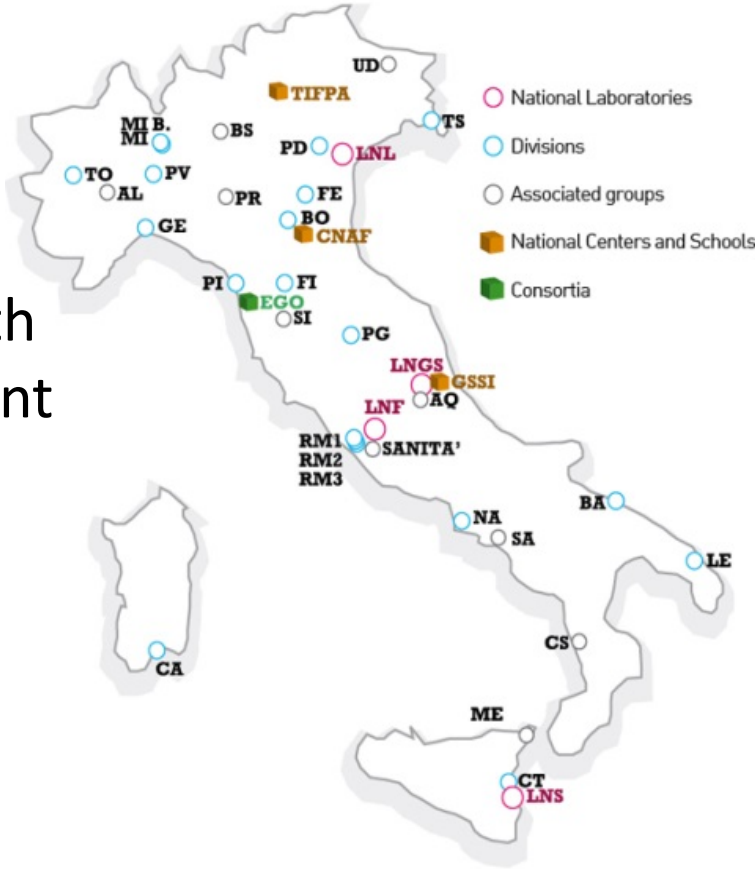
Welcome at Legnaro National Lab of INFN

Gianni Fiorentini
LNL Director

What is INFN ?

- INFN is the Italian research agency dedicated to the study of the fundamental constituents of matter and the laws that govern them, **together** with the technological developments pertinent to these areas.
- It operates in strong symbiosis with the Italian university system, being present with its **Departments** (Sezioni) in 20 universities, in an international environment.
- It provides and manages large research infrastructures at **4 National laboratories**

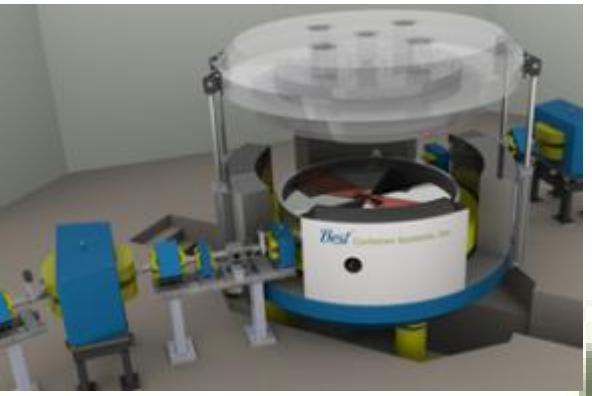



Gaudio
Legnaro National Laboratory
LNL
new

What is the LNL ?
(Legnaro National Laboratories)

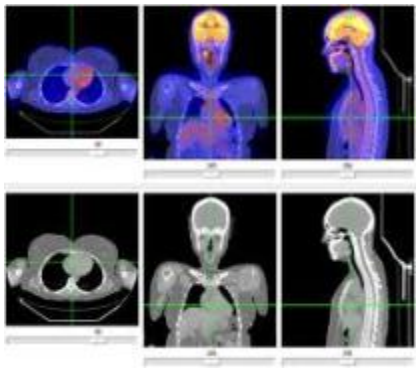
- **Mission:** Basic nuclear physics and nuclear astrophysics, together with applications of related nuclear technologies
- **Strength points :** developments of accelerators, radiation detectors and surface treatments technology
- **Personnel** : Every day 250 people work at LNL, 125 of these are INFN employees,
- **Cost** : 20 MEuro/year (half for handling and research ,half for personnel) . In 2014 some 7 MEuro arose from external funds
- **Users:** about 700 scientists, half from Italy
- **Available accelerators**: AN2000 e CN plus TANDEM-XTU and ALPI-PIAVE: deliver in total, some 8000 hours of beam time per year

