

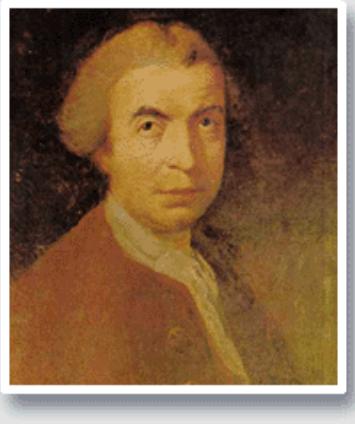
Laboratory for Ion Beam Interactions

Facilities Overview

Damir Španja

Laboratory for Ion Beam Interactions
Experimental Physics Division
Ruđer Bošković Institute
Zagreb, Croatia

RBI, founded 1950



Josip Ruđer Bošković

(Dubrovnik, 18 May 1711 - Milan, 13 Feb. 1787)

Physicist, mathematician, astronomer, land surveyor,
engineer, poet, philosopher, diplomat



First departments:

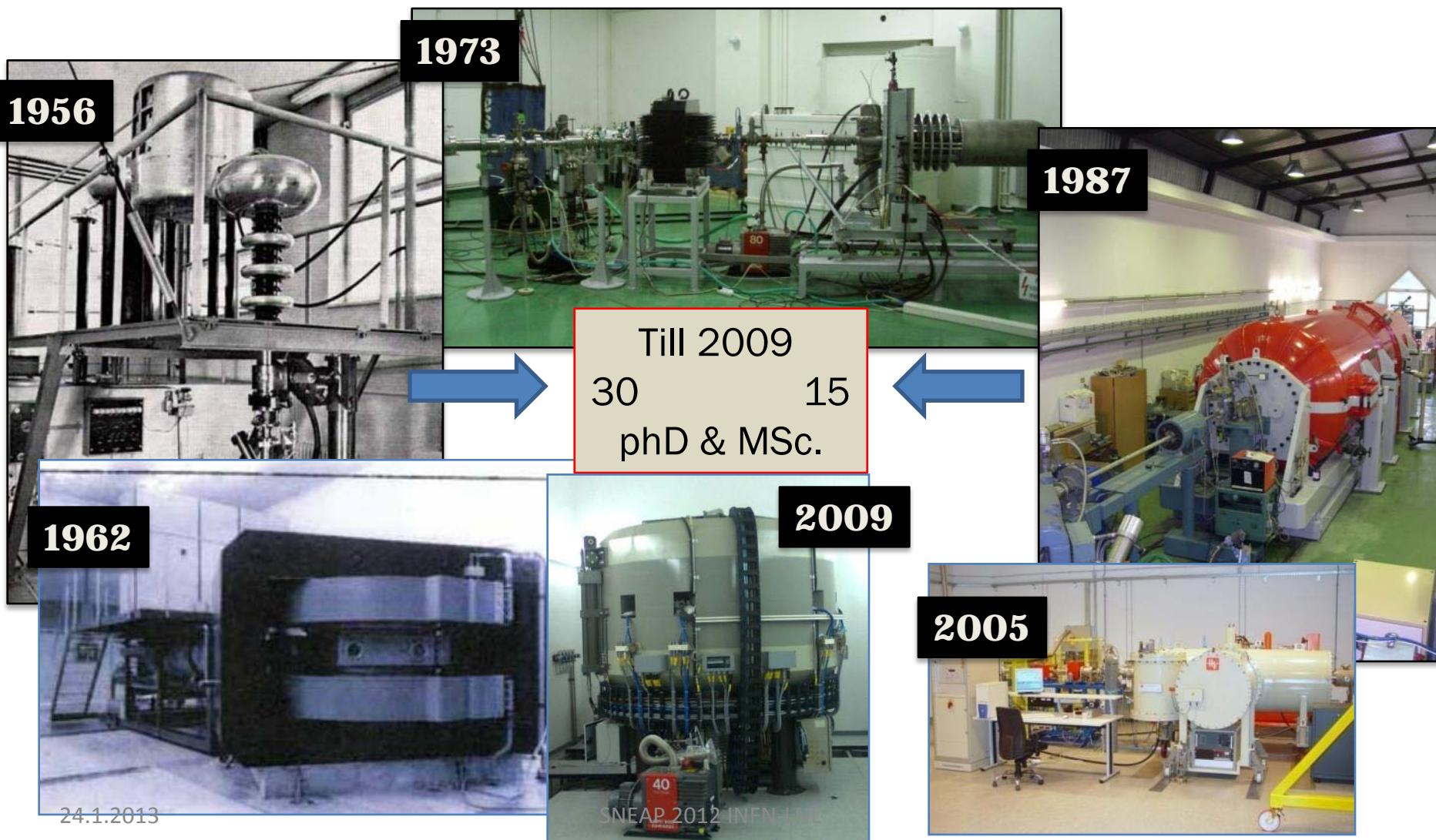
Theoretical physics
Molecular physics
Nuclear physics
Electronics

Today:

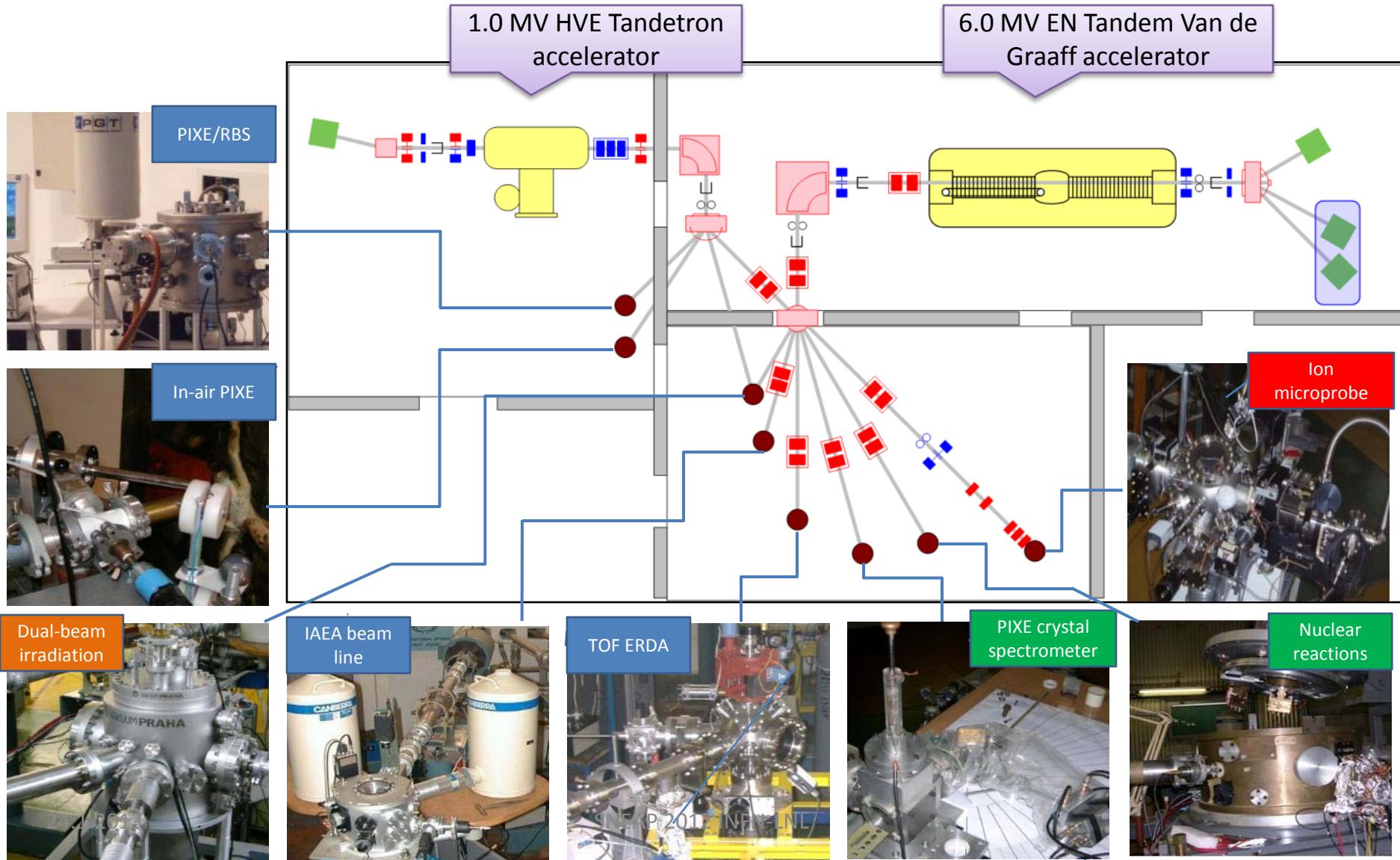
- The largest research institute in Croatia
- 12 departments: physics (4), chemistry (3), life sciences (2), marine science and environment (2) and electronics

