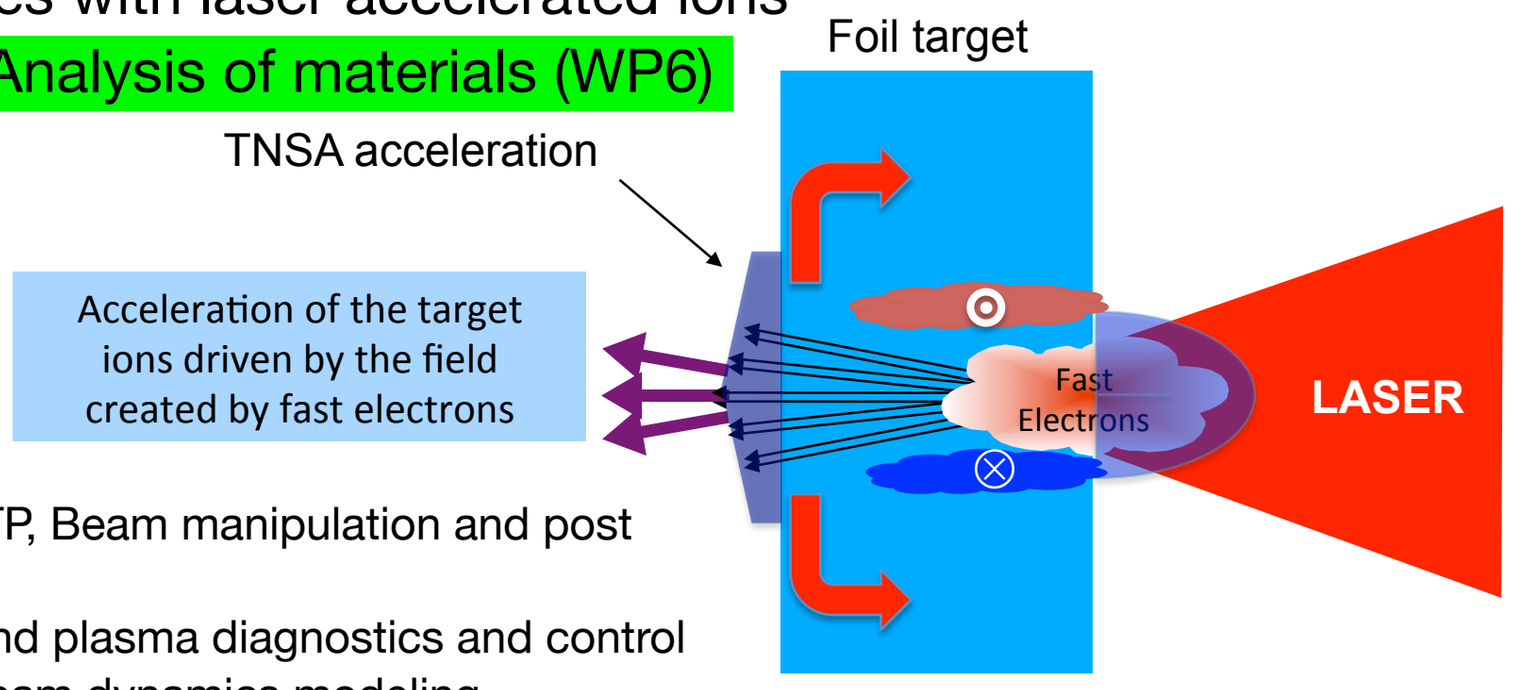
L3IA: Line for Laser Light Ions Acceleration

A laser-accelerated beamline for light ions:

- Develop ion acceleration with ultraintense lasers;
- New target techniques for control of energy spectrum and beam collimation;
- Establish a proton beam line at 14 MeV for applications;
- Provide a dedicated test beamline for ELI (e.g. ELImed@LNS)
- A platform for radiobiology studies with laser accelerated ions
- Test the feasibility for Ion Beam Analysis of materials (WP6)



Milano: detectors development – dedicated TP, Beam manipulation and post acceleration;
Pisa: laser, laser-plasma acceleration, laser and plasma diagnostics and control
Bologna: Theory: particle in cell modelling, beam dynamics modeling
LNS: beam characterization, dosimetry, medical applications;
LNF: detectors and post acceleration
Napoli: radio-biology and medical applications, analytical laser-plasma modelling
Firenze: Ion beam based analysis

