Meeting on

A Possible European SC-RF Infrastructure

CERN, 14 June 2006

INFN-Italy SC-RF Infrastructures

complementary to a possible

European SC-RF Infrastructure

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SC-RF Infrastructures in Italy at:

LNL – Laboratori Nazionali di Legnaro dell'INFN

(Material from Vincenzo Palmieri)

Sezione INFN di Genova

(Material from Renzo Parodi)

LASA – Sezione INFN di Milano

LNL: Ion Accelerator Complex

AN2000

» General Information | » Beam Time Schedule | » Call for Proposals

Mainly used for solid state physics and applied physics experiments.

- Electrostatic accelerator, Van de Graaff type.
- Single stage-Belt charging system.
- Maximum terminal working voltage 2.5 MV.
- Available accelerated ions: ^{1}H, ^{4}He single charged
- Continuous beam.
- Maximum Ion Energy: 2.5 MeV
- 1 experimental hall; 5 beam lines among which one dedicated to a microbeam facility.

CN

» General Information | » Beam Time Schedule | » Call for Proposals

Mainly used for interdisciplinary research, neutron physics research and advanced educational purposes.

- Electrostatic accelerator, Van de Graaff type.
- Single stage-Belt charging system.
- Maximum terminal working voltage: 7 MV.
- Available accelerated ions:
  $^{1,2}H$, ^{3}He, ^{4}He single and double charged
  D, ^{15}N double charged
- Continuous and pulsed beam.
- Maximum Ion Energy:
  7 MeV for single charged
  14 MeV for $^{4}He^{++}$
  8 MeV for $^{15}N^{++}$
- 1 experimental hall; 7 beam lines.

TANDEM-XTU

» General Information | » Beam Time Schedule | » Call for Proposals | » Deadlines | » List of Experiments | » Reports

Mainly used for fundamental heavy-ions nuclear physics experiments.

- Electrostatic accelerator, Van de Graaff type.
- Double stage with two stripper stations (one at the terminal and one in the High Energy stage) - Laddertron charging system.
- Maximum working voltage: 15 MV.
- Available accelerated ions range from ^{1}H to ^{197}Au (see list with available currents).
- Continuous and pulsed beam.
- Energy: from 30 MeV/AMU for 1H to about 1.5 MeV/AMU for 197Au.
- 3 experimental halls; 10 beam lines.
- At present the Tandem-XTU acts also as injector for ALPI.

ALPI

Mainly used for fundamental heavy-ions nuclear physics experiments at intermediate energy.

- Linear superconducting quarter-wave resonant cavities accelerator. At present ions are injected by Tandem
- Superconducting material: Lead and Niobium.
- Accelerated Ions: from ^{28}Si to ^{197}Au.
- Energy: about 20 MV multiplied the ion charge state.
- The total output energy of ions emerging from the Tandem-Alpi complex is the sum of injection energy (Tandem acting as injector) and ALPI energy. Hence the total energy of the complex is about 35 x charge state (MeV).
- Experimental halls and beam lines: the same ones of Tandem-XTU.

TABLE OF TANDEM-ALPI REPRESENTATIVE BEAMS

Beam	E [MeV] - (1 foil) with the most probable charge state	Average current on target [pnA] (1 foil)	E [MeV] (2 foils)
^{12}C	251	10	288
^{16}O	303	30	342
^{32}S	461	18	586
^{48}Ca	457	1	648
^{58}Ni	555	5	794
^{65}Cu	543	2	794
^{74}Ge	519	2	838
^{82}Se	559	1	880
^{90}Zr	526	1.5	976
^{104}Ru	612	1	1008

TABLE OF CURRENTLY AVAILABLE PIAVE-ALPI BEAMS

Beam	Maximum energy [MeV]	Beam Current on target [pnA]
$^{22}Ne^{4+}$	147	10
$^{40}Ar^{9+}$	330	4÷10
$^{84}Kr^{15+}$	555	5÷10
$^{132}Xe^{18+}$	675	2