1. Introduction - RBI and accelerators:

LIBI – one of the several DEP Laboratories that has been built at the tradition of RBI experimental physics



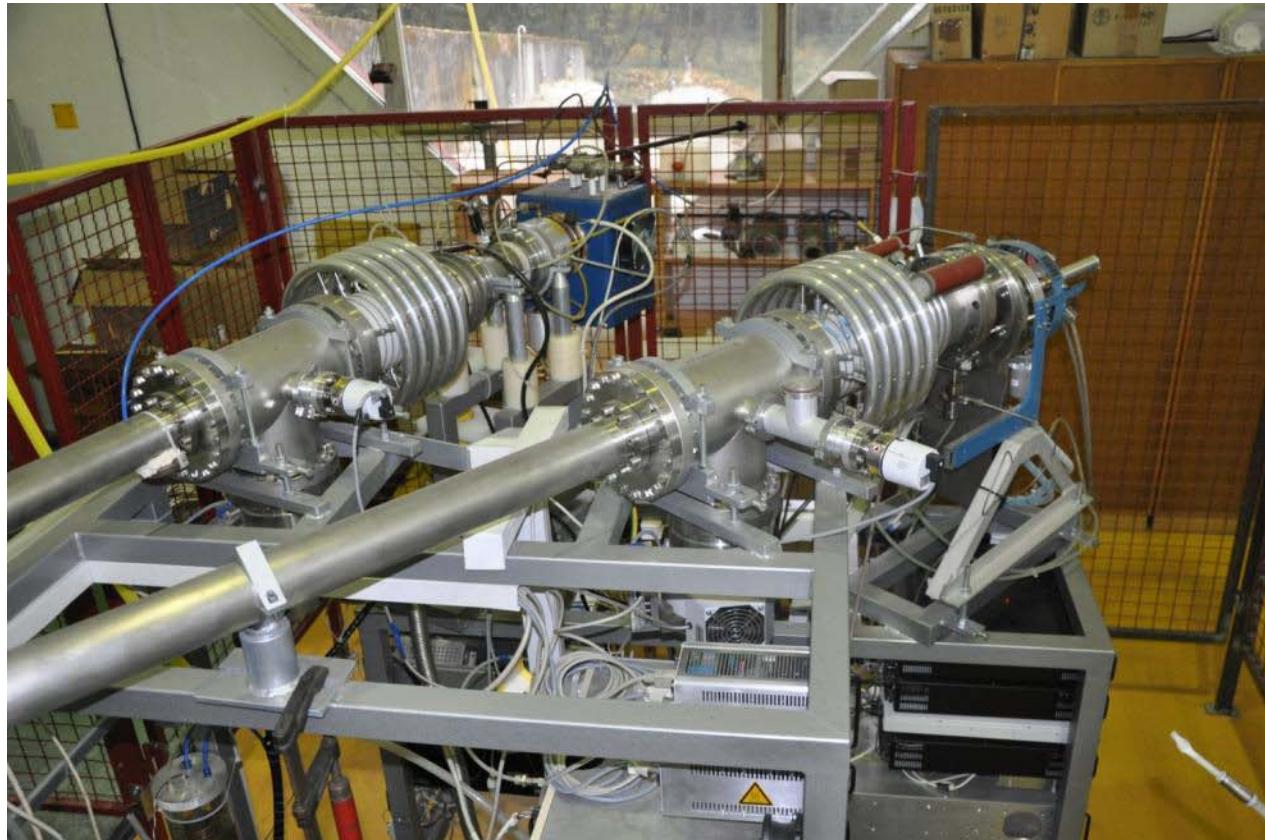
1. Introduction - Accelerator Facility



Present LIBI accelerators

HVEC EN Tandem Van de Graaff	HVEE Tandetron
6 MV Terminal Voltage	1 MV Terminal Voltage
Belt Charging	Parallel feed Cockcroft-Walton
Terminal stability ~1- 1.5 kVpp	Terminal stability ~ 0.6 kVpp
0.01-5 μ A Analyzed current	0.1-50 μ A Analyzed current
Almost all ions (except heavy noble)	H, D , O Ions (others in near future)
Optical Transmission: ~60-80 %	Optical Transmission: ~80 %
6 Beamlines	6 +2 Beamlines
Set up by operators	Easy to use, any user can run it after a short training

Ion sources – EN Tandem



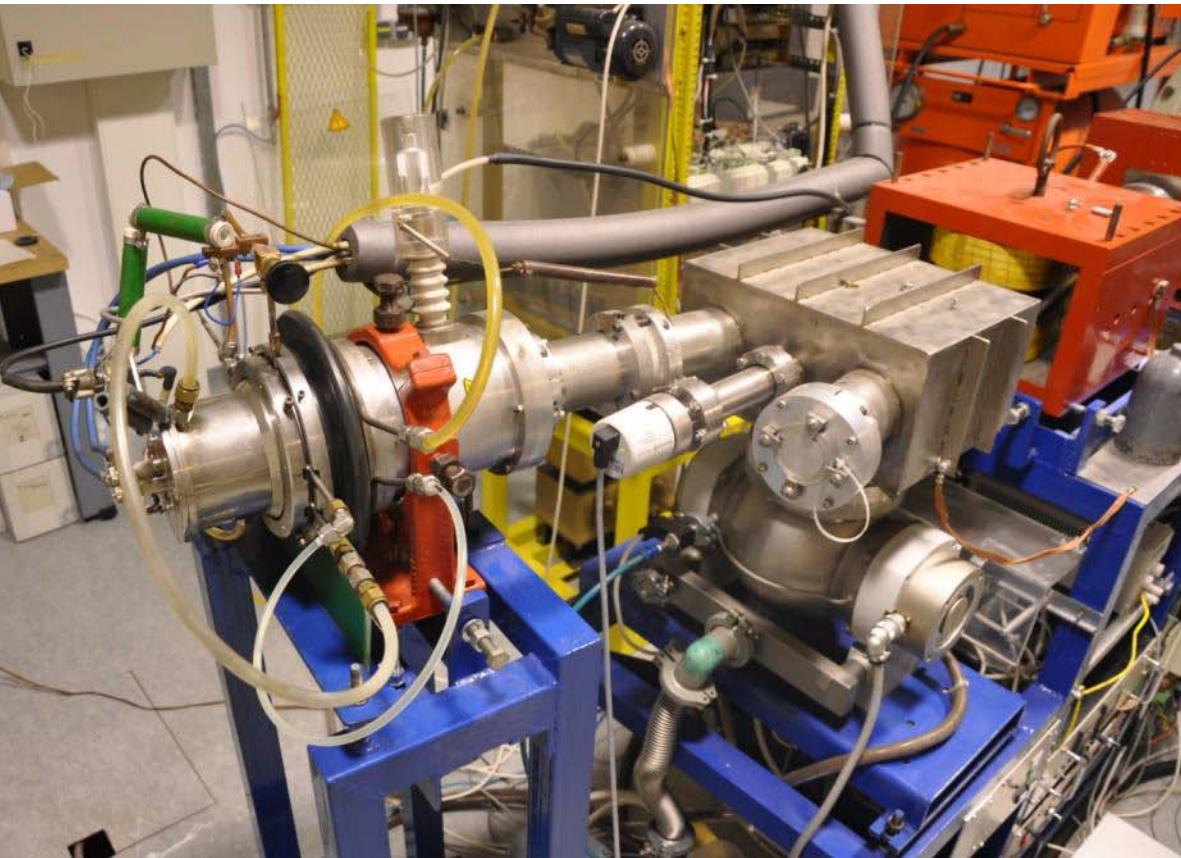
MC-SNICS Sputtering
Ion Source

- 40 Cathodes
- Almost all elements except noble gases and a few others

Albatross Ion Source

- ${}^4\text{He}$, ${}^3\text{He}$, (${}^2\text{H}$, ${}^1\text{H}$)

