SNEAP 2012

Tandem ALPI PIAVE complex

October 3 rd, 2012

Davide Carlucci

Tandem-ALPI-PIAVE complex

Operation Supervisor

I.N.F.N. - Laboratorni Nazionali di Legnaro

Outline

- Introduction to LNL
- XTU-Tandem accelerator
- ALPI accelerator
- PIAVE accelerator
- Replacement of water cooling circuit inside the tank
- Coil story
- Magnet selection system (Lines in the exp. Hall 1&2) replacement
- Summary

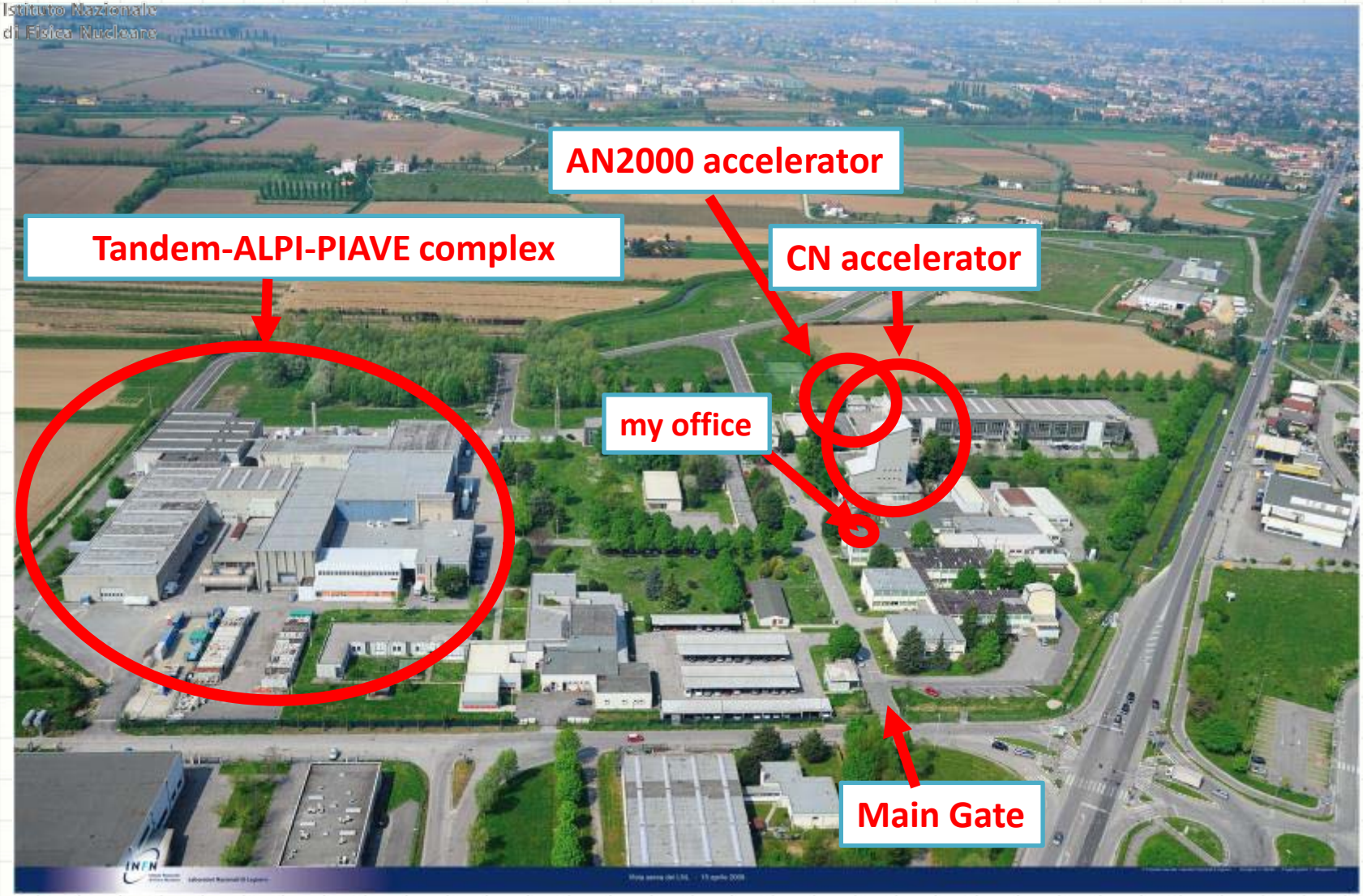
LNL – INFN - Identity Card

MULTI TASK
MULTI DISCIPLINARY
But mainly
Nuclear Physics Based
User Oriented
Laboratories

CORE RESEARCH ACTIVITIES

- Nuclear Structure and Dynamics
- Applications and Interdisciplinary use of ion beams and nuclear techniques and methods

Laboratori Nazionali di Legnaro



XTU-Tandem accelerator

XTU-Tandem accelerator

TABLE OF TANDEM+ALPI REPRESENTATIVE BEAMS

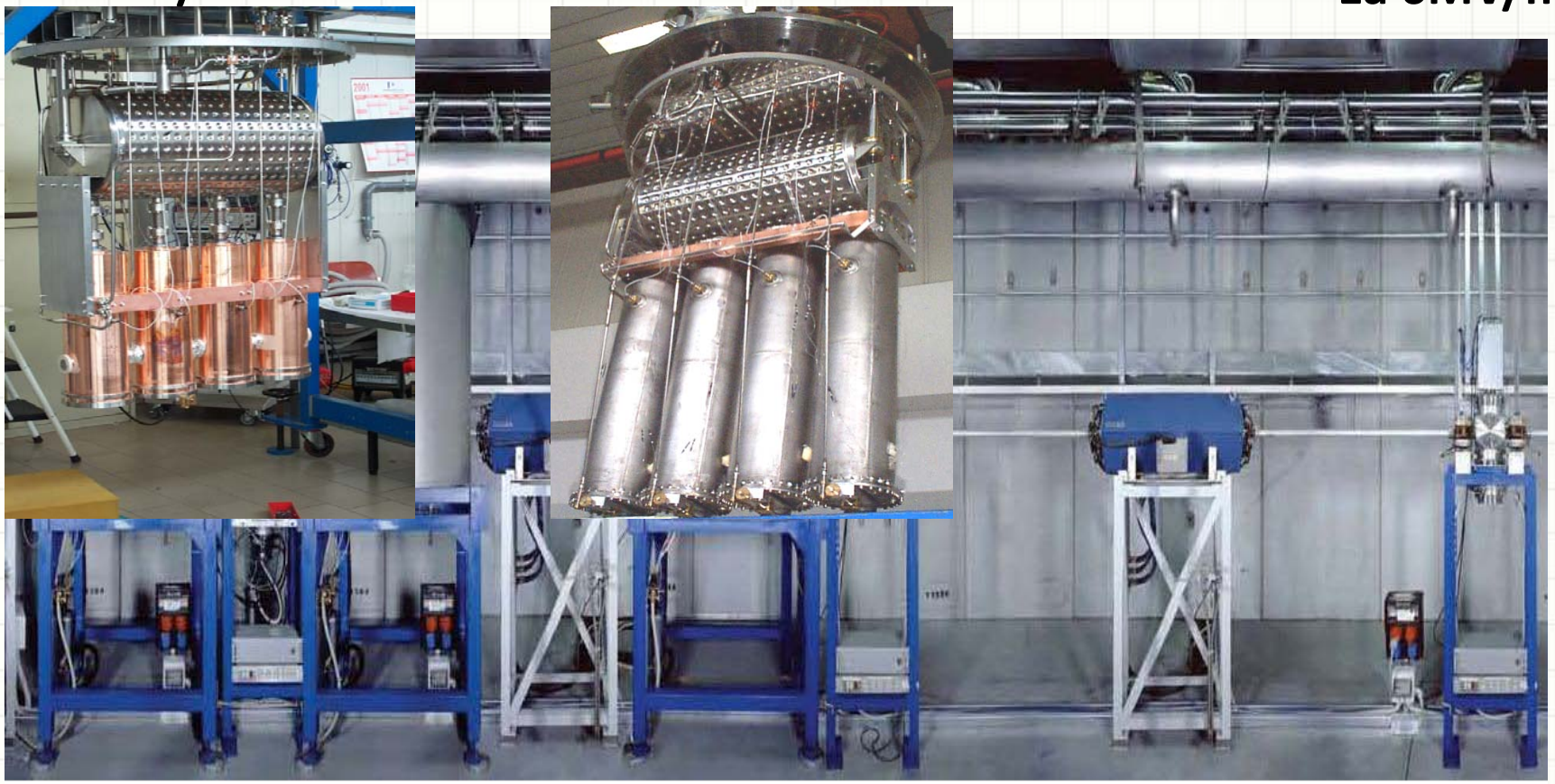
Beam	E [MeV]	E/A [MeV/A]	I target [pnA]
$^{1}H^{1+}$	240	20.0	2
$^{16}O^{7+}$	328	20.5	2
$^{48}Ca^{10+}$	505	10.5	1.3
$^{82}Se^{12+}$	582	7.1	7
$^{90}Zr^{14+}$	700	7.7	0.3

