SPES DIAGNOSTICS

Marco Poggi

Legnaro 2014 Dec 04

Presentation Outline

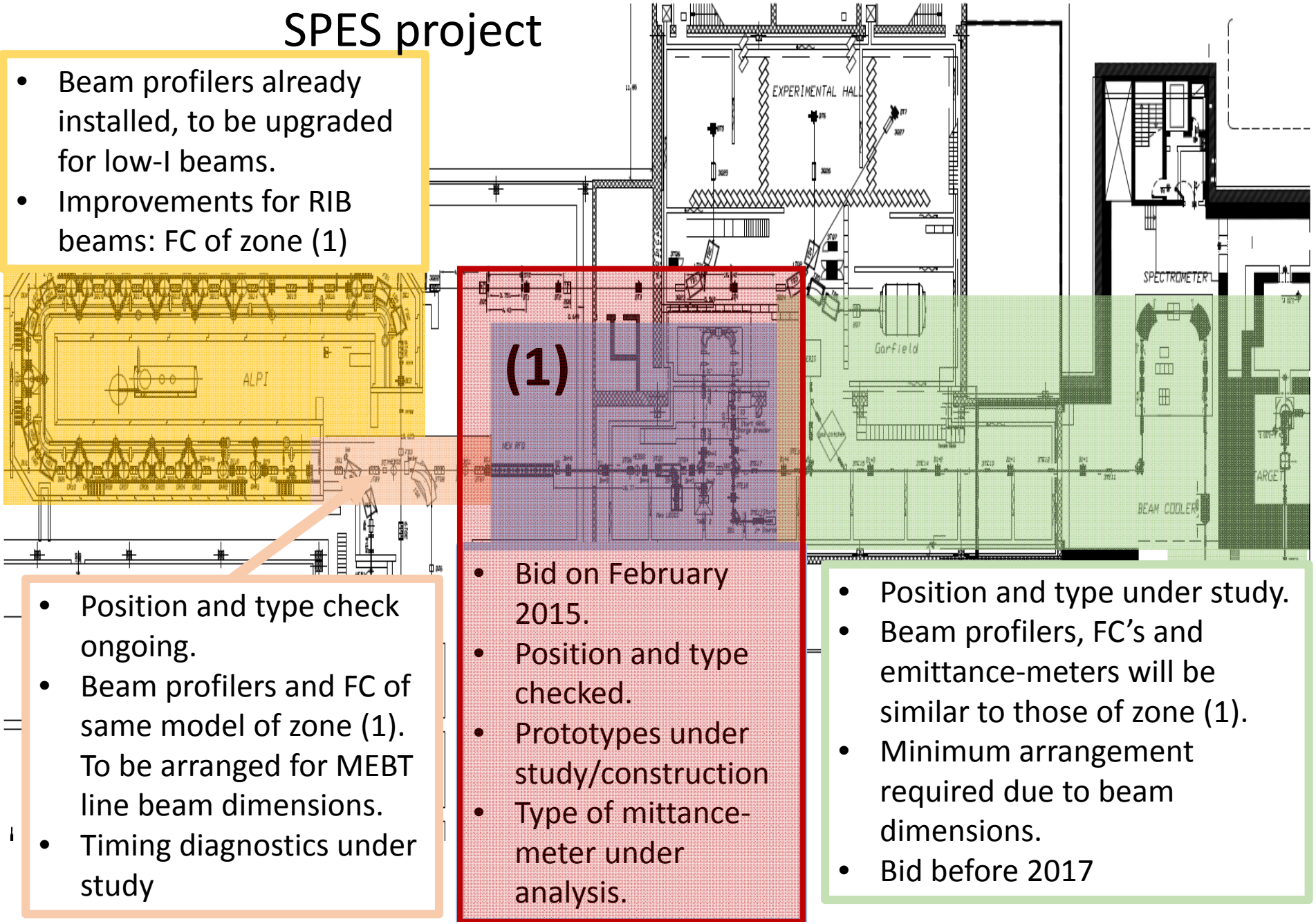
- Beam dynamics is defining beam instrumentation in stages
- Line 1+source-RFQ cooler-Charge Breeder-MRMS-RFQ injection will be built first, and equipped with b.i. first
- Robust R&D work is being conducted, to provide profilers and Faraday cups for the lowest possible bem currents