Ion sources - Tandetron



Geneal Ionex
Duoplasmatron direct
extraction negative ion
source

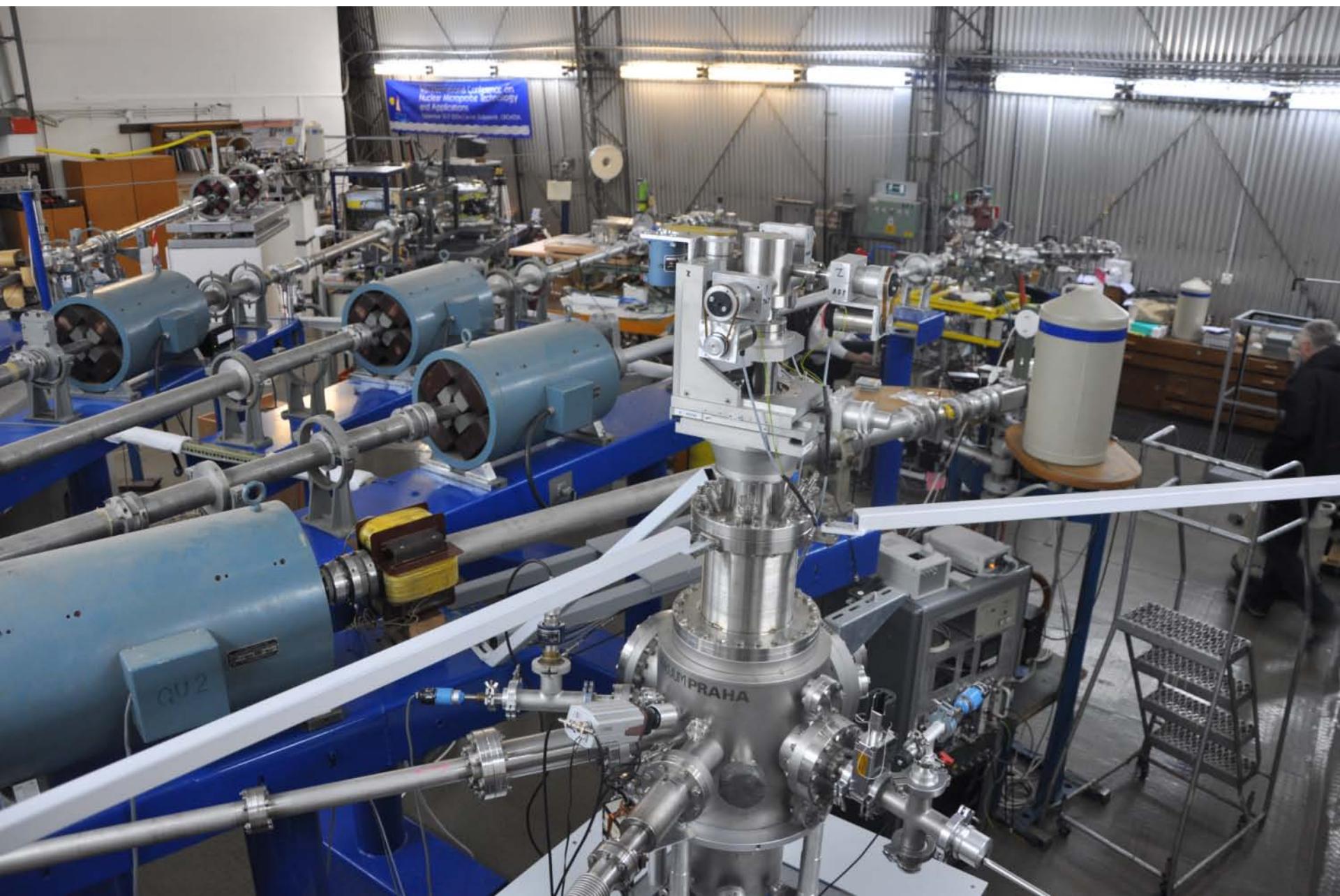
- ^2H , ^1H , ^{16}O
- very good brightness

Newly purchased and
already on site, waiting
for installation:

SNICS (Single cathode)

- different ion species

Main Experimental Hall



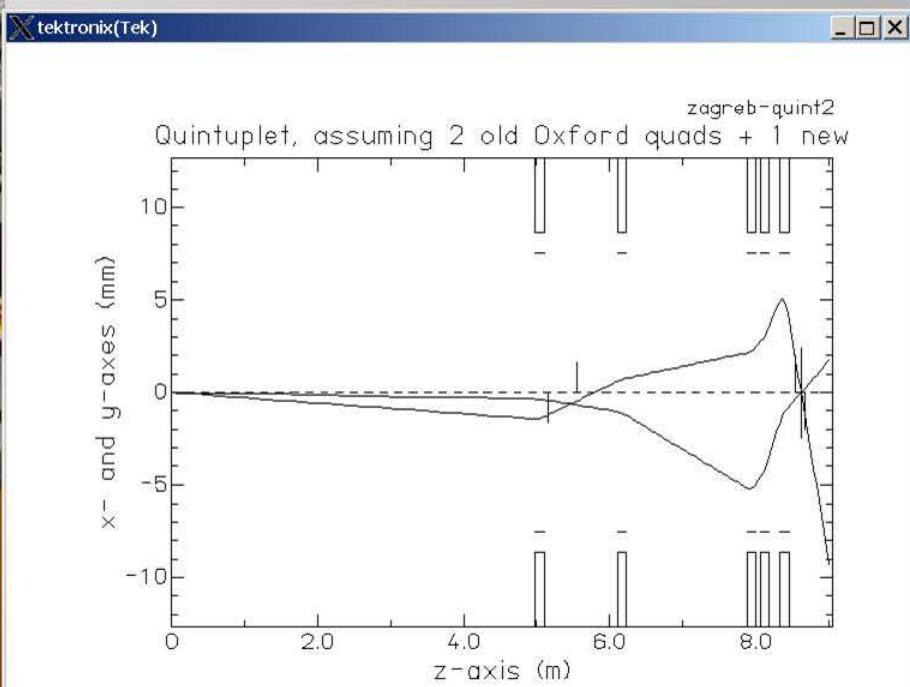
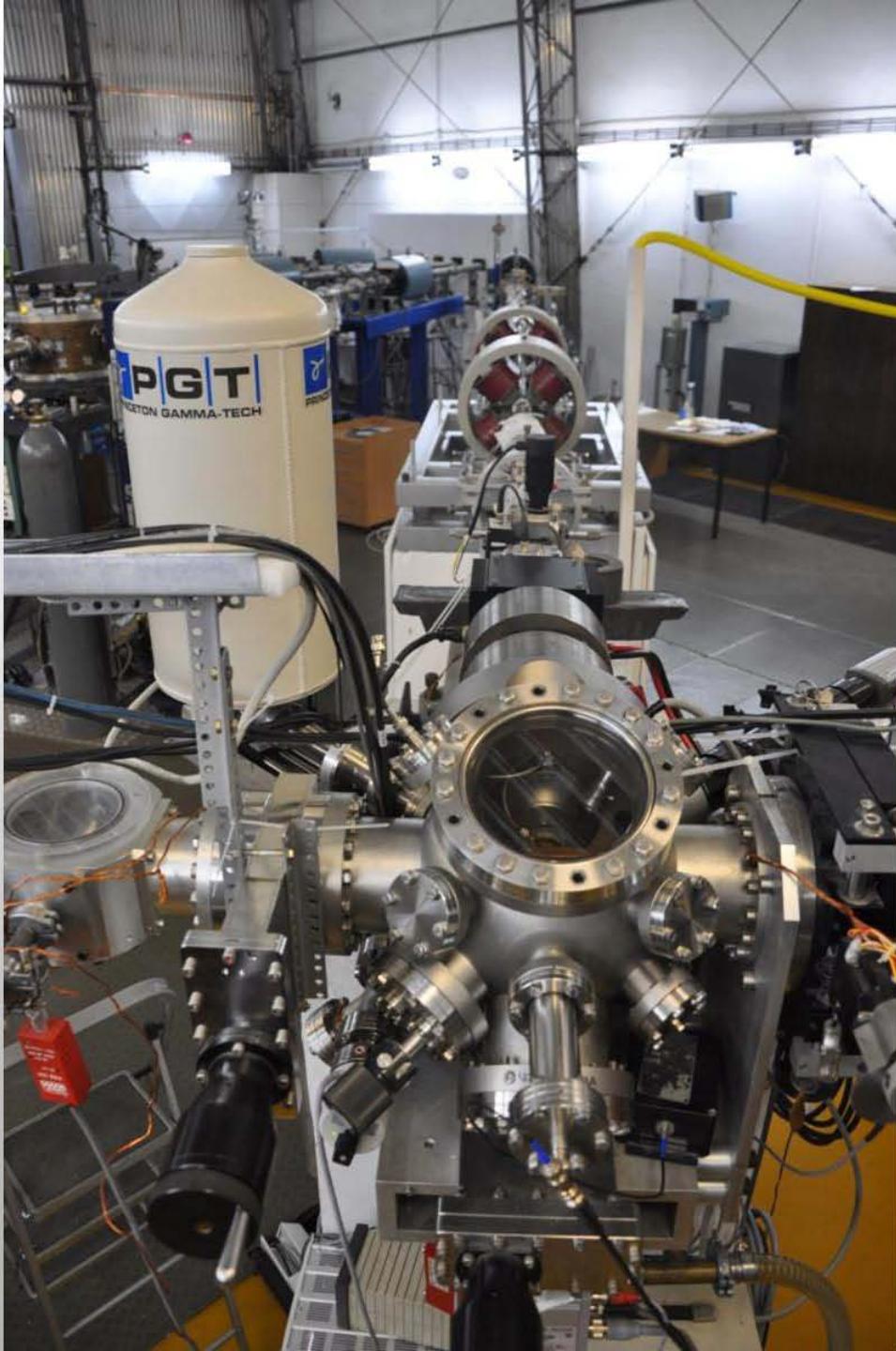


