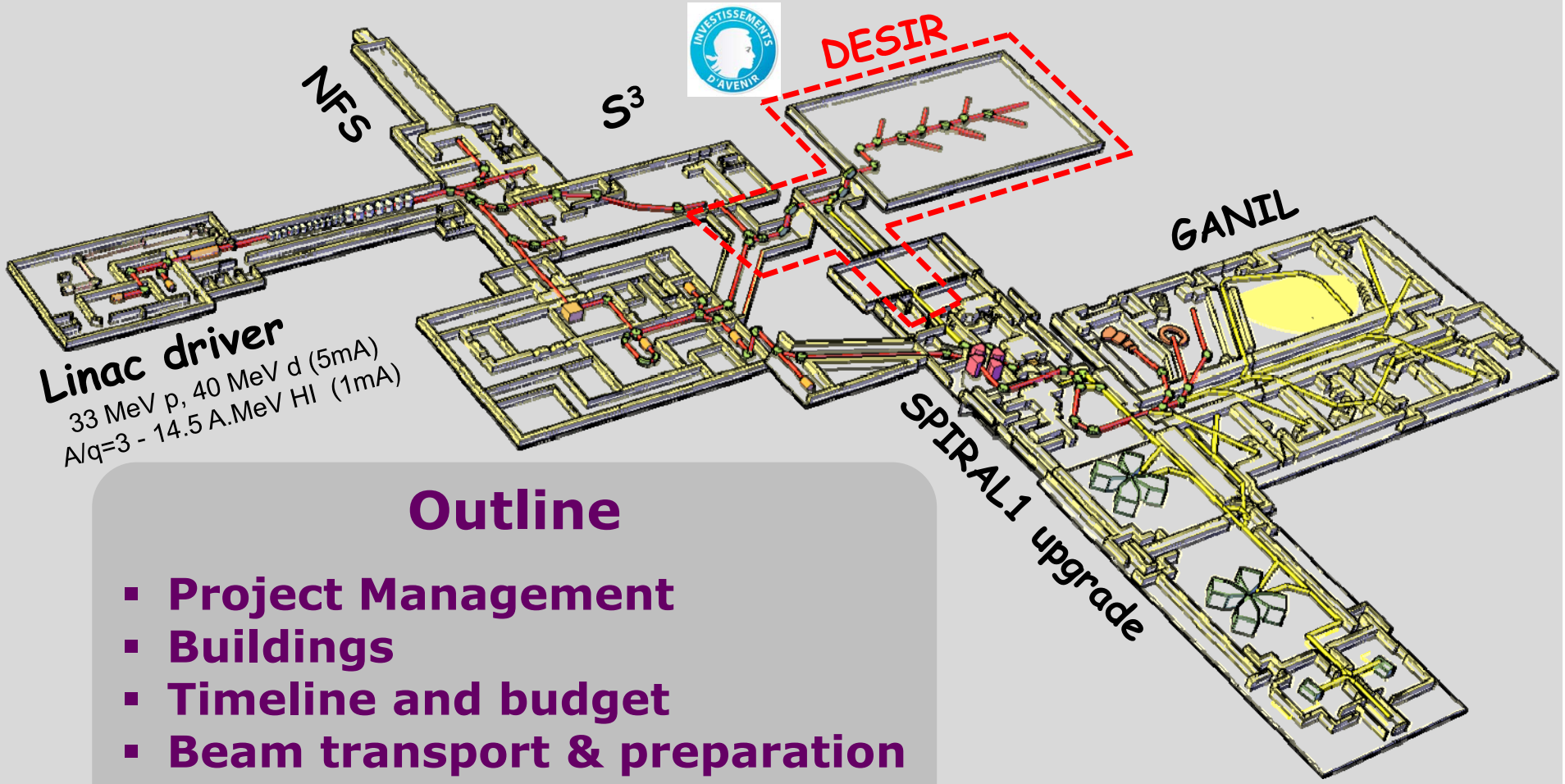
Status of the DESIR project

Collaboration Spokesperson: *B. Blank, CENBG*
Facility coordinator: *J.-C. Thomas, GANIL*
Technical coordinator: L. Serani, CENBG/GANIL

http://www.cenbg.in2p3.fr/desir

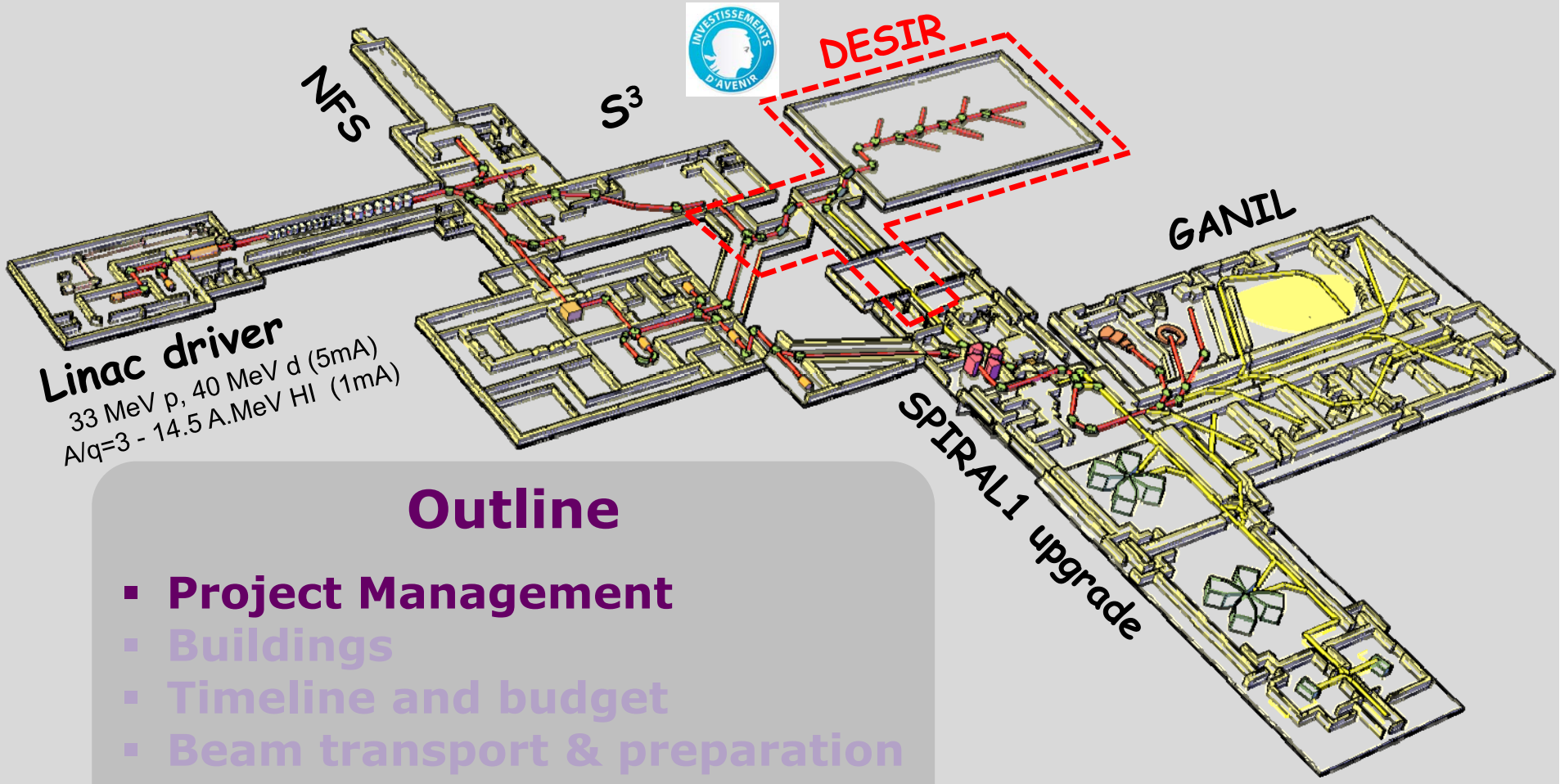


Outline

- Project Management
- Buildings
- Timeline and budget
- Beam transport & preparation
- Scientific program
- Experimental equipment

Status of the DESIR project

http://www.cenbg.in2p3.fr/desir



Outline

- **Project Management**
- Buildings
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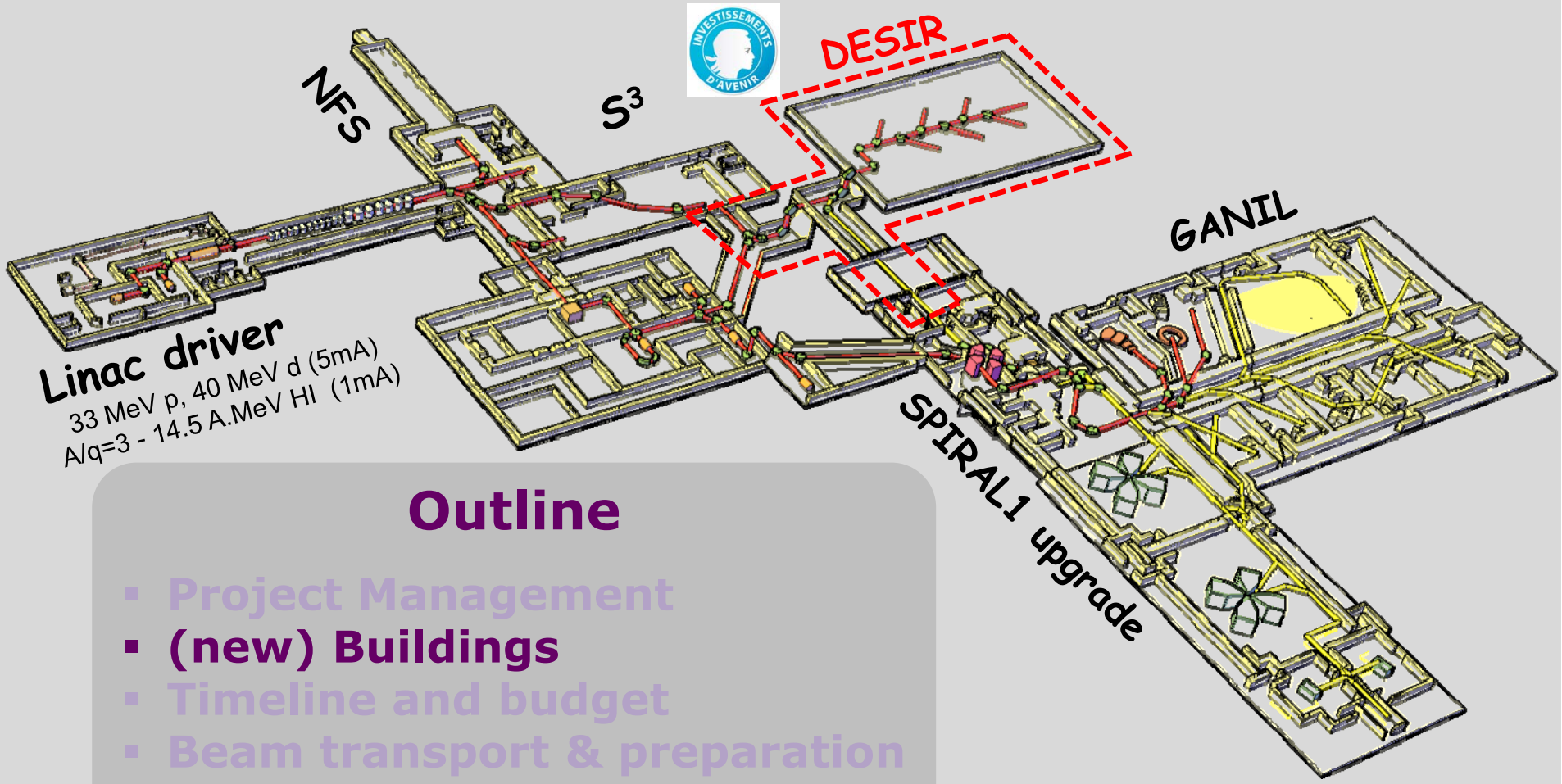
Project Management within the SPIRAL2 Phase 1+ context