LNL: SC-RF Cavities Developed

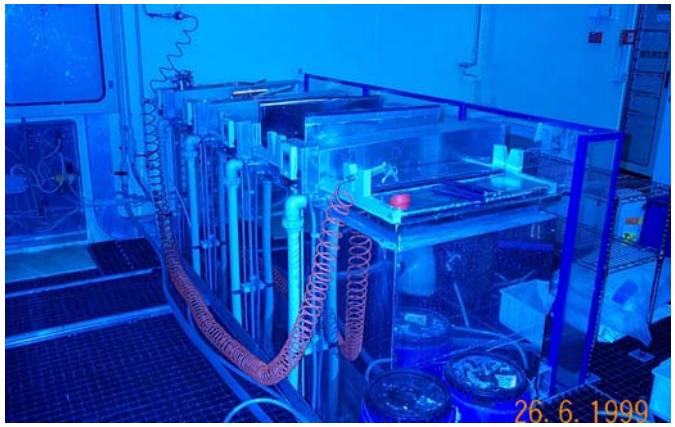
β<1 resonators, beta ranging from 0.03 to 0.5

many different shapes and sizes

LNL: SC-RF Infrastructures

BCP and EP plant to treat copper

chemical Treatment of a quarter-wave resonator



Ultrasonic Cleaning facility

Ultra-pure water system (1200 l/h – 18 MΩ cm)