Presentation Outline

- **Beam dynamics is defining beam instrumentation in stages**
- **Line 1+source-RFQ cooler-Charge Breeder-MRMS-RFQ injection will be built first, and equipped with b.i. first**
- Robust R&D work is being conducted, to provide profilers and Faraday cups for the lowest possible bem currents

State of the art of the diagnostic for SPES project

- Beam profilers already installed, to be upgraded for low-I beams.
- Improvements for RIB beams: FC of zone (1)

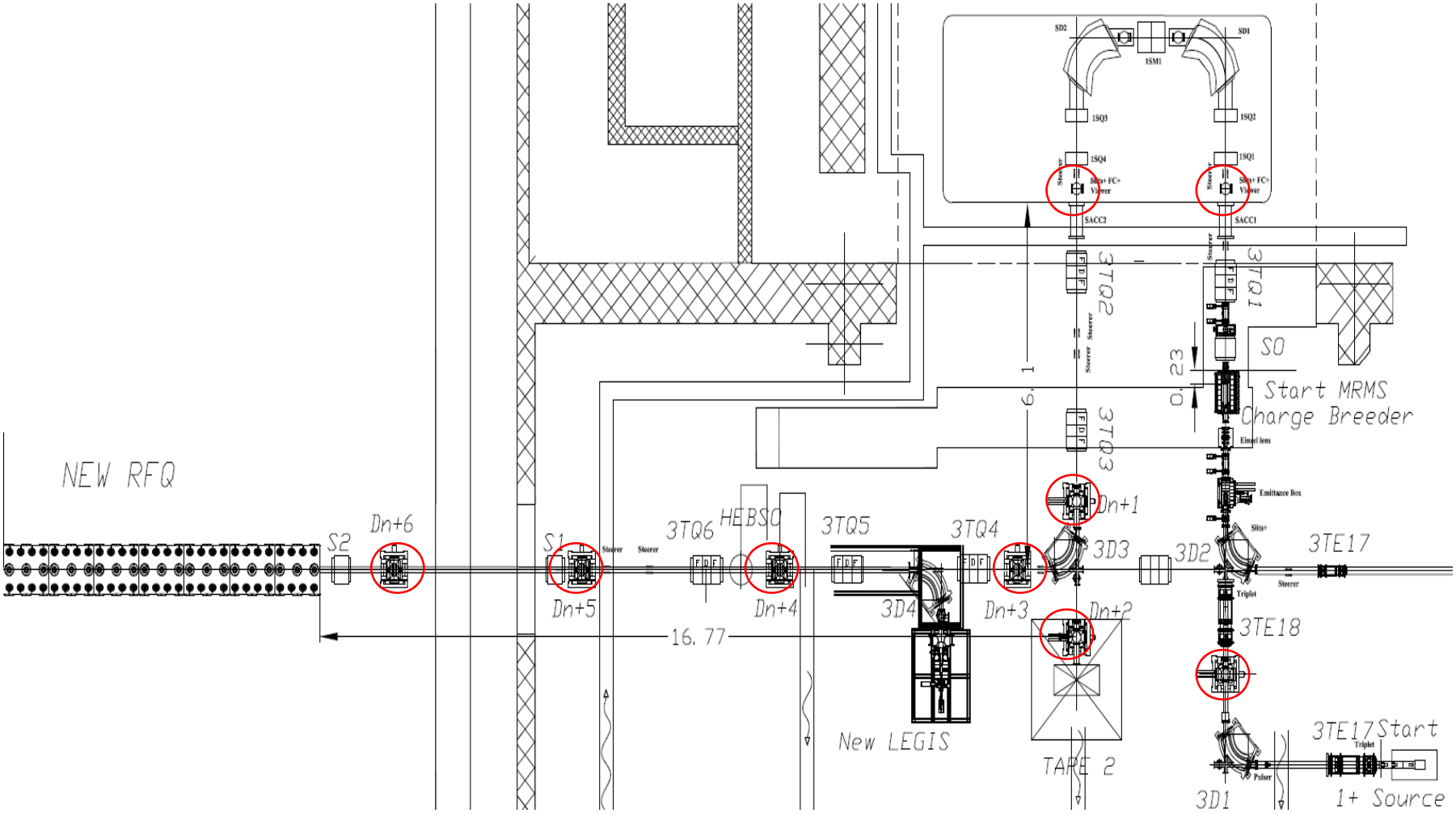


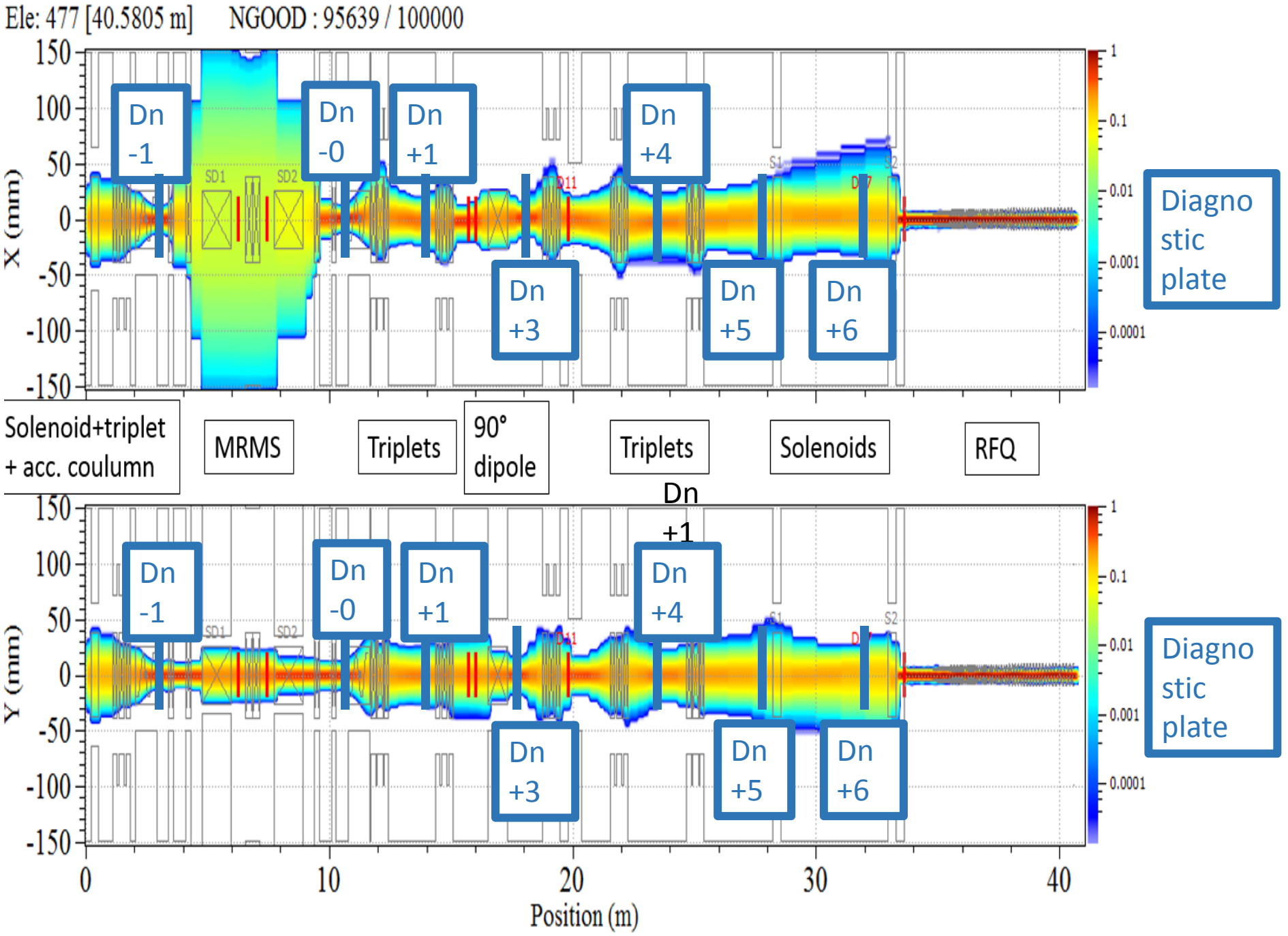
- Position and type check ongoing.
- Beam profilers and FC of same model of zone (1). To be arranged for MEBT line beam dimensions.
- Timing diagnostics under study