- **DESIR as a "+" for the SPIRAL2 Phase 1 project**
  - ➔ **DESIR construction managed by the SPIRAL2 SFRE group**
    - ✓ **DESIR Technical coordinator belonging to the SFRE (L. Serani, CENBG)**
    - ✓ **DESIR EQUIPEX: Building & beam lines work packages managed by SFRE**
    - ✓ **Current budget of the SPIRAL2 DESIR project = 8 M€**

- **Delay in the construction of SPIRAL2 Phase 2**
  - ➔ **Renegotiation of the SPIRAL2 Phase 2 contract to build the DESIR hall and two beam transport tunnels from SPIRAL1 and S^3-LEB**
    - ✓ **New specifications of the DESIR hall to reduce costs (Dec 2013)**
    - ✓ **Integration of the HRS in the beam transport tunnels**
  - ➔ **New schematic drawings of the DESIR building proposed in June 2104**
  - ➔ **Beginning of the DESIR preliminary design study phase in Jan. 2015**
  - ➔ **Reevaluation of the timeline and of the budget**

Status of the DESIR project

http://www.cenbg.in2p3.fr/desir



Outline

- Project Management
- **(new) Buildings**
- Timeline and budget
- Beam transport & preparation
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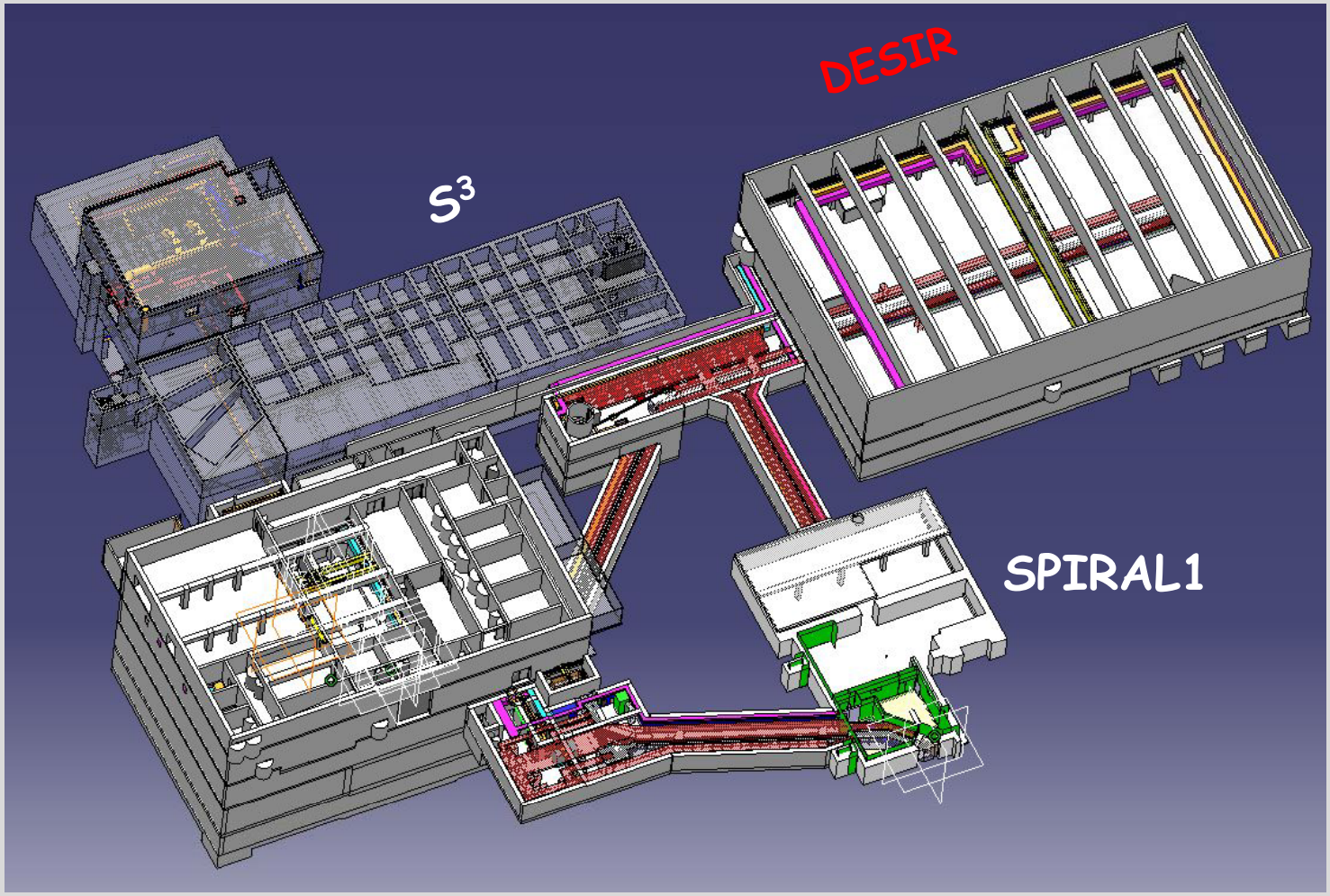
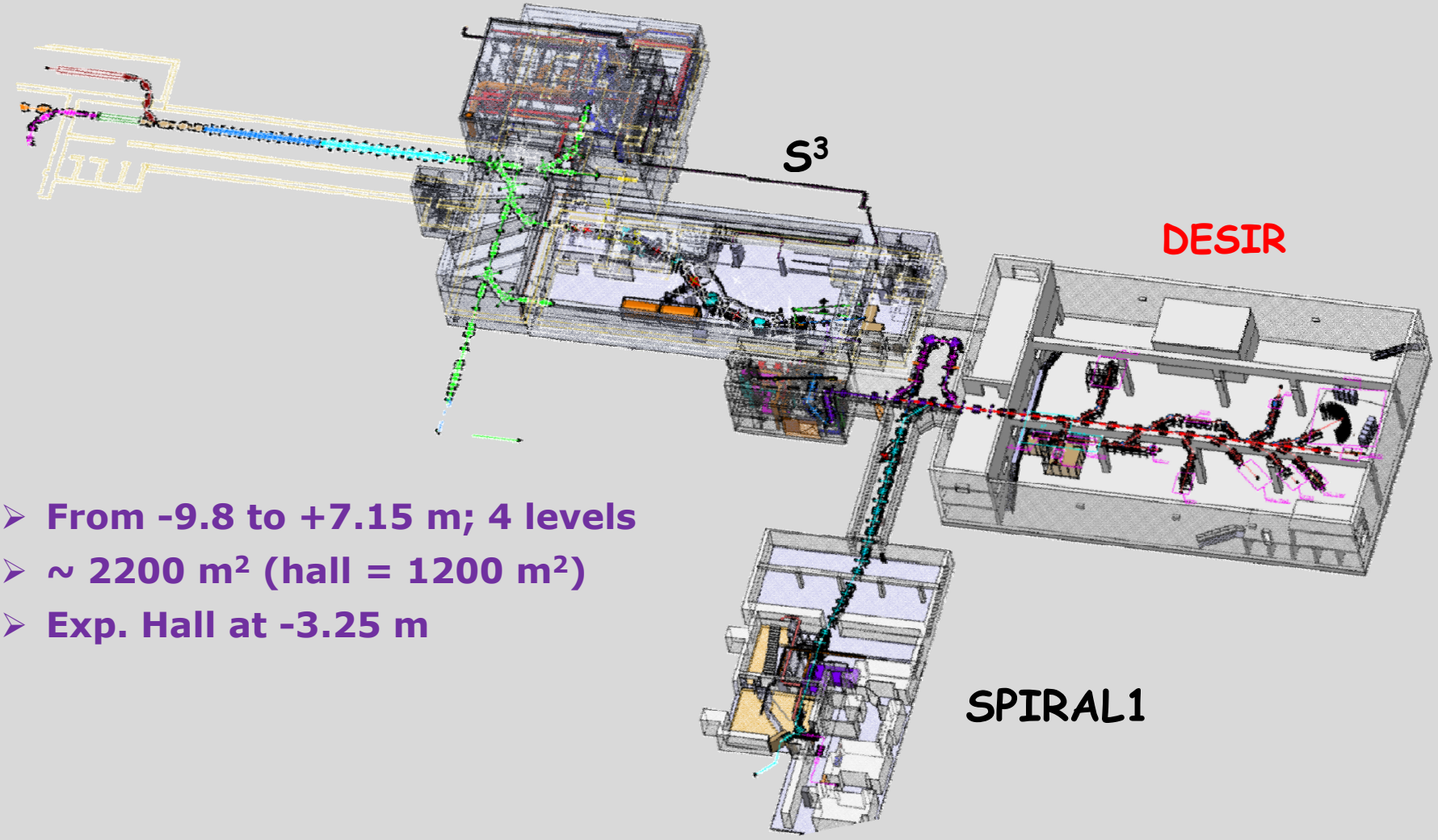
Buildings

From 2011…….



