FUTURE RESEARCH INFRASTRUCTURES: CHALLENGE AND OPPORTUNITIES

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INFN & Sapienza Universita' di Roma

Workshop on Particle Accelerators

July 8-11 , 2015

Varenna

THE NEED

- shall not be explained

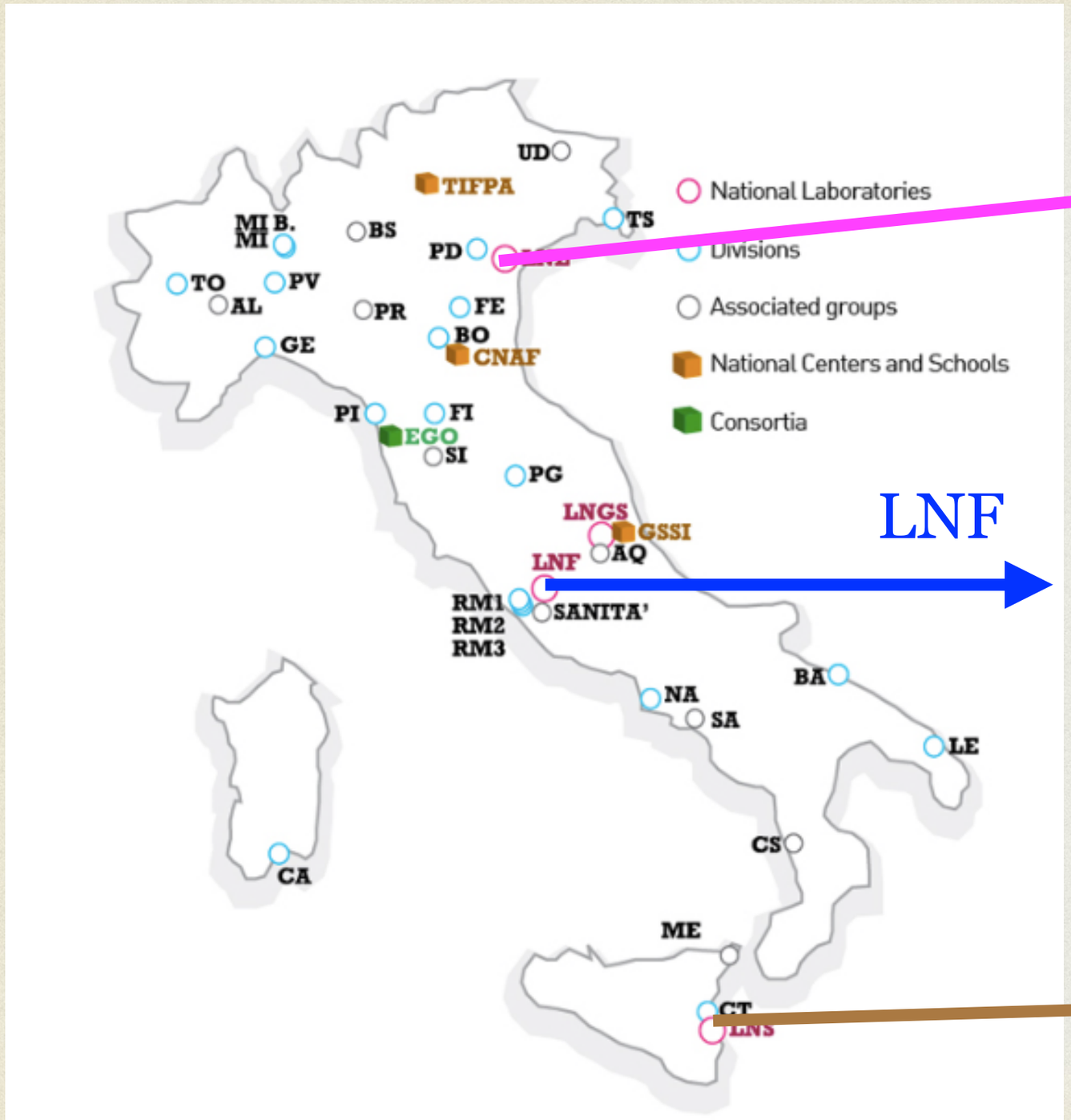
- anywhere you want to be at the frontier of energy, intensity, coherence….you have to spend a huge amount of money and invest a wealth of human resources

- if were not for little short-sightedness of the politics it would be trivially obvious

I WOULD TAKE THE SIDE OF AN AGENCY IN A COUNTRY THAT SHALL NOT/DOES NOT WANT TO ENGAGE AS HOST

- INFN has the human capital to design an accelerator, built and likely commission and operate it (to a scale)
- INFN wants to preserve this capability
- INFN will not build ‘big’ machines
- so what INFN does ? The OPPORTUNITY !