Dual Beam Chamber

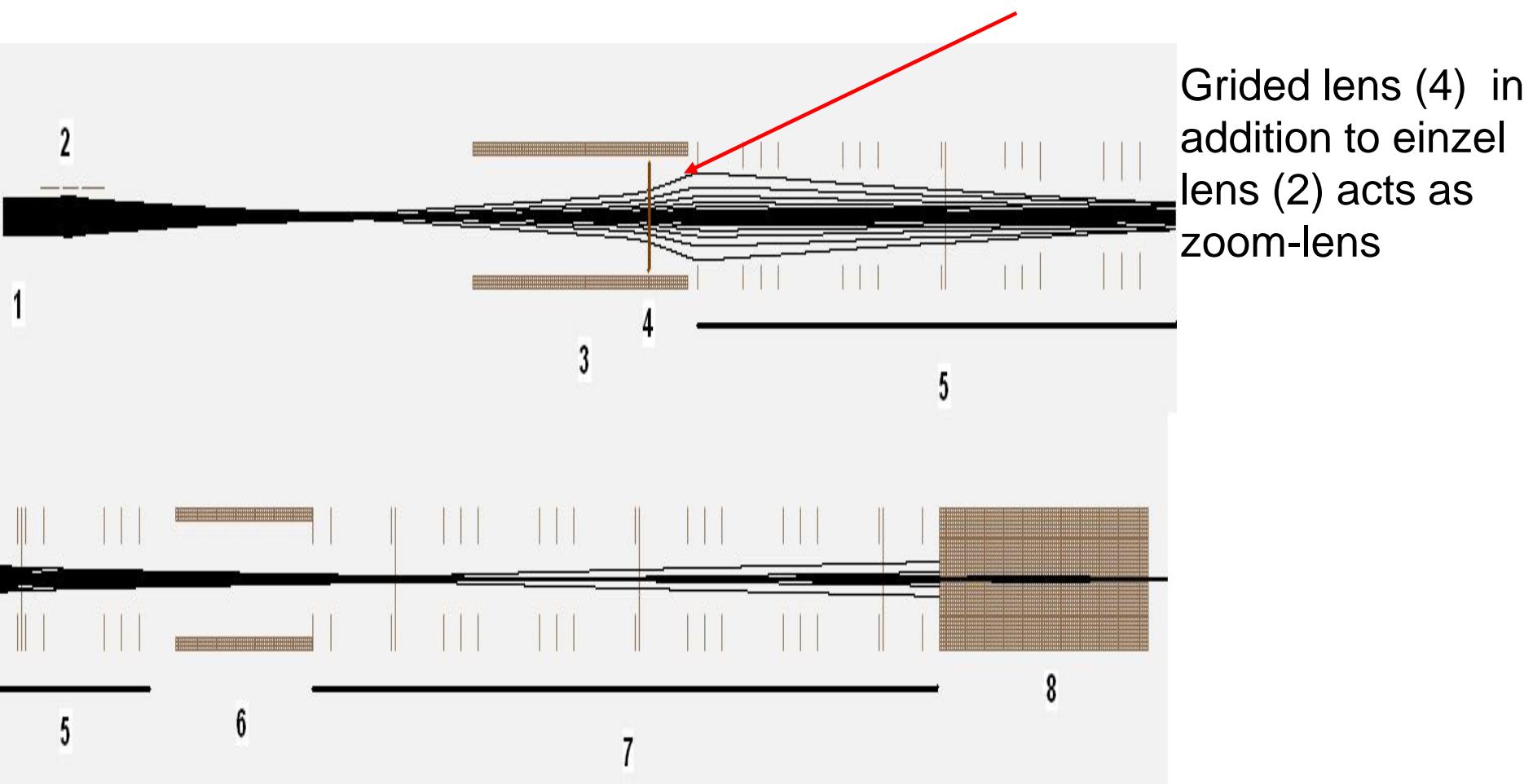
5 Axes goniometer for use in channeling, ion beam mixing and general dual beam experiments (e.g. implantation and IBIC)

Nuclear Microbeam line

- Quadrupole quintuplet or Triplet
- m^*E/q^2 up to 25!
- Micron size beams (the best achieved 250 nm)



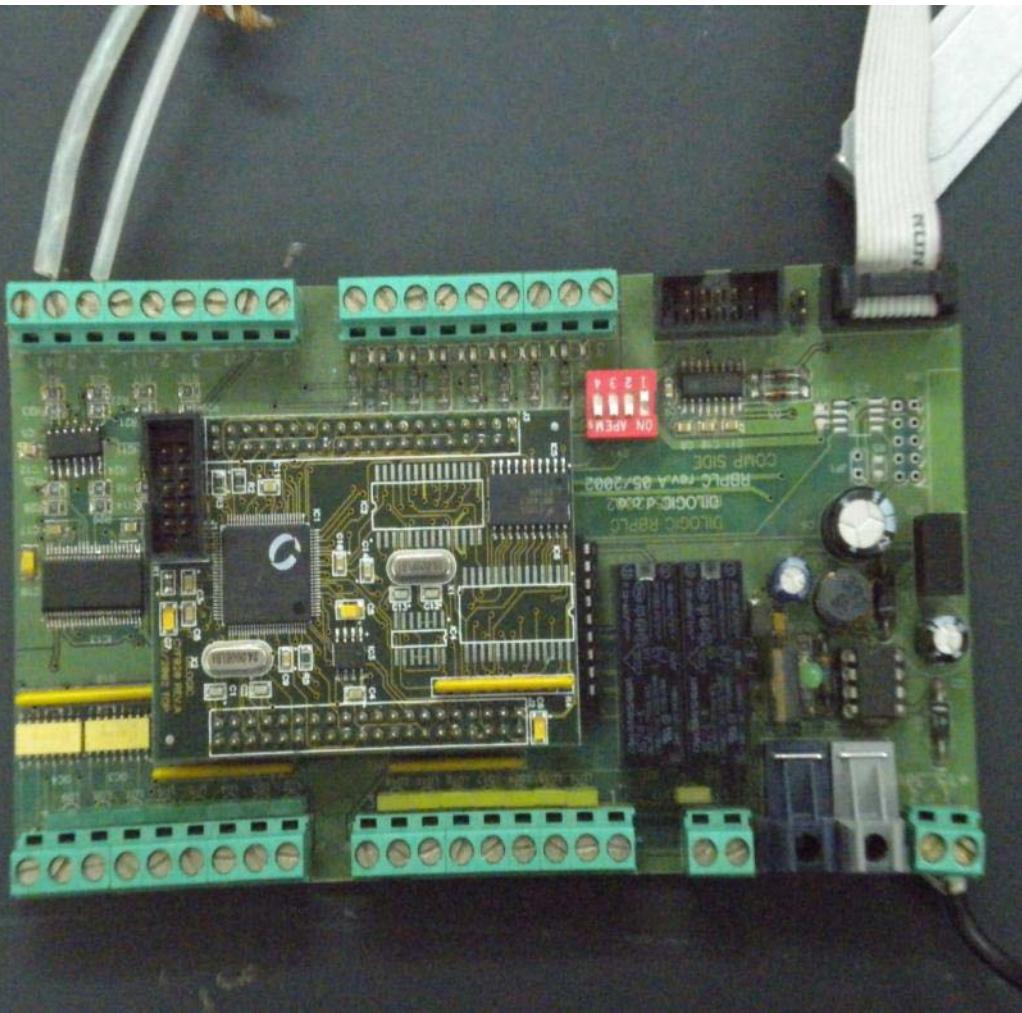
Some upgrades to the optics of EN: LE improvement - gridded lens addition