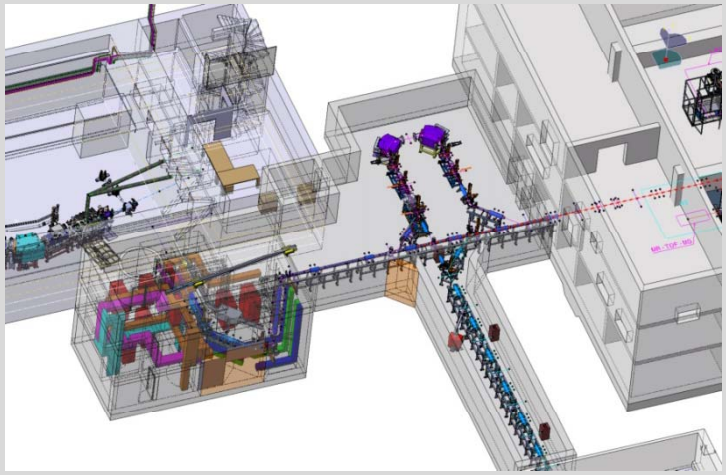
Buildings

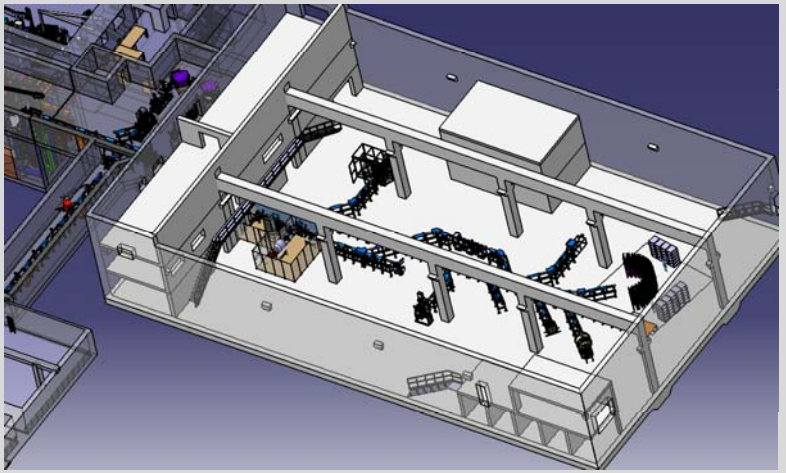
to June 2014



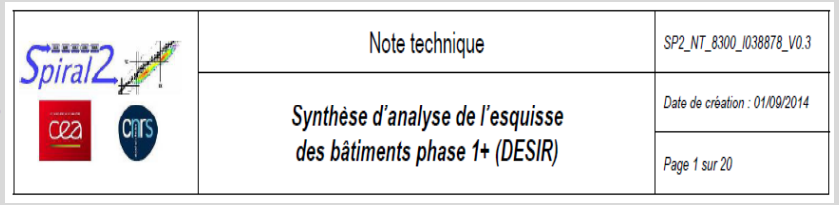
- From -9.8 to +7.15 m; 4 levels
- ~ 2200 m² (hall = 1200 m²)
- Exp. Hall at -3.25 m

Building preliminary drawings (June 2104)





- Integration of SHIRaC + HRS
- No Basement; concrete structure
- Since June: analysis of the drawings and proposed optimizations:
  - supplies, technical rooms, accesses
  - equipment handling (cranes)
  - building infrastructure: pillars?

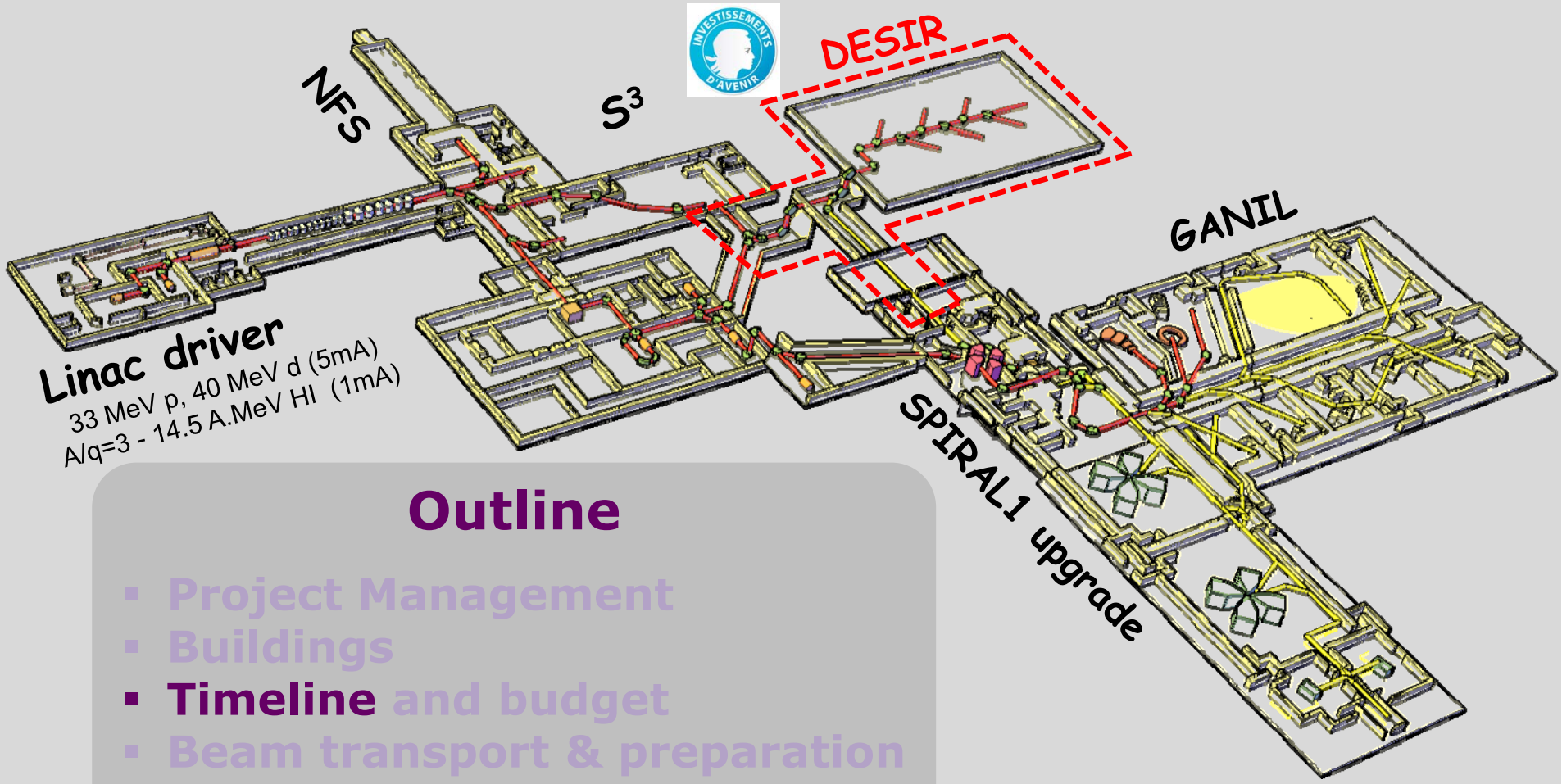


Spiral2 cea cnrs	Note technique	SP2_NT_8300_I038878_V0.3
	Synthèse d'analyse de l'esquisse des bâtiments phase 1+ (DESIR)	Date de création : 01/09/2014
		Page 1 sur 20

➔ Beginning of the APS phase in January 2015

Status of the DESIR project

http://www.cenbg.in2p3.fr/desir



Outline

- Project Management
- Buildings
- **Timeline** and budget
- Beam transport & preparation
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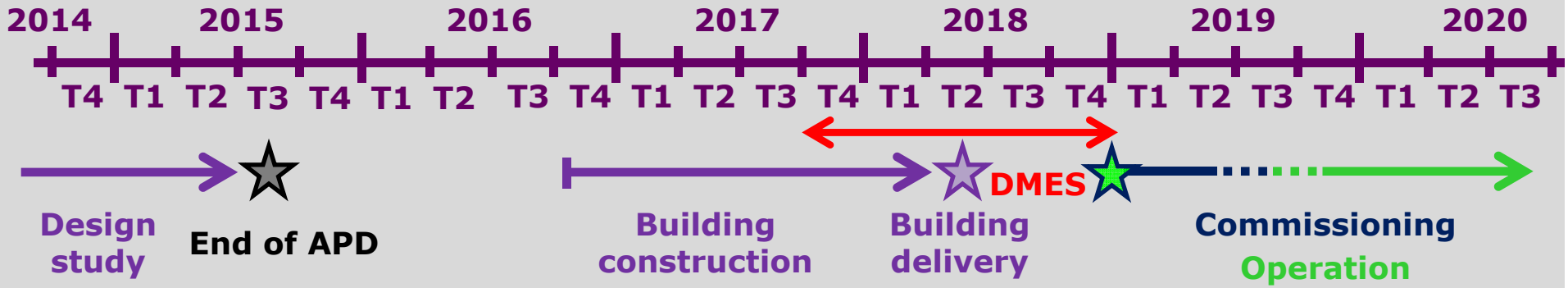
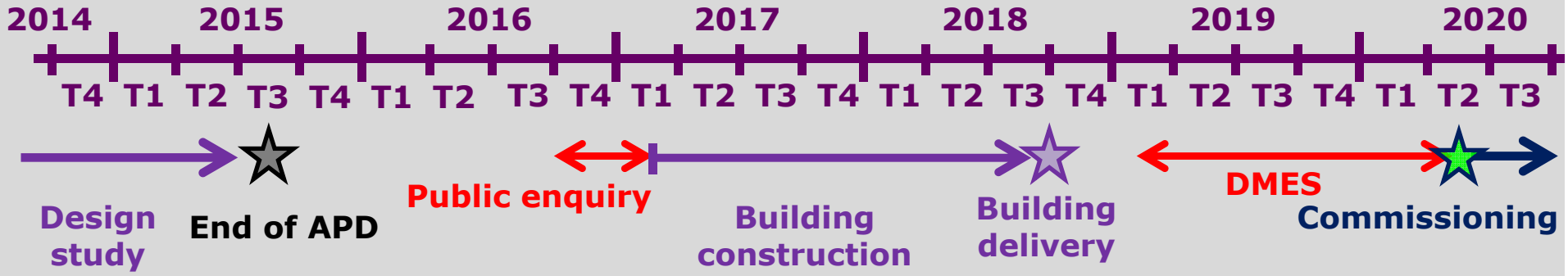
Timeline