INFN LABS
(WITH ACCELERATORS)



LNL

LNF

LNS

MAIN FOCUS (NOW)

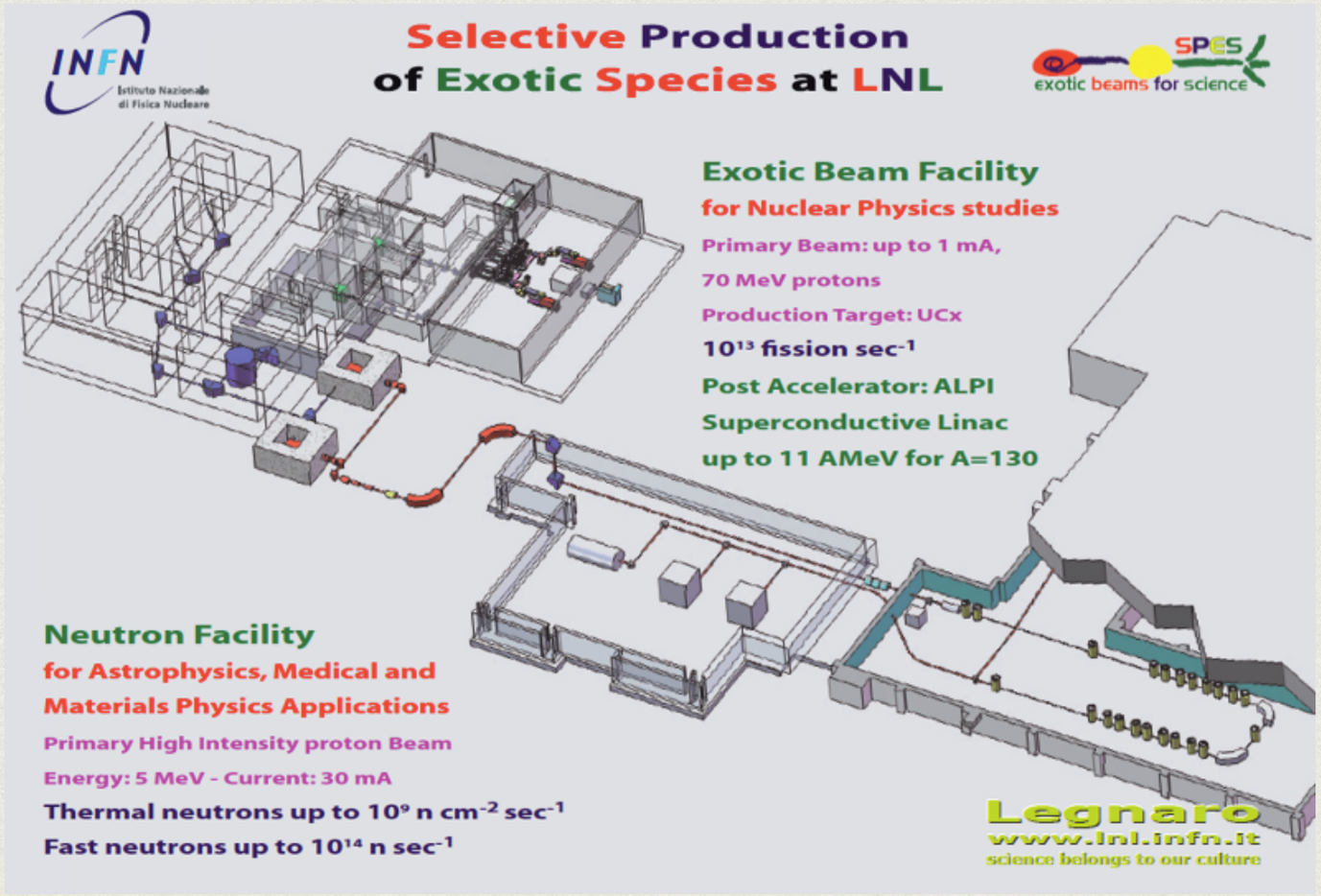
- LNL: SPES
- LNF: DAFNE & SPAR-C
- LNS : Superconducting cyclotron