EN Tandem terminal upgrade – gas recirculation pumps



Control hardware

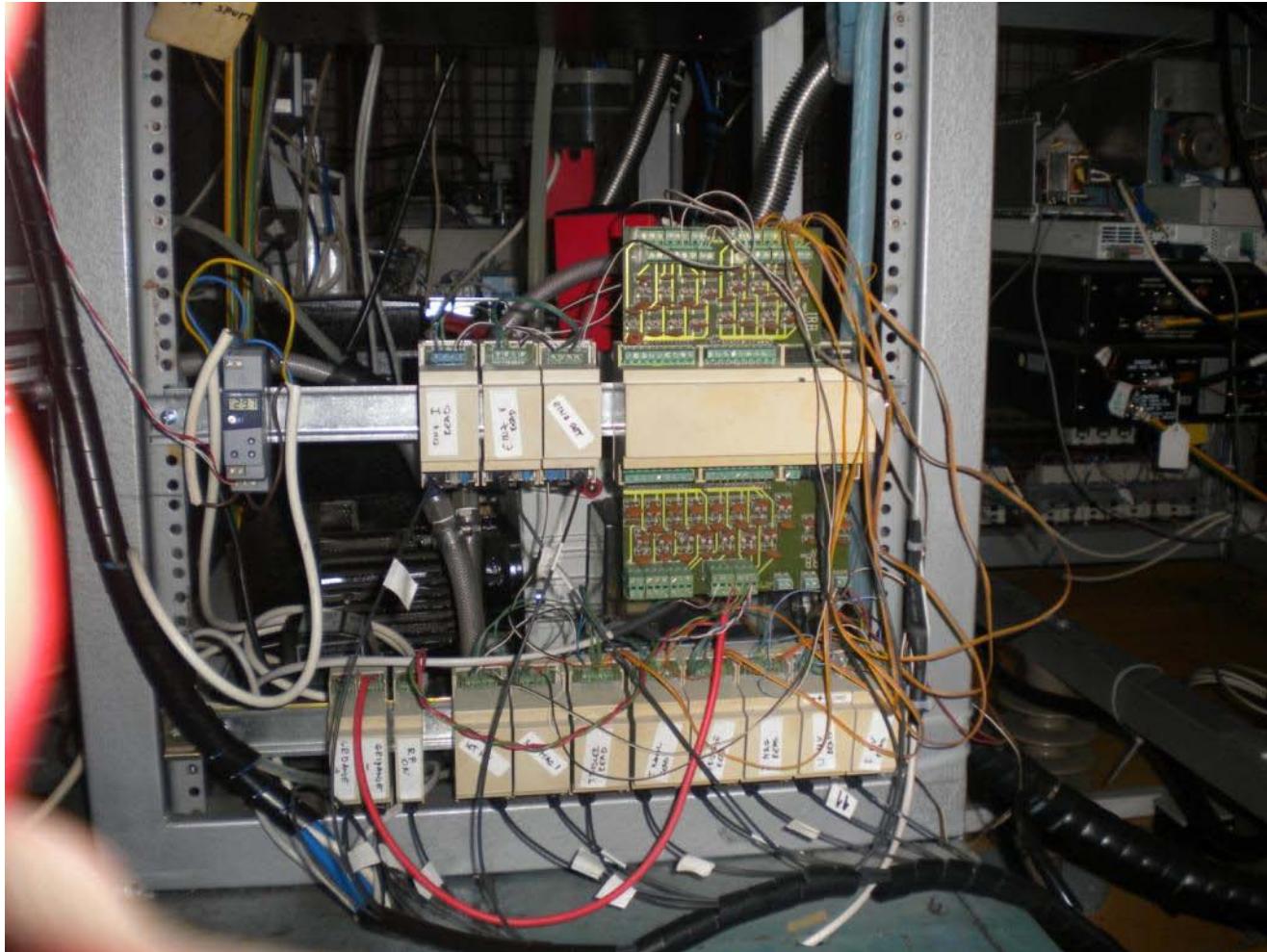


Produced in local company by our specifications:

- 8 Analog Inputs
- 8 Analog Outputs
- 8 DI
- 8 DO
- RS-232 communication

New versions:
Ethernet
communication

Control hardware: Module installed and working



SOFTWARE

Accelerator Control & Data Acquisition software entirely produced in house

LabView, TestPoint and Microsoft Visual Studio used

Parts of the software under permanent upgrade and changes

AKCELERATOR microSv/h
2.83

TARGET microSv/h
0.15

INJ. MAGNET
514243.0000 %%

glavna1	me	vrijednost
0	"q1a"	" 0.7137 V
1	"q1b"	" 0.5978 V
2	"q2a"	" 0.4907 V
3	"q2b"	" 0.6305 V
4	"q3a"	" 3.7660 A
5	"q3b"	" 3.6023 A
6	"INJ. MAGNE"	" 514243.000
7	"LE.DEF.L"	" 0.0000 V
8	"LE.DEF.R"	" 27.7200 V
9	"LE.DEF.U"	" 0.0000 V
10	"LE.DEF.D"	" 0.0000 V
11	"EINZ. L.E."	" 10805.3760
12	"EINZ. SPUT"	" 11606.1650
13	"HE.DEF.UP."	" 0.0000 V
14	"HE. DEF. DQ"	" 106.2600
15	"TERMINAL Y"	" 3.3878 M
16	"SW MAGNE"	" 1.0000 1
17	"SW1"	" -1.0362 A
18	"ANALIZATO"	" 87.5357 A
19	"GRID"	" 6896.0500
20	..."	..."
21	..."	..."
22	..."	..."
23	..."	..."
24	..."	..."

upisi vrijednost

Selector1

- INJ. MAGNET
- LE.DEFL
- LE DEF R
- LE DEF U
- LE DEF D
- EINZ. L.E.
- GRID

osjetljivost
0.1

ANALIZATOR

Tandem Control (2002)

ALL 0 **injector panel** **ucitaj vrijednosti** **matematika** **ANALIZATOR CTRL**

TUNE **ZAJEDNICKA PETLJA** **spremi vrijednosti** **CURRENT IN CHAMBER** **SW1**

INTERVAL 0.5

GRID + EINZ	delta	G+E/TV	Term. TMP HE / A	Term. TMP LE / A
17701	0.22085	5225.1	0.000	0.007

Grid pol
neg
pos

Terminal TMP
ON
OFF

AKCELERATOR:SW_DILOGIC

ILOADJAK / C	U LOAD	U RECT
27	1.3	63.6
TERMOSTAT / C	U FET	P FET / W
50.0	62.4	-55.98
I READ	READY	MAG VODA!!!
-0.9		
I SET	T!!!	FATAL
-1.036		