Scenario 1: DESIR as an extension of SPIRAL2 Phase 1

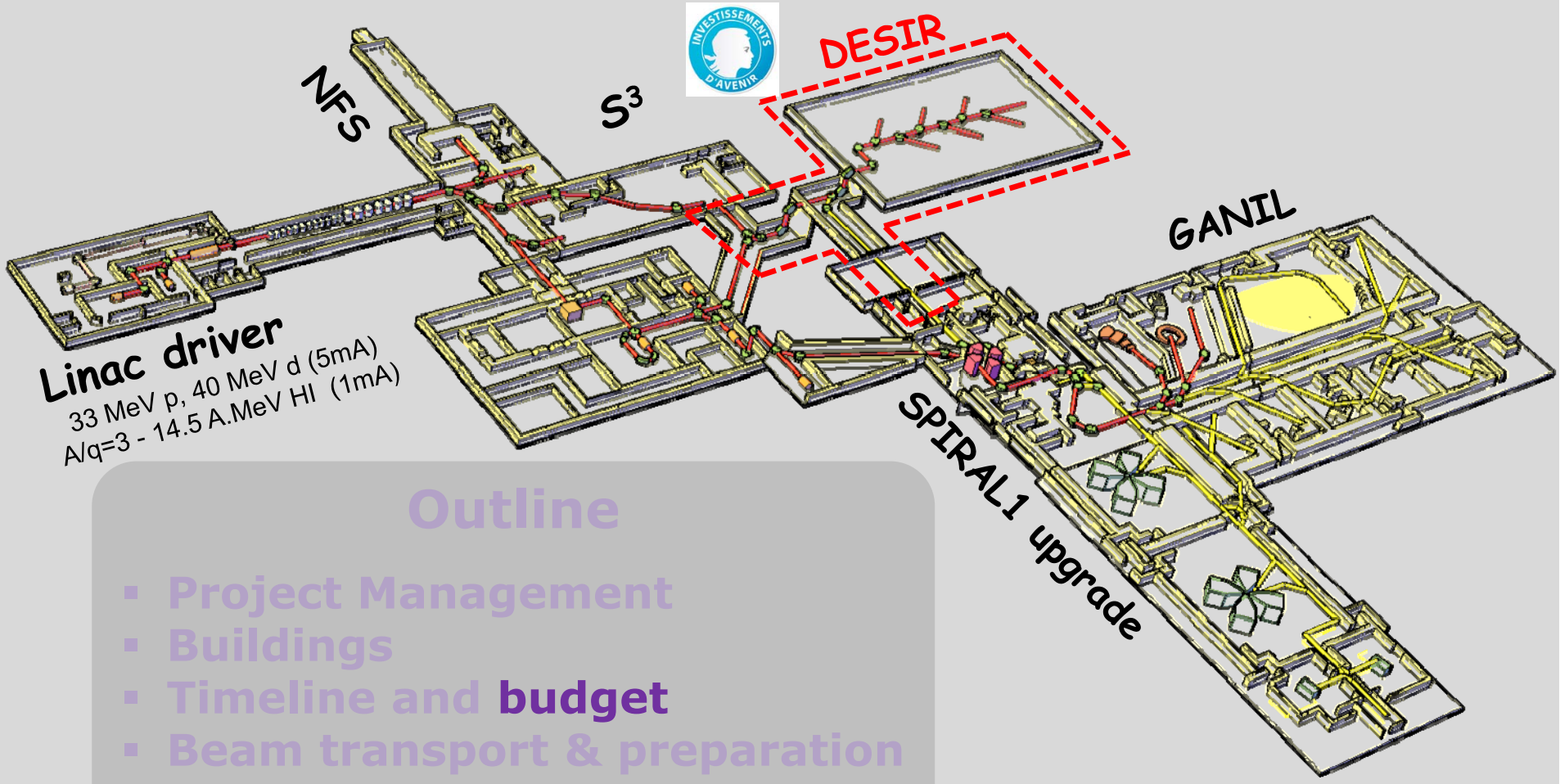


Scenario 2: DESIR concidered as independent by safety authorities



Status of the DESIR project

http://www.cenbg.in2p3.fr/desir



Outline

- Project Management
- Buildings
- Timeline and **budget**
- Beam transport & preparation
- Scientific program
- Experimental equipment

Budget

Cost estimates (May 2014):

- Building (2180 m²): 15.9 M€
- Beam lines (~140 m): 5.6 M€

Total (10% overheads): 21.5 M€

Missing: 13.6 M€

EQUIPEX Funding (ANR):

- Construction: 6.7 M€
- Beam lines: 1.2 M€
- Operation: 1. M€
- Management: 0.1 M€

Total: 9 M€

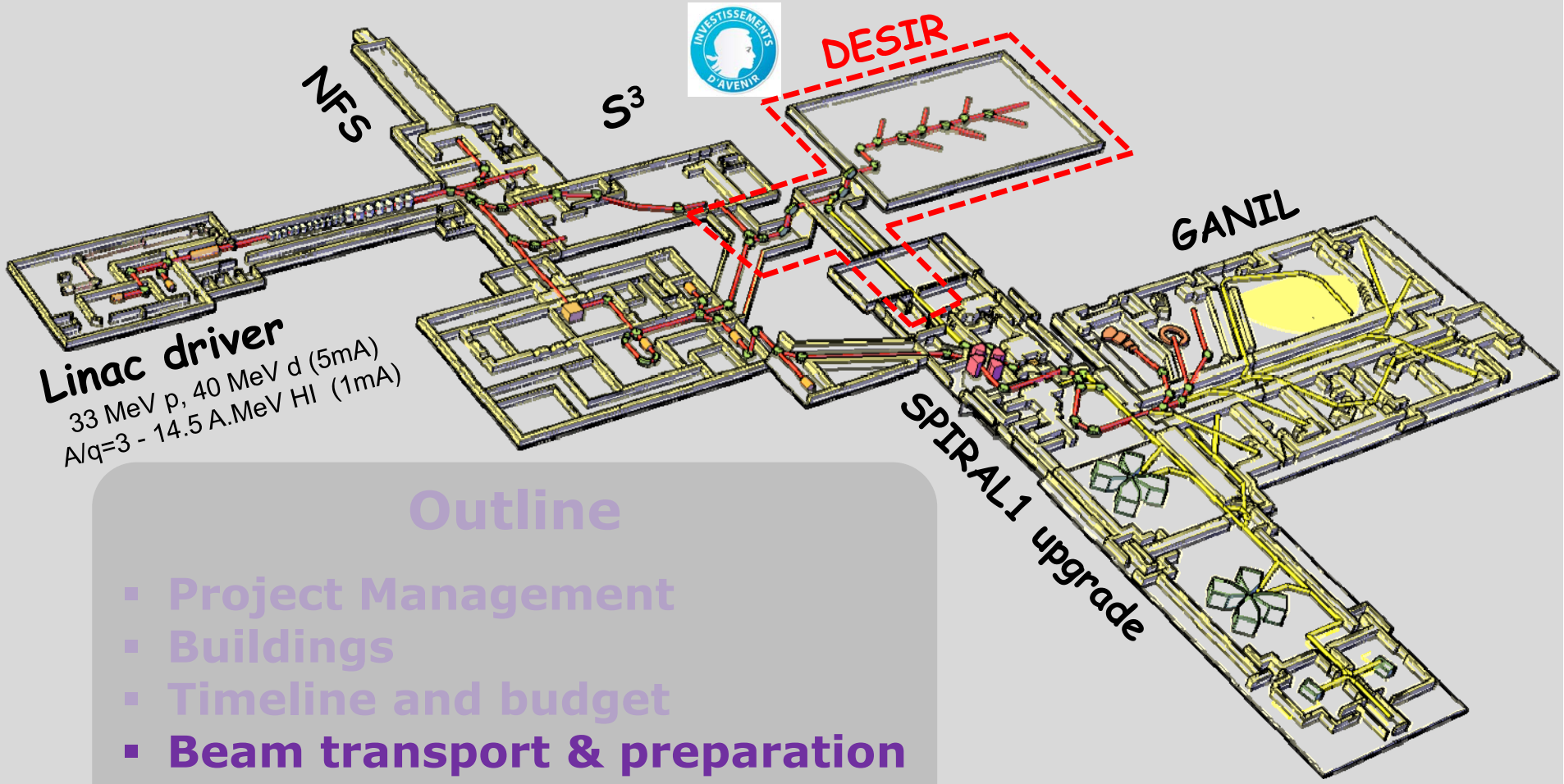
CPER Funding:

- SHIRaC+HRS: 1.13 M€

Estimated cost of the experimental equipment: ~5 M€

Status of the DESIR project

http://www.cenbg.in2p3.fr/desir



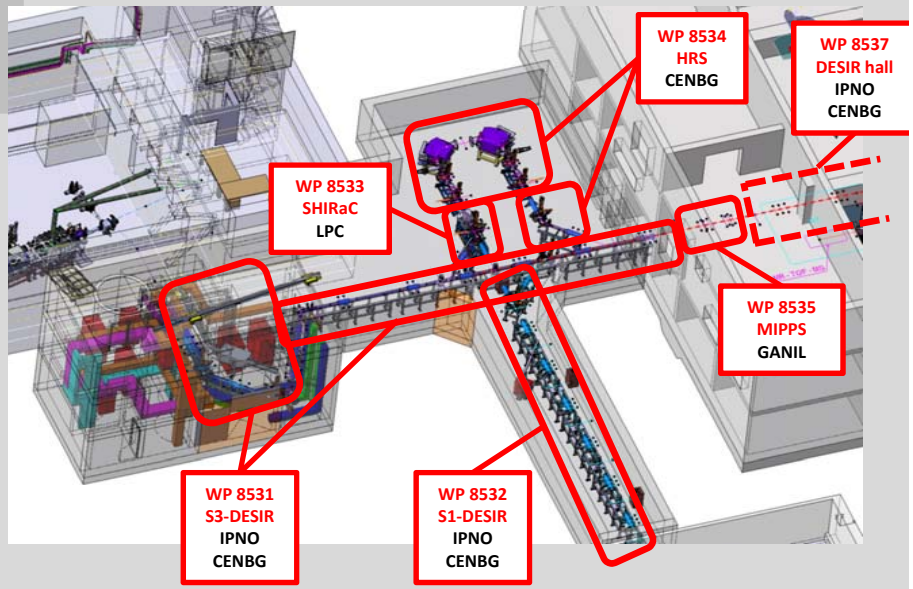
Outline

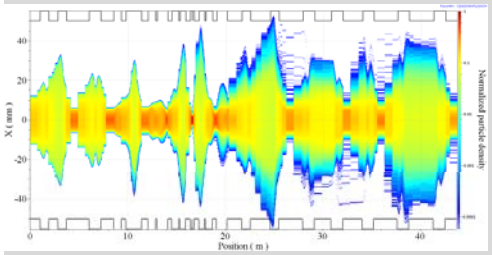
- Project Management
- Buildings
- Timeline and budget
- **Beam transport & preparation**
- Scientific program
- Experimental equipment

Beam lines (L. Perrot, IPN Orsay)

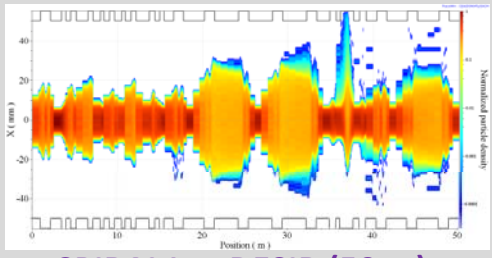
L. Perrot and H. Cherif, EPJ Web of Conference 66 (2014) 08029, INPC 2013

- **Beam optics (toward DESIR)**
  - ✓ first order simulations
  - ✓ error calculations
  - ✓ "HRS loop" to be studied
- **Beam optics (inside DESIR)**
  - ✓ to be done
- ➔ **Beam line review in Jan. 2015**

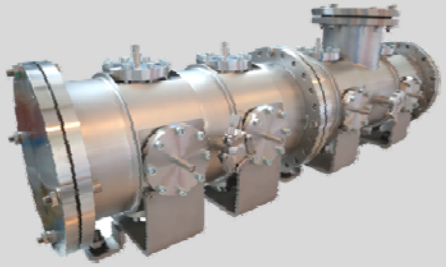




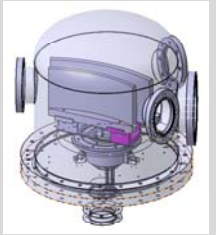
S^3-LEB -> DESIR (44 m)



SPIRAL1 -> DESIR (50 m)



- **Design study of the beam line equipments (electrostatic)**
  - ✓ Quad triplet + steerers prototype: built, to be tested at CENBG in 2015
  - ✓ 45° deflector design: to be built and tested in 2015
- **Next steps:**
  - ✓ consolidation of the beam line studies
  - ✓ partnership with BARC, India?