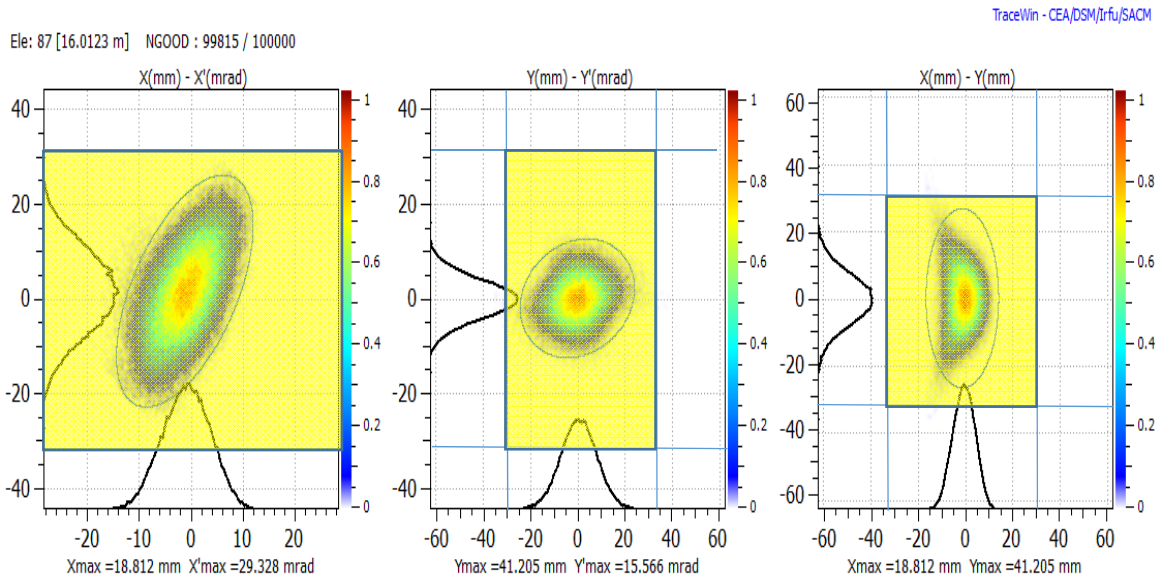
- Bid on February 2015.
- Position and type checked.
- Prototypes under study/construction
- Type of mittance-meter under analysis.

- Position and type under study.
- Beam profilers, FC's and emittance-meters will be similar to those of zone (1).
- Minimum arrangement required due to beam dimensions.
- Bid before 2017

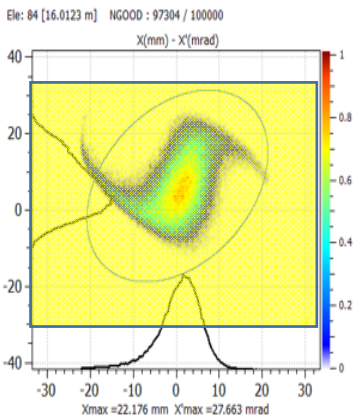
Diagnostic for the CB-MRMS-RFQ line




Ele: 477 [40.5805 m]
NGOOD : 95639 / 100000
X (mm)
Y (mm)
Position (m)
Dn -1
Dn -0
Dn +1
Dn +3
Dn +4
Dn +5
Dn +6
Diagnostic plate
Solenoid+triplet + acc. coulumn
MRMS
Triplets
90° dipole
Triplets
Solenoids
RFQ



Active areas in yellow



Effect of wrong multipole settings

An example

- Dn+1 diagnostic: beam phase spaces and diagnostic active areas are shown.
- Dn+1 will be used for setting the multipole of the MRMS. Its effect can be seen via emittance