and a Lab without accelerators but fundamental in our strategy

LNL

1. Radioactive Ion Beams are produced by proton induced fission on a UCx direct target at a rate of 10^{13} fission/s.
2. Neutron rich re-accelerated beams will be available at energies up to 13 MeV/u in the mass region A=130.
3. Re-acceleration will be performed by the superconducting linear accelerator complex (PIAVE-ALPI) of the Laboratori Nazionali di Legnaro.
4. The facility for applied physics is based on proton and neutron beams from a two exit port cyclotron (70 MeV, 500 microA) and the high intensity RFQ TRASCO (5 MeV, 30 mA).

Working out an agreement with a private company for radioisotopes production

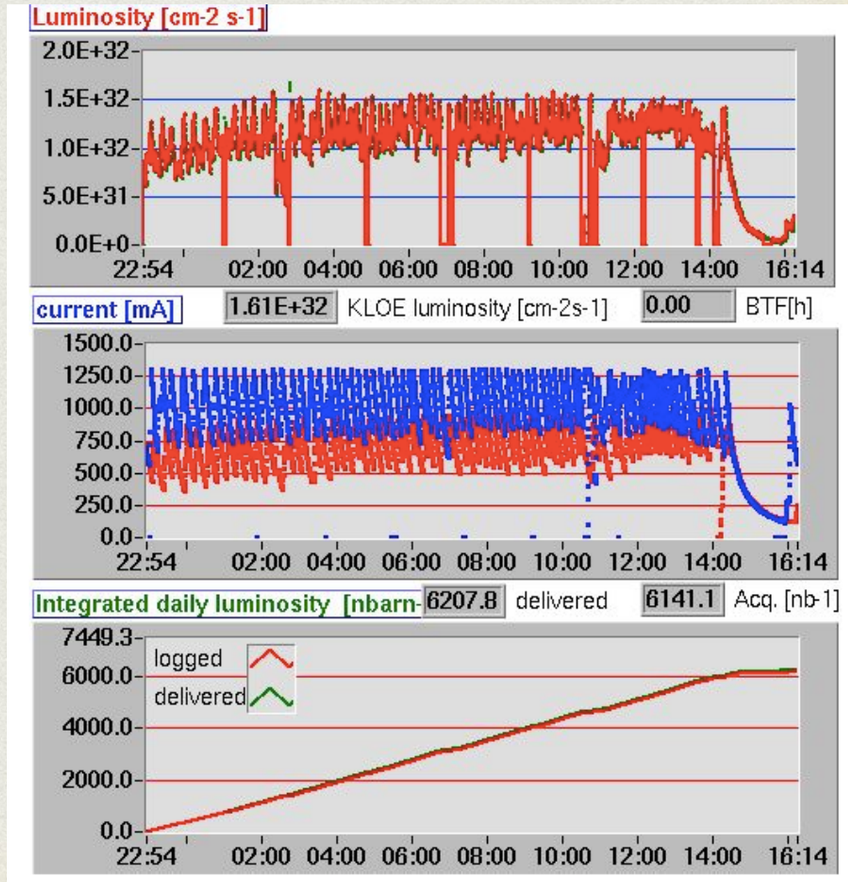


JUST ARRIVED ....