ALPI (Superconducting Linear Accelerator)

57 Nb /Cu, 160 MHz Medium β Ea 5MV/m

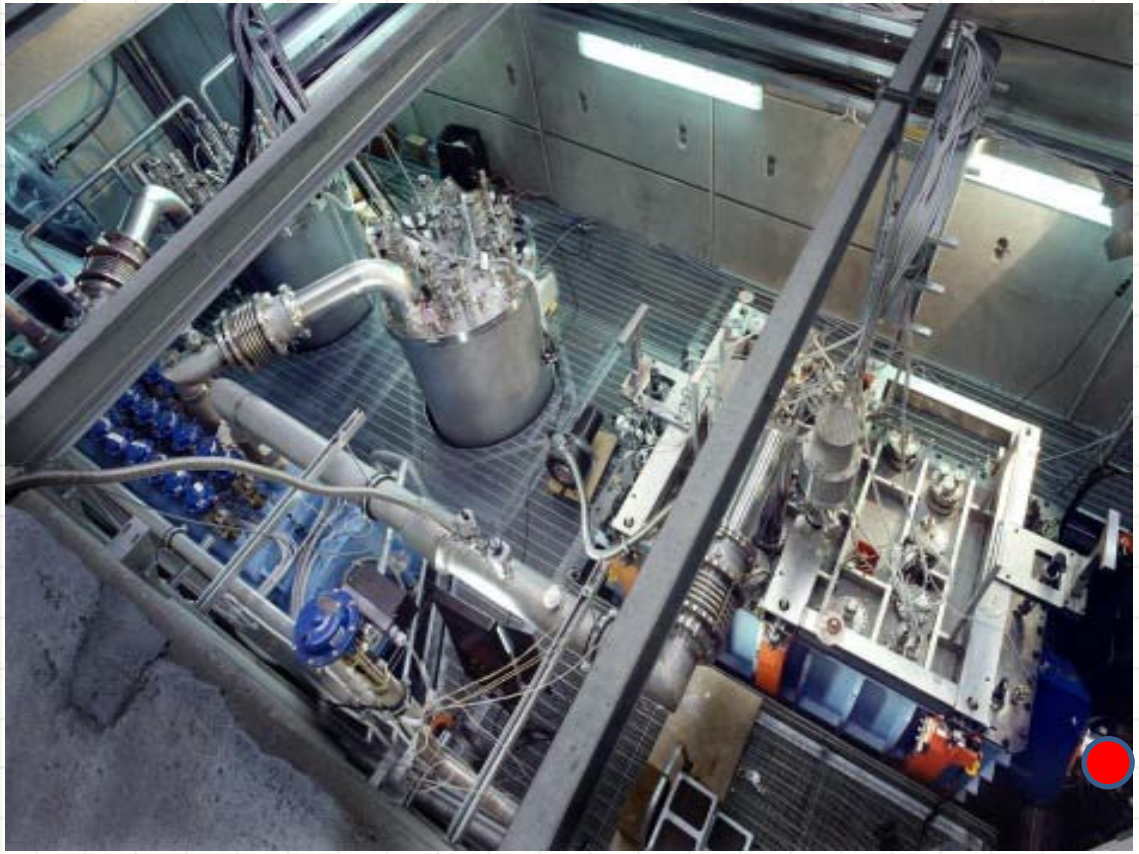
77 Super Conducting Quarter Wave Resonators (Nb, Nb/cu) In 20 Cryostats V_{eq} ~ 48 MV

20 Full Nb, 80 MHz Low β Ea 6MV/m



ALPI: Linear Accelerator for Ions

PIAVE: positive injector for ion at low velocity



PIAVE Veq ~ 8 MV

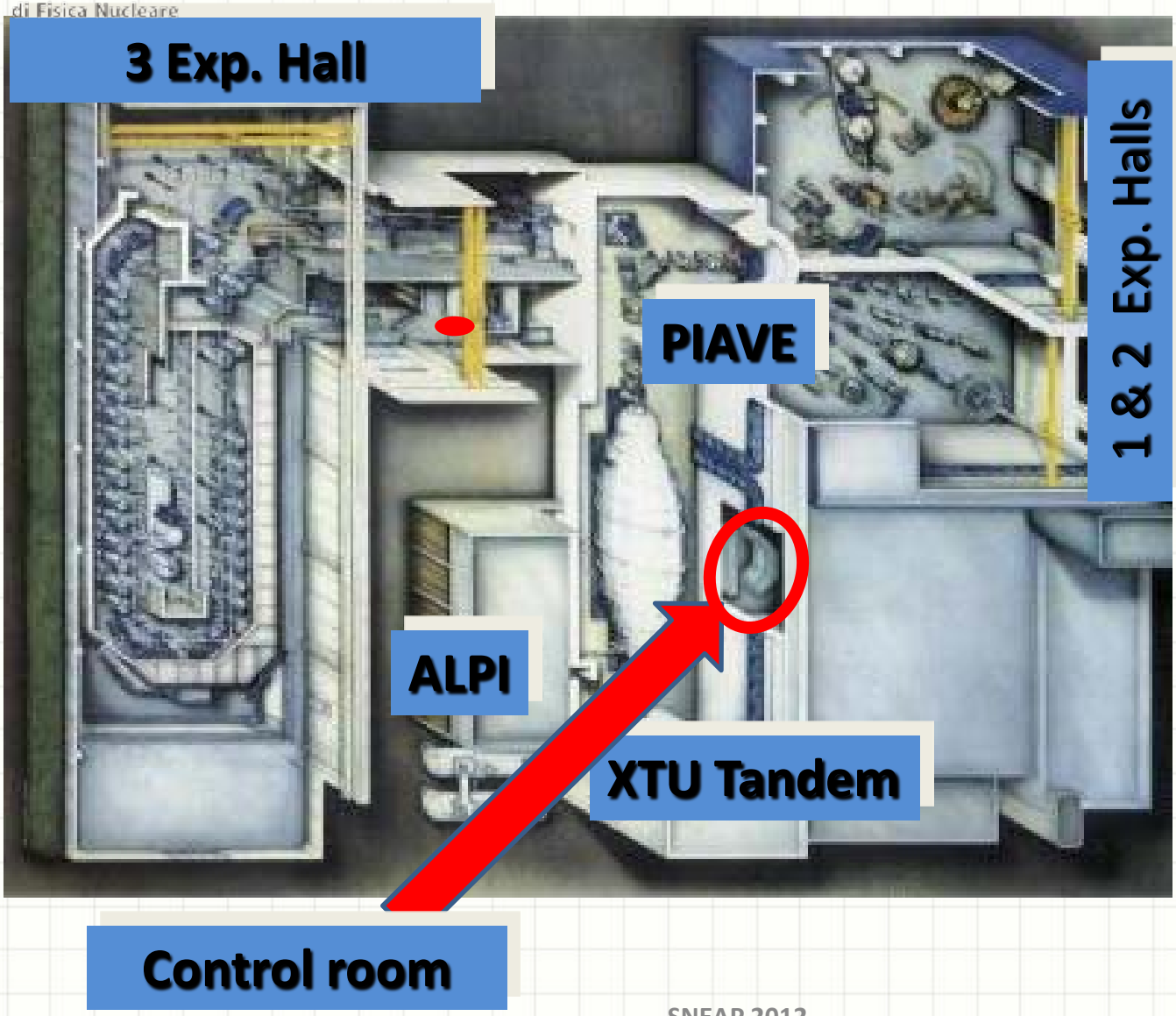
PIAVE is a superconducting linac (for us main an injector) operating at a rf frequency of 80 MHz and containing two SRFQ resonators followed by eight QWR's.