Il WP6 di L3IA nel contesto internazionale

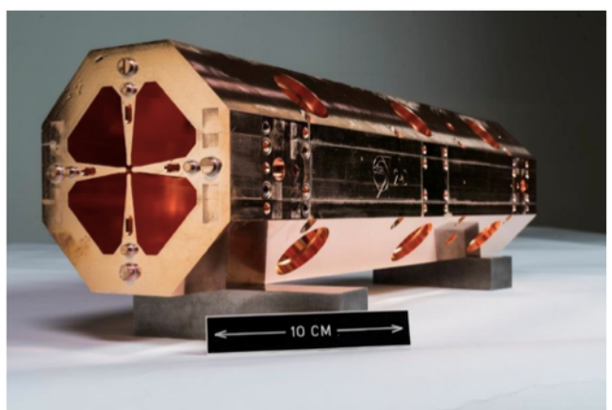
A Roadmap for Ion Beam Techniques (International Atomic Energy Agency)

IBT Roadmap

IAEA

"…reducing the instrument footprint …"

The miniature accelerator (CERN)



RFQ at 3 MeV
Lenght 1.5 m
Weight 150 kg

"Can become a portable accelerator for the analysis of artwork in museums or archeological sites"
(in collaborazione con M. Vetrenar, CERN)

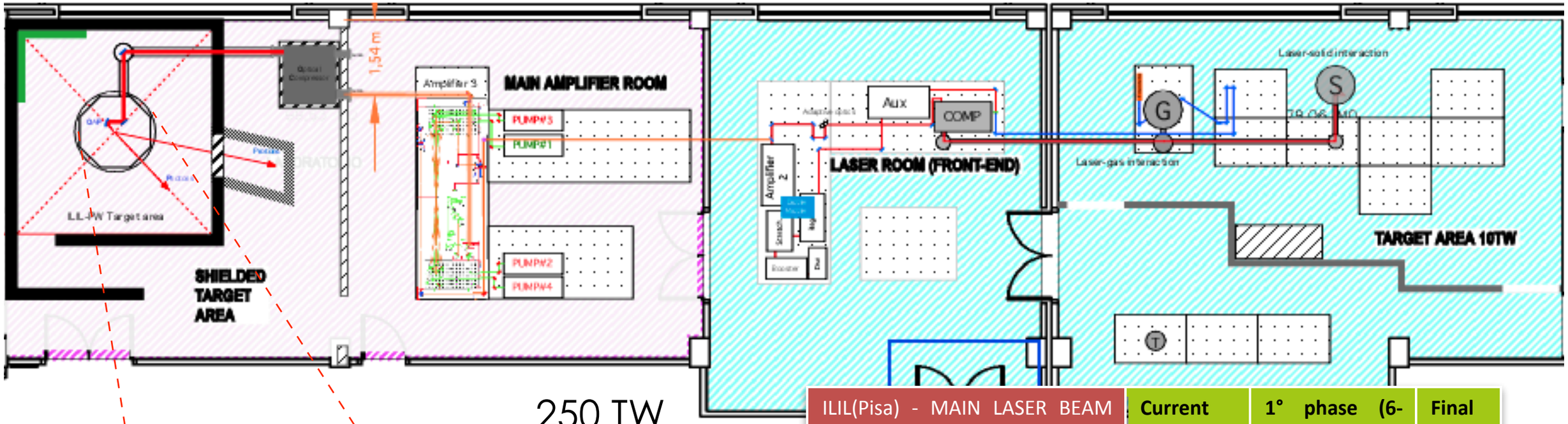
Laser driven ion acceleration:

- High gradient acceleration: MeVμm–1, compared with ~MeV m–1 provided by radio frequency (RF) based accelerators;
- Ultra-short duration at the source of the ion bunch of the order of picoseconds
- Very small effective source size: ≈10 μm
- Highly laminarity and very low emittance
- Broad energy spectrum, low collimation
- High charge: 10^8-10^9 particles

L3IA @ILIL (INO CNR Pisa)