Radioisotopes by 2016

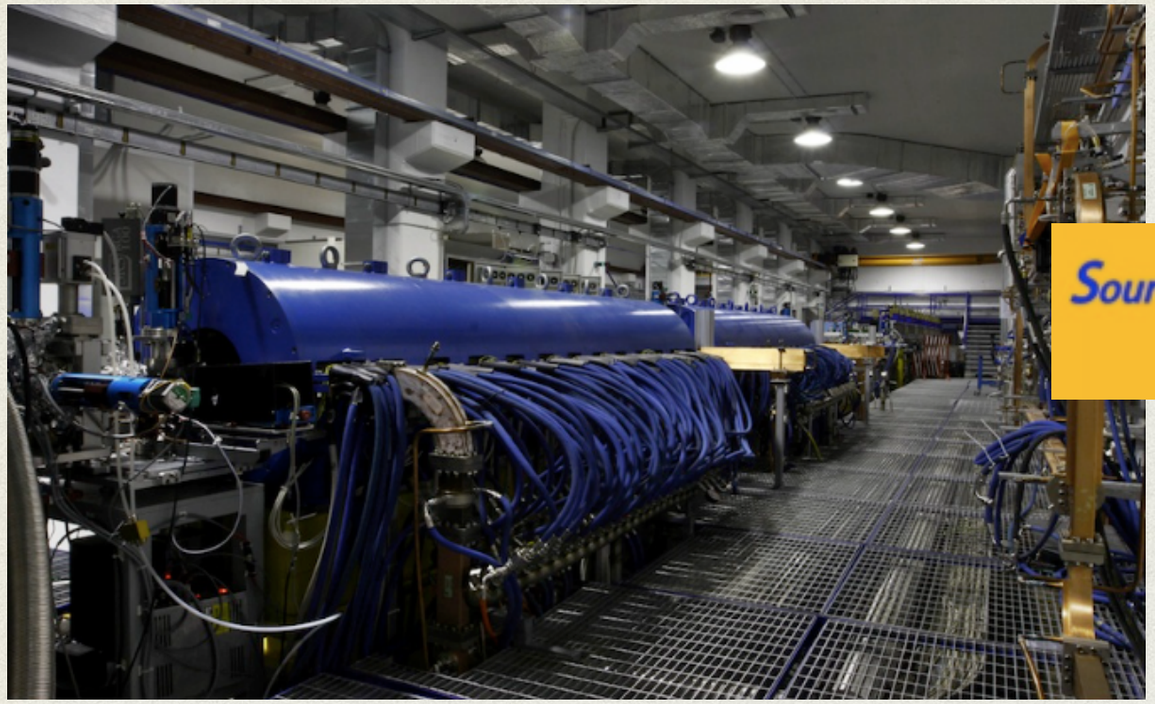
NP by 2018

LNF: DAFNE



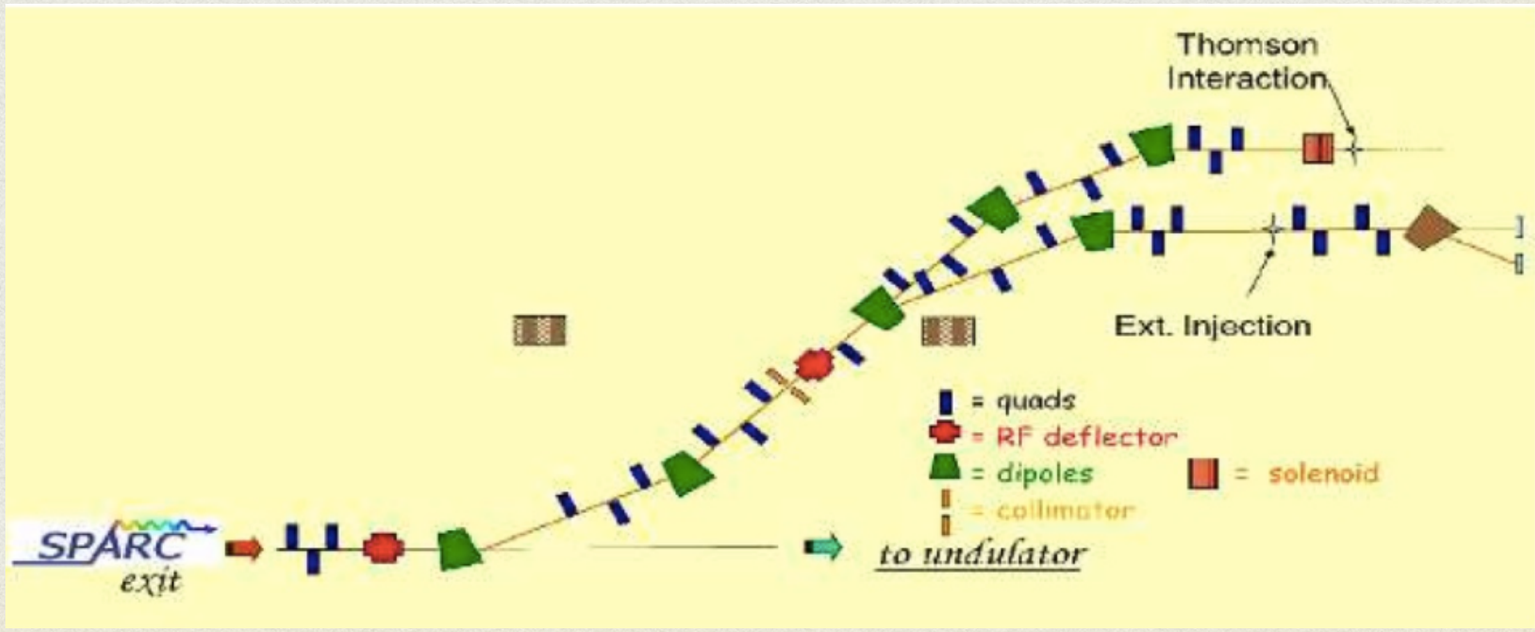
Serving KLOE: no more than a couple of years in front

