

Istituto Nazionale di Fisica Nucleare

SNEAP 2012

Tandem ALPI PIAVE complex

October 3 rd, 2012

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Tandem-ALPI-PIAVE complex

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<u>Outline</u>

- 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 NFN - Ide Zard Istituto Nazionale di Fisica Nucleare **MULTI TASK** TRIESTE MILANO **MULTI DISCIPLINARY** TORINO DAR ALESSANDRIA BOLOGNA **But mainly** GENOVA CNAF FIRENZE **Nuclear Physics Based** SIENA PISA **User Oriented** PERUGIA LNGS Laboratories L'AOUIL/ OMA2 NAPOLI BARI **CORE RESEARCH ACTIVITIES Nuclear Structure and Dynamics** CAGLIAR COSENZ **Applications and Interdisciplinary** • MESSIN use of ion beams and nuclear CATANI/ techniques and methods

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XTU-Tandem accelerator

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Beam injected to the super conducting LINAC

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Beam to the

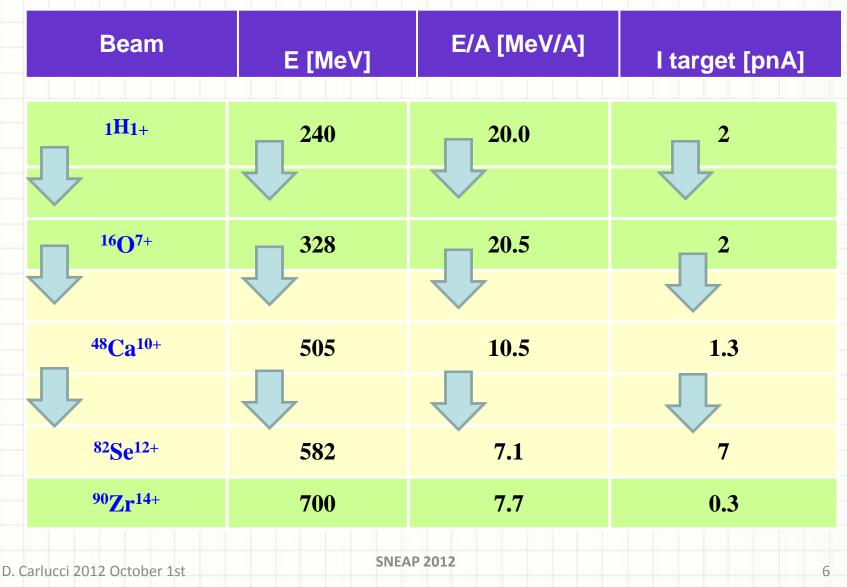
experimental halls

XTU-Tandem accelerator

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TABLE OF TANDEM+ALPI REPRESENTATIVE BEAMS



INFN 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



INFN ALPI: Linear Accelerator for lons

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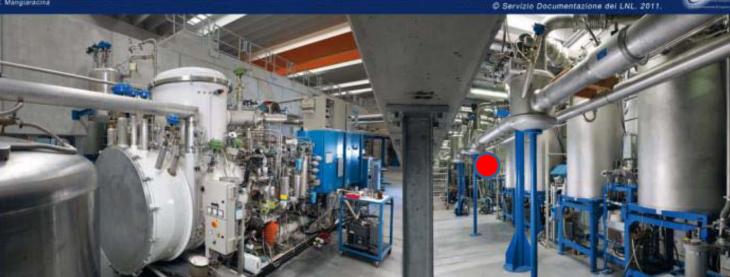
Foto e composizione grafice: F. Mangiaracin

L'acceleratore ALPI, costruito negă anni '90 e progettato interamente nei LNL, consta di 72 cavită acceleranti, contenute in 18 oriestati.

Una prima sectorie (bassa e media energia, 8 criostati), e seguita da un'ambie magnetica, che ourve il fascio di 180°, e de una seconda suzione (media ed aña energia).

Al centro dell'interene, fa le duotimes accelerante, a colocotri il refrigeratore criogenico ad Ello, con capacita nominale costemia equivalenta, a 45 K, di 1000 W, più 3000 W acros 70%. La cavita acceleranti anno in Rame investo di Nocho, oppute in Noboli massicoso, e, antiveidate dall'Ello liquido, laverano in regime di superconduttività, a Visopenco di 80 o 160 MHz, sintropenco campi acceleranti di 4-7 MVim

ALPI può acceletare fasci di oni dei può leggen ("Ci al piùpesanti ("Au), Nirotonando come postacceleratore dell'acceleratore Van de Graafi XTU-TANDEM, oppure, separatamente, con Finiettore PIAVE L'orengia finale dei fascio può variare da 5 a 20 MeV/L.