The four phases of SPES



Cyclotron and Infrastructure

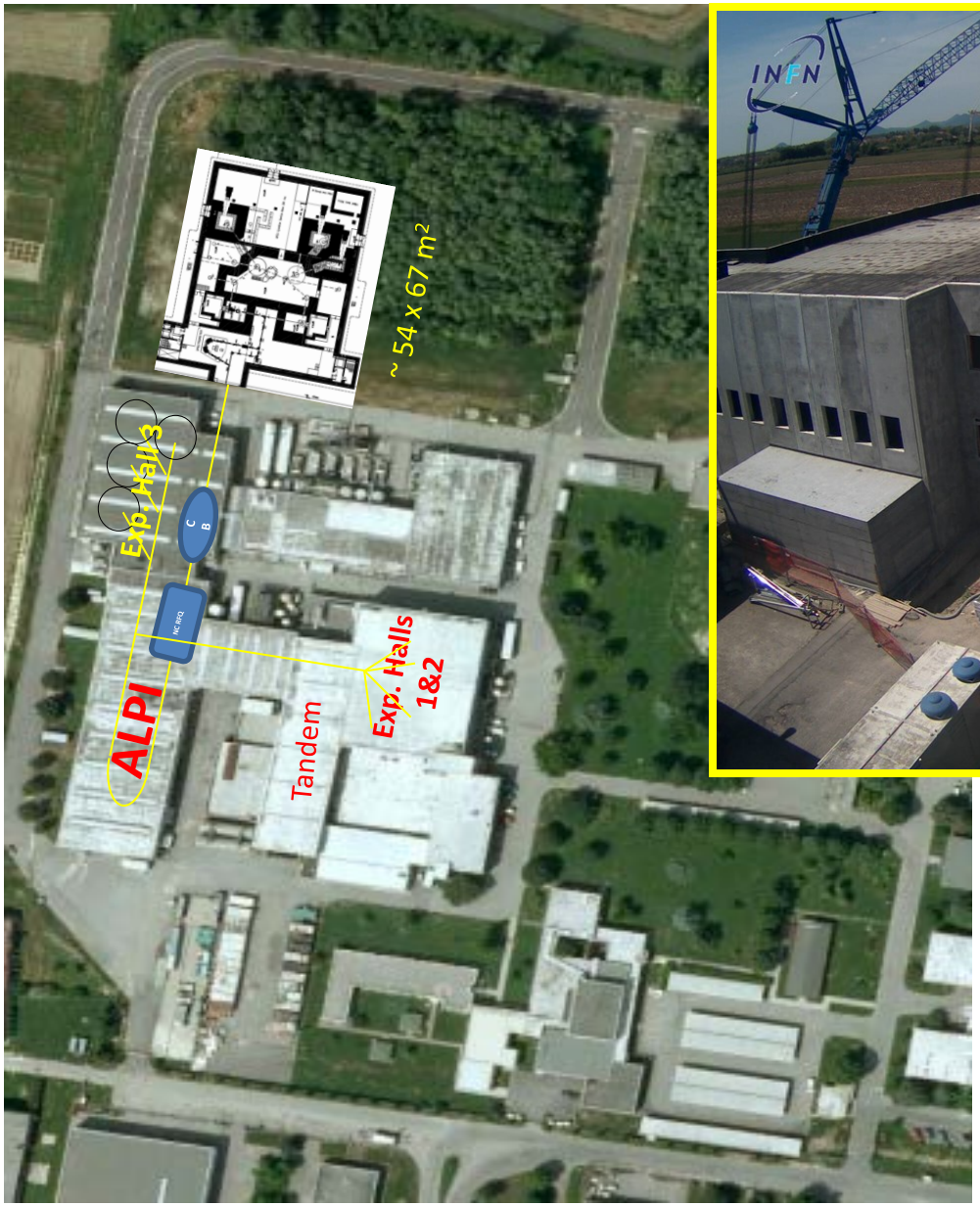
Radioactive Ion beam facility



