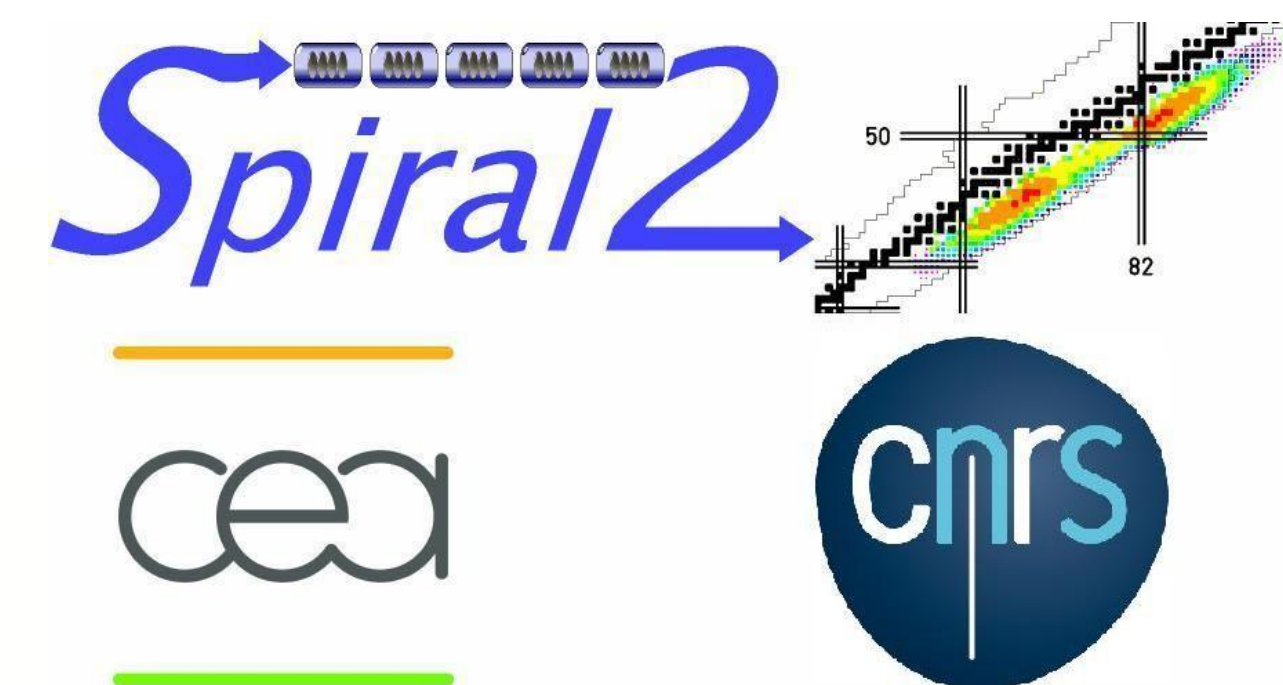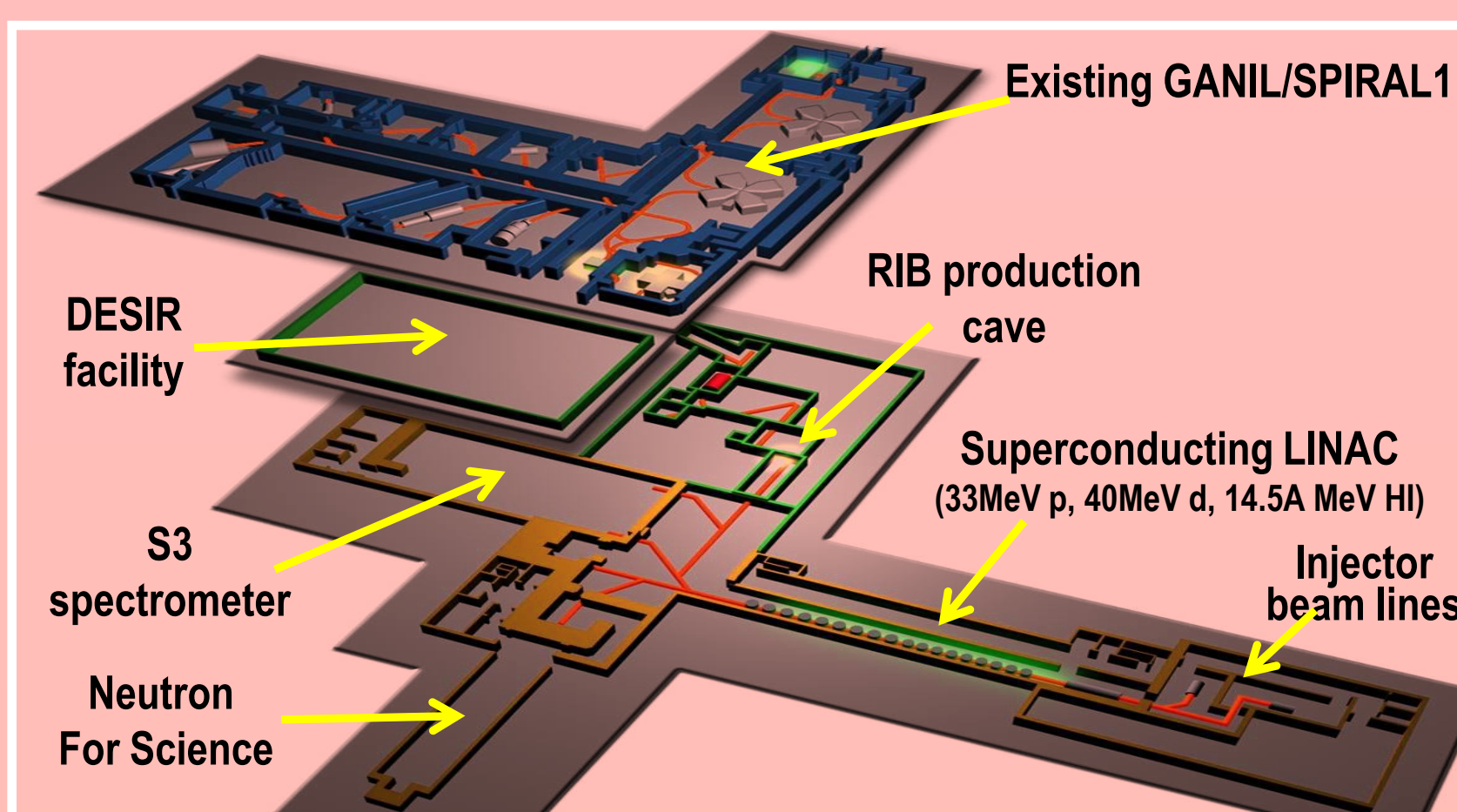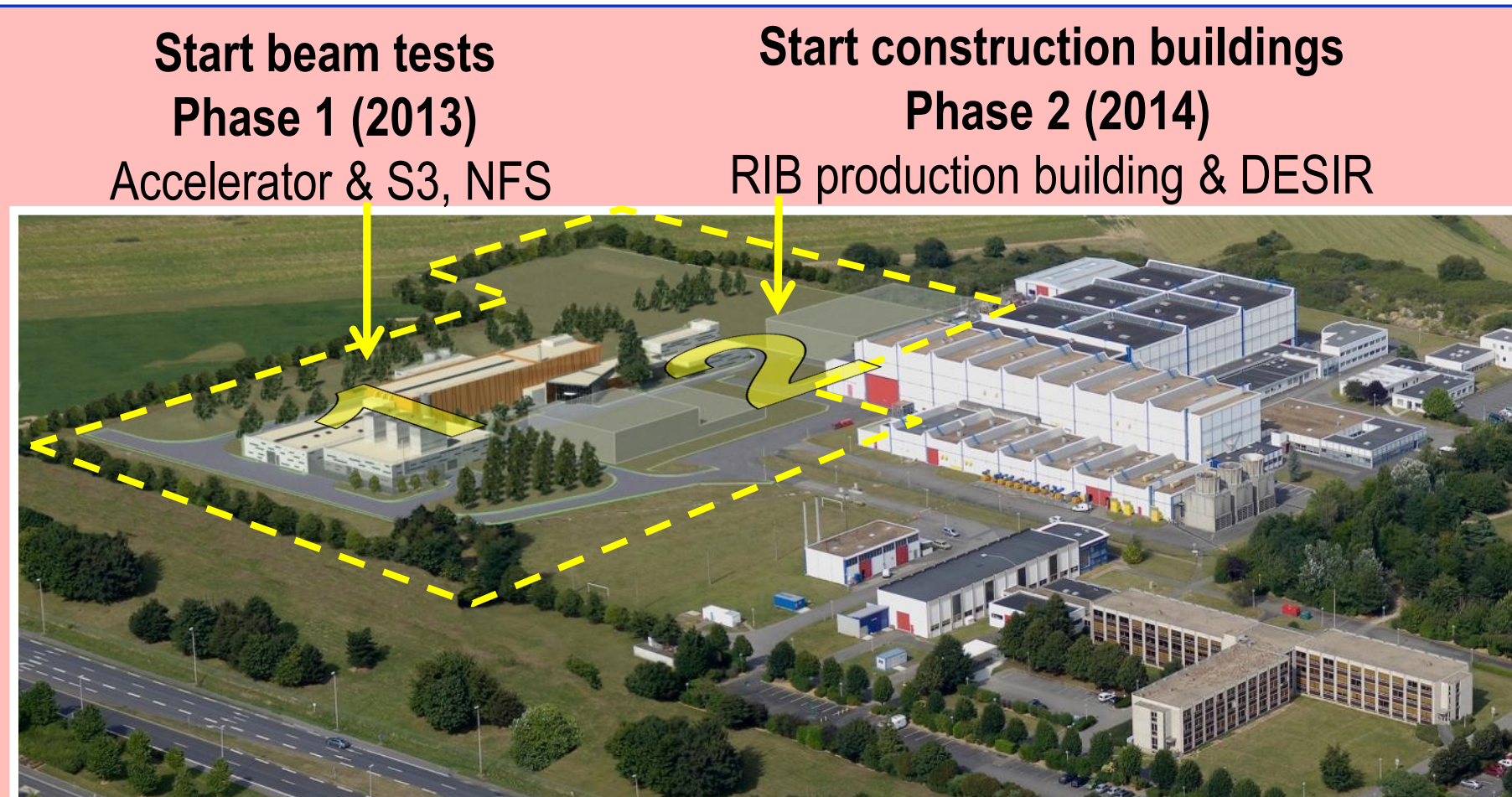# Overview on the Preliminary Geodetic Network for SPIRAL2 Process Installation at GANIL