Acceleratore lineare superconduttivo

"ALPI"

Sopra: linea di alta energia e refrigeratore criogenico ad Elio.

Sotto: refrigeratore criogenico ad Elio e linea di bassa energia.



PIAVE: positive injector for ion at low velocity

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PIAVE Veq ~ 8 MV

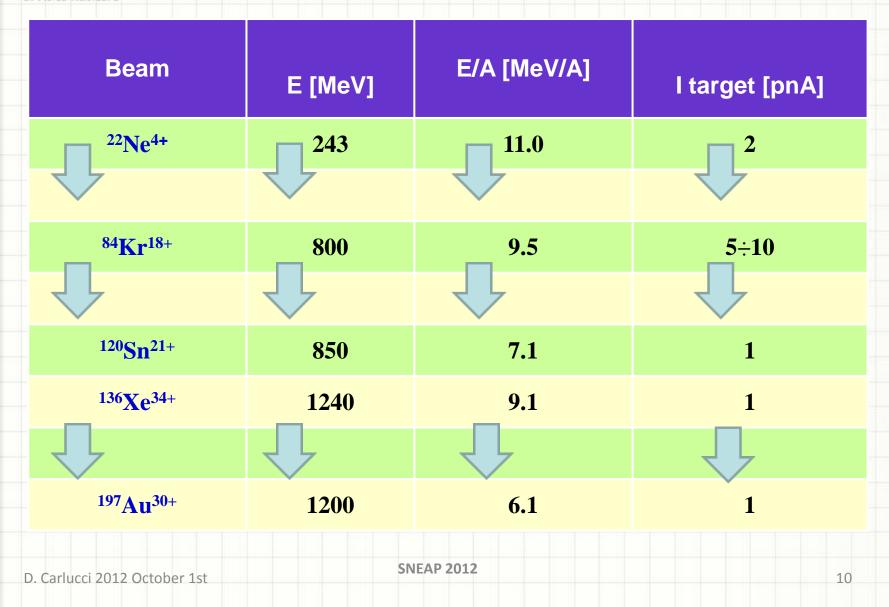
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PIAVE is a superconducting linac (for us main an injector) operating at a rf frequency of 80 MHz and containing two SRFQ resonators followed by eight QWR's.

It accelerates beams from b=0.0089 to b=0.045, in the case of a +28U238 beam, for an efficient injection into ALPI. SNEAP 2012

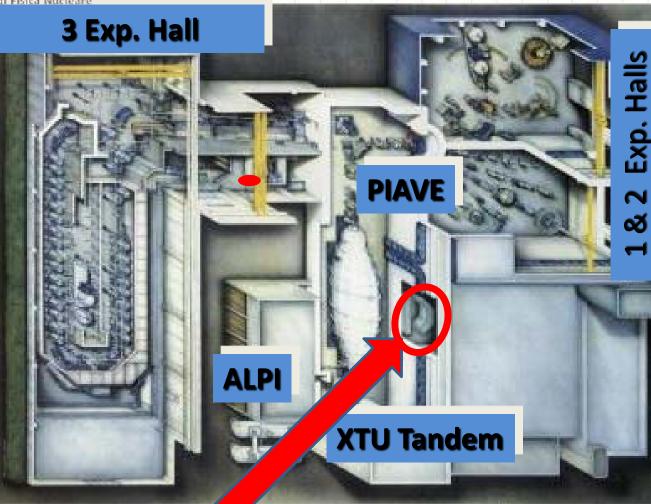
INFN' TABLE OF CURRENTLY AVAILABLE PIAVE+ALPI BEAMS