RadioIsotopes for medicine

Accelerator based neutron source

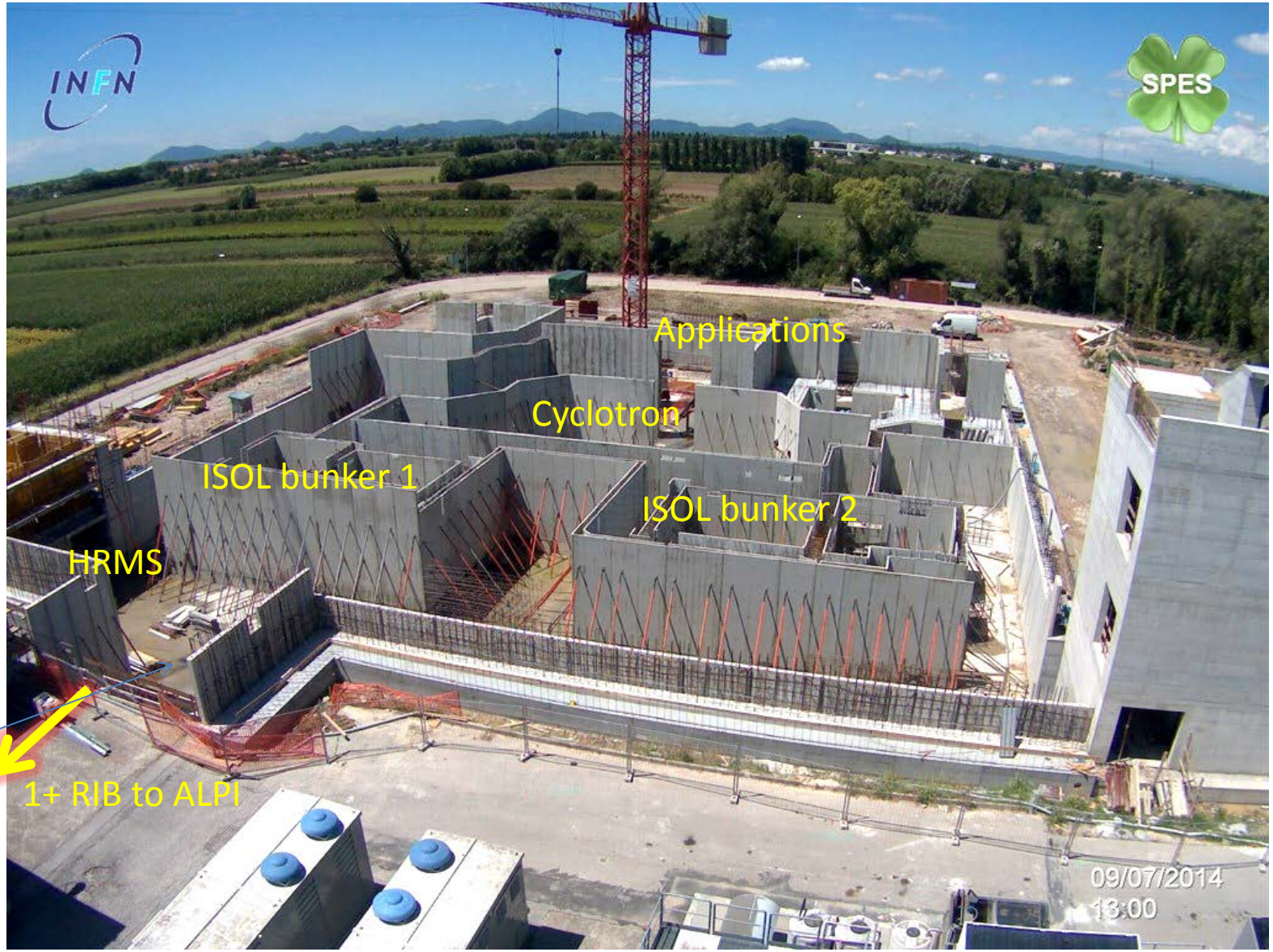
SPES-α Facility Layout



New infrastructure for:

- cyclotron
- RIB (Radioactive Ion Beam)
- application

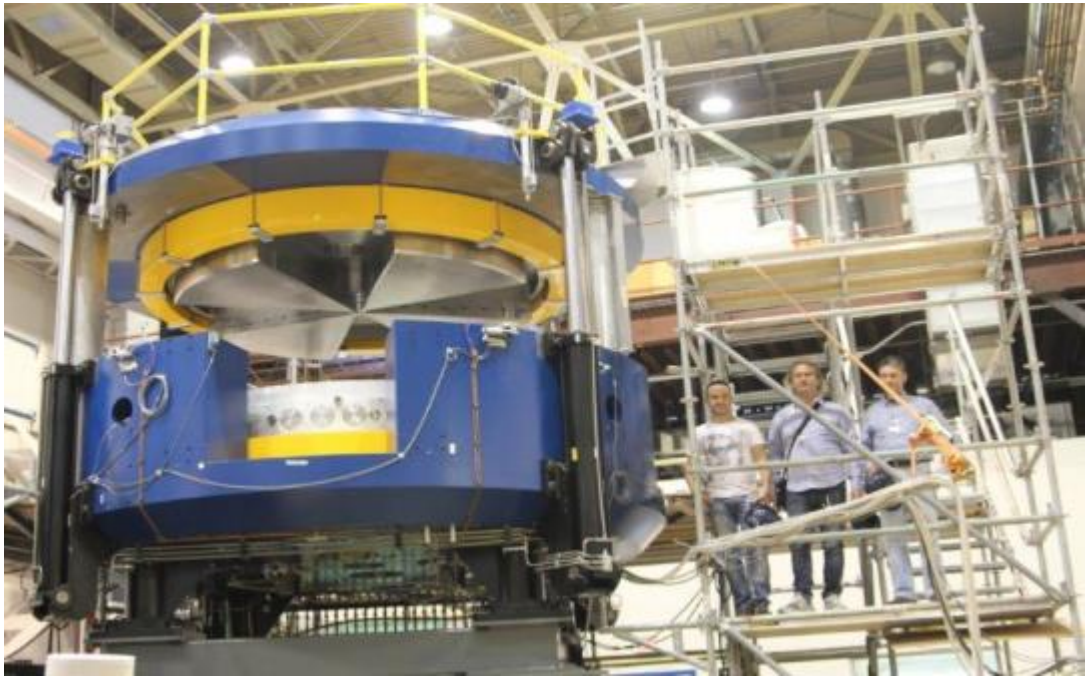
April 2014


INFN
SPES
Applications
Cyclotron
ISOL bunker 1
ISOL bunker 2
HRMS
1+ RIB to ALPI
09/07/2014
13:00