LNL: R&D on single-cell 1.3 GHz cavities

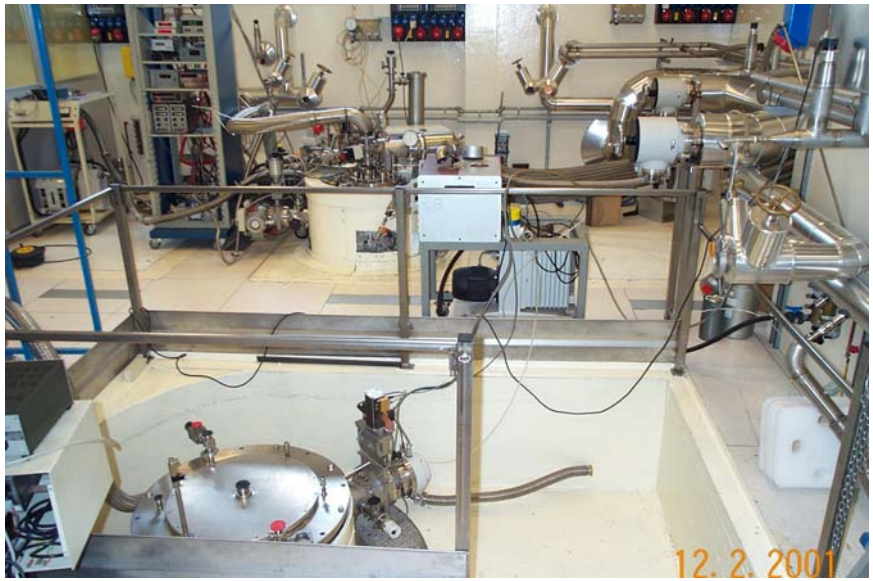
LNL: Film Deposition Systems

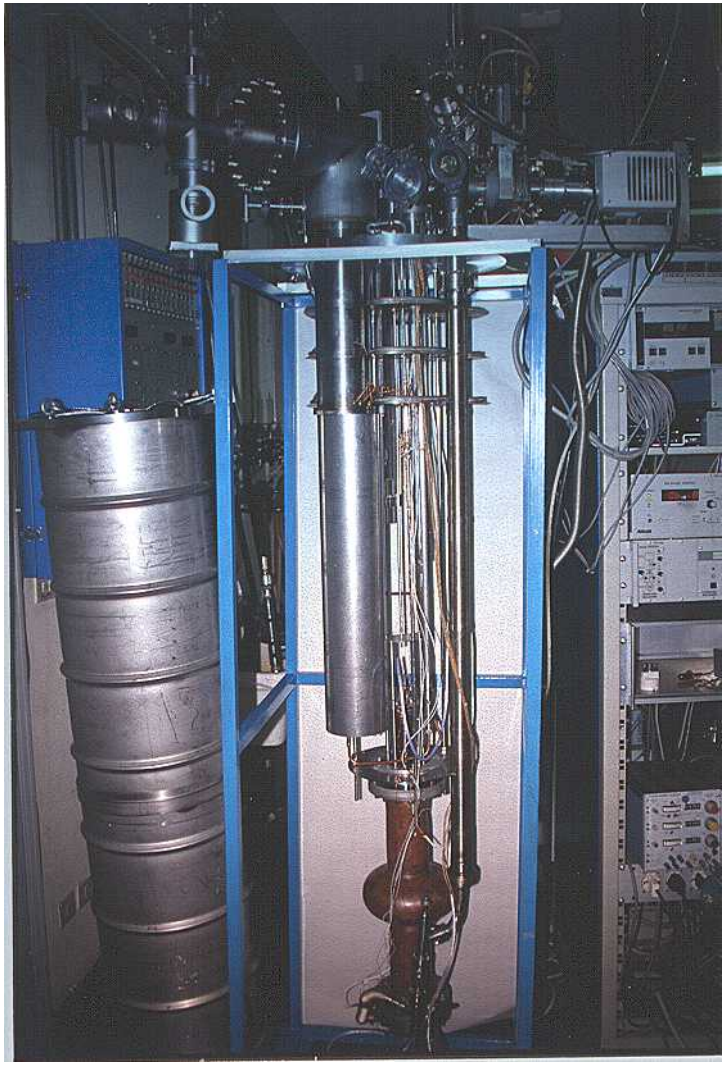
Large experience on film deposition

- Magnetron sputtering of Nb on Cu
- Thin film cathodic arc deposition
- High Tc exotic film deposition

LNL: Vertical cryostats and inserts

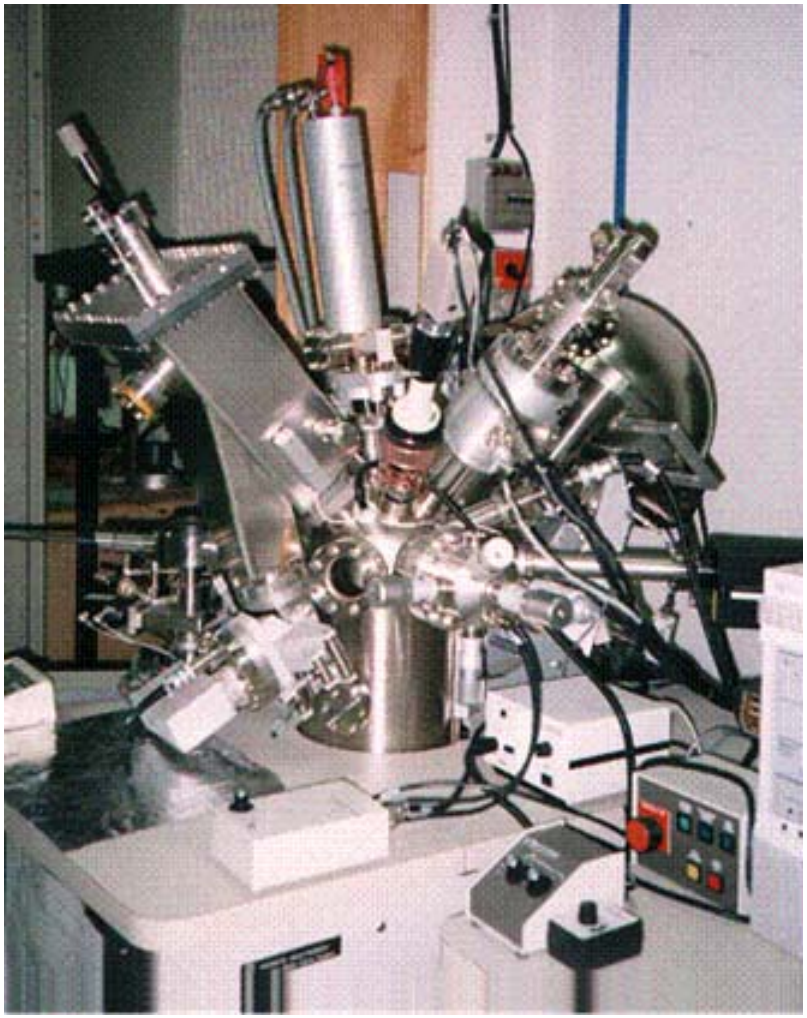
- Variety of cryostats and inserts for SC-RF tests
- The largest cryostat can accommodate a 9-cell ILC cavity: h = 3 m, Φ = 500 mm (60 W, 1.8 K)
- LNL Priority on ALPI and ion accelerators





Genova: Surface treatment and analysis

- Basic measurements on RF properties of Niobium and Nb based superconductors
- XPS-Auger apparatus dedicated to surface analysis of SC samples of Niobium and niobium on copper, treated in the lab.
- Test of 3GHz cavities to verify surface preparation receipts
- Long tradition in Multipactoring calculation (pioneering work from Genova in this field)



LASA

LASA = Laboratorio Acceleratori e Superconduttività Applicata

Built in meddle Eighties for the construction and commissioning of the 800K Superconducting Cyclotron now in operation at INFN-LNS