Gaussmetri1.vi

Tandem Injektor
0.387178

Tandem Analiza
-1.360958

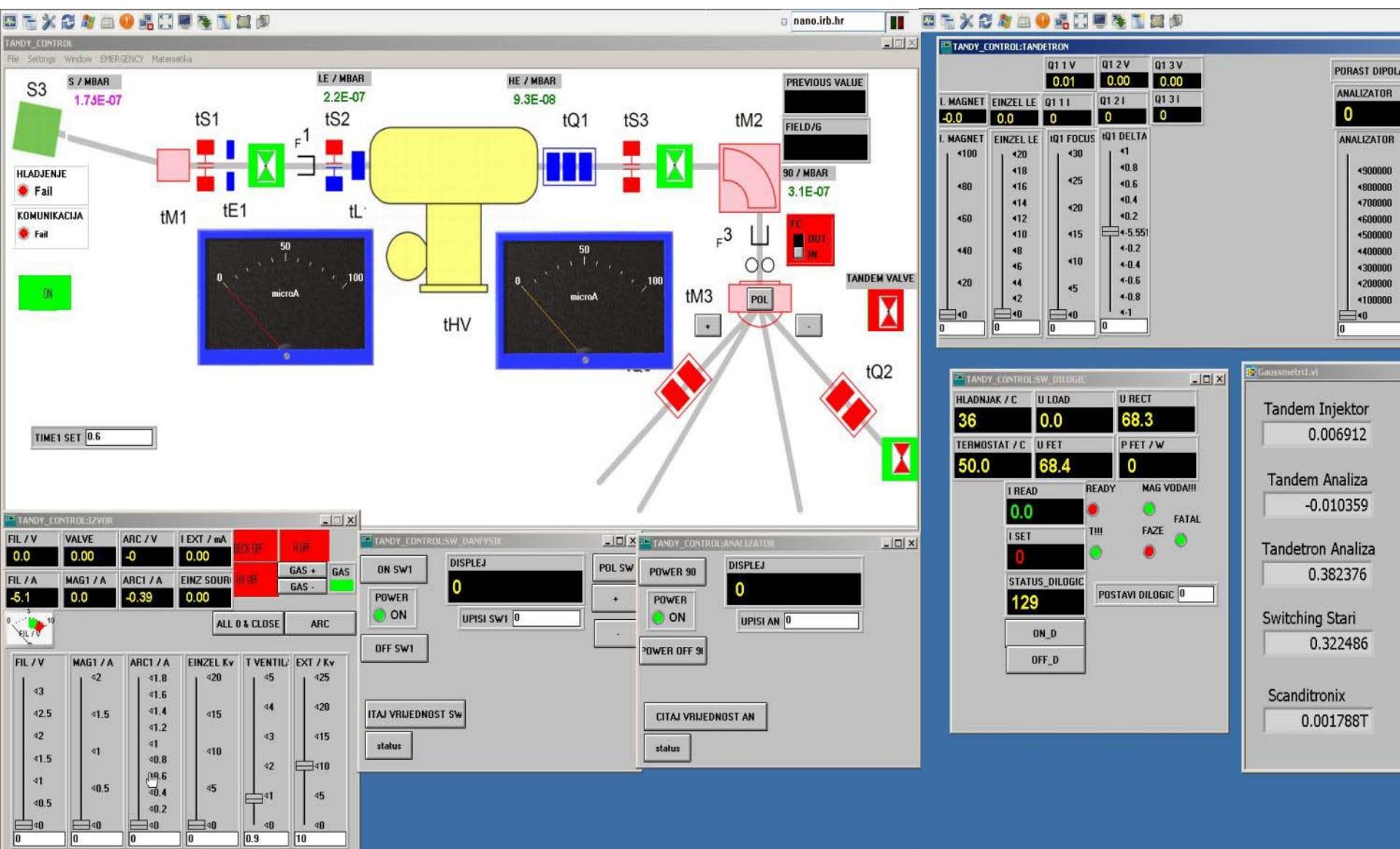
Tandetron Analiza

COMM
ON

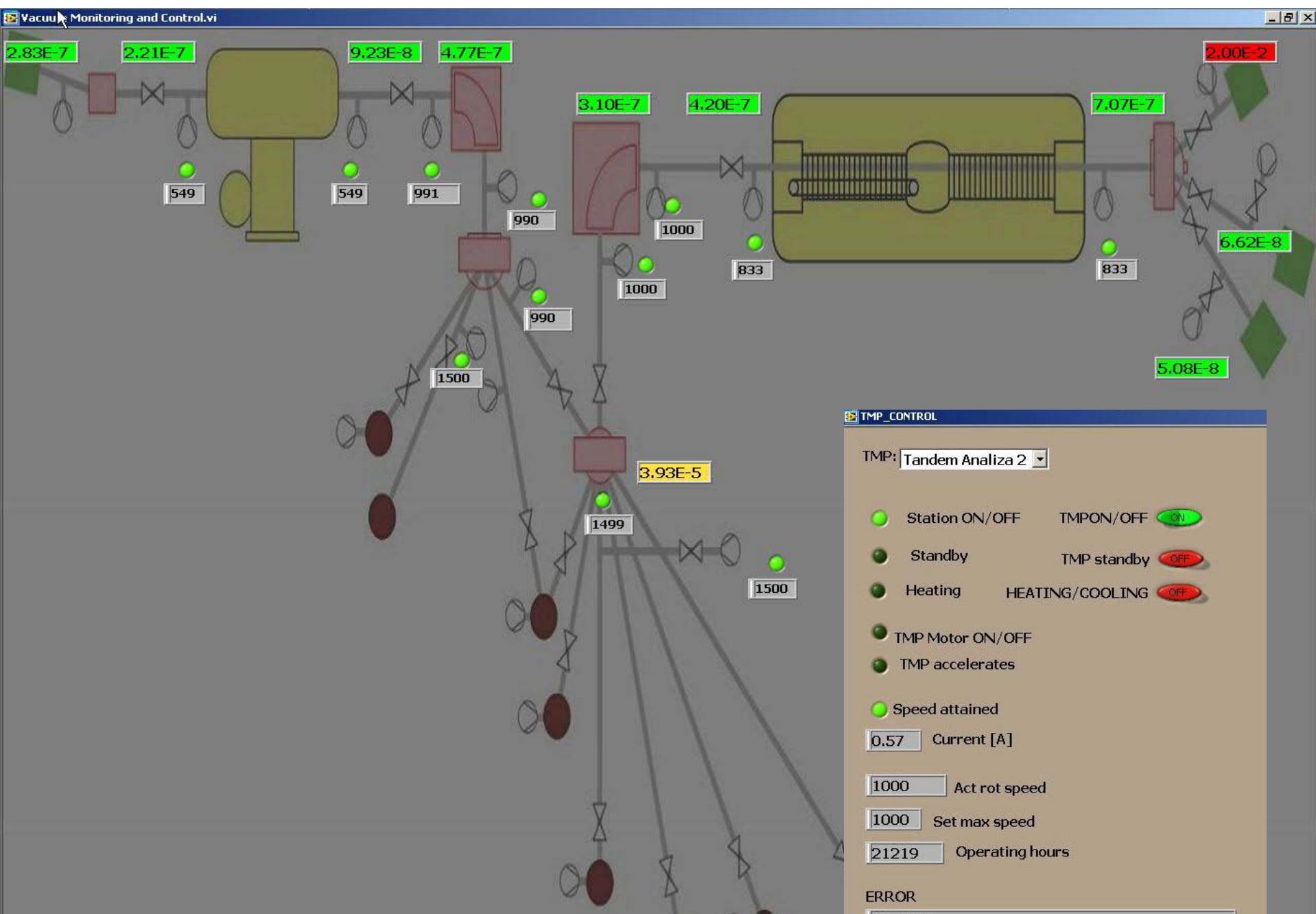
COMM 2
ON

COMM 3

Tandetron control (2005)