Rémy BEUNARD, Alexis LEFEVRE, François LEGRUEL, Arnaud LEWANDOWSKI
GANIL, B.P. 55027, 14076 CAEN, CEDEX 5, France
Alignment / Instrumentation Group / Techniques of Physic Department

Overview

Start beam tests
Phase 1 (2013)
Accelerator & S3, NFS

Start construction buildings
Phase 2 (2014)
RIB production building & DESIR

FERMILAB   GANIL

Existing GANIL/SPIRAL1
RIB production cave
DESIR facility
Superconducting LINAC (33MeV p, 40MeV d, 14.5A MeV HI)
S3 spectrometer
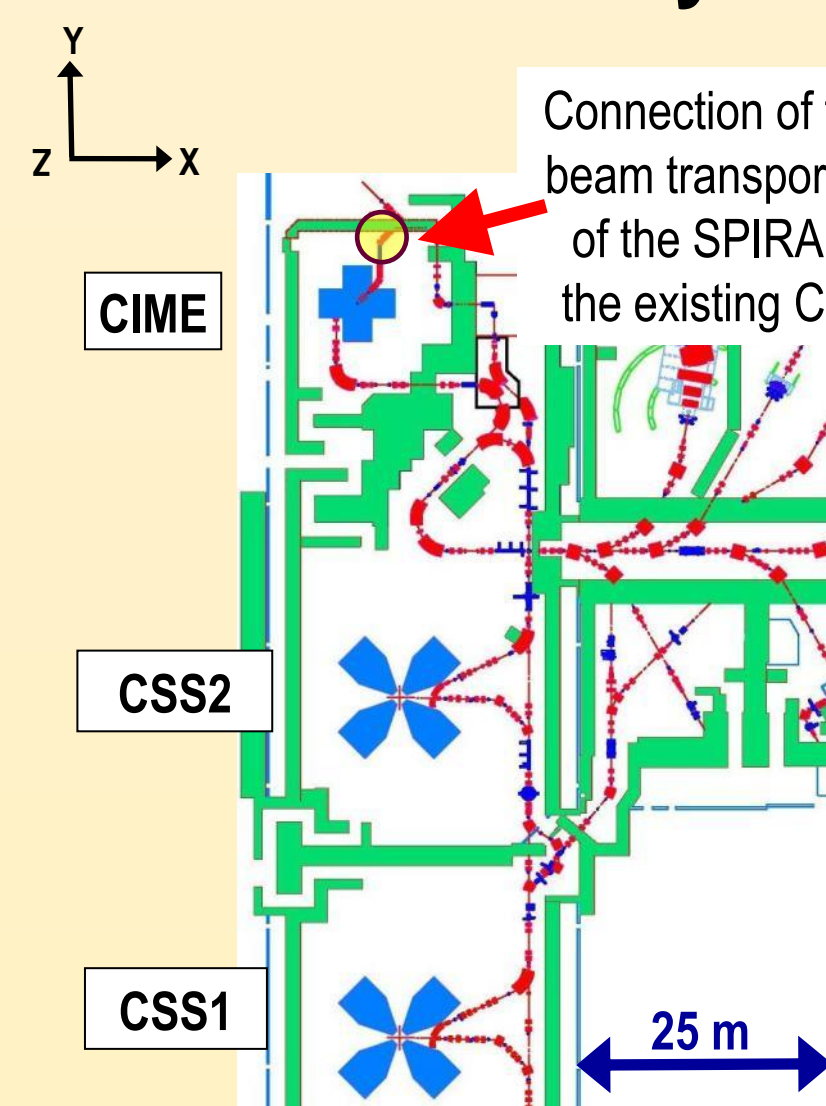Injector beam lines
Neutron For Science

This poster covers mainly the preliminary geodetic network for the SPIRAL2 process installation. The positioning of the process and by extension of the buildings is subject to an important constraint due to future connections of the radioactive beam lines to the existing accelerator complex.
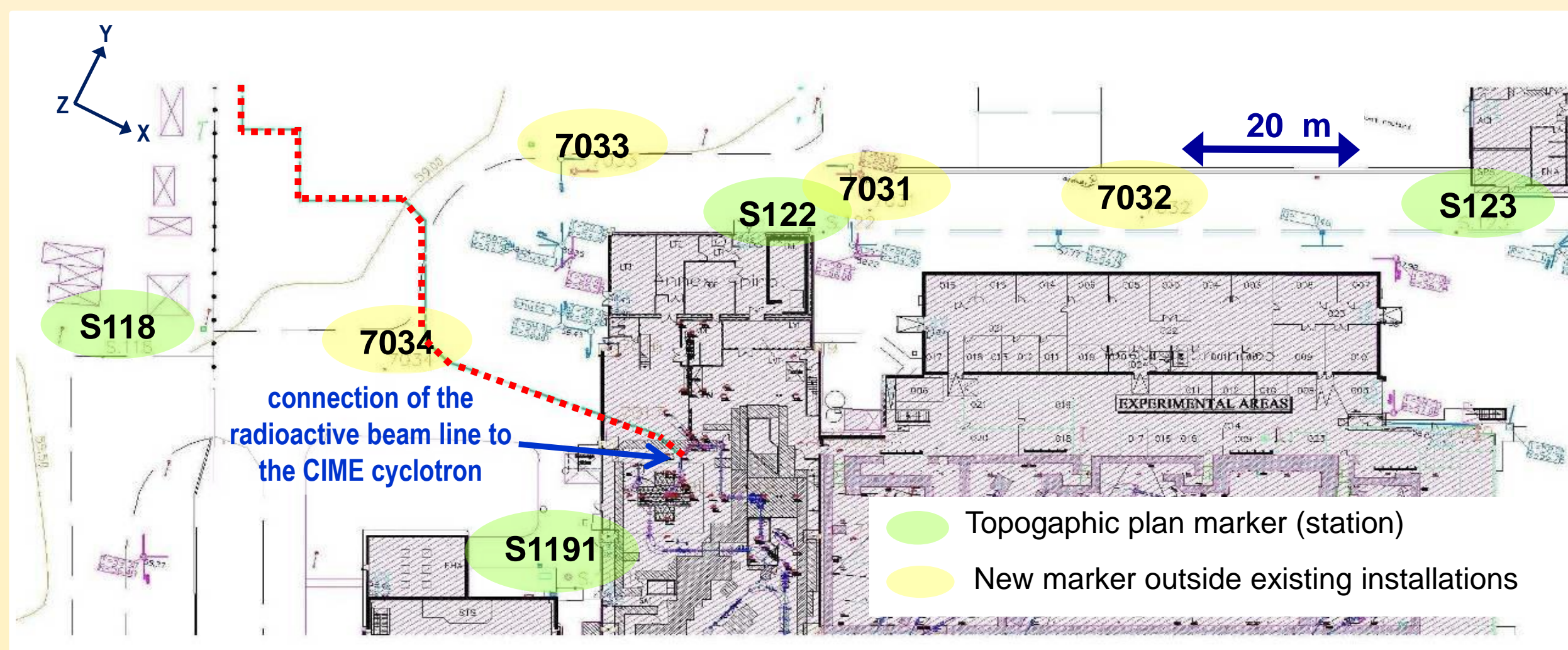
To reach the required accelerator performances, a geodetic surface network made up of concrete monuments around the construction is linked to the local network of the existing accelerator. The surface network has been transferred to the slab of the accelerator tunnel at -2 level (-9.50 m) in order to define the underground reference network for the process setup.