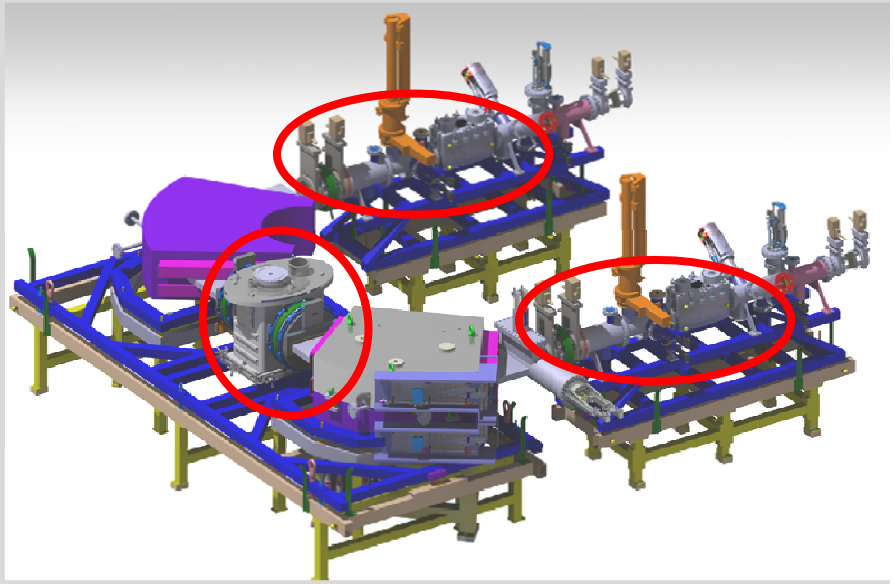
Beam preparation: HRS (T. Kurtukian Nieto, CENBG)

T. Kurtukian Nieto et al., Nuclear Instruments and Methods in Physics Research B 317 (2013) 284

Beam preparation: HRS (T. Kurtukian Nieto, CENBG)

T. Kurtukian Nieto et al., Nuclear Instruments and Methods in Physics Research B 317 (2013) 284

- **Optical design of the HRS done**
- **Dipole magnets delivered**
  - ✓ field map scans at GANIL in 2015
  - ✓ expected field homogeneity: 10^{-5} over 300 mm
  - ✓ curvature of the poles to be defined at CENBG
- **Design of the QQHQ ensembles**
  - ✓ optics defined
  - ✓ drawings and specification ok
  - ✓ call for tender to be launched by FAIR
- **Design of the multipole**
  - ✓ optics studied -> April 2015
  - ✓call for tender to be launched by FAIR



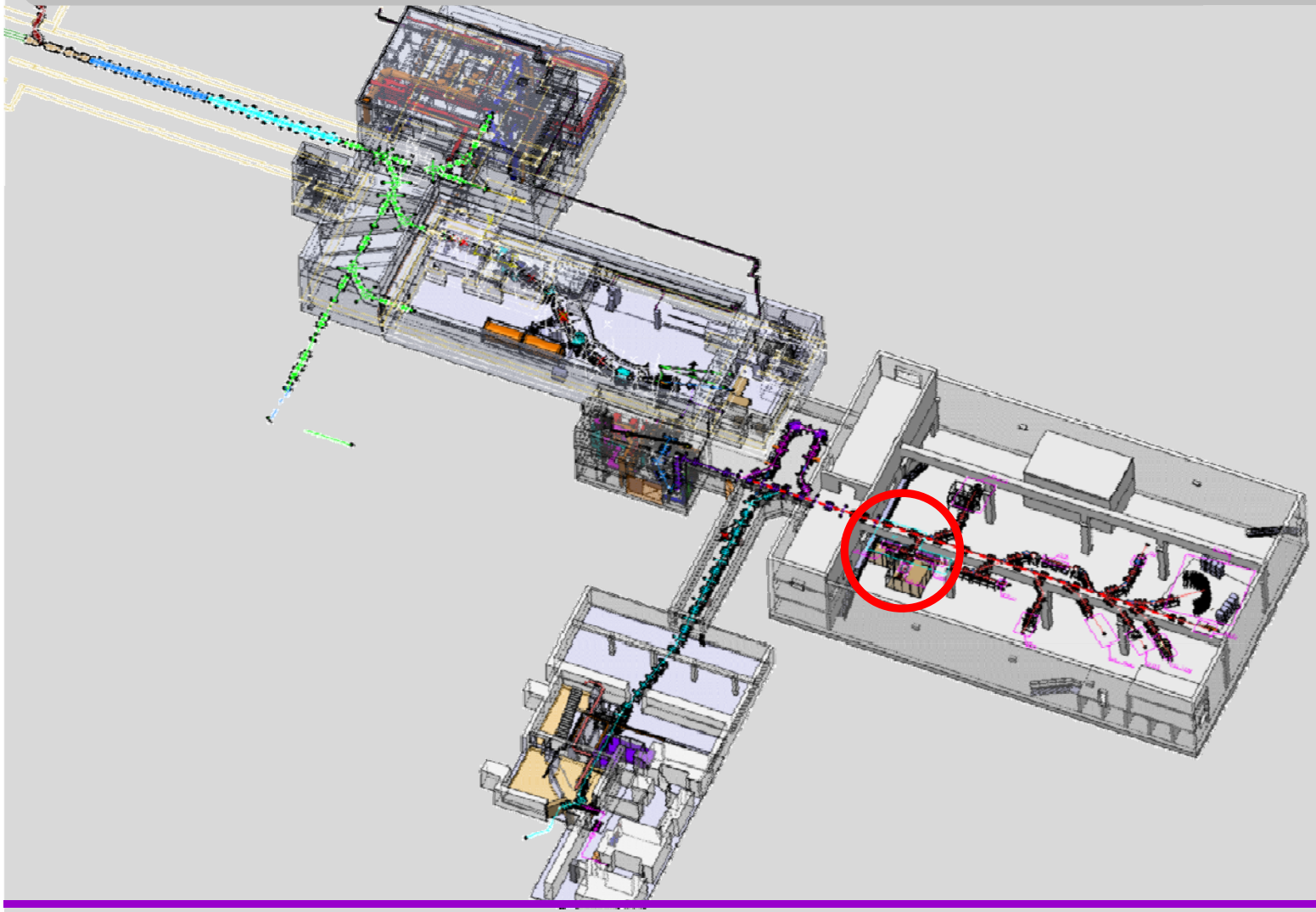
➔Commissioning of the HRS at CENBG in 2016

Expected performances: M/ΔM = 20000 at 60 kV with 3 π.mm.mrad beams, ΔE ~1 eV

Beam preparation: PIPERADE (S. Grévy, CENBG)

Ph-D theses: A. de Roubin, MPIK , P. Dupré, CSNSM,, H. Guérin, CENBG – Post-Docs: P.Ascher, E. Minaya Ramirez, MPIK

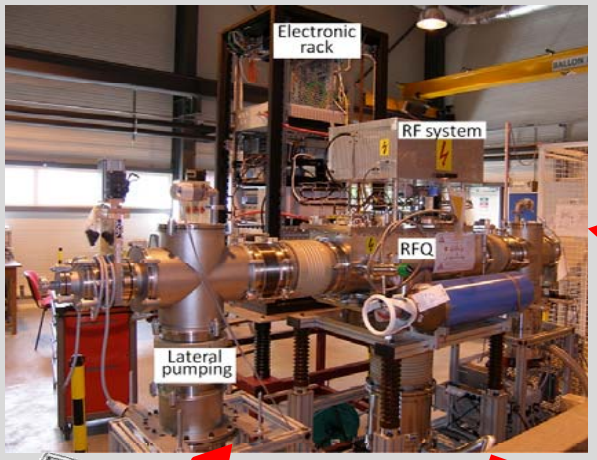
P. Ascher et al., EPJ Web of Conference 66 (2014) 11029, INPC 2013



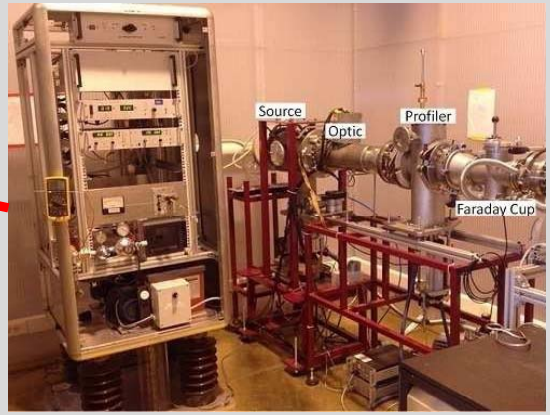
Beam preparation: PIPERADE (S. Grévy, CENBG)

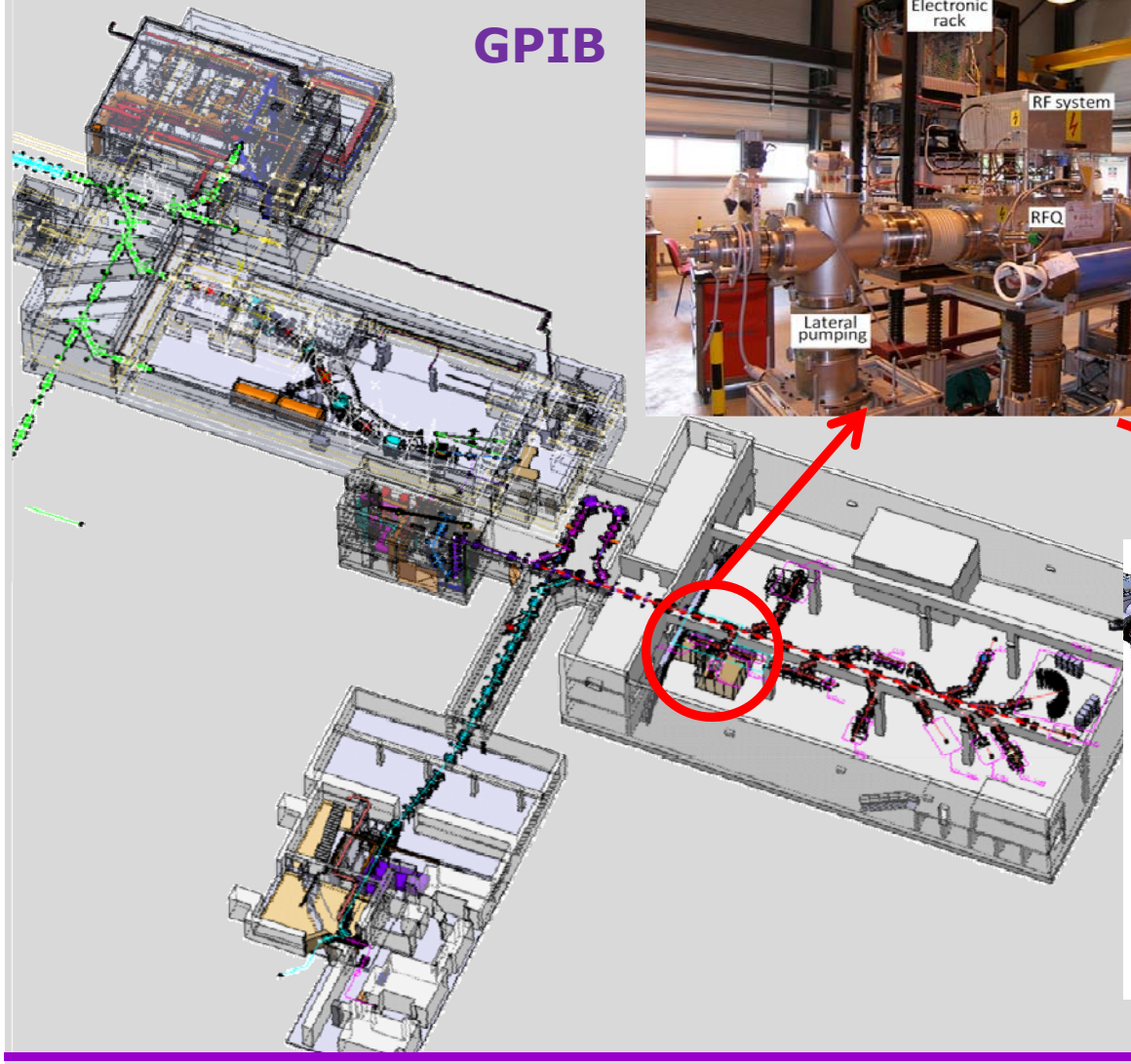
P. Ascher et al., EPJ Web of Conference 66 (2014) 11029, INPC 2013