It accelerates beams from b=0.0089 to b=0.045, in the case of a +28U238 beam, for an efficient injection into ALPI.

TABLE OF CURRENTLY AVAILABLE PIAVE+ALPI BEAMS

Beam	E [MeV]	E/A [MeV/A]	I target [pnA]
$^{22}Ne^{4+}$	243	11.0	2
$^{84}Kr^{18+}$	800	9.5	5÷10
$^{120}Sn^{21+}$	850	7.1	1
$^{136}Xe^{34+}$	1240	9.1	1
$^{197}Au^{30+}$	1200	6.1	1

Tandem-ALPI-PIAVE complex



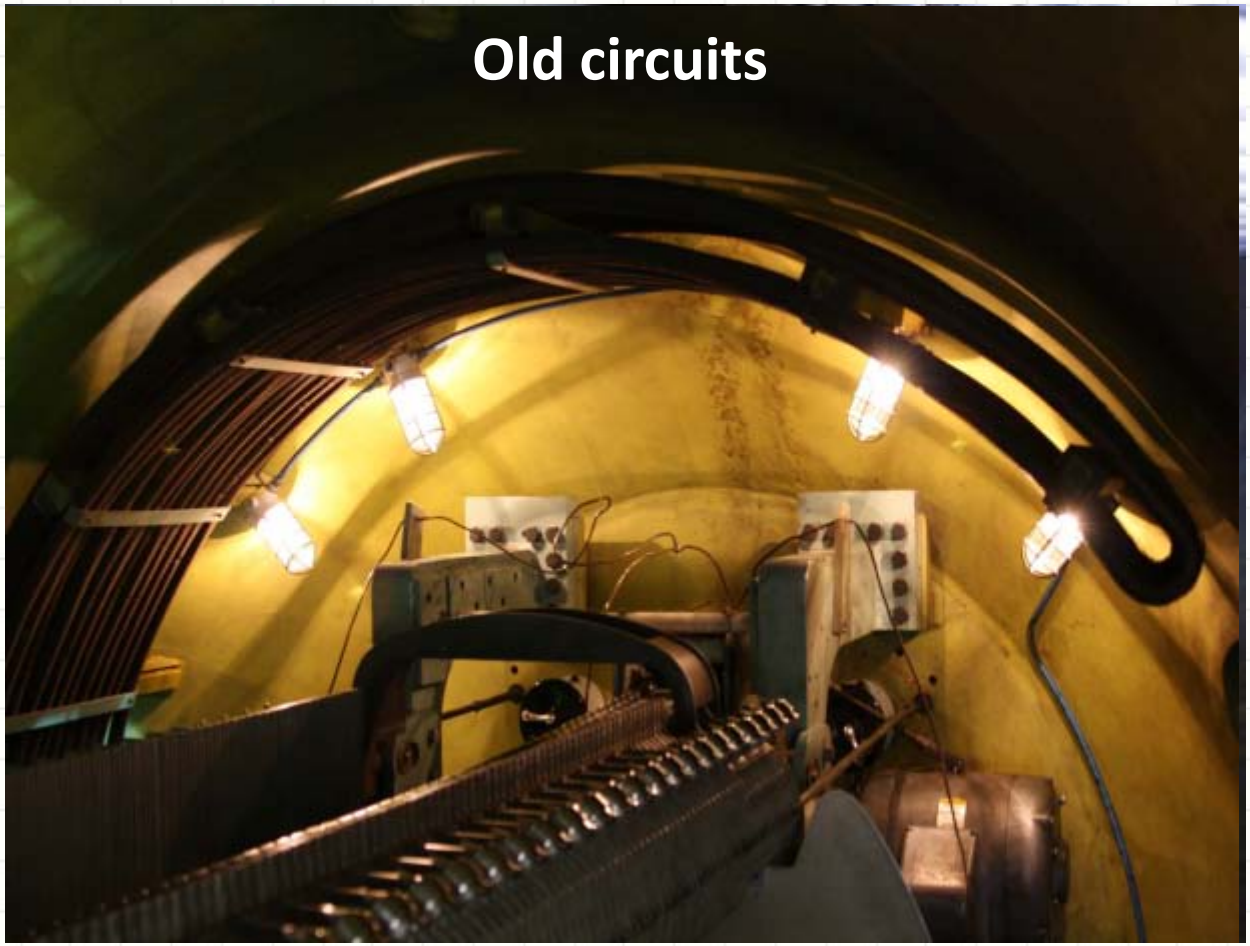
Here is displayed the PIAVE-Tandem-ALPI complex, the beams being injected by the XTU Tandem into the three experimental Halls, or in to the superconductive LINAC and then distributed to three experimental halls, two of them are shown.

Last maintenance two maintenance march 2011 & may 2012

1. Replacement of water cooling circuit inside the tank
2. Coil failure of a triplet (3q7) inside the ALPI U-bend
3. Magnet selection system replacement

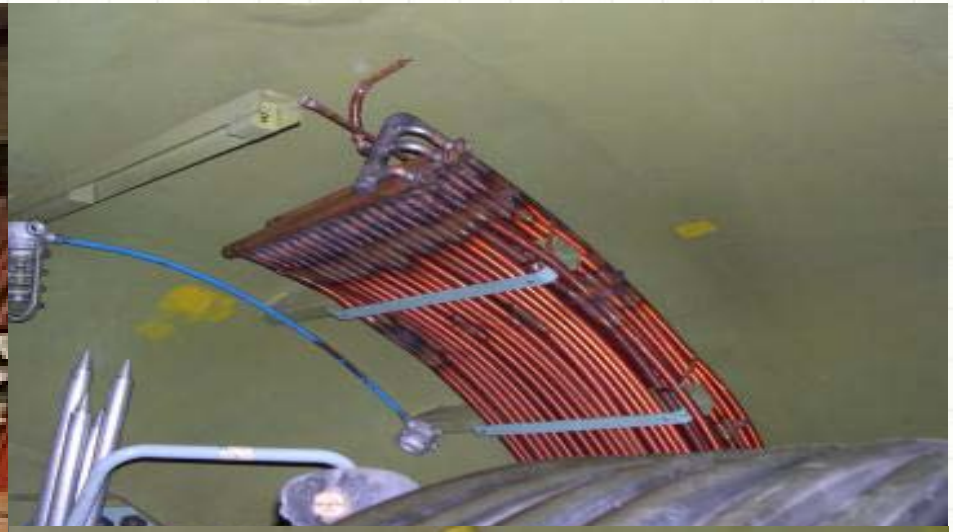
Replacement of water cooling system inside the tank