Vacuum Monitoring LabView, 2008

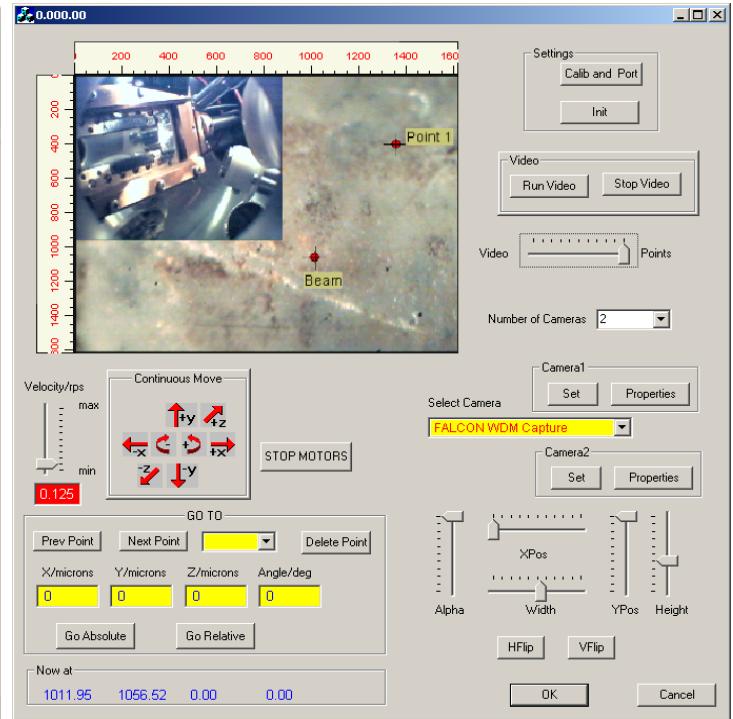
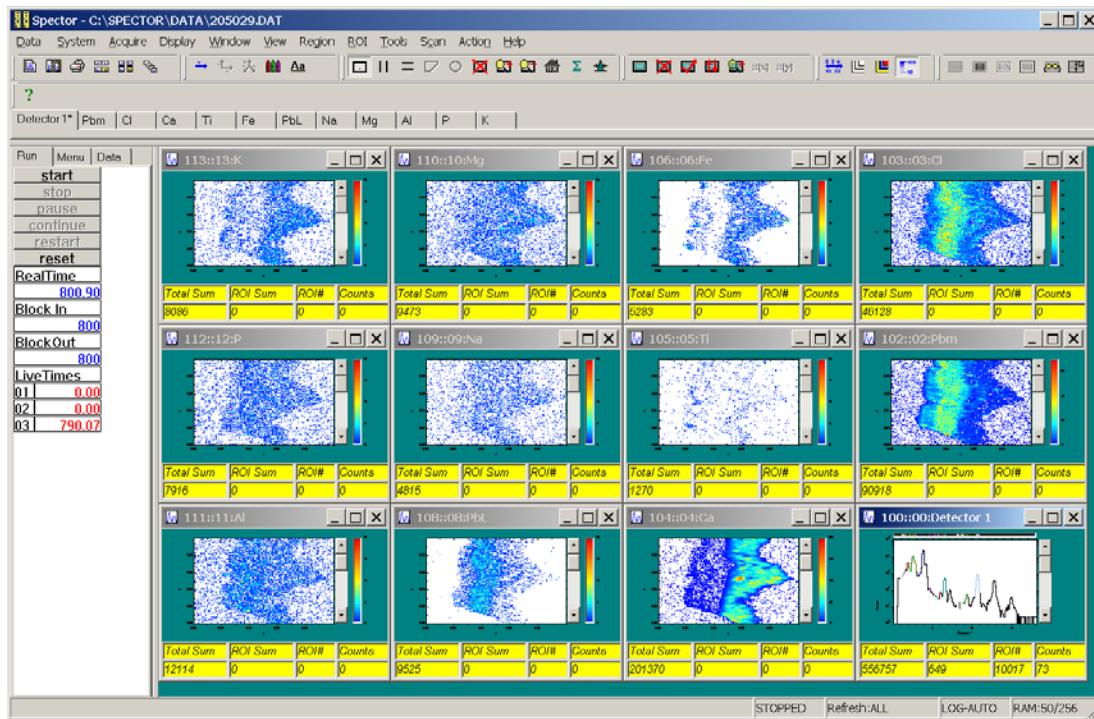
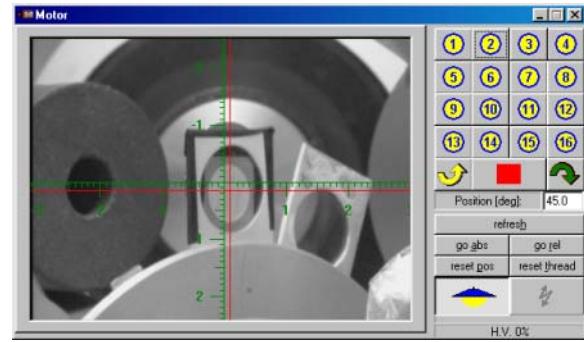
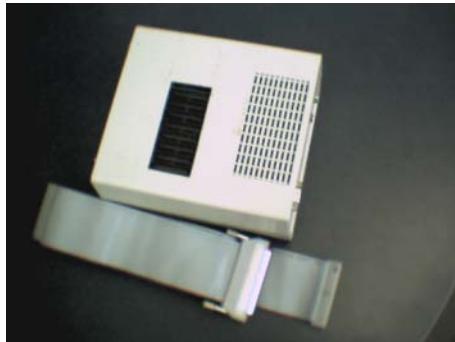


New 40-cathodes Sputtering Ion Source, 2010



SPECTOR -

Data acquisition /target positioning & beam scanning software
Digital data acquisition under development