GPIB

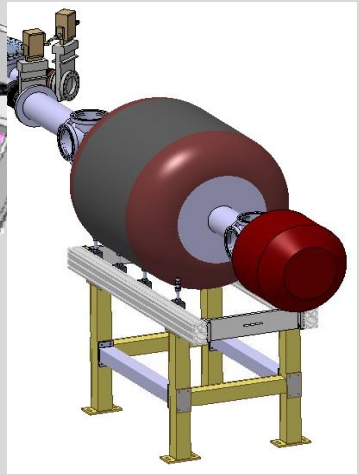


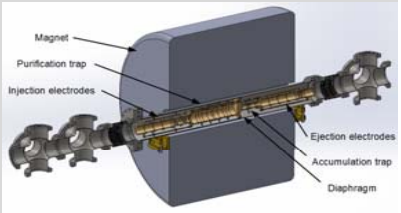
Stable ion source





Penning trap



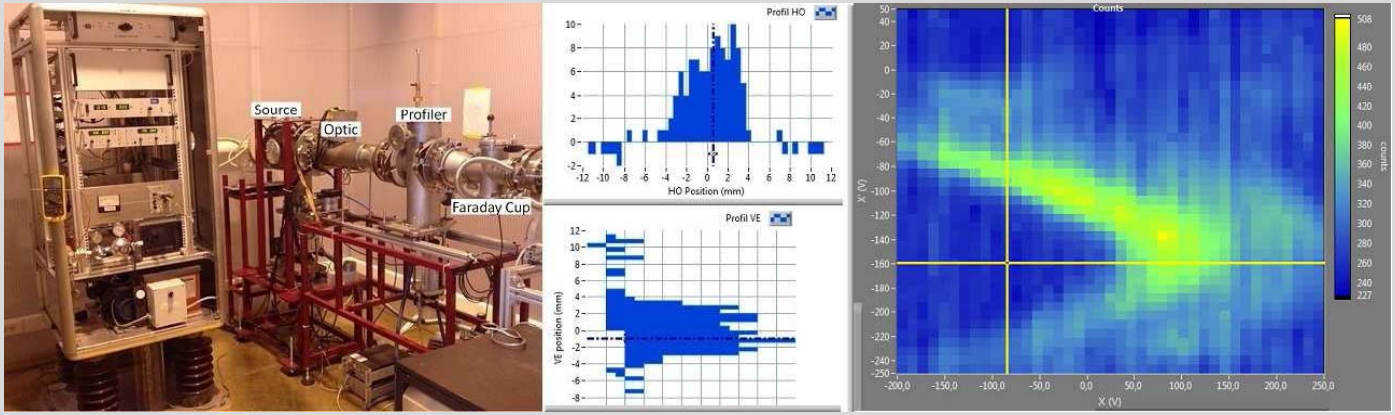


PIPERADE
Pieges de Penning pour les Radioisotopes x DESIR

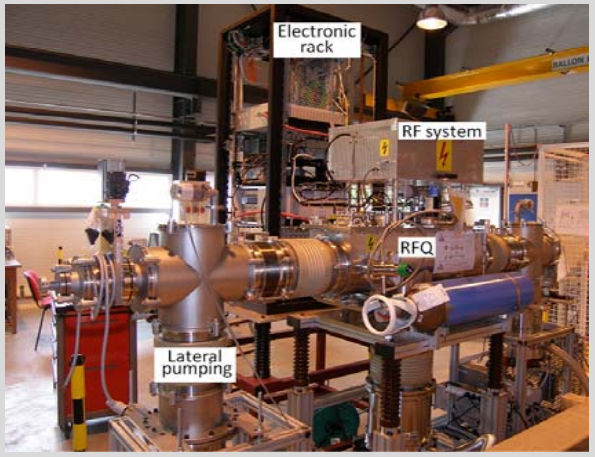
ANR

Beam preparation: PIPERADE (S. Grévy, CENBG)

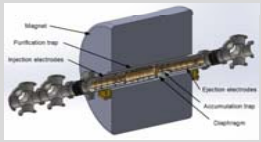
- **The stable ion source and associated optics**
  - ✓ in operation at CENBG



- **The GPIB**
  - ✓ to be coupled soon to the ion source
  - ✓ expected performances: 10^5-10^6 ions/bunch at 100 Hz, 1 π.mm.mrad

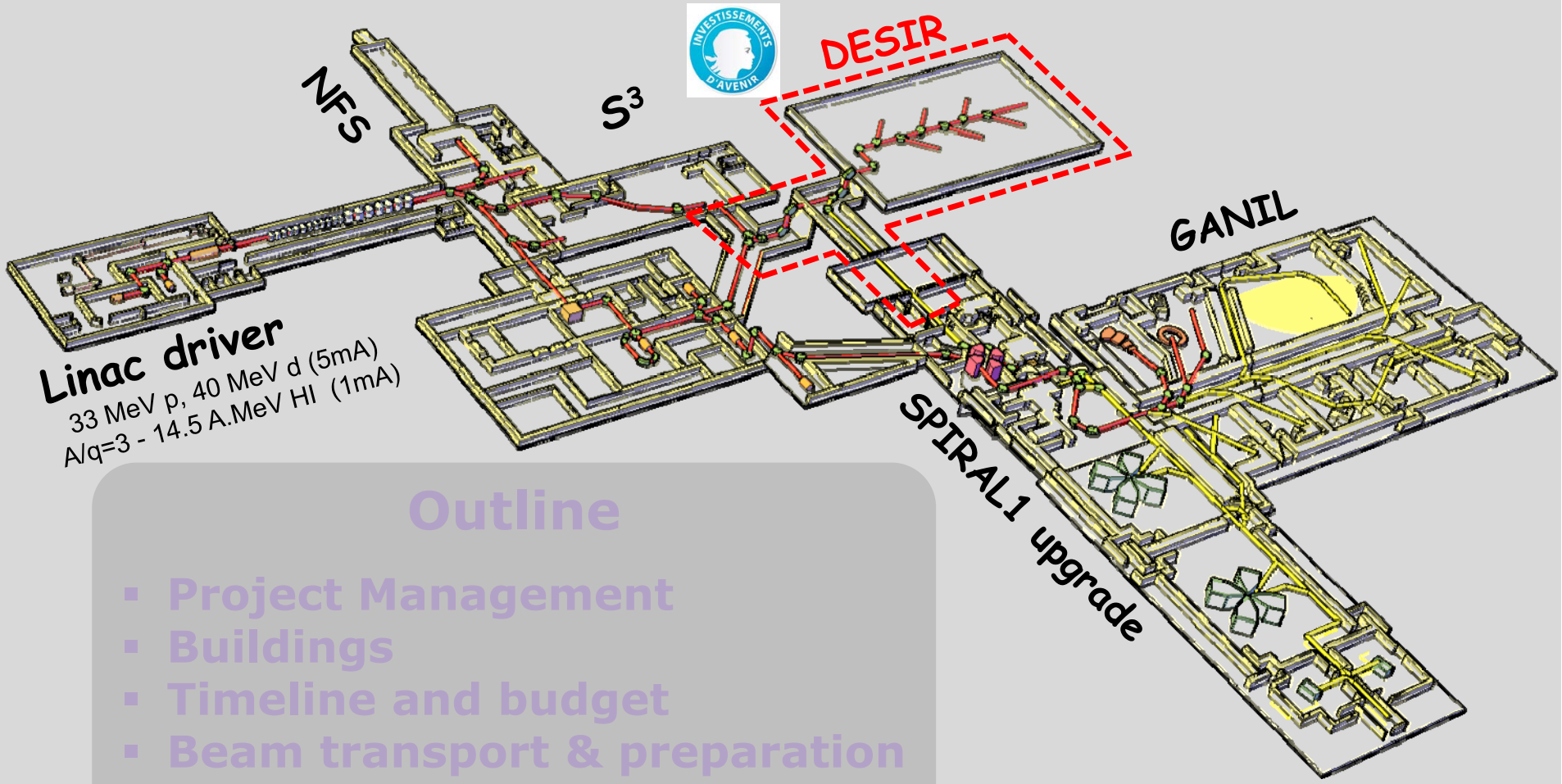


- **The double Penning trap**
  - ✓ simulations at CSNSM and MPIK
  - ✓ design ok; assembly at MPIK beginning of 2015
  - ✓ delivery at CENBG in 2016
  - ✓ expected performances: $M/\Delta M = 10^5$; > 10^4 - 10^5 ions/bunch, 2-20 Hz