SPES α: the cyclotron

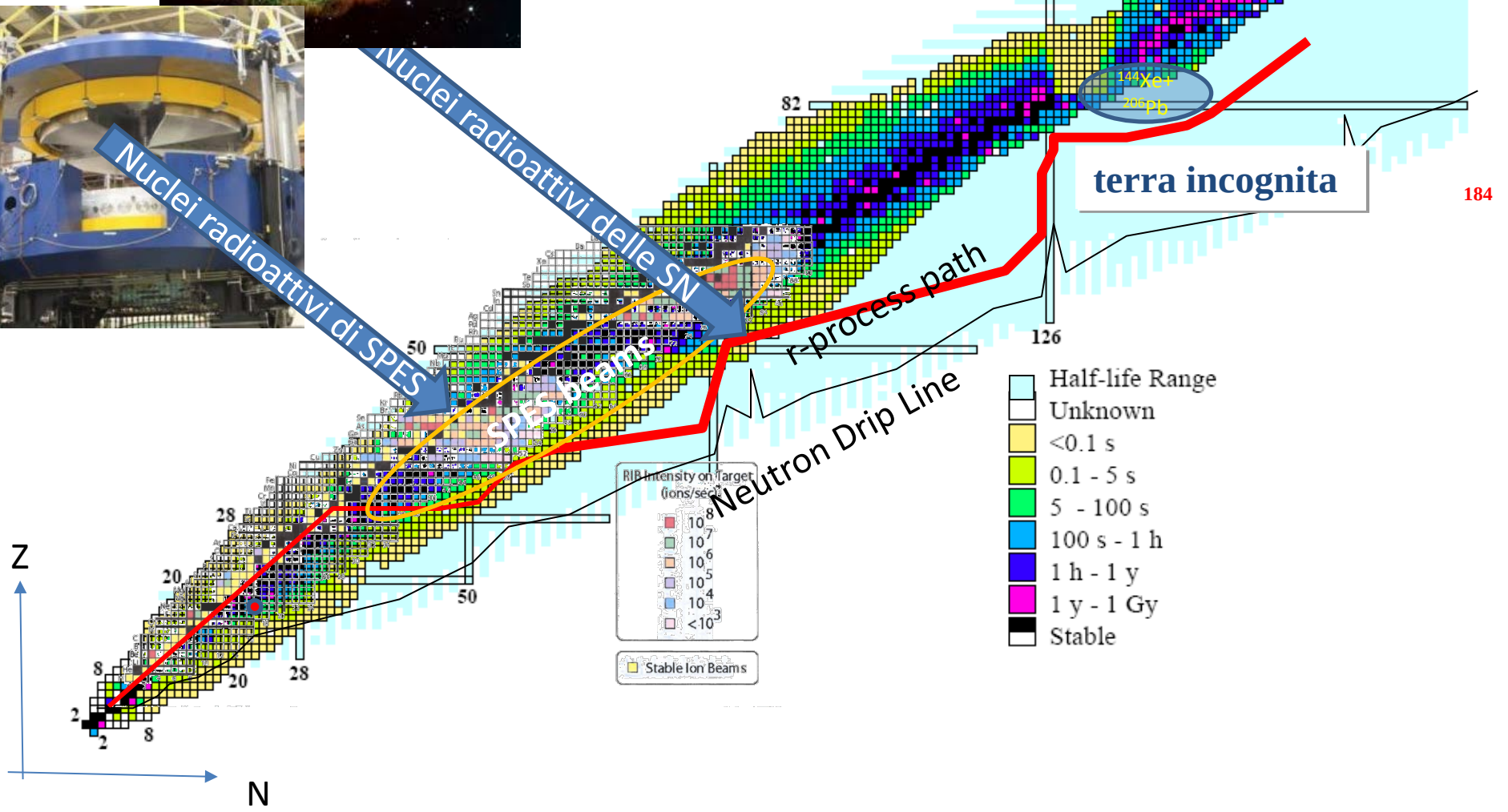
Built by BEST Cyclotron Systems

- Negative Hydrogen ion (H-)
- Simultaneous **double beam** extraction
- 35 to 70 MeV variable energy
- 700 μA combined beam current (to be upgraded to 1 mA)



-Factory Acceptance Tests (FAT) passed
-700 μA goal demonstrated
-Cyclotron arrived at LNL in may 2015

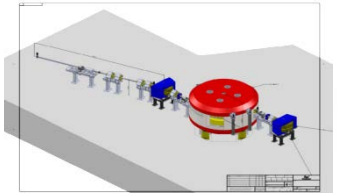
SPES-β: Nuclei for stars



The ISOL choice for SPES-beta

'Commercial' Cyclotron → Proton Driver:

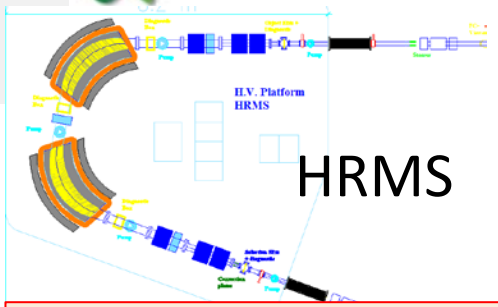
70MeV 0.75 mA 2



NEW CONCEPT
direct target
Multi-foil UCx

A cost-effective facility in the order of **50 M€**

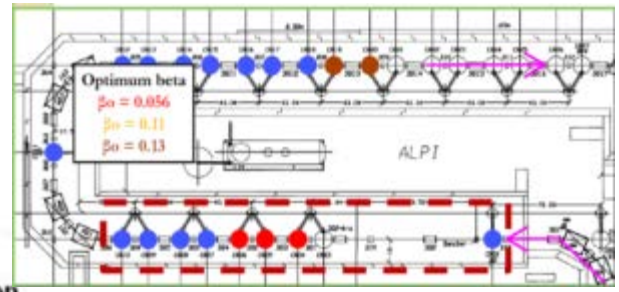
SPES direct target-ion source
30g UCx
ISOLDE-type target/source



HRMS

Mass resolution 1/20000

New RFQ



ALPI SC LINAC

Target designed to reach **10^{13} fission/s**

Radioactive beam energy: 10A MeV (A=130)

Project fully funded by INFN, to be completed by 2019

Nuclei for medicine
LARAMED

INFN, CNR and BEST-Medical International have expressed a joint interest for the creation of a Laboratory for **research and production** of radionuclides and radio-pharmaceuticals.