15th dicembar 2010



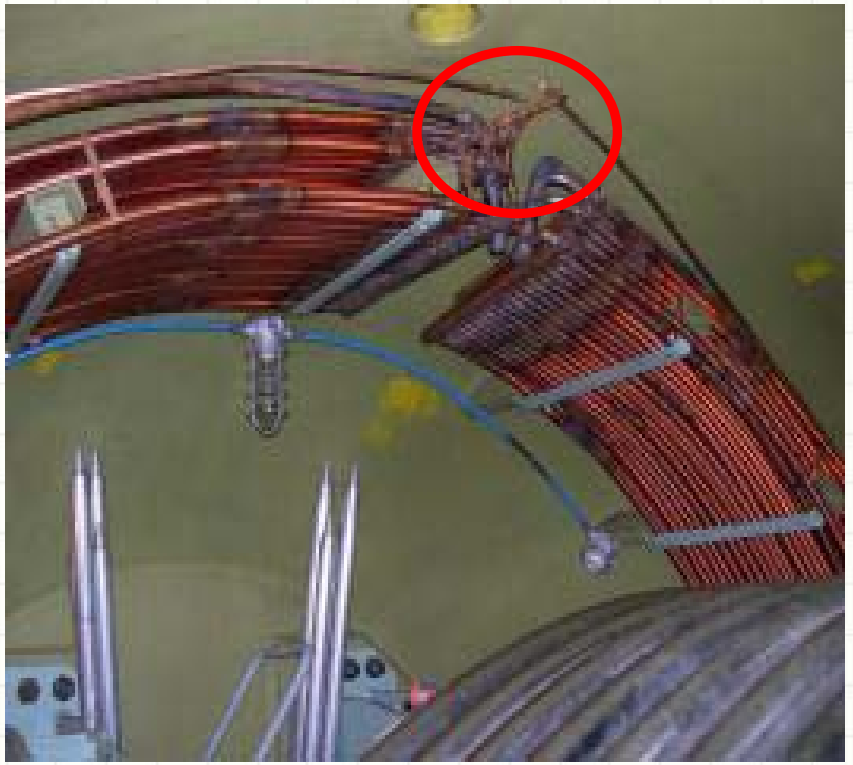
Immediately we have soldered the pipe to finish the last week of shift. After we have sent a request of quotation for a new one, with the same characteristics: thermal power exchange, conductivity, temperature and water velocity. But it was clear that the main problem would be to put inside and handling about 1 ton of copper (no crane inside the tank!). So we designed a new cooling system in a modular way.

We changed the design of the circuit



We found a modular solution: no more 4 x 280 Kg each one, 20 x 50 Kg each one.

We changed the design of the circuit

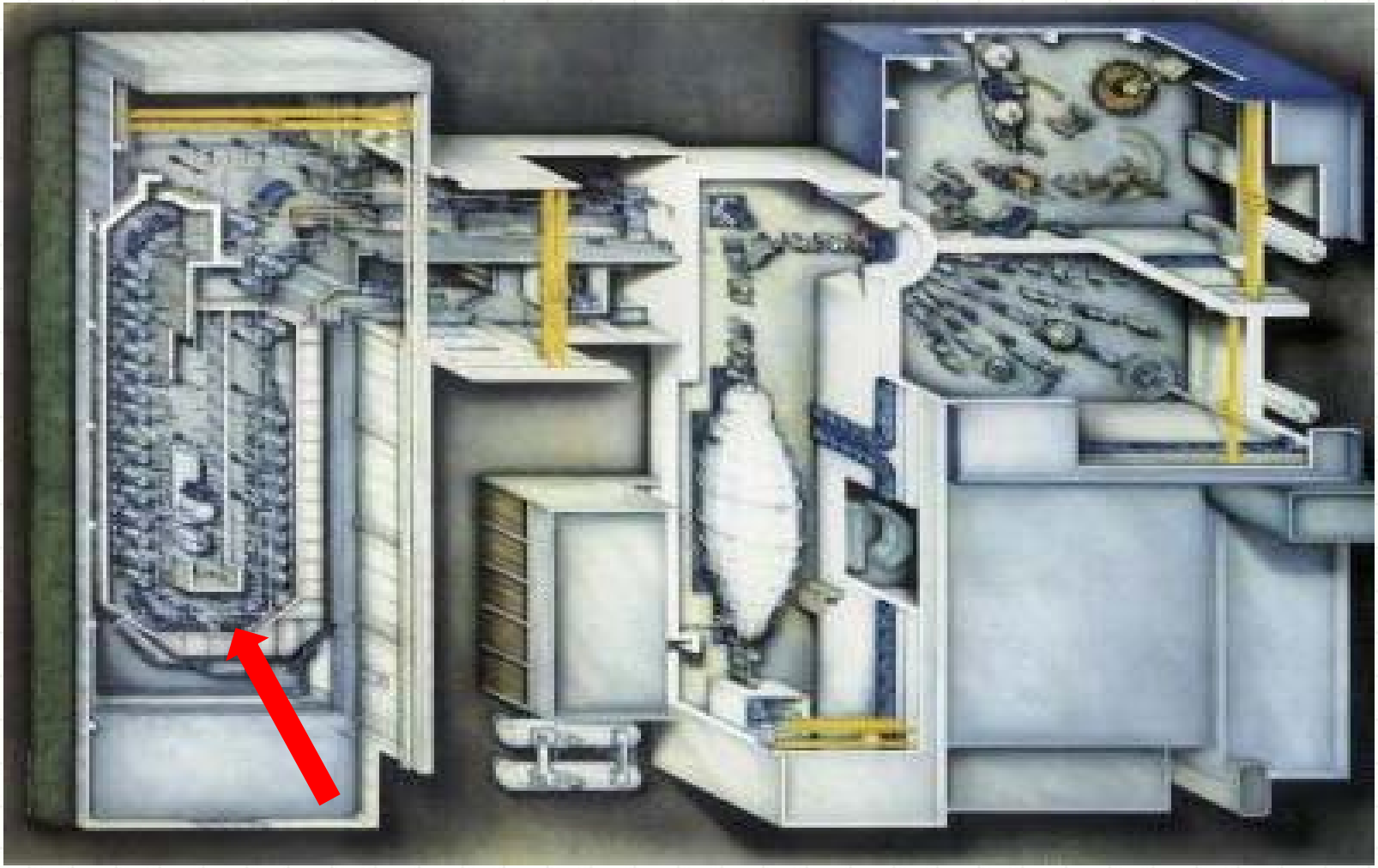


Thank to this particular kind of siphon, it was very easy to fill the circuit without leaving air bubbles inside.

We changed the design of the circuit

When all the welds were made, we tested the circuit at 8 bars

Coil failure of one triplet (3q7) inside ALPI U-bend



Coil failure of one triplet (3q7) inside ALPI U-bend

We found open one of the 12 coils: unbelievable but true! Temporarily, we worked connecting the coils of the triplet using it as a doublet. We were penalized a few % in transmission, but it allowed us to work waiting for new coils.