Status of the DESIR project

http://www.cenbg.in2p3.fr/desir



Outline

- Project Management
- Buildings
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- **Scientific program**
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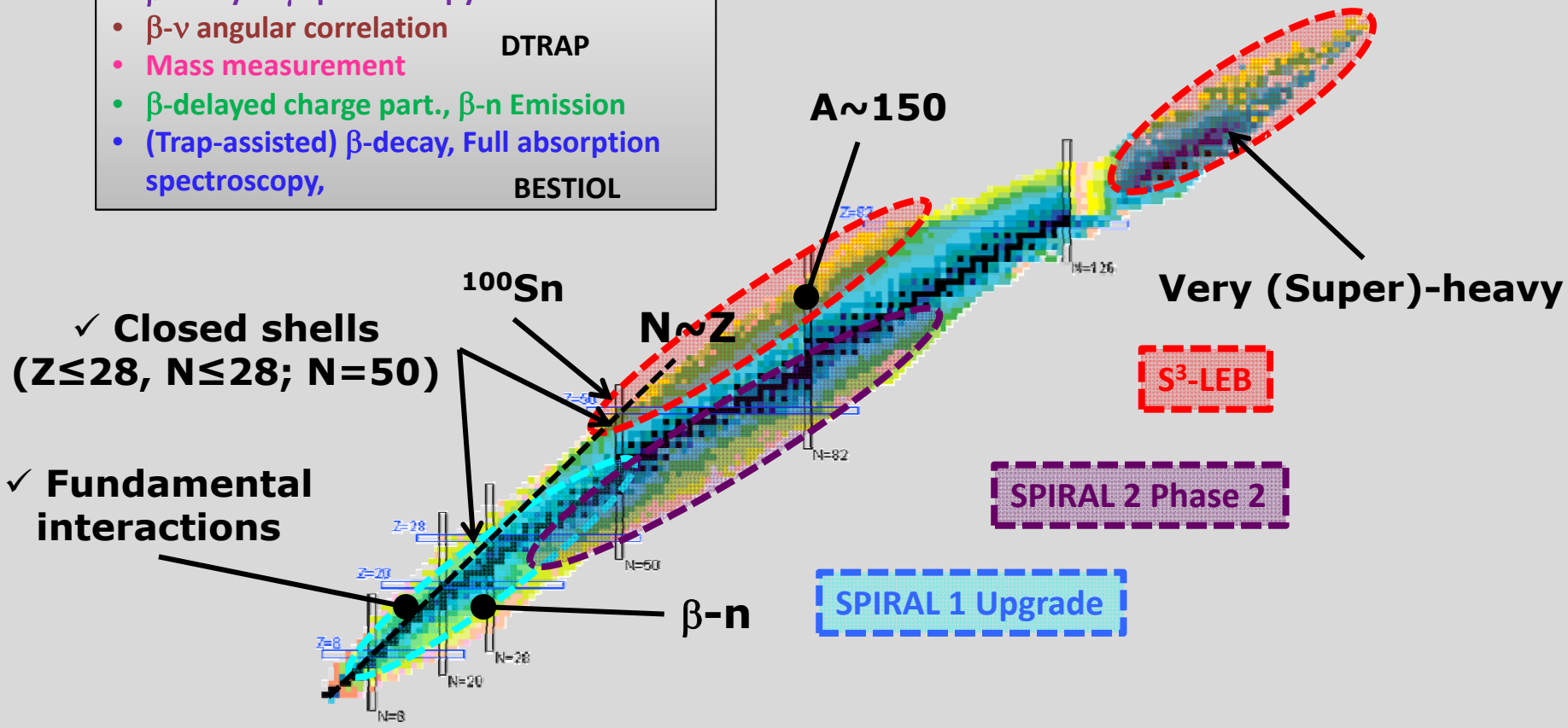
Update of the scientific program

http://www.cenbg.in2p3.fr/desir/-DESIR-S3-LEB-workshop-

➢ **18 letters of intent presented at the joint DESIR – S³-LEB workshop (GANIL, March 2014)**

- Collinear laser spectroscopy
- β-delayed γ spectroscopy — LUMIERE
- β-ν angular correlation — DTRAP
- Mass measurement
- β-delayed charge part., β-n Emission
- (Trap-assisted) β-decay, Full absorption spectroscopy, — BESTIOL



Status of the DESIR project

List of DESIR (updated) LoIs presented at the DESIR – S³-LEB workshop held at GANIL in March 2014

In-trap decay studies

1. E. Liénard *et al.*, LPC Caen, *"High precision measurement in mirror β decays to test the CVC hypothesis and the CKM unitarity"*
2. X. Fléchard *et al.*, LPC Caen, *"Search for exotic couplings using precision measurements of nuclear β decay"*
3. P. Delahaye *et al.*, GANIL, *"Test of the time reversal symmetry in the beta decay of ^{23}Mg and ^{39}Ca using an in-trap polarization method at DESIR"*
4. B. Blank *et al.*, CENBG, *"Search for scalar currents with β-delayed proton emitters"*
5. S. Grévy *et al.*, CENBG, *"In-trap decay spectroscopy to measure neutron energies"*

SPIRAL 1 Upgrade

Radioactive decay studies

6. T. Kurtukian Nieto *et al.*, CENBG, *"High precision measurements of half-lives and branching ratios in mirror β decay"*
7. H. Guérin *et al.*, CENBG, *"High precision studies of the super-allowed beta decay of T_z = 0, -1 and -2 nuclei"*
8. J. Giovinazzo *et al.*, CENBG, *"Study of the beta-delayed two-proton decay"*
9. A. Algora et al., IFIC Valencia, *"Beta strength measurements in the ^{100}Sn region"*
10. B. Blank *et al.*, CENBG, *"Search for cluster radioactivity in the region above ^{100}Sn"*

SP1-U

S³-LEB

Laser spectroscopy

11. T. Cocolios *et al.*, Univ. Manchester, *"From N=Z=28 to the proton drip line at LUMIERE"*
12. M. Bissell *et al.*, IKS Leuven, *"Collinear laser spectroscopy of neutron deficient isotopes of Ag and Sn across the N=50 shell closure"*
13. D. Yordanov *et al.*, IPN Orsay, *"Laser spectroscopy of very neutron deficient indium and cadmium isotopes"*

S³-LEB

Mass measurements

14. Ch. Weber *et al.*, LMU Munich, *"Mass Measurements with MLLTRAP at DESIR: Transfermium nuclides & super-allowed β emitters revisited"*
15. D. Lunney *et al.*, CSNSM Orsay, *"The mass of ^{100}Sn and the extraordinary binding of N = Z nuclides"*
16. M. MacCormick *et al.*, IPN Orsay, *"High-resolution mass measurements of odd-odd T=1 nuclides"*
17. D. Lunney *et al.*, CSNSM Orsay, *"Mass measurements for SPIRAL2 - phase 1+: mapping the proton drip line in the A=150 region"*
18. P. Ascher et al., MKPI Heidelberg, *"Mass measurement of light nuclei using an MR-TOF-MS or a Penning Trap @ DESIR"*

S³-LEB

SP1-U

- **8 LoI with upgraded SPIRAL1 beams and 10 with S³-LEB beams**

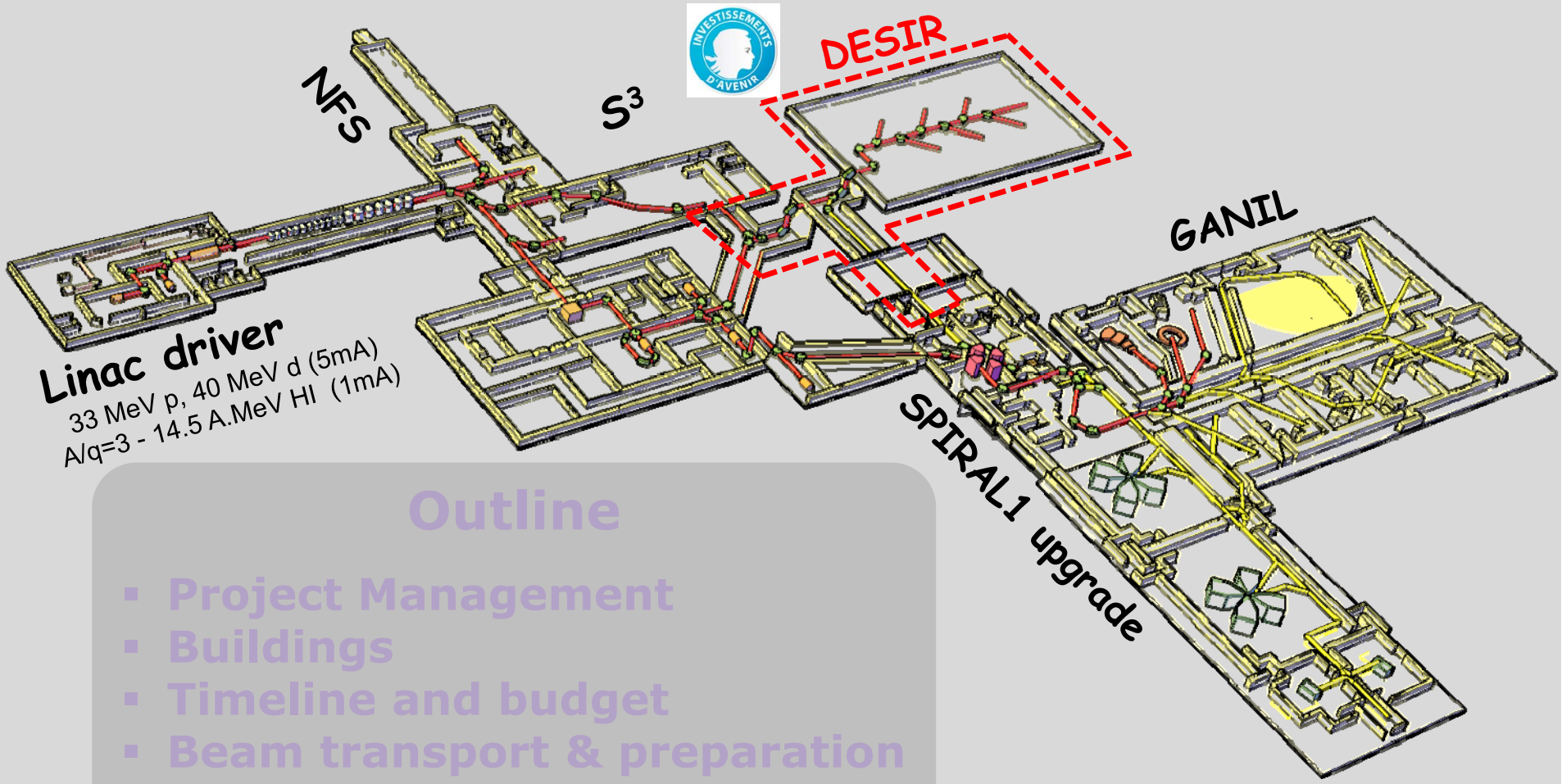
Update of the scientific program

http://www.cenbg.in2p3.fr/desir/-DESIR-S3-LEB-workshop-

- **Technical and scientific synergies with S³-LEB**
  - → **MR-ToF-MS technique**
  - → **90° 4-arms deflector**
  - → **Need for a "fast gas cell"**
  - → **laser light "sharing"**
  - → **Common region of interest: ^{100}Sn**
  - → **Complementary laser spectroscopy studies ("in-source" viz. "collinear")**
  - → **Complementary mass measurements (precision, intensity, purity)**