A joint 7Meur project has been financed by Italian government as a PREMIUM PROJECT

BEST has officially proposed to INFN a 10 year contract:

-BEST uses 50% of the cyclotron beam for radionuclide production

- BEST provides investment for the radiopharmaceutical plant and operates it

-BEST pays a fee to INFN for investment costs and operational (direct and indirect) costs

LARAMED Products

Radioisotope	Half-life
Fe-52	8.3 h
Cu-64	12.7 h
Cu-67	2.58 d
Sr-82	25.4 d
Ge-68	270.8 d
I-124	4.18 d
Ac-225	10 d

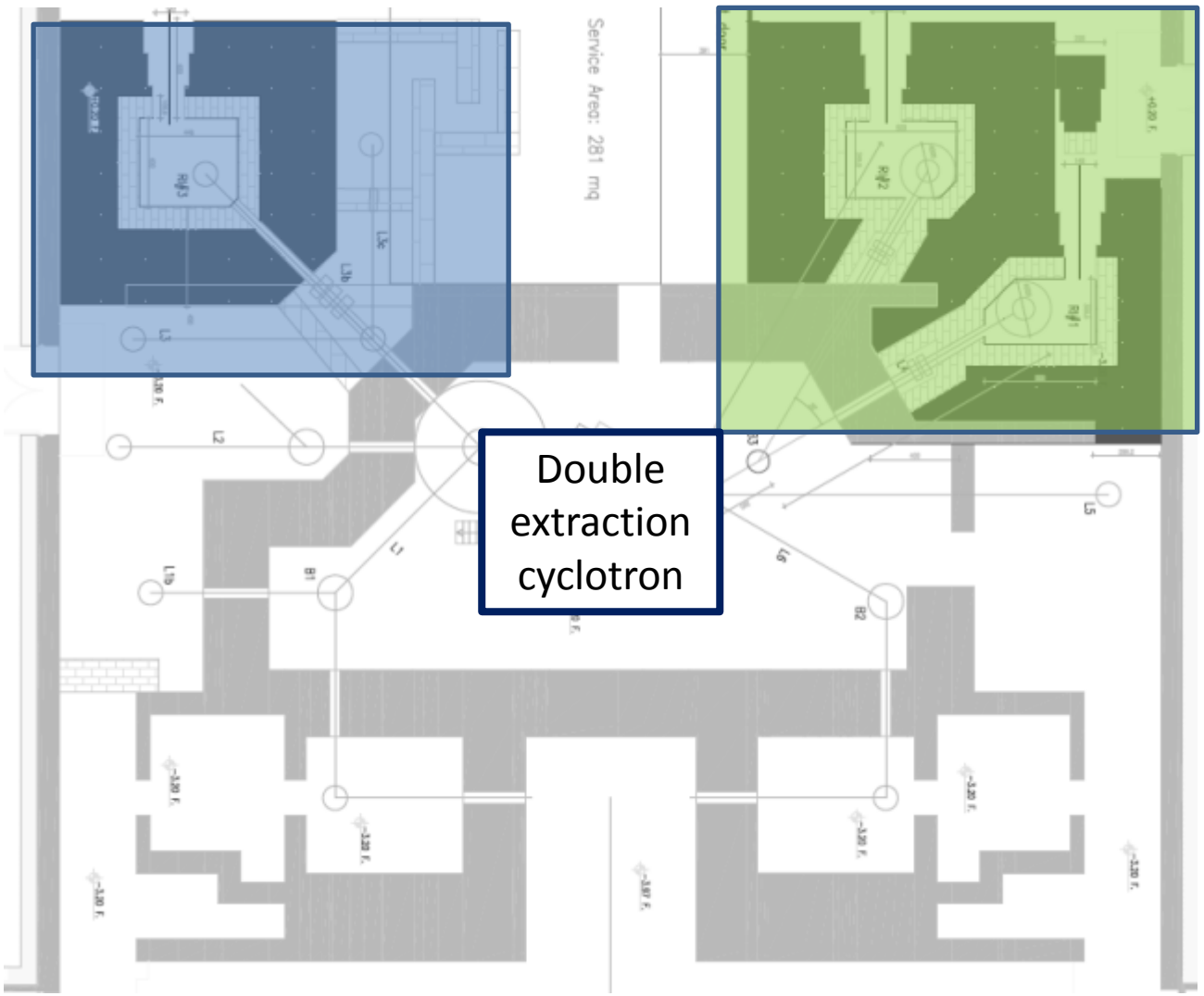
Some radionuclides of interest for nuclear medicine. They can be produced by means of the cyclotron of the SPES-α phase