LNF: SPARC

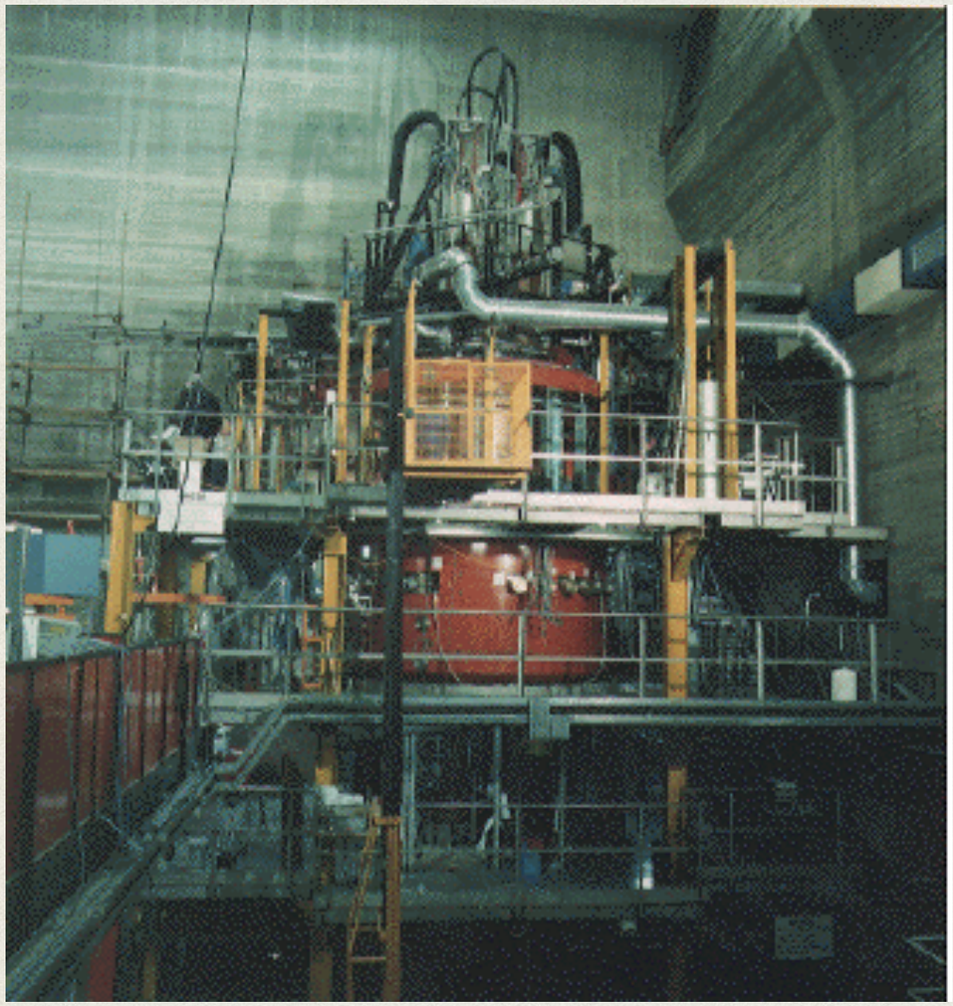


Sources for Plasma Accelerators and Radiation Compton with Lasers And Beams

Main focus: PWA either with a Laser (300TW) generated plasma or electron driven plasma



LNS : SC



Main focus: Nuclear Physics

Evaluating an upgrade for (beside other reactions) exploring double charge exchange processes with the goal of improving NME calculation for Double Beta Decay

A LOT OF ACCELERATOR PHYSICIST AND EXPERT

- on the other end the road to build larger machine than the one we have is unlikely to be open (lack of money at a level of a couple of hundred MEuro in, say, 5 years)

- look outside, there are several sites in Europe (and perhaps elsewhere) where our contribution can be substantial

- find the right balance between maintaining the expertise, have new people to train , offer in-kind contribution made at home , send people to help (and possibly get them back !)