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Tandem-ALPI-PIAVE complex

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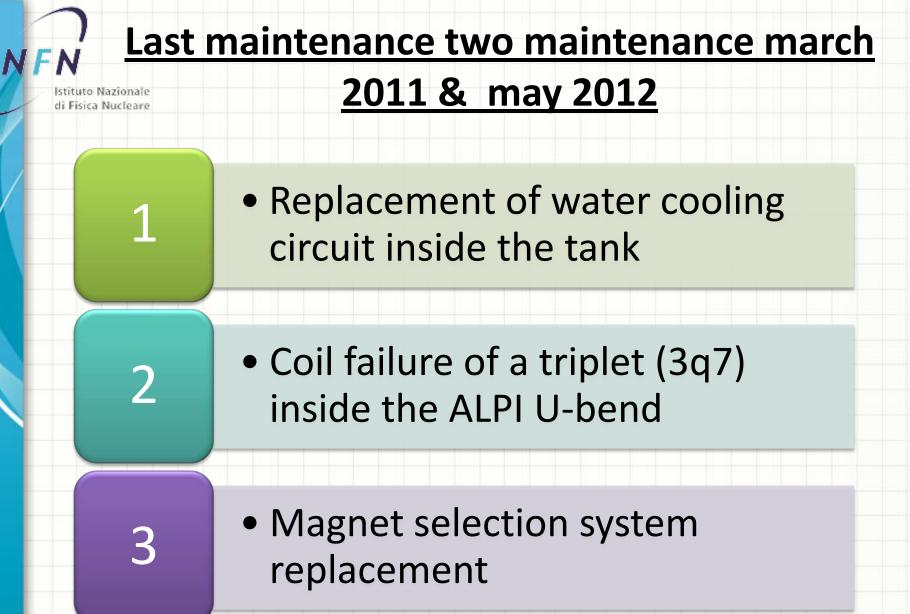
Here is displayed the PIAVE-Tandem-ALPI complex, the beams being injected by the **XTU Tandem** into the three experimental Halls, or in to the superconductive LINAC and then distributed to three experimental halls, two of them are shown.

Control room

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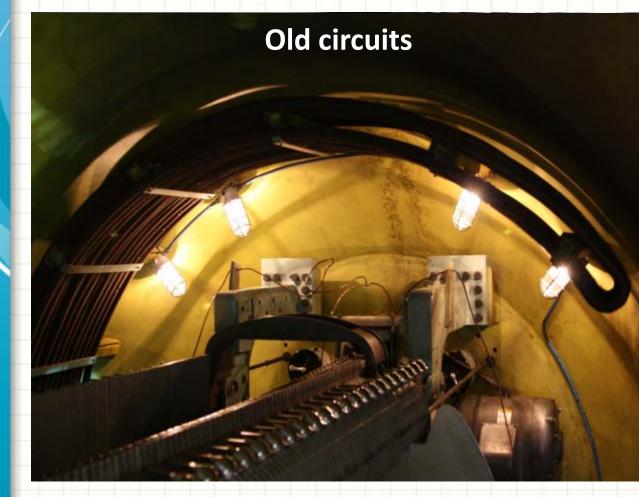
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Replacement of water cooling

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

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INFN We changed the design of the circuit

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We changed the design of the circuit

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

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INFN We changed the design of the circuit

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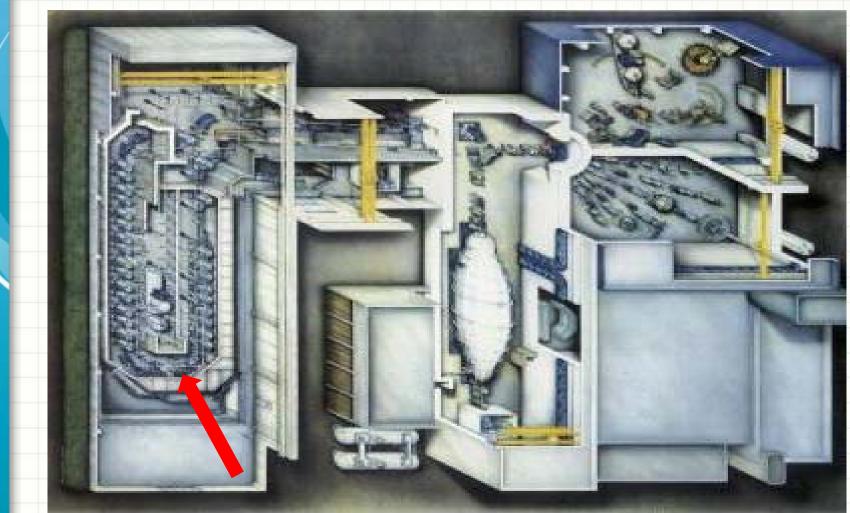
When all the welds were made, we tested the circuit at 8 bars





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Coil failure of one triplet (3q7) Istituto Nazionale di Fisica Nucleare inside ALPI U-bend



Coil failure of one triplet (3q7) inside Istituto Nazionale di Fisica Nucleare 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.