Comments	name	slits	Faraday cup	Beam profiler	emittance meter	timing	X_max [mm]	Y_max [mm]	monitor range X,Y [mm]	X'_max [mrad]	Y'_max [mrad]	monitor range X',Y' [mrad]
Object point	Dn-1	x	x	x			9	9	±16			
Image point	Dn+0	x	x	x			13.3	14	±10			
Emitt. measurement	Dn+1	x	x	x	x		18.8	41	±35	29	16	±32
Tape system	Dn+2		x	x			17.3	21	±23			
ALPI injection line	Dn+3		x	x			33	23	±20			
pre-buncher	Dn+4			x			36.2	30	±30			
pre-solenoids	Dn+5			x			34.2	45.8	±35			
pre-RFQ	Dn+6		x	x		x	66	51	±40			
RFQ	Diagnostic											

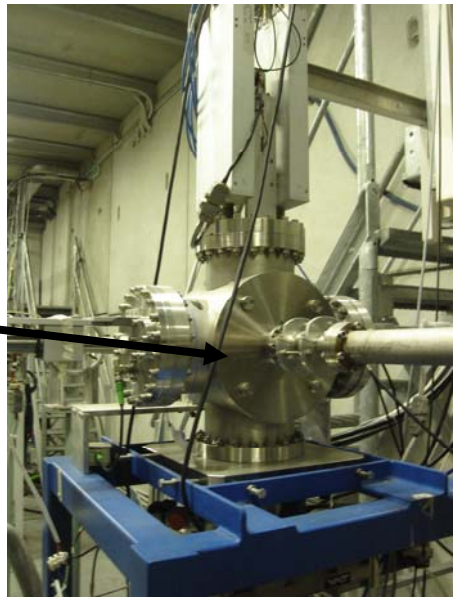
Diagnostics for commissioning

- Use of stable beams (pilot beam): intensity 1 μA from 1+ source:
  - Setup of CB: emittancemeter, beam profiler.
  - Setup of MRMS: beam profiler, emittancemeter for multipole
  - Setup @ RFQ entrance: emittancemeter
  - Setup @ RFQ exit: diagnostic plate (transverse/longitudinal)
- Use of RIB beams (same A/q): intensity max few nA after CB from ISOL target.
  - Check of CB: low intensity Faraday Cup
  - Check of MRMS: low intensity Faraday Cup, tape system.
  - Check @ RFQ exit: low intensity Faraday Cup.

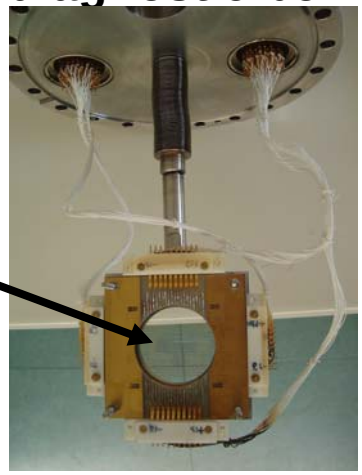
R&D work to provide profilers and Faraday cups for the lowest possible bem currents

SPES DIAGNOSTICS

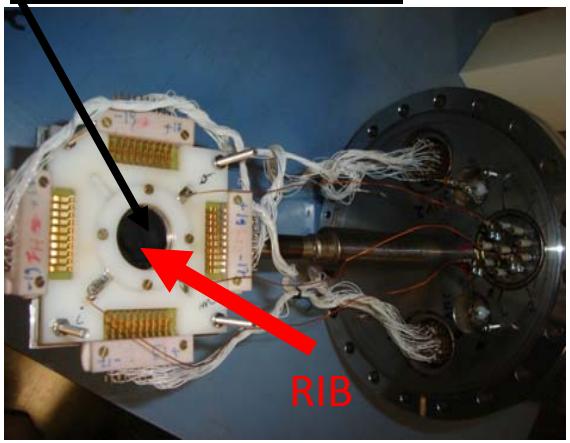
BEAM PROFILE MONITOR: two kind of detector with the same electronics and the same handling inside the **diagnostic box**



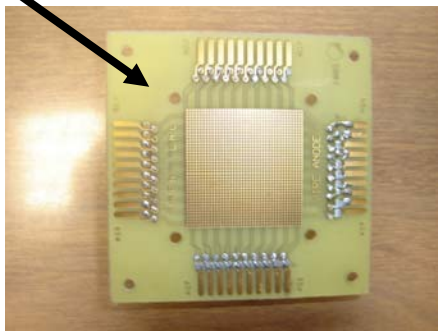
Beam profile monitor using **grids**
40 wire step 250 μm for current
from 1nA to 500 nA: **pilot beam**