AND STRONG INDUSTRIAL PARTNERS

E. ZANON

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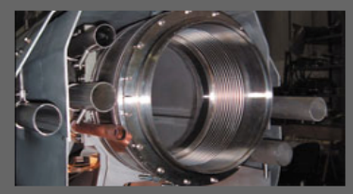
Equipment for Physics Research Institutes

Equipment
Prefabrication of Cryomodules
for LINAC (Linear Accelerator)

Material of Construction
C.S. vacuum vessel
S.S. and Aluminium internal cold mass

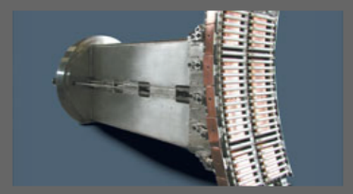


Equipment
Prefabrication of Cryomodules
for LINAC (Linear Accelerator)

Material of Construction
C.S. vacuum vessel
S.S. and Aluminium internal cold mass

Equipment
RF Cavity for LHC
Project CERN

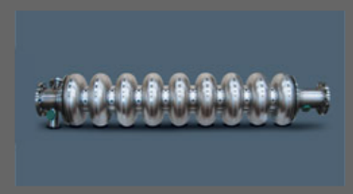
Material of Construction
Copper Forgins
Electron Beam Welding



Equipment
Components for Nuclear Fusion
Antenna RF 8MW for JET/ITER

Material of Construction
Inconel 625-Inconel 718 / Stailess Steel
S.S. and Aluminium internal cold mass

Surface Treatments
Nickel and Silver Plating
Copper Deposition



Equipment
Superconducting Cavities
for linear accelerators

Material of Construction
High RRR Niobium
Electron Beam Welding

Equipment
Superconducting RF Components
made of pure Niobium

ASG Superconductors

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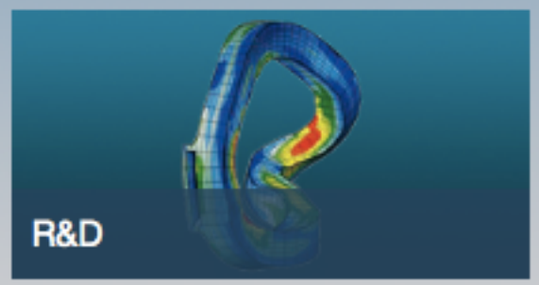
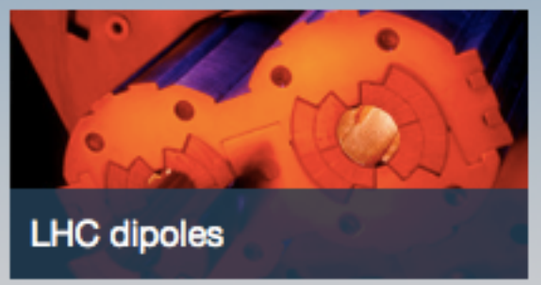

R&D


ITER Toroidal Field Coils


IBA, hi-tech collaboration


LHC dipoles


SFCL, advantages of MgB_2


ITER Poloidal Field Coils


MrOpen, cryogen free MRI system


JT-60SA, coils for fusion in Japan

WHERE DO WE GO ?