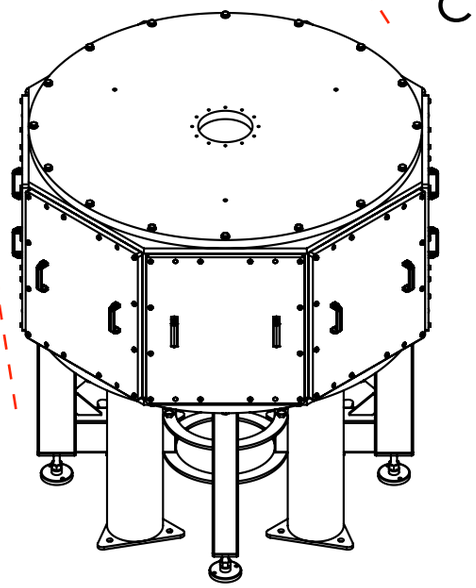
Upgrade

Existing



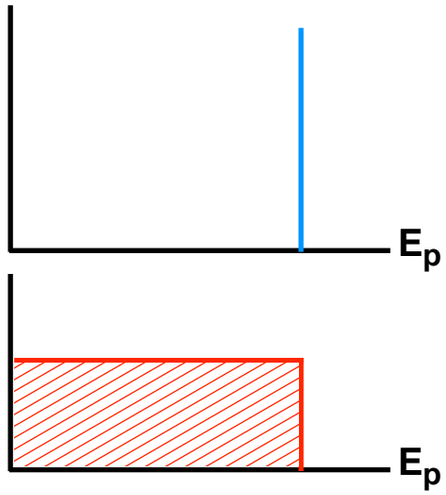
New target area

250 TW amplifier and compressor



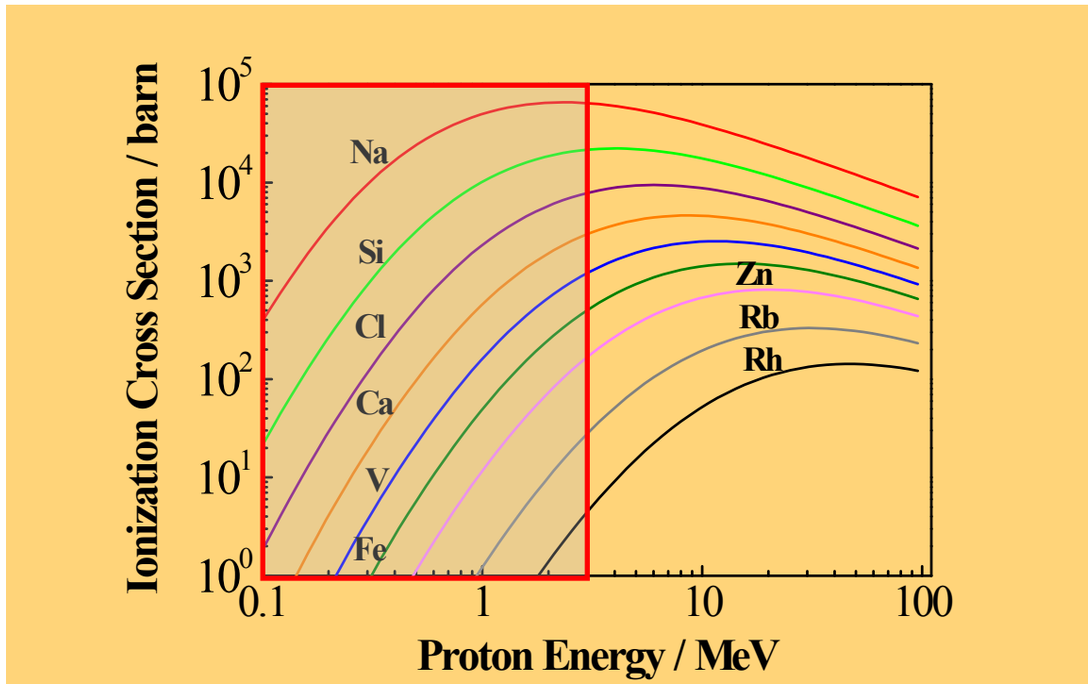
ILIL(Pisa) - MAIN LASER BEAM PARAM.	Current (dec.2015)	1° phase (6-2016)	Final
Wavelength (nm)	800	800	800
Pump Energy (J)	1.8	6(12)	24
Pulse duration(fs)	40	30	25
Energy before compression (J)	0.6	2(4)	7
Energy after compression (J)	0.4	1.5(3)	5
Rep rate (Hz)	10	1	1
Max Intensity on target	2E19	7.5E19(1.2E20)	4E20
Contrast (ns)	>1E9	>1E9	>1E10
Expected proton beam energy (MeV)	2	6(8)	12