LARAMED

Radioisotope Laboratory

Radioisotope Factory

^{99m}Tc
^{64}Cu
^{67}Cu



$^{82}Sr/^{82}Rb$
$^{68}Ga/^{68}Ge$

SPES-δ: Multidisciplinary Neutron source

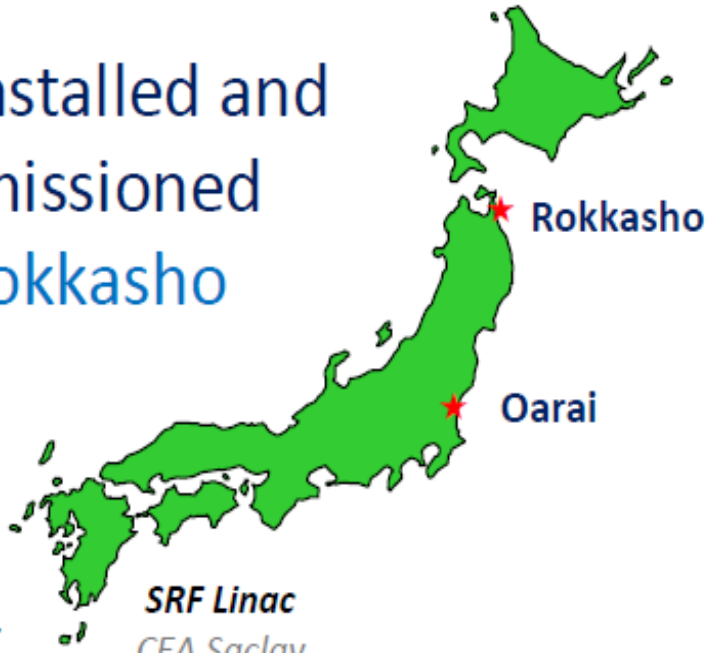
- Neutron sources have several applications Nuclear astrophysics, Characterization of nuclear waste, BNCT. Study of materials for future fusion reactor..)
- The first phase of MUNES Project (Multidisciplinary neutron source based on RFQ) has been financed by MIUR in the framework of “Premium Projects” with 5 Meuro
- This is part of the story about the involvement of LNL in LINACs: **MUNES, IFMIF, ESS**