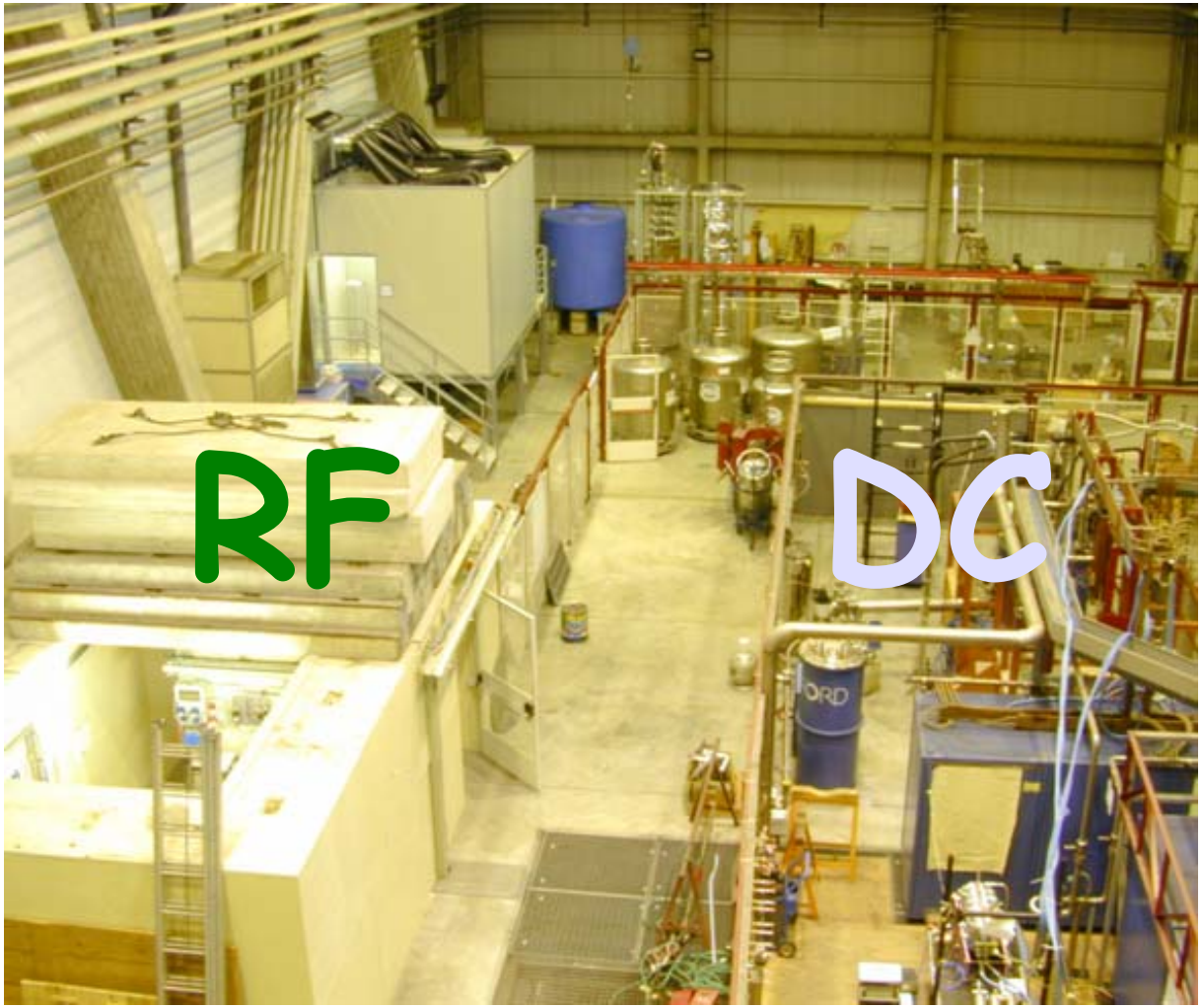
~ 40 People: Researchers, Technician and Students

Since 15 years dedicated to contribute in big international accelerator projects based on Superconducting components: Magnets and Cavities

LASA: SC Infrastructures

LASA SC area and general services

- Experimental area: 2000 m^2, served by a 50 t crane.
- Installed electrical power: 1.6 MVA
- 100/ Mbit/s – 1 Gbit LAN
- Machine workshop
- Radiochemistry Lab.