The geodetic systems

The local system

CIME
CSS2
CSS1
25 m

Connection of the radioactive beam transport line (Phase 2 of the SPIRAL2 project) to the existing CIME cyclotron
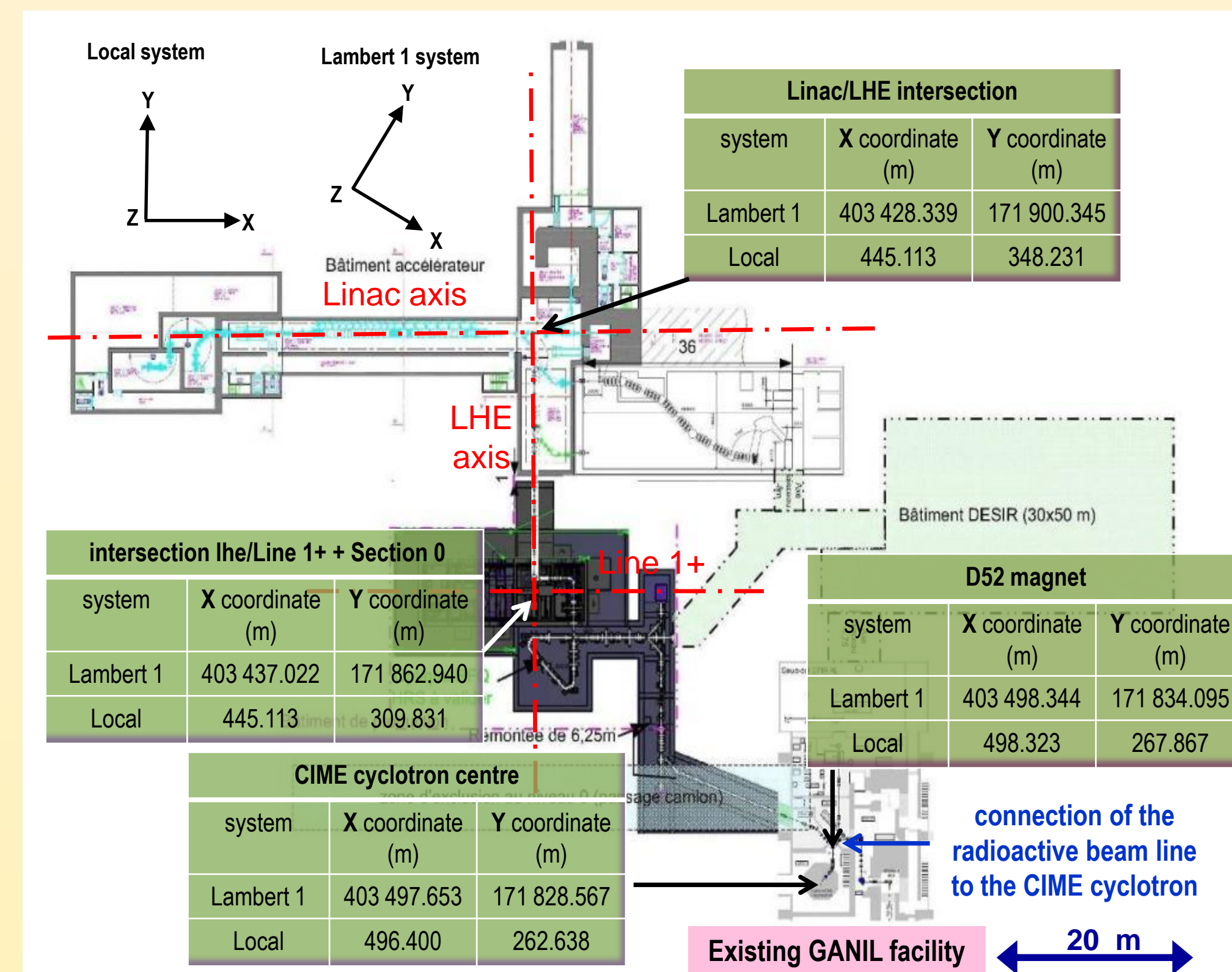
The GANIL local system is a Cartesian coordinate system defined by the centres of the two cyclotrons; CSS1 and CSS2. These centres are represented by plates on the concrete foundations supporting the cyclotrons at level -1 of the accelerator building.

The national geodetic systems

20 m

7033   7031   7032   S123
S122
S118   7034
S1191

connection of the radioactive beam line to the CIME cyclotron

EXPERIMENTAL AREAS

Topographic plan marker (station)
New marker outside existing installations

Connection of the local geodetic system to the national system around the GANIL facility

The general topographic plan of the site is expressed in the French national geodetic systems, whose characteristics are as follows:
1) in planimetry – Lambert 1 conical projection system, 2) in altimetry – NGF IGN69 system
The work plans of the SPIRAL2 project (work site, earthworks, facilities) were produced on the basis of the topographic plan. Consequently, these plans are expressed in the Lambert 1 and IGN69 systems. The GANIL local system therefore had to be "connected" to the national system, so we know the relation between the two systems. (observations have been measured between local system points and national system points).

Cartesian coordinates in the two systems of the process fundamental points

Local system   Lambert 1 system
Bâtiment accélérateur
Linac axis
LHE axis
Line 1+
Bâtiment DESIR (30x50 m)

Linac/LHE intersection		
system	X coordinate (m)	Y coordinate (m)
Lambert 1	403 428.339	171 900.345
Local	445.113	348.231

intersection lhe/Line 1+ + Section 0		
system	X coordinate (m)	Y coordinate (m)
Lambert 1	403 437.022	171 862.940
Local	445.113	309.831

D52 magnet		
system	X coordinate (m)	Y coordinate (m)
Lambert 1	403 498.344	171 834.095
Local	498.323	267.867

CIME cyclotron centre		
system	X coordinate (m)	Y coordinate (m)
Lambert 1	403 497.653	171 828.567
Local	496.400	262.638

connection of the radioactive beam line to the CIME cyclotron

Existing GANIL facility   20 m

Surface geodetic network

Geodetic pillars

Pillar under construction
Pillar no 4
Measurement of the geodetic network

The geodetic network was indicated by six cylindrical concrete pillars of height above ground 1.20 m and diameter 0.30 m. A cylindrical plate equipped with a Leica type socket mounted offset is sealed on the top end of the pillar. The pillars had to be anchored on a more geologically stable bed and isolated from the future infrastructures and their excavations.