Linear IFMIF Prototype Accelerator

Source delivered 2013

RFQ to be delivered 2015

Being installed and commissioned in Rokkasho



or + LEBT
CEA Saclay

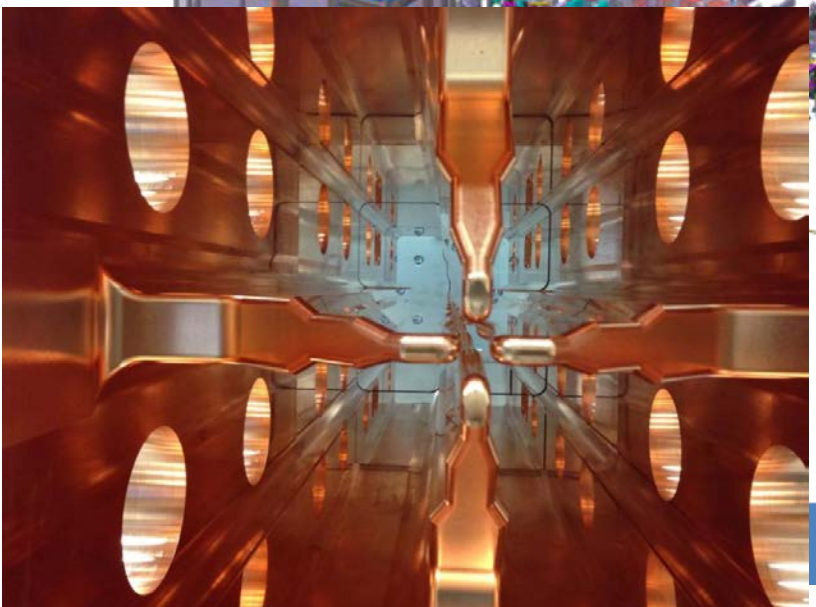
RFQ
INFN Legnaro
JAEA Tokai

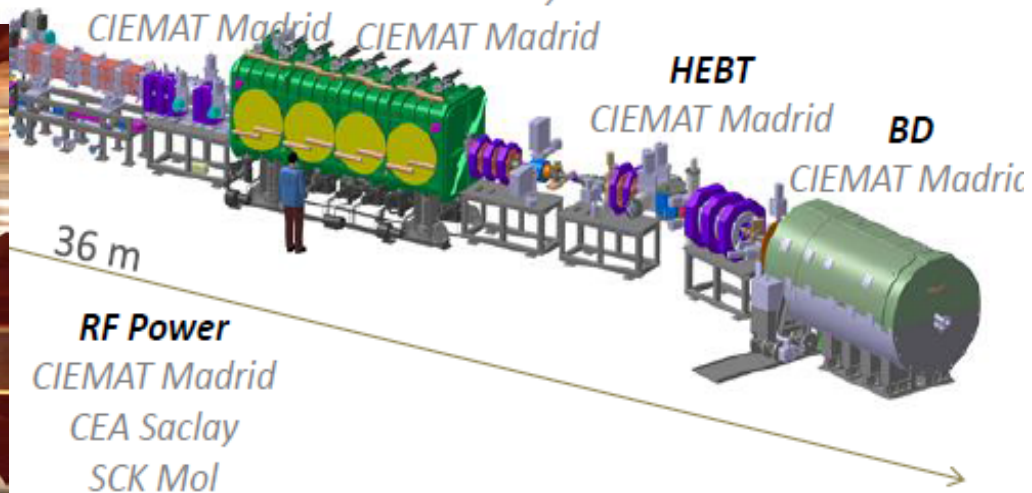
MEBT
CIEMAT Madrid

SRF Linac
CEA Saclay
CIEMAT Madrid

HEBT
CIEMAT Madrid

BD
CIEMAT Madrid



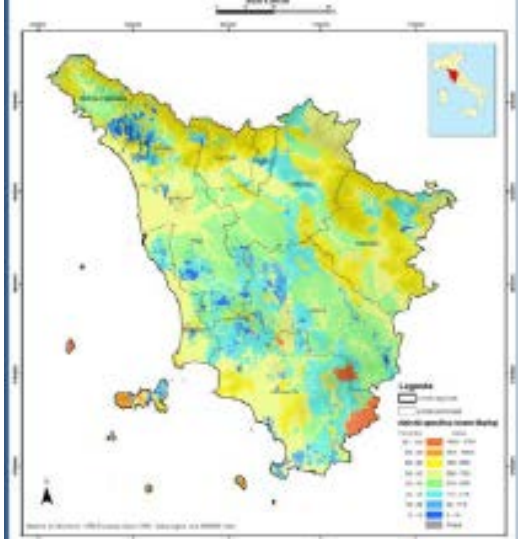


RF Power
CIEMAT Madrid
CEA Saclay
SCK Mol

Gamma detection: from GASP to Galileo

- The international dimension of LNL in gamma detection was recognized in the nineties, with the detector GASP, which has been dismantled after 20 years of honorable work
- The years 2011-2012 have been characterized by the succesful performance of the AGATA demonstrator, which has just moved to GSI
- Since summer 2015 a new gamma detector, GALILEO, is available at LNL.

Monitoring of environmental radioactivity by means of gamma spectroscopy



- The knowledge of natural radioactivity is important for geological studies as well as for environmental aspects
- Project ITALRAD has been been funded by MIUR in the framework of the "Premium projects "
- Tuscany and Veneto radioactivity maps completed and published
- Sardinia in advanced stage, Marche and Umbria in progress…


Be one of them, join us !

Be one of them, join us !

UNIVERSITÀ DEGLI STUDI DI FERRARA
- EX LABORE FRUCTUS -

- Young bright guys are welcome st LNL for
  - Master thesis
  - PhD thesis
  - Post-docs

in one of the several LNL projects;
please write to me fiorenti@fe.infn.it
or to other physicists @LNL

Thank you and have a nice stay