Status of the DESIR project

http://www.cenbg.in2p3.fr/desir



Outline

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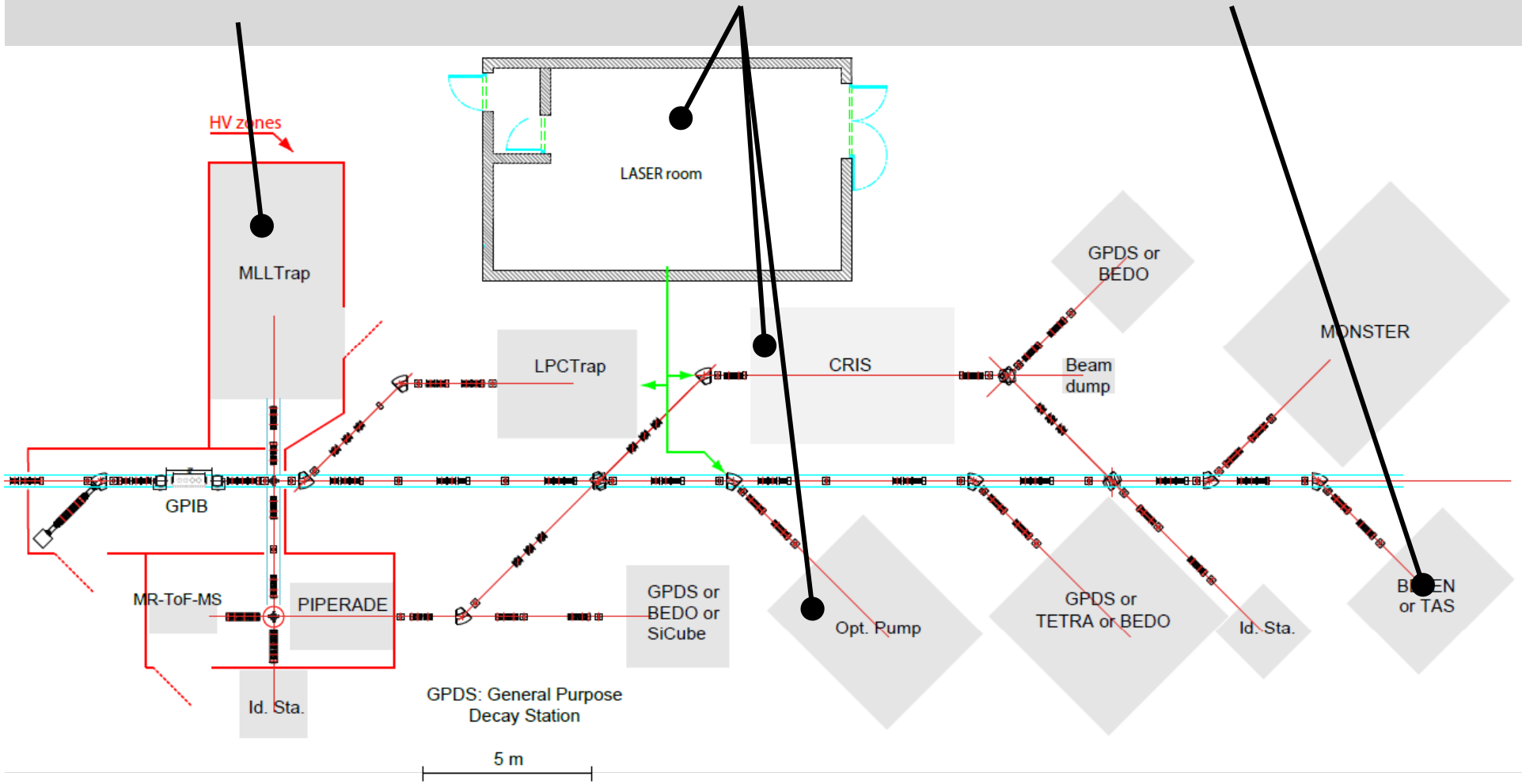
Status of the DESIR project

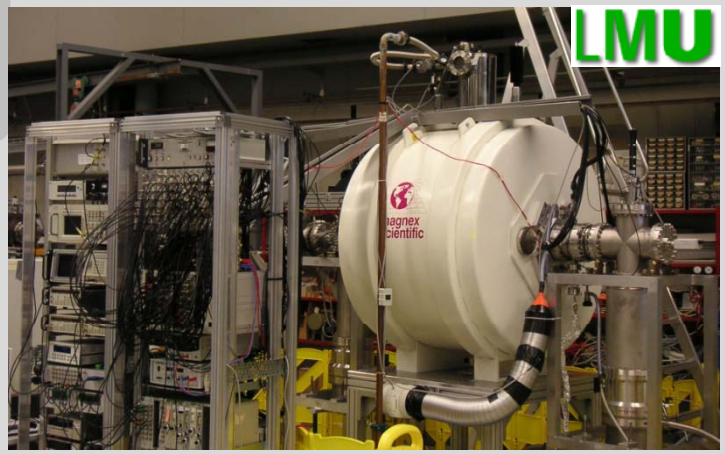
- **MLLTrap**
- **LUMIERE**
- **DTAS**



Status of the DESIR project

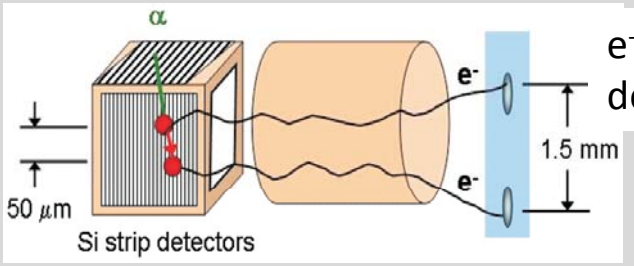
MLLTrap (P.Thirolf, Ch. Weber, LMU)

Ch. Weber et al., Int. J. Mass Spectrom. 349 - 350, 270 (2013)
Ch. Weber et al., Nucl. Instr. Meth. B 317, 532 (2013)



- **Implementation of an α Si strip detector and an e- pixel detector to perform in-trap decay spectroscopy of very-heavy isotopes**

- **α detection:**
  - **characterization of the magnetic field/T° effects**
  - **➔ ΔE correction required**
  - **➔ precision of the position reconstruction?**



e⁻ pixel detector

- **e- detection:**
  - **aim: $T_{1/2}$ of excited states populated in α decay (~100 ps)**
  - **➔separation of the e- originating from the α decaying ion (shake-off) AND from the recoiling ion (Auger e- following conversion e- emission)**
  - **➔response function investigated with a dedicated low-energy e- gun (0-10 keV)**

- **Operation of MLLTrap at ALTO: from mid-2016 to 2019?**
  - **dedicated beam line + RFQ-CB to be built**

Status of the DESIR project

LUMIERE (IKS Leuven, IPN Orsay, Univ. Manchester, IPHC)

- **"CRIS" line: collinear spectroscopy by resonant laser ionization**
  - improvement of the total efficiency (~1%) and selectivity (10^6)
  - laser specifications from laser-ion interaction simulations and online tests with a stable ^{39}K beam
  - possibility to transport the laser light from S^3-LEB under investigation

T.Cocolios, Univ. Manchester

- **"LINO": Laser-Induced Nuclear Orientation at ALTO**
  - β-delayed spectroscopy with polarized beam + conventional β-NMR and fluorescence detection techniques

  ➔Nuclear spins of the populated nuclear states in addition to the ground state moments and spin of the decaying nucleus

  D. Yordanov, IPNO
  - n-rich Ag isotopes to be studied at ALTO before the setup moves to DESIR

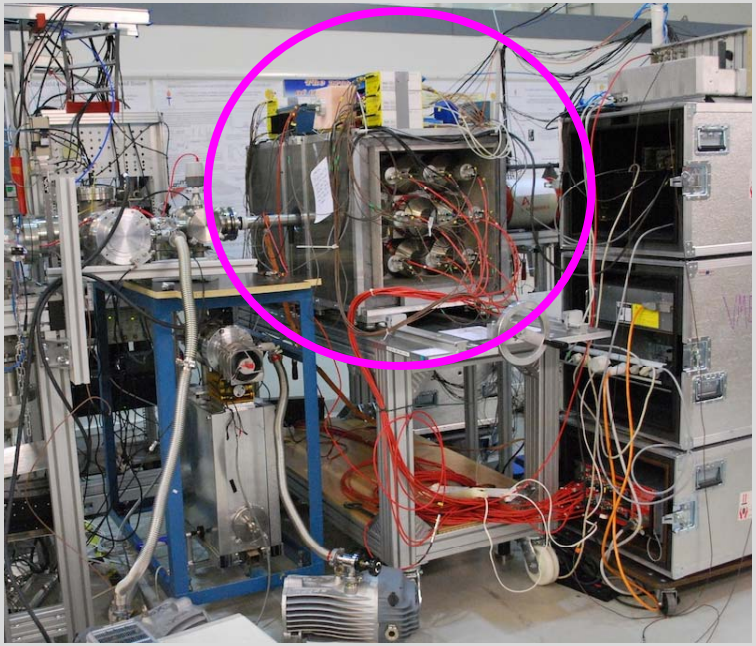
- **"ConeTraps": laser spectroscopy of cold ions (trapping at 1 keV)**
  - novel project following an ongoing development at JYFL (exp. In 2015)

P.Campbell, Univ. Manchester

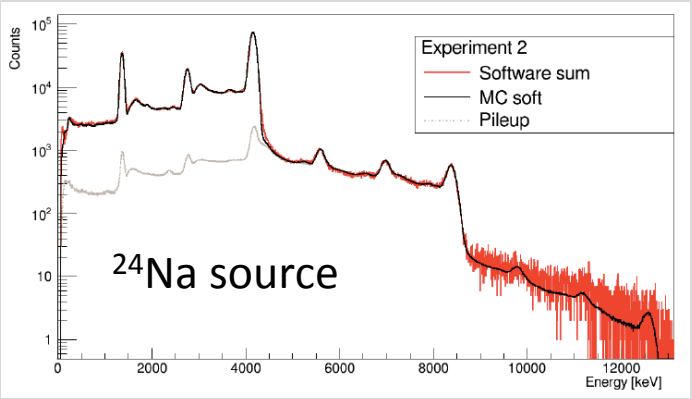
Status of the DESIR project

DTAS (J.L. Tain, IFIC Valencia)

- 18 15x15x25 cm NaI(Tl) crystals to perform full absorption spectroscopy experiments with pure beams
- 2014 run in combination with the JYFL trap:
  - double beta decay
  - reactor decay heat
  - reactor antineutrino spectrum



DTAS@IGISOL-JYFLTRAP



- Online tests of a digital electronics
- Offline response function studies (^{24}Na)

  ➔Full characterization of the spectrometer + Geant4 simulations benchmarking

Conclusions

- **Optimistic scenario: building delivery by the mid-2018**
  commissioning at the beginning of 2019

➔ **Alright with respect to:**
- **the availability of SPIRAL 1 and S³-LEB beams**
- **the construction of the beam lines and beam preparation devices**
- **the development of the experimental equipment**

- **Scientific strategy:**
  - **operation of the setups at other facilities (science + training)**
  - **synergies with S³ (scientific program, lasers, MR-ToF-MS, beam line equipments, …)**
- **Issues:**
  - **building architecture (pillars)**
  - **building construction viz. S³ operation**
  - **funding (~14 M€ missing)**

Thank you for your attention!

…. And to the contributors to this report:
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