Measurement of the "surface" geodetic network

The network was measured by tacheometric measurements using a TDA5005 tacheometer. A total of 300 observations were made. The standard deviations are calculated relative to the sigma a priori (equal to 1). The calculations gave the following distribution for both the distances reduced to the XY plane and horizontal angles:
• mean residue: 0.12 mm for a 95 % confidence interval (-0.09, +0.09)
• standard deviation: 0.38 mm for a 95 % confidence interval (0.33, 0.46)
• mean residue: 0.0 CC for a 95 % confidence interval (-0.8, +0.8)
• standard deviation: 3.4 CC for a 95 % confidence interval (2.9, 4.1)
The network was analysed with CERN software LGC and the following parameters:
• sigma a posteriori = 1.0
• significance level, for testing wi, alpha = 1.0 % or expressed as confidence level, (1-alpha) = 99.0%
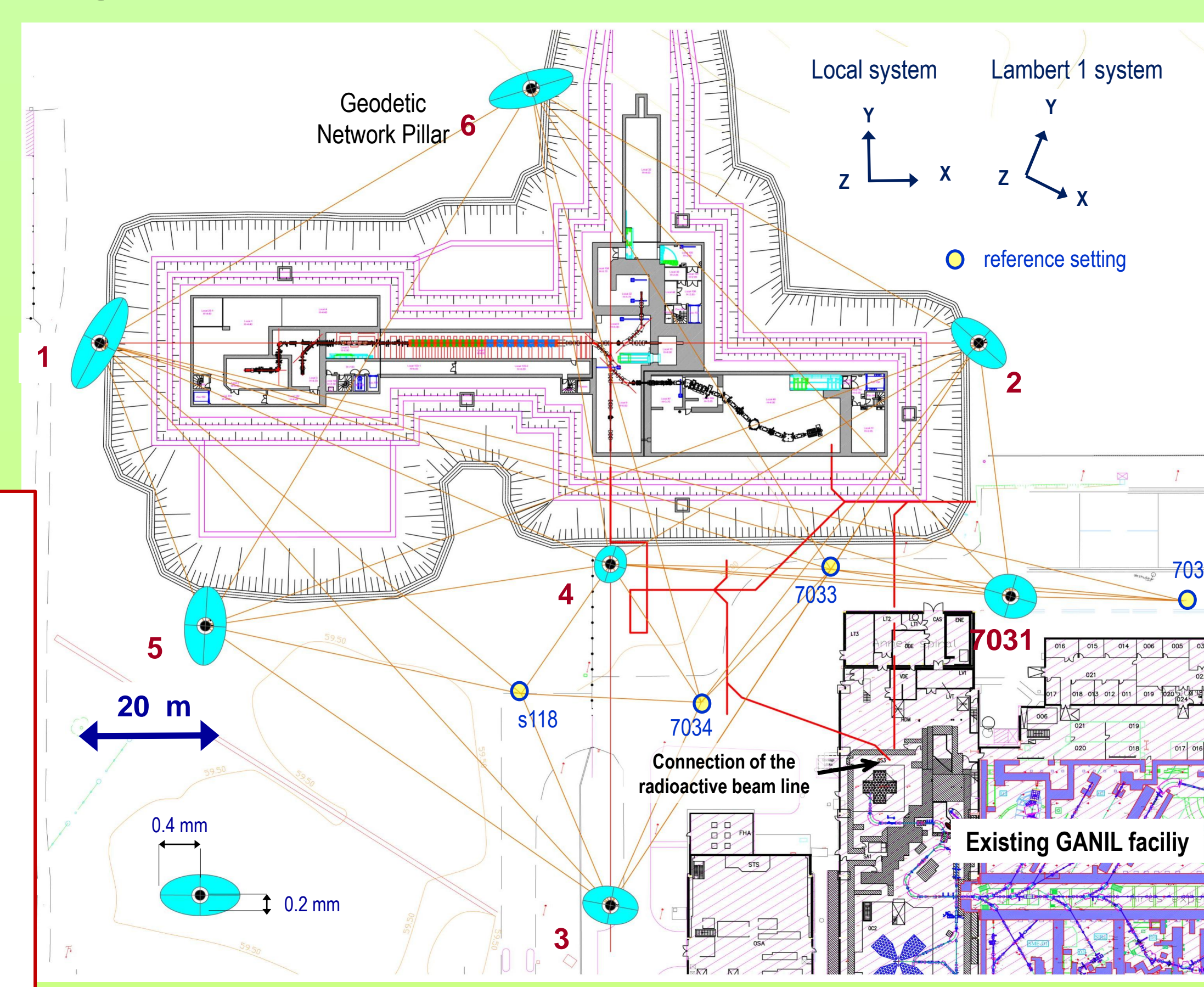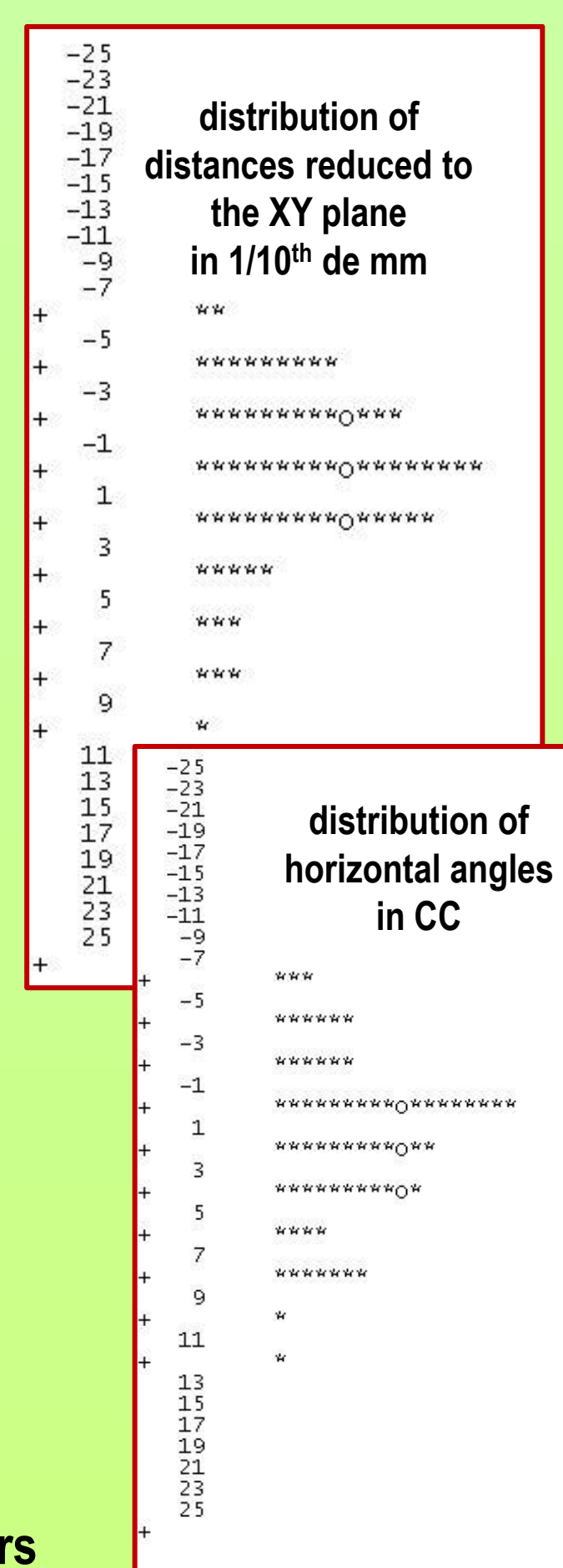• power of test, to determine nabla and delty, (1-Beta)=90.0%
The overall network reliability factor is equal to 0.2195