- ELI-NP at Magurele (Romania)
- ESRF at Grenoble (France)
- ESS at Lund (Sweden)
- X-FEL at Hamburg (Germany)
- SESAME at Allan (Jordan)
- CERN not as last but trivially first

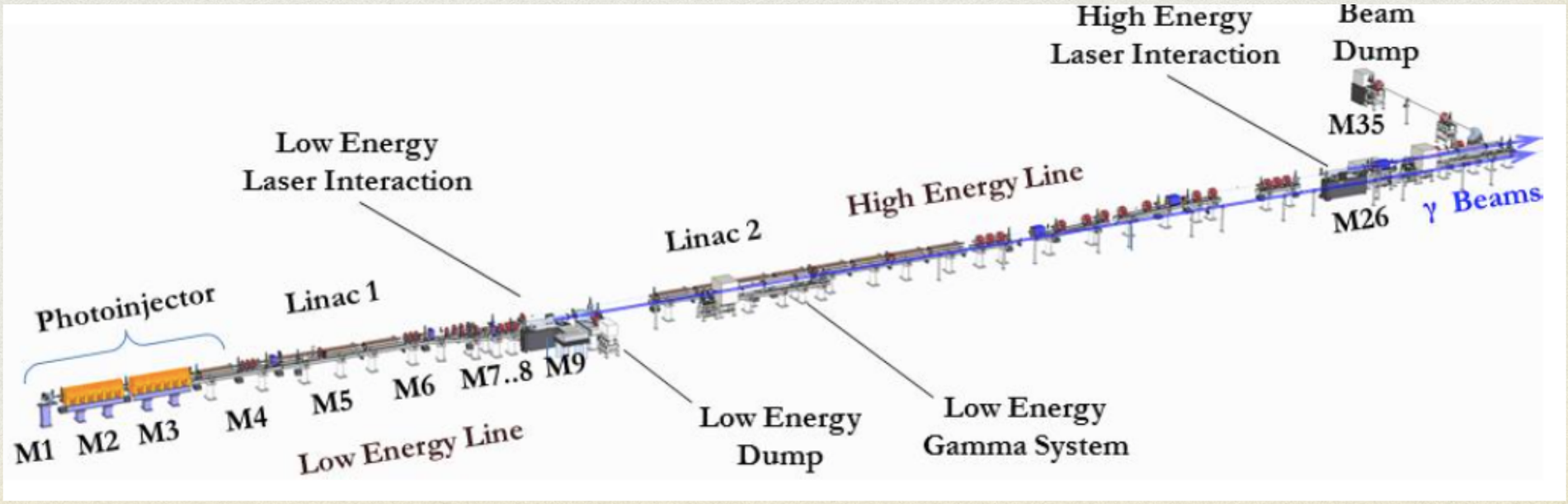
ELI NUCLEAR PHYSICS

INFN leader of an association with many partners (IN2P3, industries, STFC..): awarded the contract to build the accelerator

LNF

A very intense (10^{13} γ/s), brilliant γ beam, 0.1 % bandwidth, with E_{gamma} > 19 MeV, which is obtained by incoherent Compton back scattering of a laser light off a very brilliant, intense, classical electron beam (E_e > 700 MeV) produced by a warm linac.

based on SPARC Thomson source



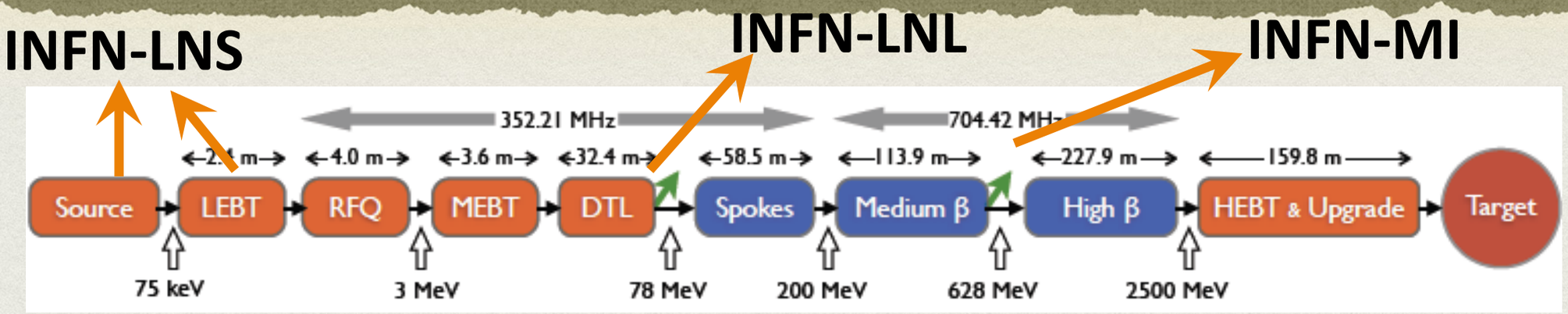
and a very little brother at Uni Cosenza with the name STAR