Coil failure of one triplet (3q7) inside ALPI U-bend

We know that the copper oxide production it is mainly a result of:

- Air introduced in the water;
- Radiolysis: water + radiation;

In our case, the principle of copper oxide production has occurred due to a loss of cooling water circuit through which oxygen entered.
We have analyzed the water and we found values of conductivity > of 1000 µS / cm. After analysis, the fault in the circuit has been repaired and today the conductivity is <0.01 µS / cm.

Dr. Per Ladefoged,
Project Manager,
Research & Industry, DANFYSIK

Coil failure of a triplet (3q7) inside ALPI U-bend

Coil failure of a triplet (3q7) inside ALPI U-bend

Istituto Nazionale di Fisica Nucleare

January 2012

July 2012

Coil failure of a triplet (3q7) inside ALPI U-bend

Next month we will receive back the «open» coil, so we can investigate more. Until now we are sure it is not black magic (the «open» measure) we know it is something phisical, but…. we will investigate better next year.

Magnet selection system replacement

Do you remebar ?

In the experimental halls 1& 2 we have 7 beam lines each hall

And we have 2 doublet each line

But

We have just 2 P.S. (+ 1 spare)

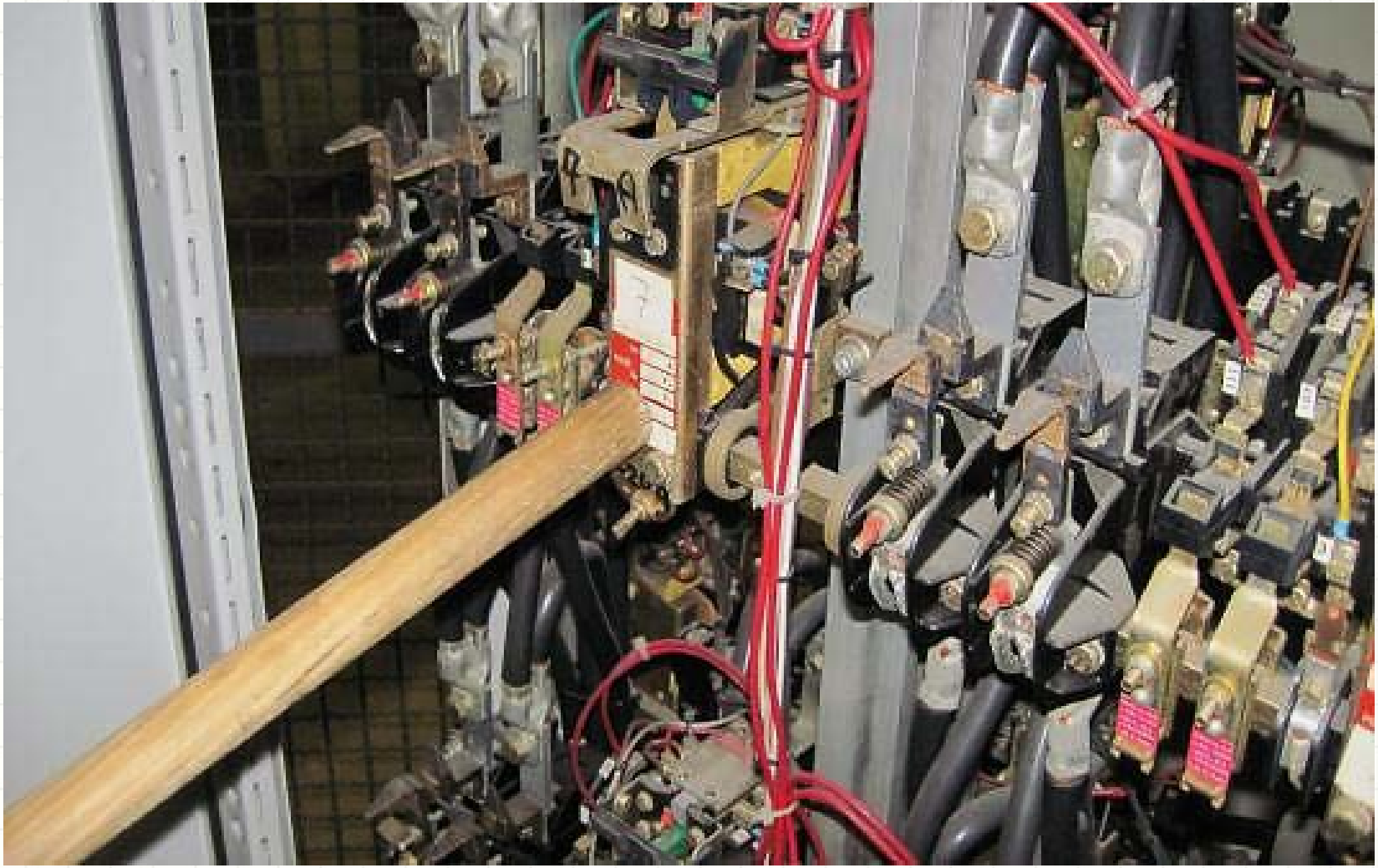
So we have a Magnet selection system

associates Power Supply to the lens (A & B).

But it was old, and last may we replace it

Magnet selection system replacement

Status on March 21, 2012



Magnet selection system replacement

Magnet selection system replacement

Magnet selection system replacement

Function

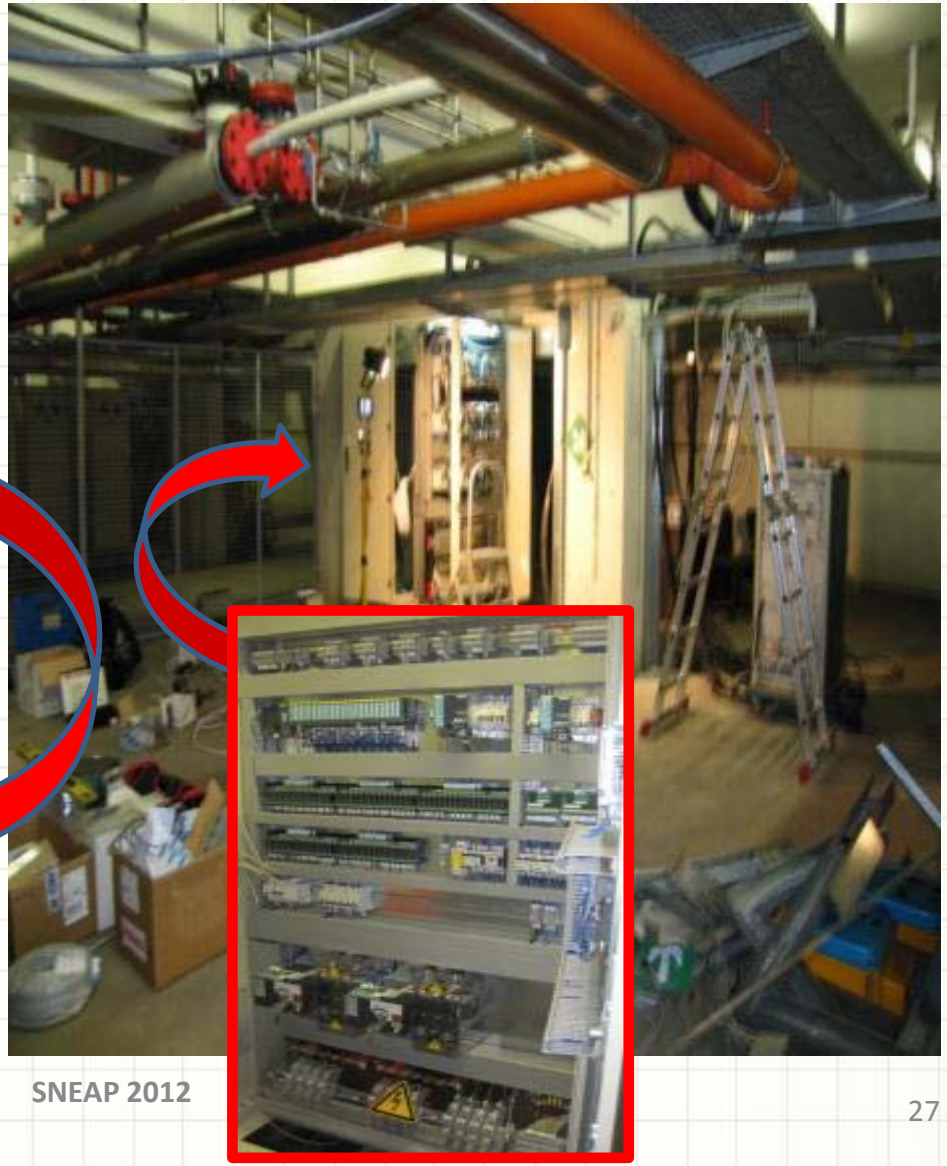
It switches:

- Control P.S. Lens A, B, SW, H.E.
- Control Magnetic lenses
- Vacuum control interface (valve 1 for each line)
- Management of safety interlocks

Use

- Bistable switches remote control
- Open industrial Ethernet standard of PROFINET International (PI) for automation.

Status on April 13, 2012



Magnet selection system replacement

The bistable switches
If there is a PLC failure, it is possible to swicth manually

1700 m of cables were wired for auxiliary

The solution is industrial architecture with PROFINET

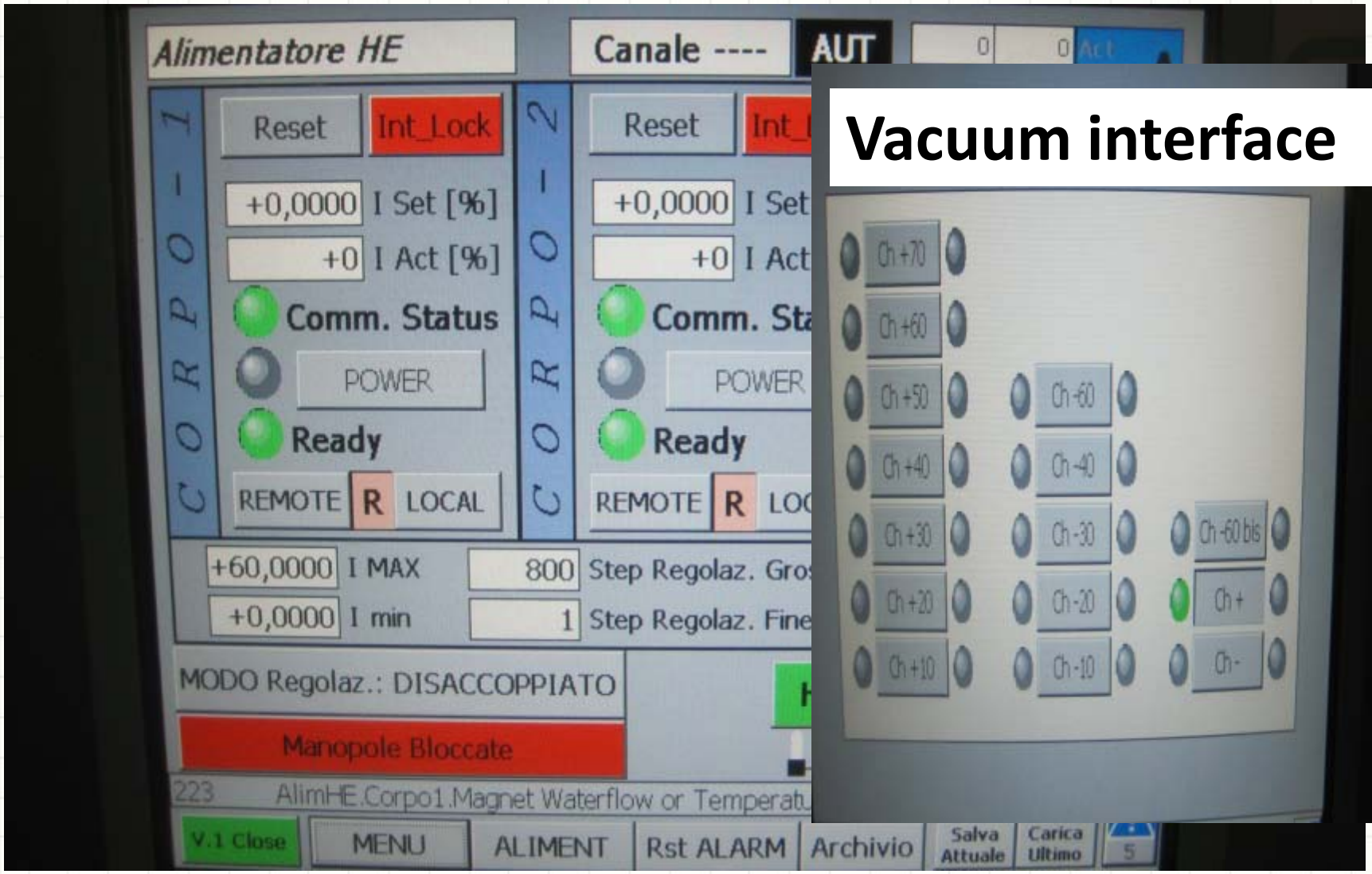
PROFINET is the open Industrial Standard Ethernet that combines the strength of traditional fieldbus "Profibus" with the standard Ethernet opportunity;

In this way, we have a robust fieldbus able to use all the facilities of the networks;