distribution of distances reduced to the XY plane in 1/10th de mm

distribution of horizontal angles in CC

Pilier n°	X (m)	Y (m)	Z (m)	SX (mm)	SY (mm)	DX (mm)	DY (mm)
1	37.79855	348.23640	0.0	0.27	0.44	0.19	0.18
2	515.26920	348.23325	0.0	0.26	0.25	0.22	0.04
3	445.11160	239.83972	0.0	0.26	0.19	-0.09	-0.17
4	445.10967	305.60347	0.0		0.18	0.08	0.06
5	367.93259	293.69425	0.0		0.8	-0.07	0.13
6	430.00353	397.29607	0.0	0.40	0.20	0.29	0.17
7031	521.33469	299.41569	0.0	0.21	0.25	0.88	0.15

Standard errors (1σ)

Result of the calculation in Cartesian coordinates of the geodetic pillars

Geodetic Network Pillar
Local system   Lambert 1 system
reference setting
7032   7033   7031   s118   7034
Connection of the radioactive beam line
Existing GANIL facility
20 m   0.4 mm   0.2 mm
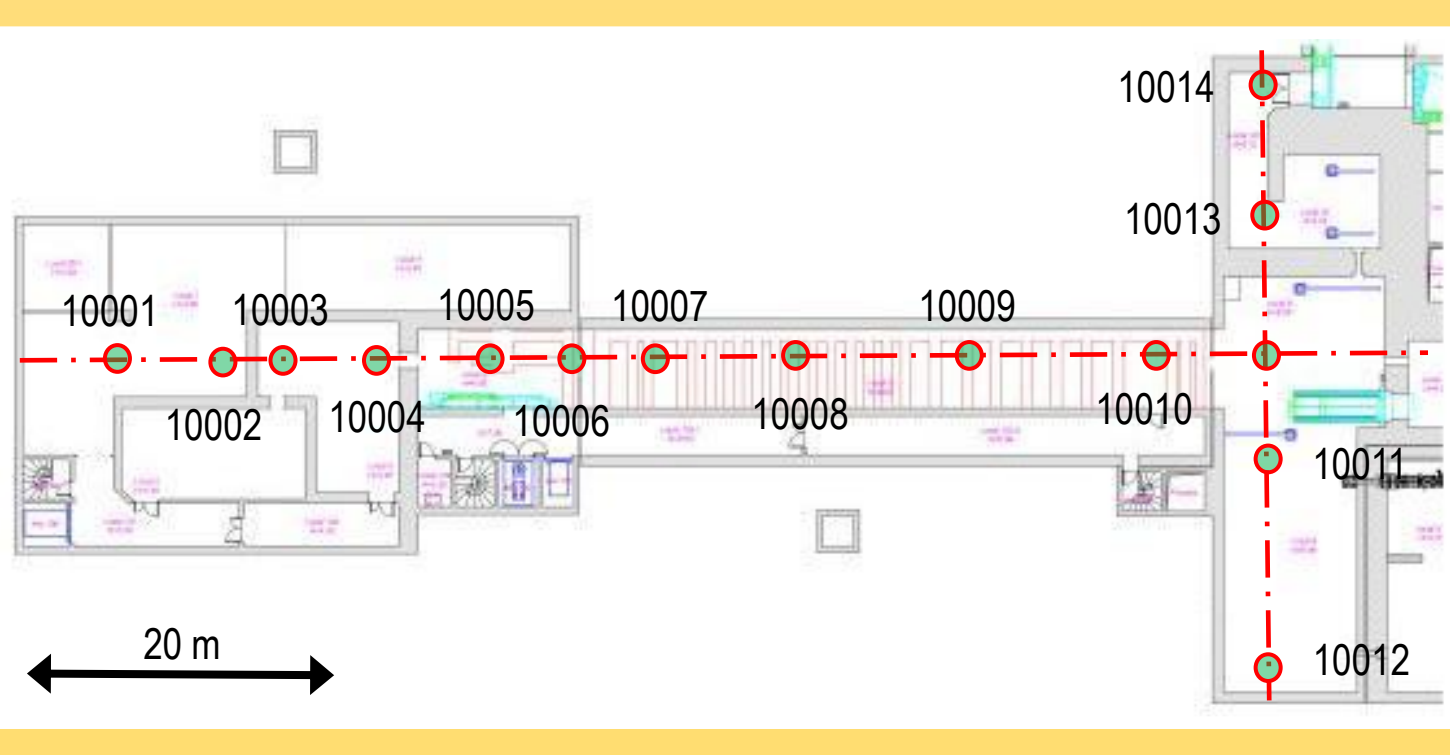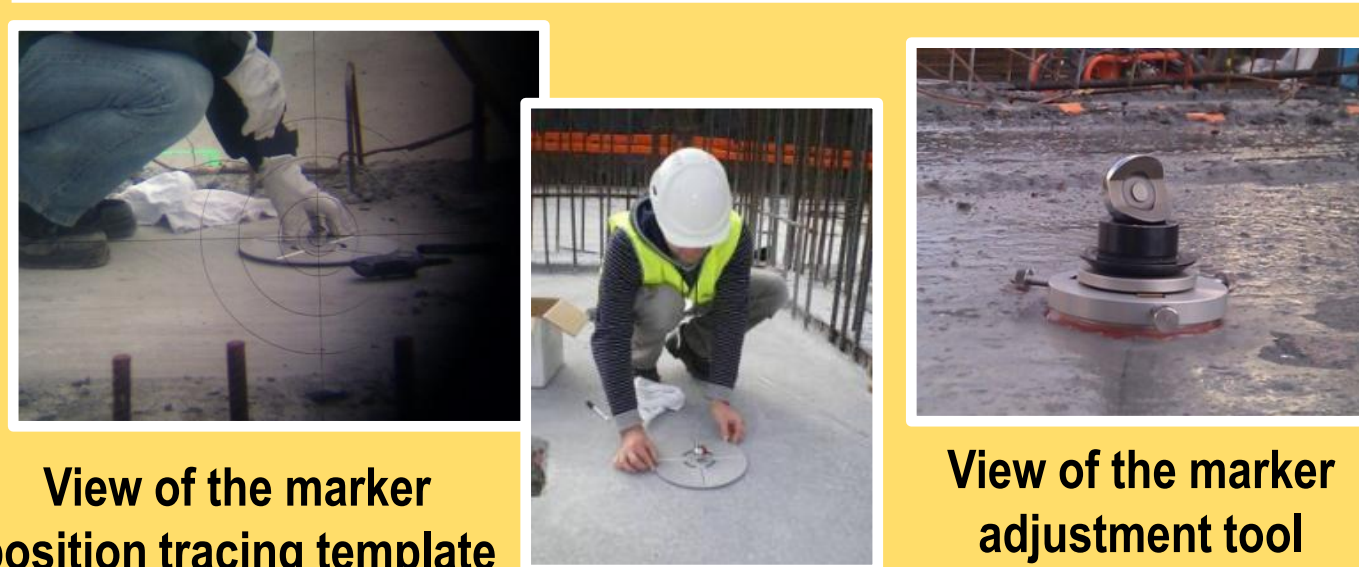
Surface geodetic network and the absolute error ellipses at June, 2011