ESRF

LNF

- Design of the (non trivial) Al vacuum chambers for the ESRF upgrade

ESS



INFN is in charge of the management of the WP3-Normal Conducting Linac

1. **Ion Source & LEBT (INFN-Laboratori Nazionali del Sud, Italy)**
2. **RFQ (CEA-IRFU, France),**
3. **MEBT (ESS Bilbao, Spain)**
4. **Drift Tube Linac (INFN-Laboratori Nazionali di Legnaro, Italy)**
5. **INFN-LASA-Milano (superconducting elliptical cavities for WP5)**

construction of medium beta section **(strong industrial background for series construction)**

6. **Potential: LNL for ICS ; LNS, LNL and Milan for support to commissioning**

1+4+5+management WP3 is agreed with ESS Accelerator Division, 6 under discussion

SESAME

- cavities together with ELETTRA synchrotron …a nice collaboration for an extremely important project both for science and scientific policy notwithstanding peace

During the meeting in Frascati an agreement was signed between Elettra-Sincrotrone Trieste S.C.p.A., SESAME and the Istituto Nazionale di Fisica Nucleare (INFN) to establish scientific-technical collaboration between the three research institutions for the joint development of the RF (radio frequency) cavities needed for SESAME's storage ring. The agreement will allow SESAME to benefit from the Italian institutions' expertise in accelerator physics, as well as financial support from Italy – through INFN

X-FEL

superconducting lab LASA in Milan

1.3 GHz SC cavities and 3.9 GHz cryomodule

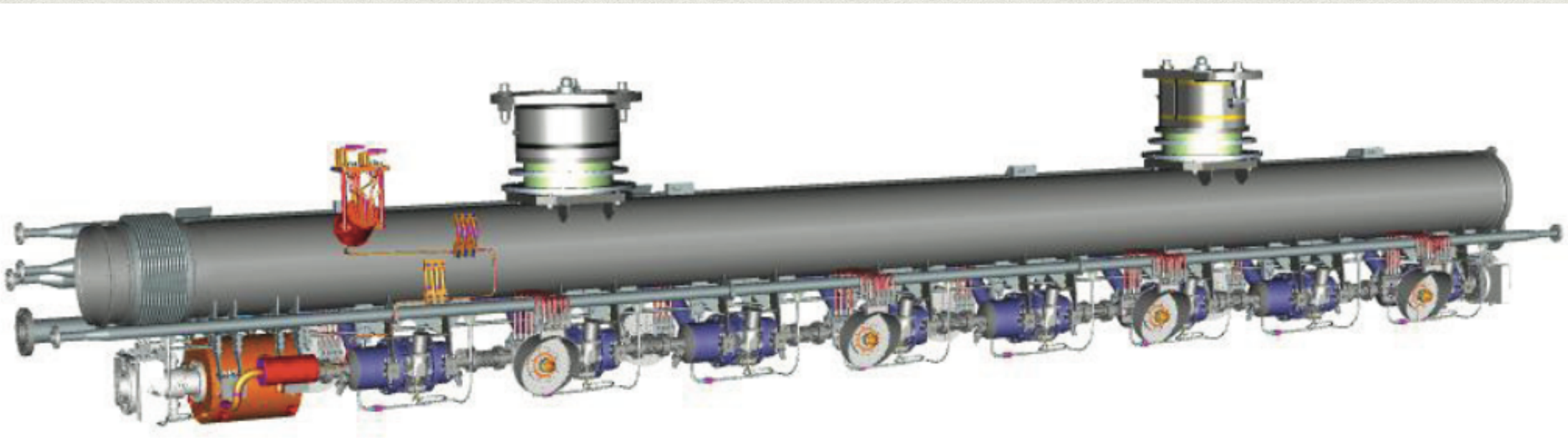


Figure 3: The string of beamline elements (8 cavities and a magnet package) supported by the Helium Gas Return Pipe of the cryomodule.

CONCLUSION

- accelerator physics is well alive in INFN laboratories
- a specific Ph.D. in Sapienza on the subject
- labs with running machines, copying with what is possible , not too big but with enough money for upgrades and extensions
- healthy synergy with many labs and projects around Europe and beyond
- try to balance education at home, forefront research in our labs and outgoing flux of researchers