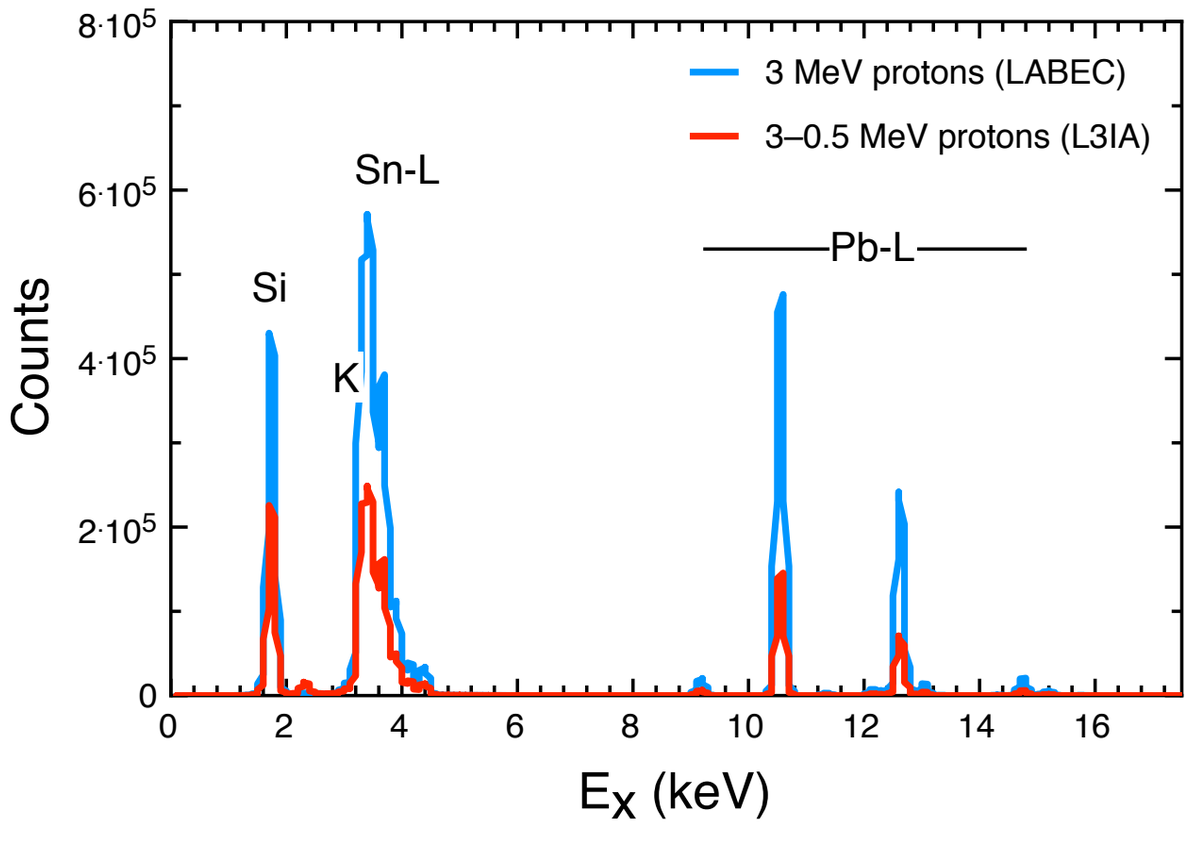
Simulazione spettri PIXE

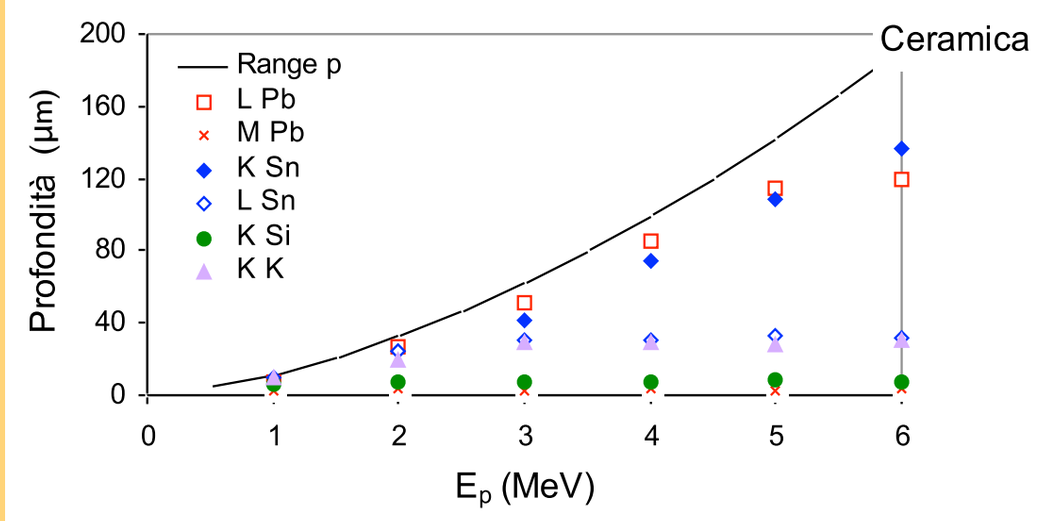


Distribuzione di energia di un fascio di protoni da:

- acceleratore elettrostatico
- accelerazione TNSA





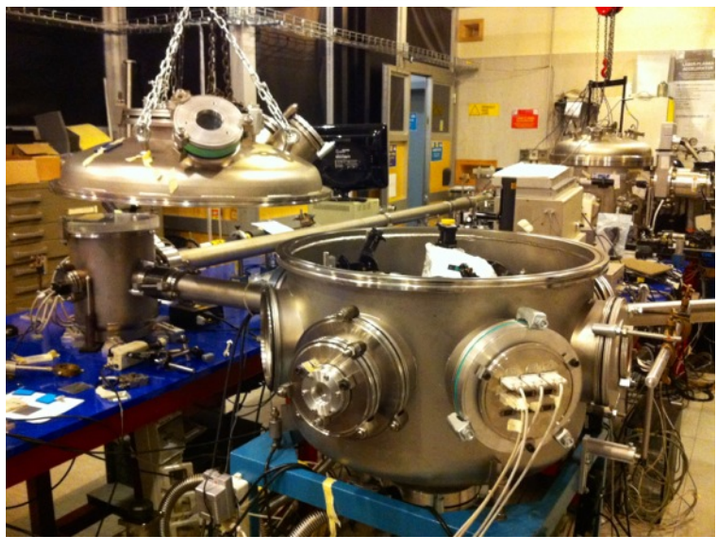


Campione ceramica: 45% SiO_2, 30% PbO, 20% SnO_2, 5% K_2O; ρ = 5.44 g/cm^3

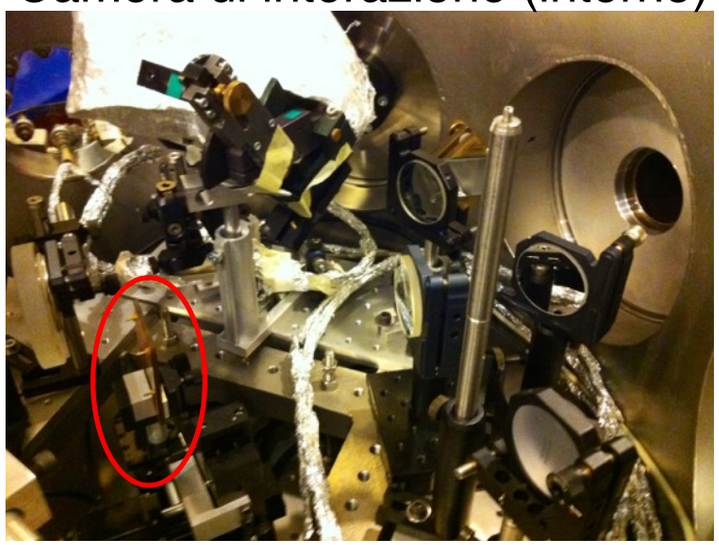
Apparato L3IA per test misure PIXE (in sviluppo)

Laser

Camera di interazione



Camera di interazione (interno)



Nasino estrazione

Nasino estrazione + rivelatore X SDD

Attività previste (fine 2016-2017):

- Test con set-up attuale ("punto zero”), 2016
- Stesura *blue book* dei requisiti a partire dal "punto zero”, 2016
- Test con prototipo di camera di interazione dedicata, 2017