Installation of the room and process topometric network at level -9.50 m of the accelerator building

Transfer from the surface geodetic network to level -9.50 m

sketch
Linac axis
Pillar n°1   Block limit ACC 1/2 -2/2   Intersection Linac/LHE   Pillar n°2
Lev. 0.0m
Surveying shot   Surveying shot
Slab Lev. -9.50 m   Slope
Markers sealed in the slab
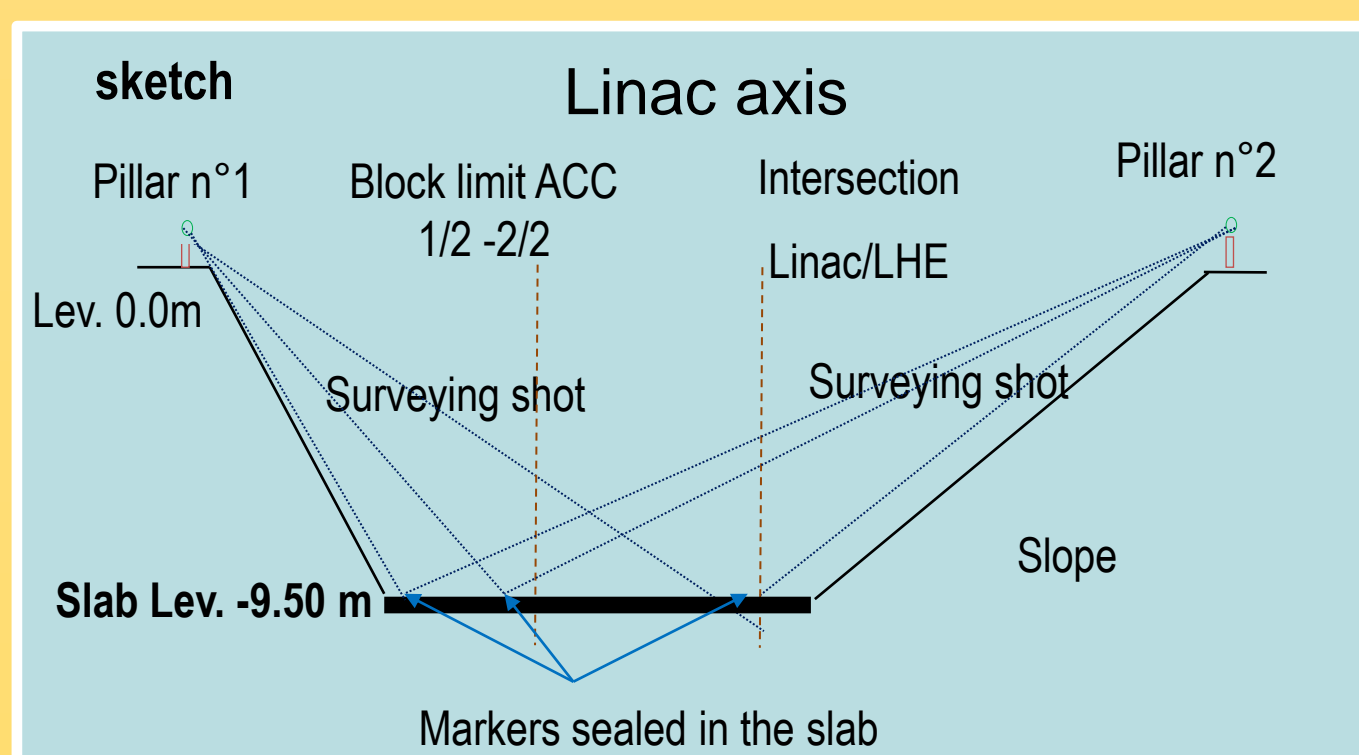
The axes of the beam lines (Linac and LHE) were indicated on the concrete slab at level -9.50 m from pillars 1 to 4 of the surface geodetic network. This operation was carried out before the concrete slabs of the higher levels were cast.