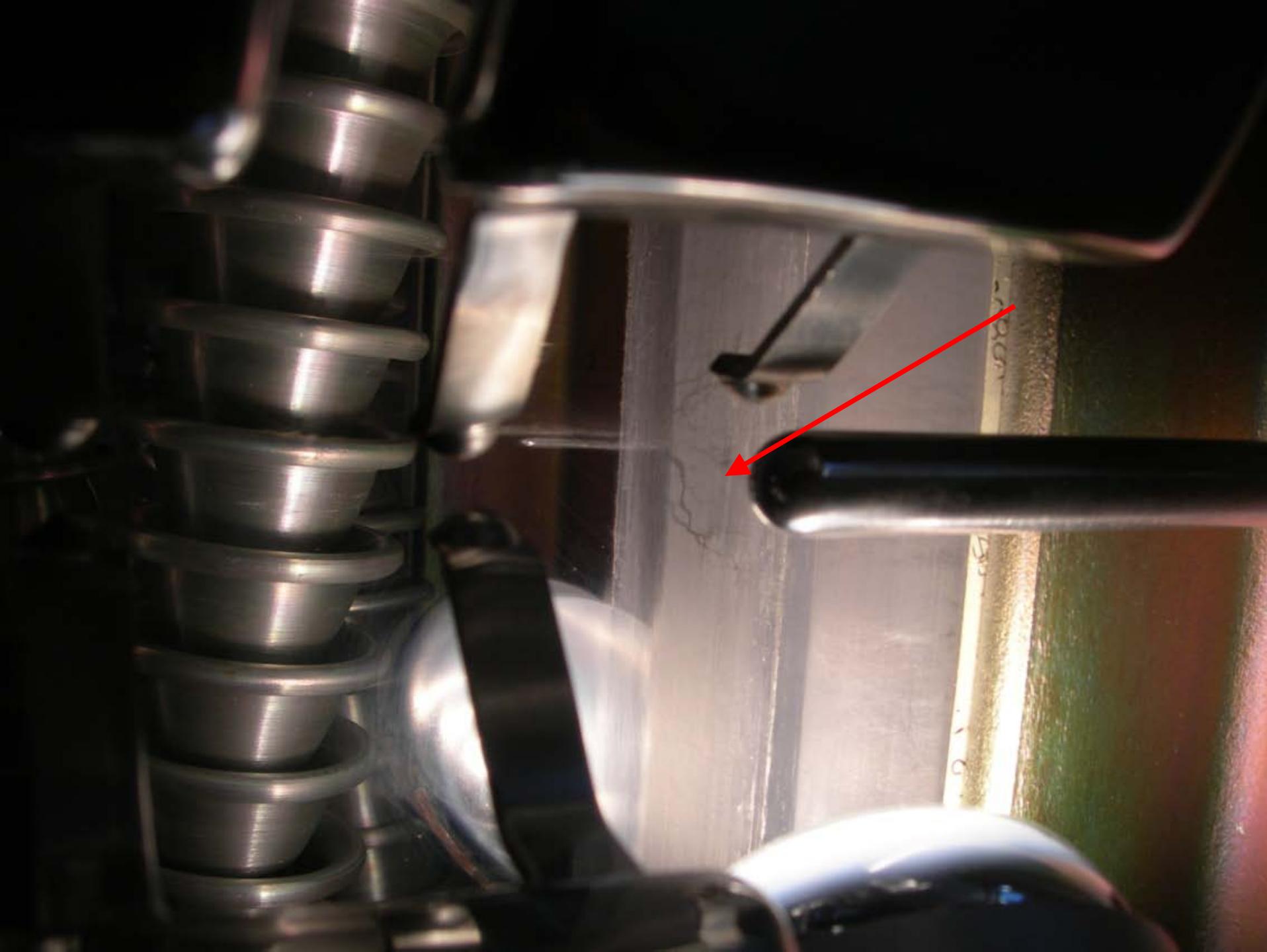


Major recent problems, faults & fault tracing

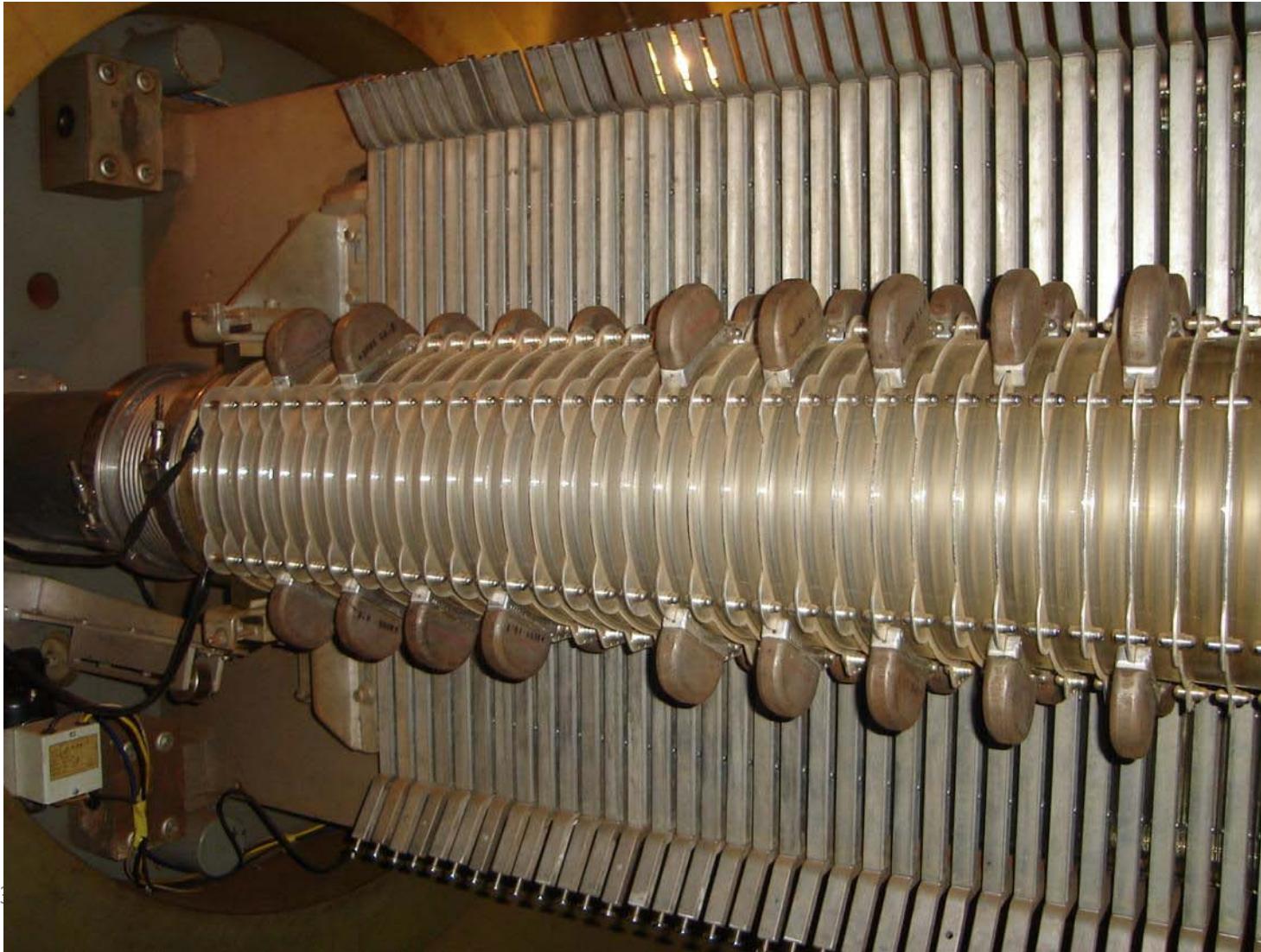
- High voltage generation related problems
- Vacuum faults inside and outside the tank
- Turbo-pumps damage
- Alkali metal migration from ion source
- Electronic devices faults

High voltage breakdown of polycarbon (Lexan) Tandetron support plate – 6 months out of order





Vacuum leak inside the EN tank: opens at pressures
above 10 bar. Still not solved



Two TMPs breakdown:

1. Atmospheric pressure at foreline
2. Unknown reason



Rb & Cs migrating from the sources to extraction
(or glass tube) area causing instabilities and sparking.

Solution: through cleanning of ion source



LIBI Staff

- 4 Permanent staff scientists
- 2 Operators / technicians
- 1 machine workshop technician
- 2 Development engineers
- 2 Postdocs
- 4 PhD students

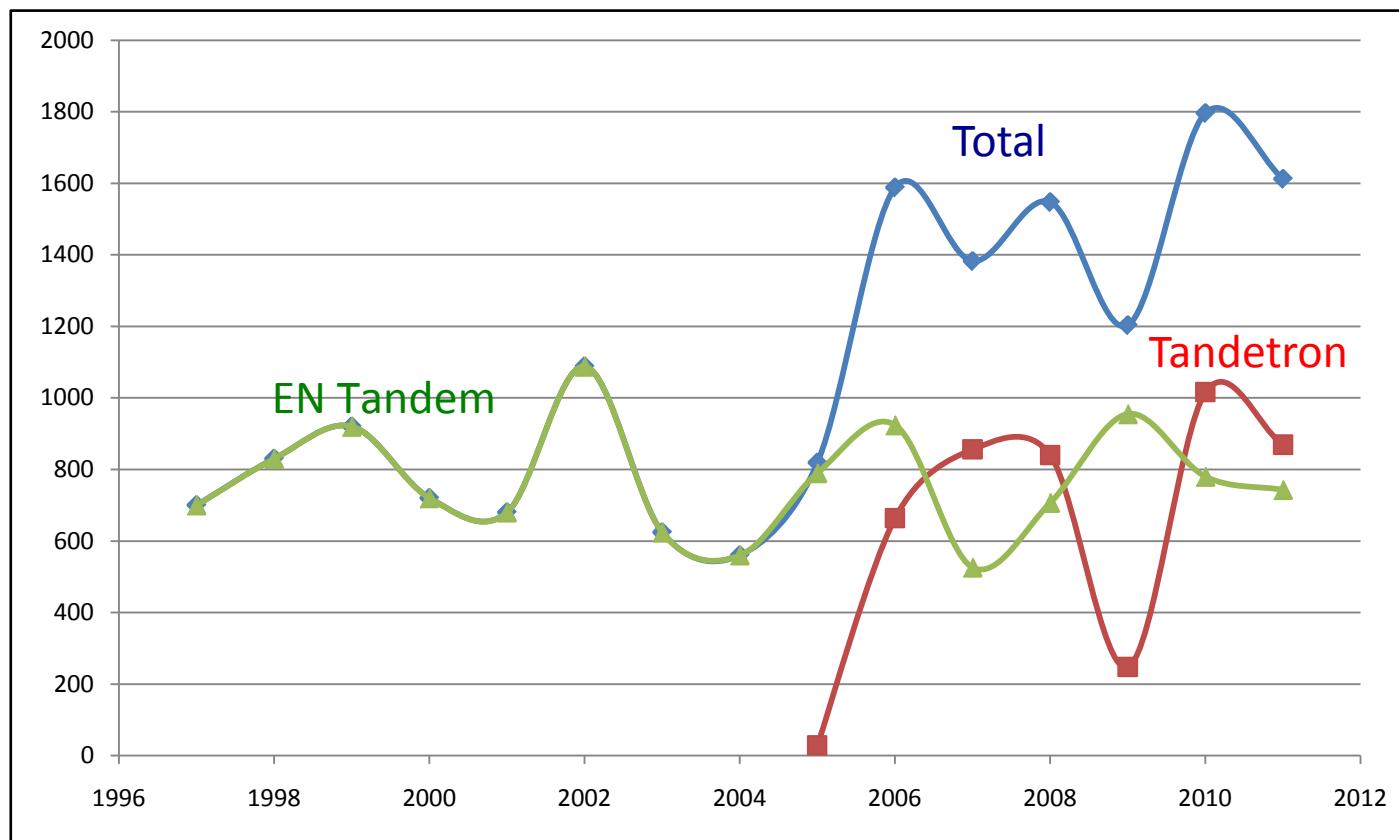


24.1.2013

SNEAP 2012 INFN-LNL

Accelerator utilization

Beam time / hours



Accelerator utilization

Users

- Laboratory for ion beam interactions – 50%
- Department of experimental physics – 10%
- R. Bošković Institute – 10%
- CRO science – 4%
- Services – 6%
- International – 20%
 - IAEA
 - FP7
 - Bilateral projects
 - Other links

Accelerator utilization

Main projects

- 3 EU FP7 projects
- PARTICLE DETECTORS – 1.3 MEu
- ENSAR – European Nuclear Science and Applications Research
- SPIRIT Network – Support of public and industrial research using ion beam technology
- IAEA beam line agreement (since 1997)



THANK YOU FOR ATTENTION!

Elastic Recoil Detection Analysis Chamber



Wavelength dispersive PIXE chamber & Gas RBS chamber