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Coil failure of one triplet (3q7) inside

ALPI U-bend

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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 μ S / cm.



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

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

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

di Fisica Nucleare

January 2012

July 2012



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

Istituto Nazionale di Fisica Nucleare 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.

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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



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Status on March 21, 2012



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di Fisica Nuffeare

Status on April 13, 2012

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.



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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 Istitute Nazionale di Fisica Nucleare 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).

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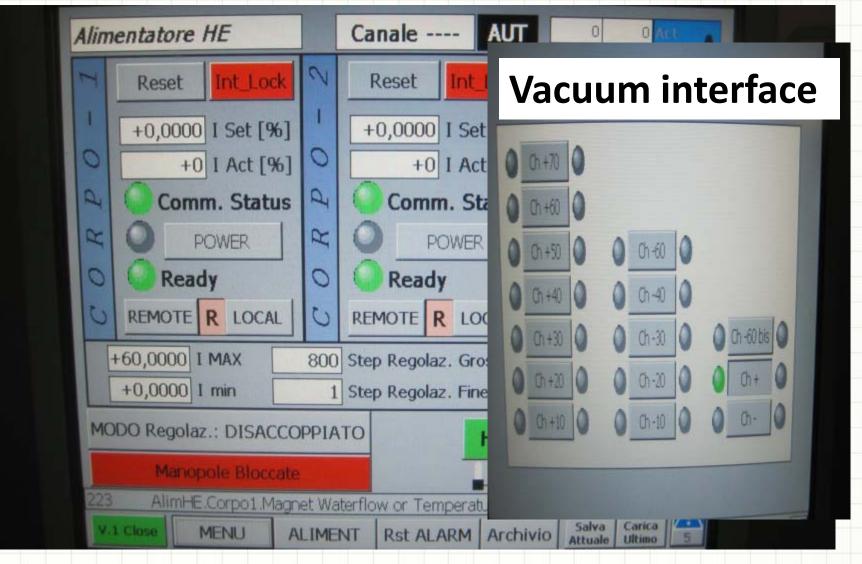


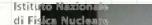
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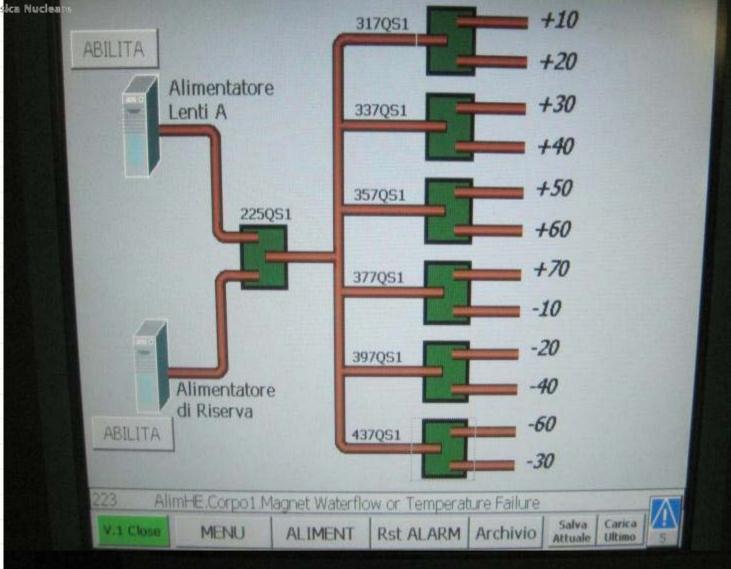
Magnetic Lens Control System