View of the marker position tracing template
View of the marker adjustment tool

10014
10013
10001 10003 10005 10007 10009
10002 10004 10006 10008 10010
10011
10012
20 m

View of the points transferred onto the slab at level -9.50 m
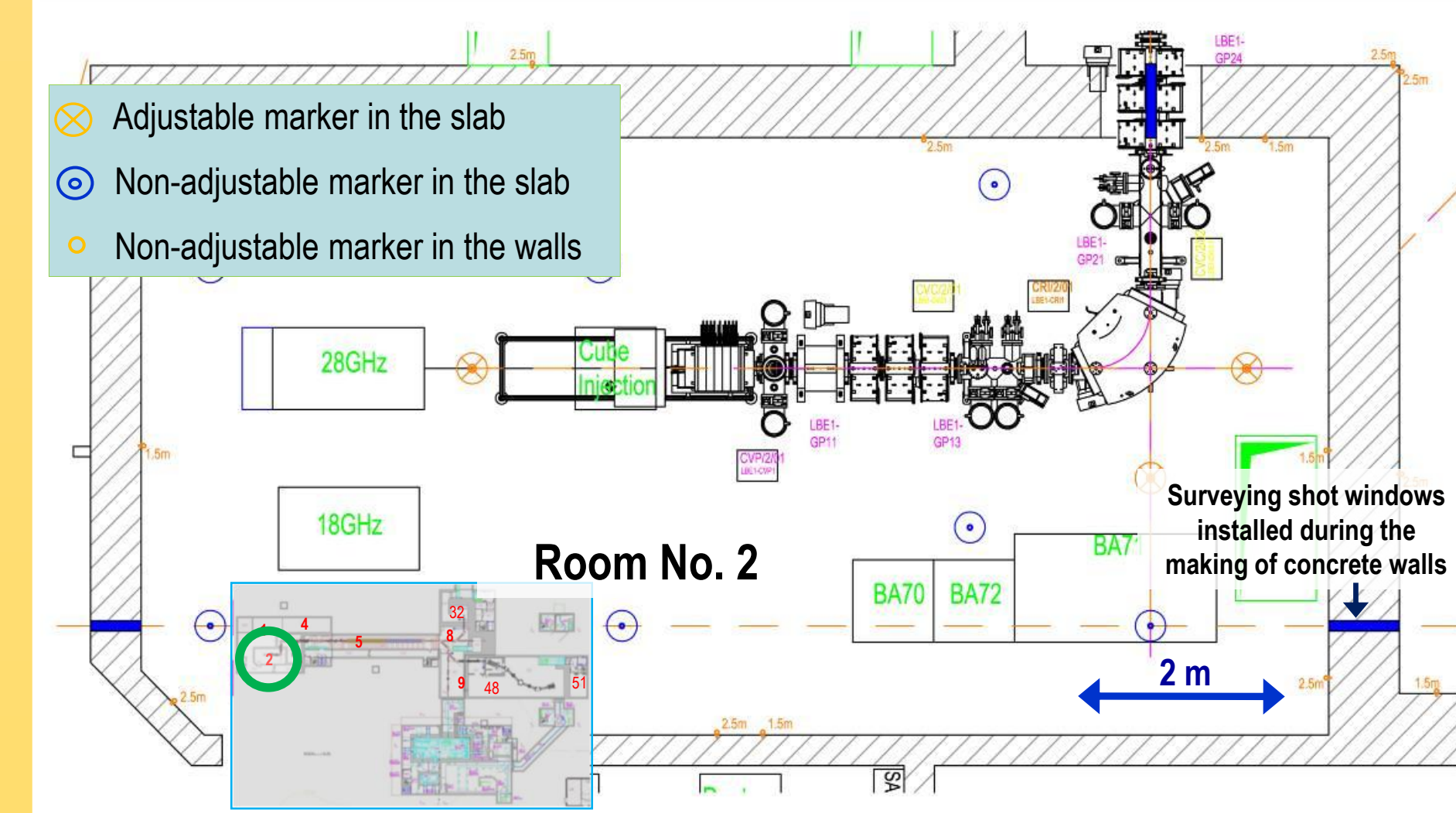**Base of the building and process topometric network**

The ground markers transferred onto the slab at level -9.50 m indicate the Linac and high-energy line (LHE) axes. They have become the absolute reference for setting up the room and process topometric network.
The axes are indicated by adjustable markers sealed in the slab at predefined positions. These markers form the framework of the process topometric network. Their Cartesian coordinates were determined using the geodetic pillars of the surface network.

View of ground and wall markers

Adjustable marker XY, Ø 76 mm
Source: GANIL

Marker adjustment tool
Source: GANIL

Non-adjustable marker Ø 50 mm
Source: HUBBS

Wall marker, Ø 19 mm
Source: BRUNSON

Coring/drilling operations

Topometric network of room No. 2

Adjustable marker in the slab
Non-adjustable marker in the slab
Non-adjustable marker in the walls

28GHz
18GHz
Room No. 2

Surveying shot windows installed during the making of concrete walls

2 m

The room and process topometric network started in July.
Measurement of the topometric network is made more complicated by the walls between the various rooms. Surveying shot windows were planned between the rooms during the building programming studies.
The network measurements will be carried out using the laser tracker AT401 acquired very recently. The network will be calculated using Spatial Analyser software.

12th International Workshop on Accelerator Alignment (IWAA 2012)
September 10-14, 2012 – Fermilab, Batavia, Illinois

IWAA 2012