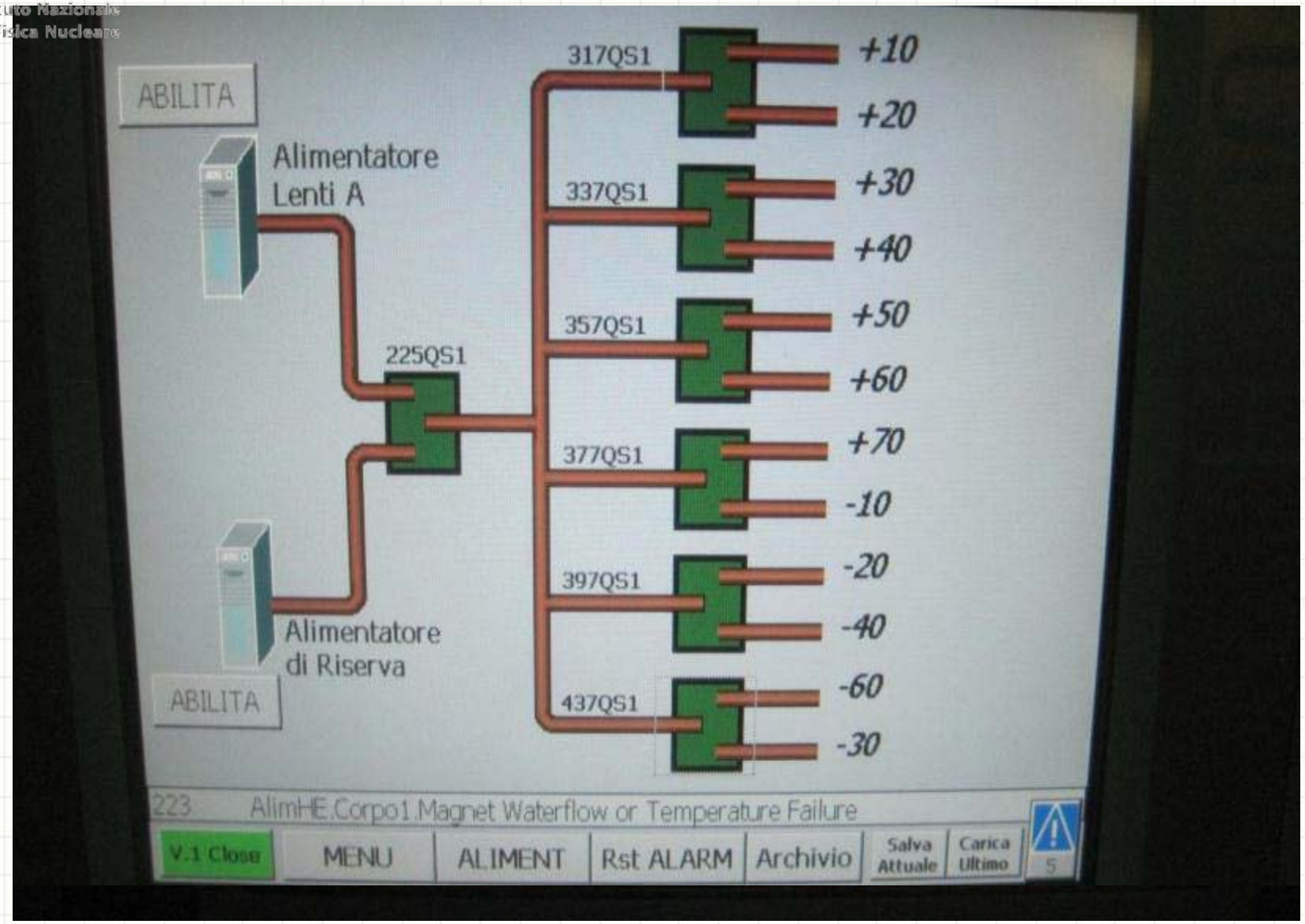
It is divided into three levels (input, output and communication, managed with priority levels).