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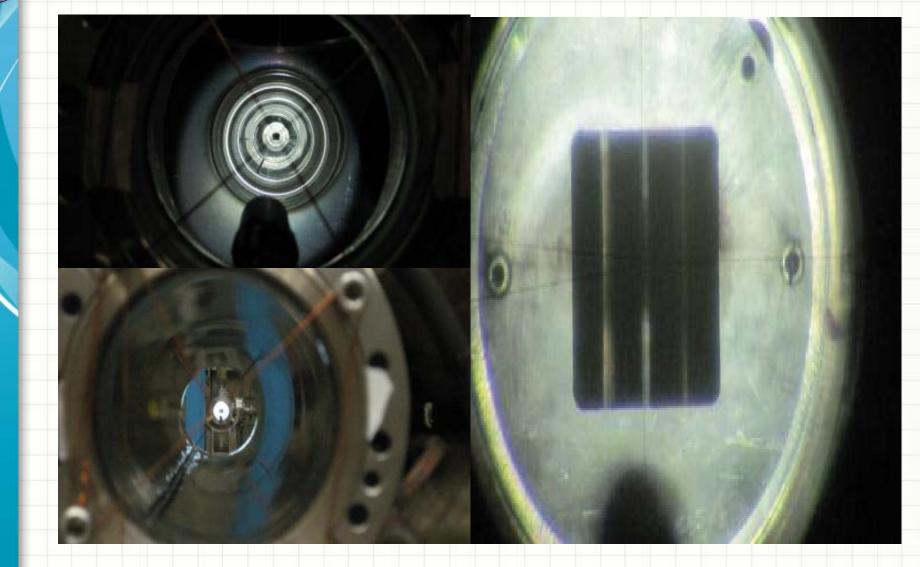




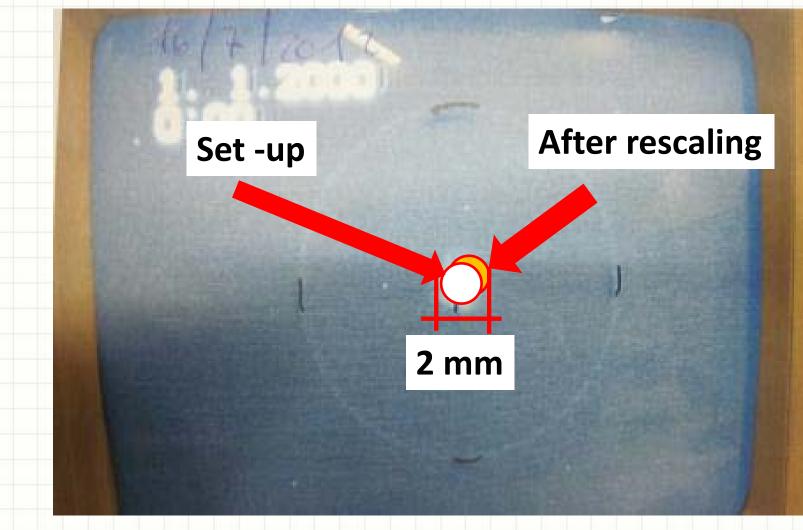


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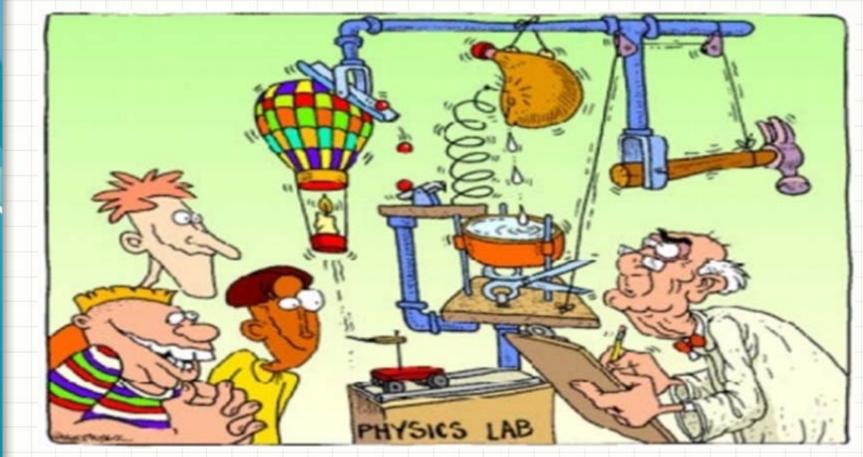
Summary

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This presentation, it is not a lesson of Physics

but: Just ours experience



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Acknowledgments:

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Marco Poggi

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INFN My acknowledgments to Operation Team

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Thank you for your attention