LASA: Cryogenics

- He liquefier: 40 l/h (with LN_2 precooling)
- Liquid Storage: 4.000 l
- LHe distribution lines
- He Gas Recovery and storage:
  - Max recovery rate: 60 m^3/h (NTP)
  - 1.000 m^3 storage balloon
- He purification system
- 15 bar He gas storage: 2.800 m^3 (NTP)

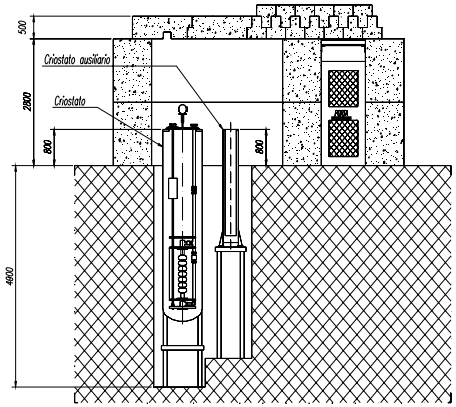
40 l/h He liquefier

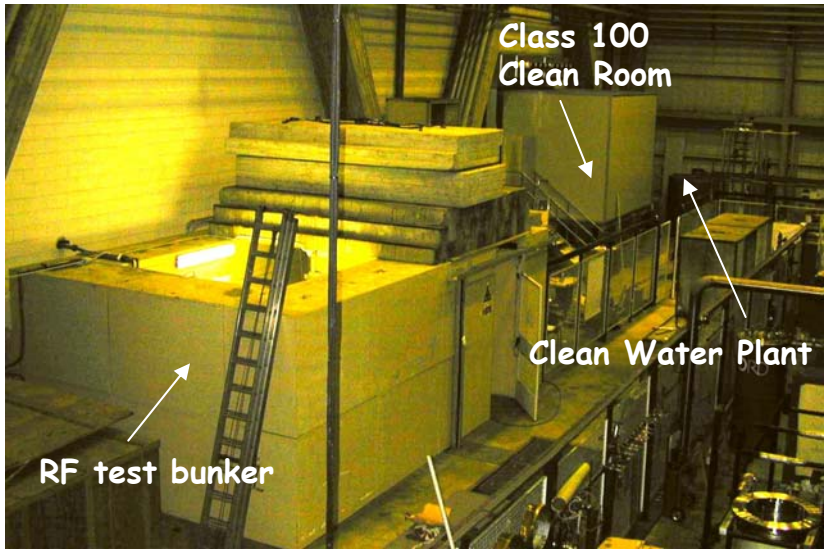
Main He compressor

He gas storage

LASA: SRF Cavity Test Facility

The RF bunker

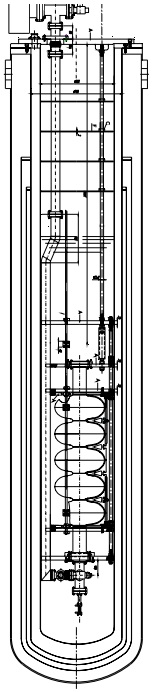


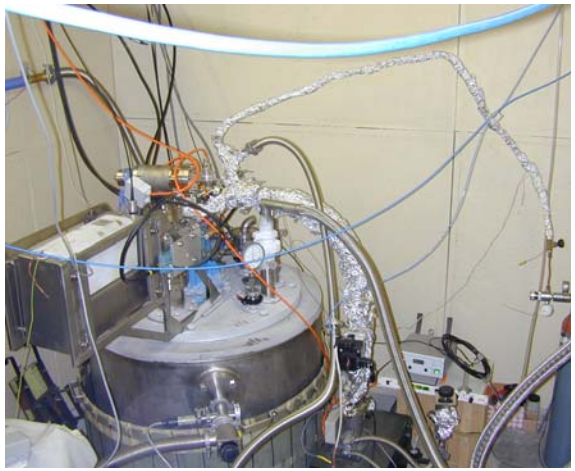


3 x 3 m^2 Class 10/100 Clean Room

18 MW cm ultra pure water plant and high pressure rinsing

An RF insert for a 500 MHz 5 cell cavity





LASA: U-Pure Water and HPR Systems

My Conclusions

- **LNL**: fully dedicated to ALPI and to the development of ion accelerators for nuclear physics as SPES, Eurisol
  - LNL prefers contributing to R&D programs on SRF basics
- **Genova**: since a few years concentrated its SC activity on magnets and gravitational wave detectors, de facto abandoning SC-RF.
  - In case of an European infrastructure Genova is willing to contribute with its surface analysis equipment and experience
- **LASA**: 15 year experience in contributing, with Industry, to large accelerator projects based on Superconducting RF: LEP, LISA/ARES, TTF, ADS/TRASCO, SNS, SPL, etc.
  - The existing SC-RF infrastructure is tuned to be complementary to larger infrastructures
  - The SRF group at INFN LASA is strongly supporting the new European infrastructure at CERN.