Magnet selection system replacement

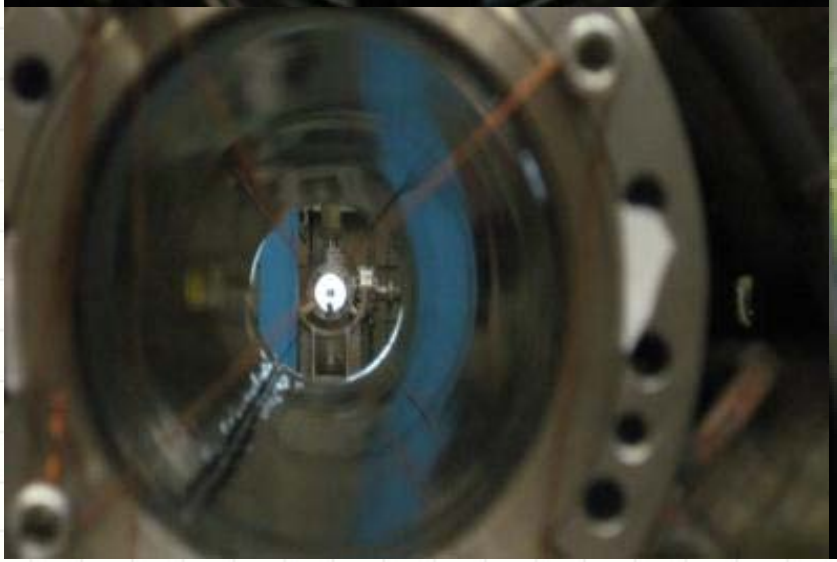
Magnetic Lens Control System

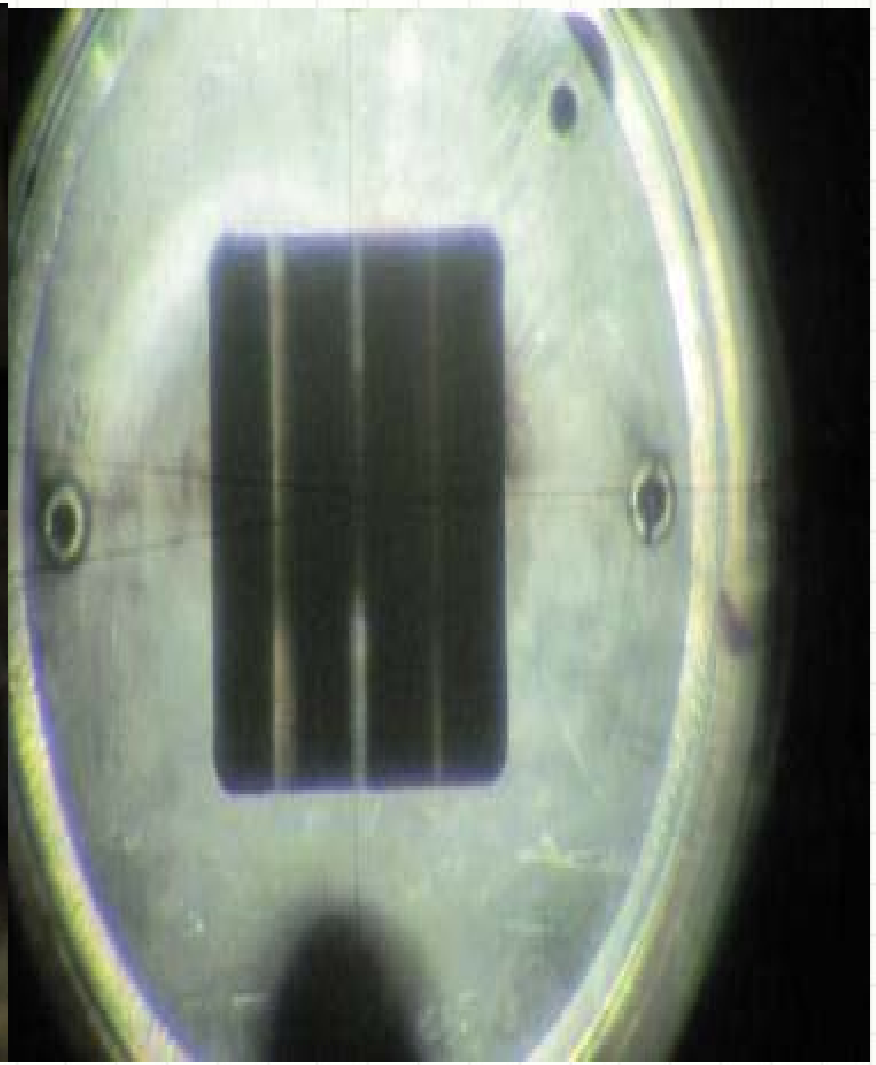


Magnet selection system replacement

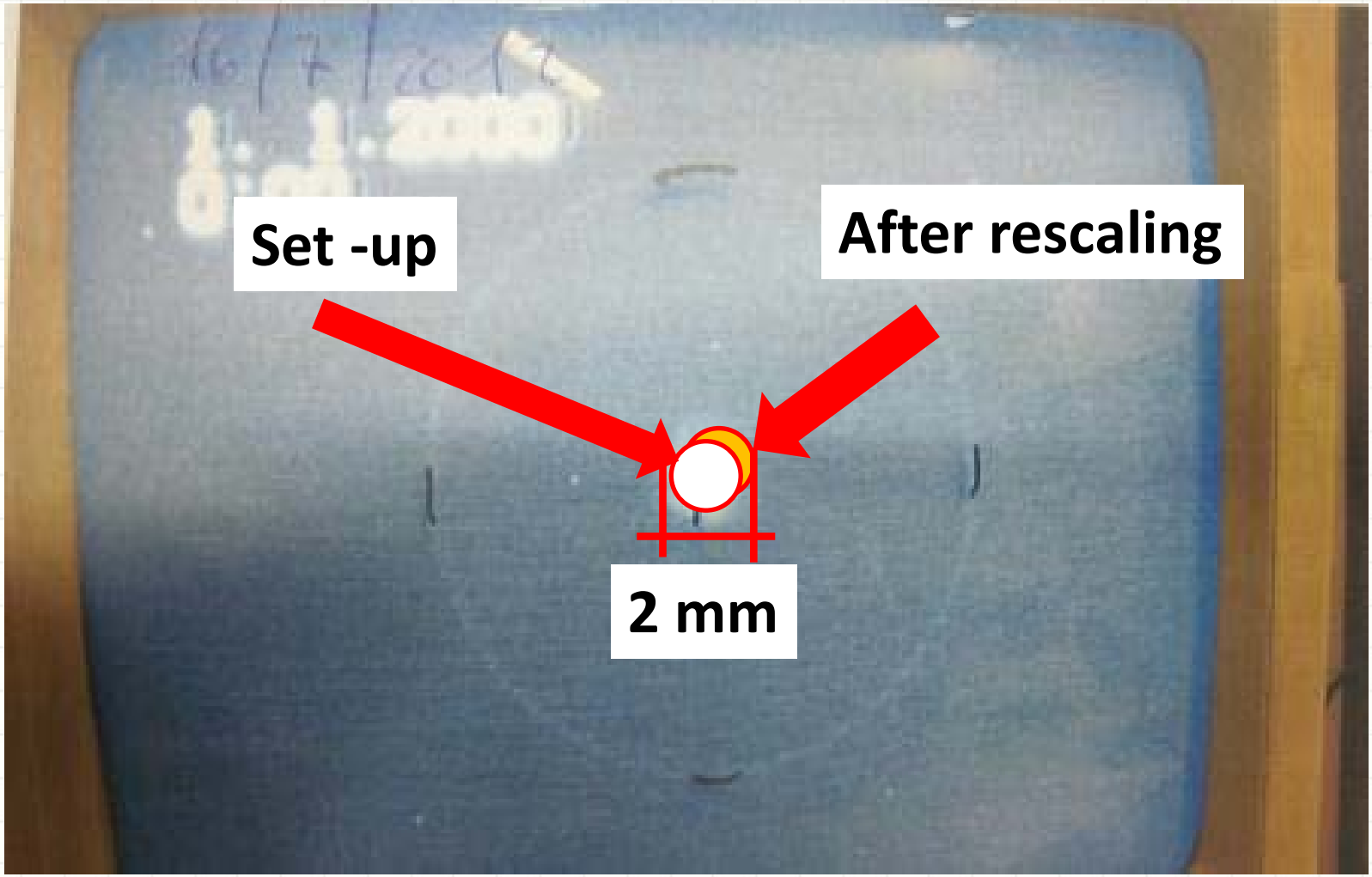


Magnet selection system replacement



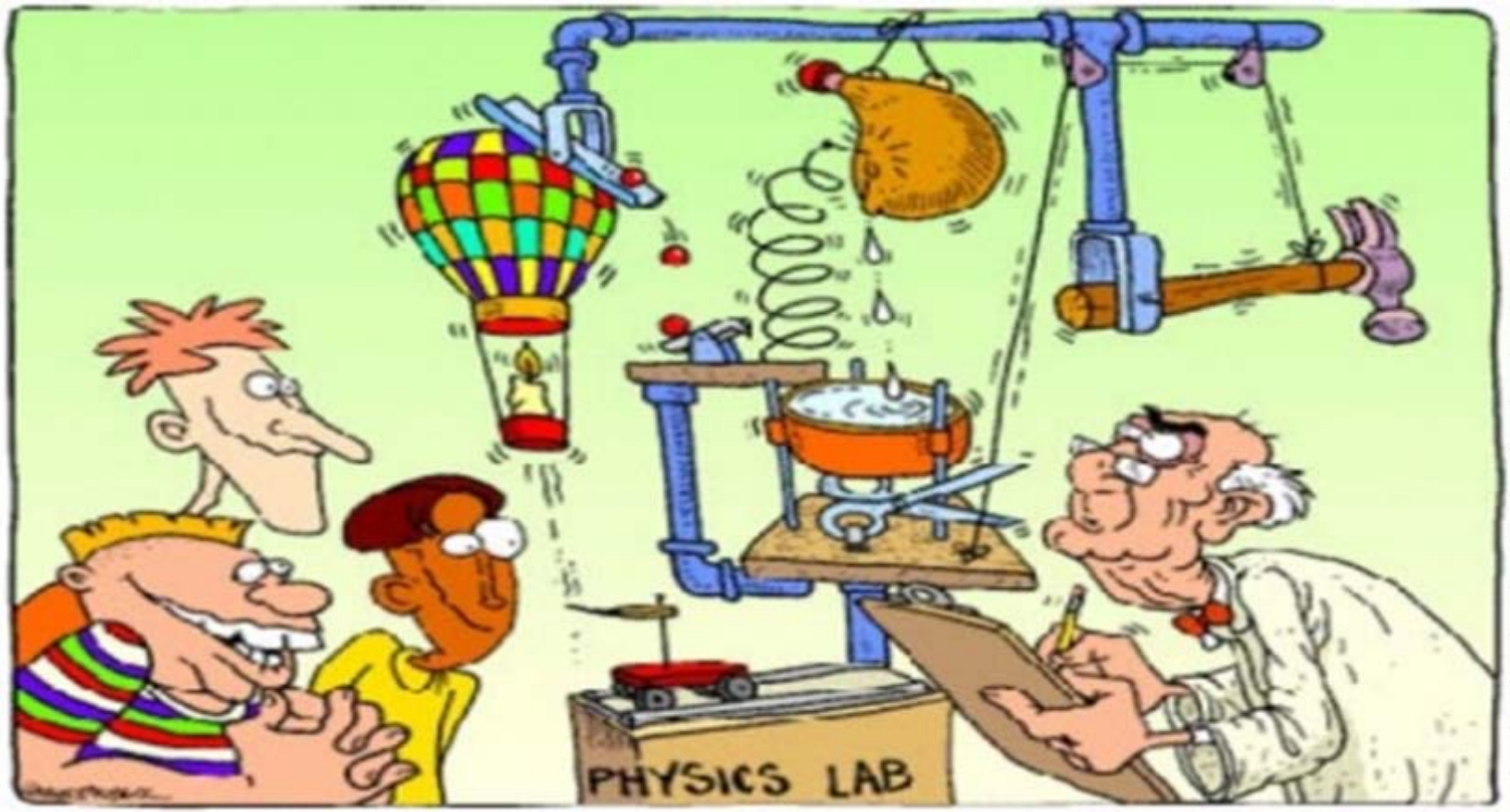


After just a simple scaling with the new magnet selection system



Summary

This presentation, it is not a lesson of Physics but: <u>Just ours experience</u>



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Istituto Nazionale di Fisica Nucleare

Thank you for your attention