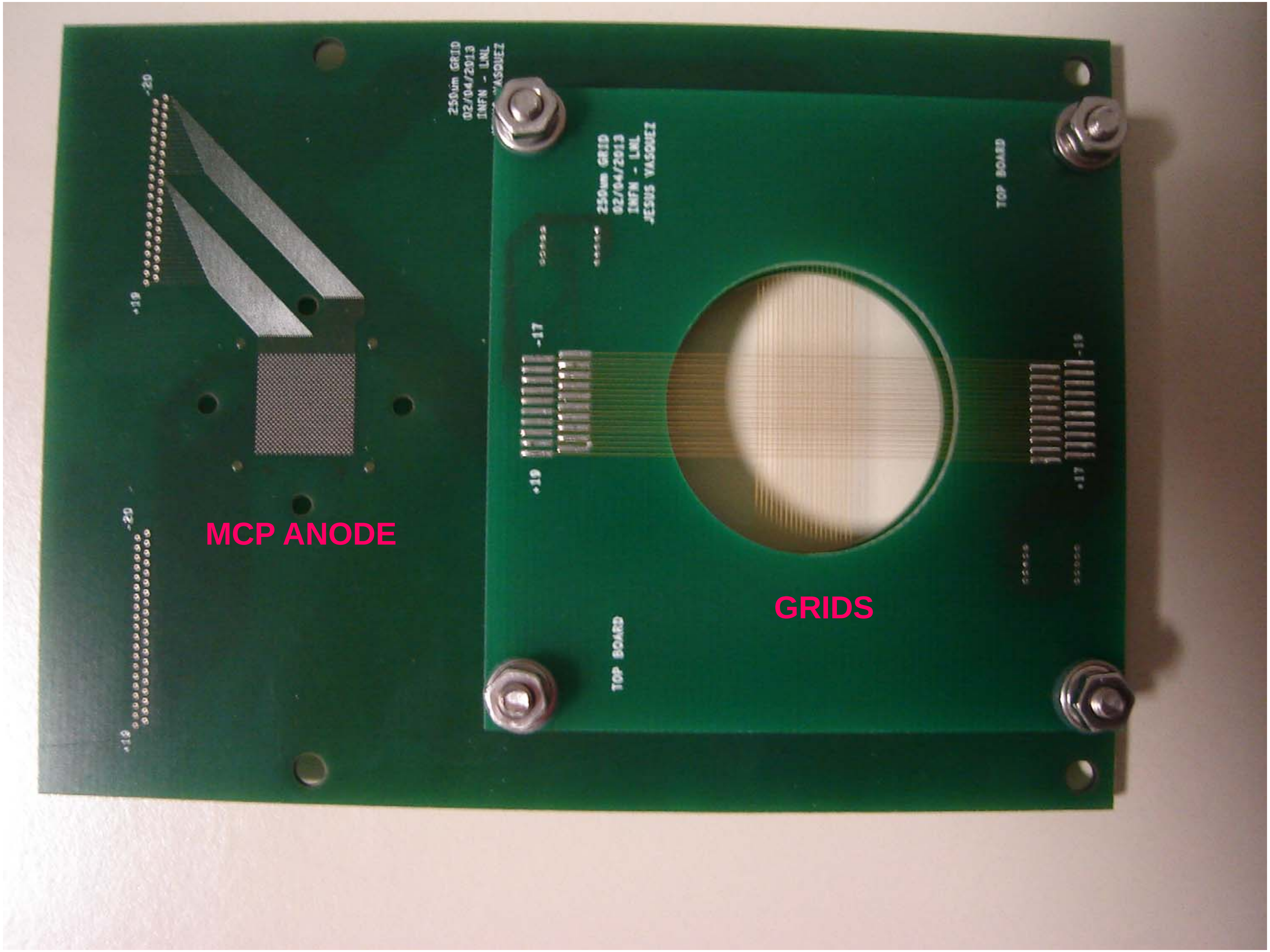
Micro channel plate in front of a X-Y electron **collecting anode**: current from 10fA to 1 nA: **radioactive beam**

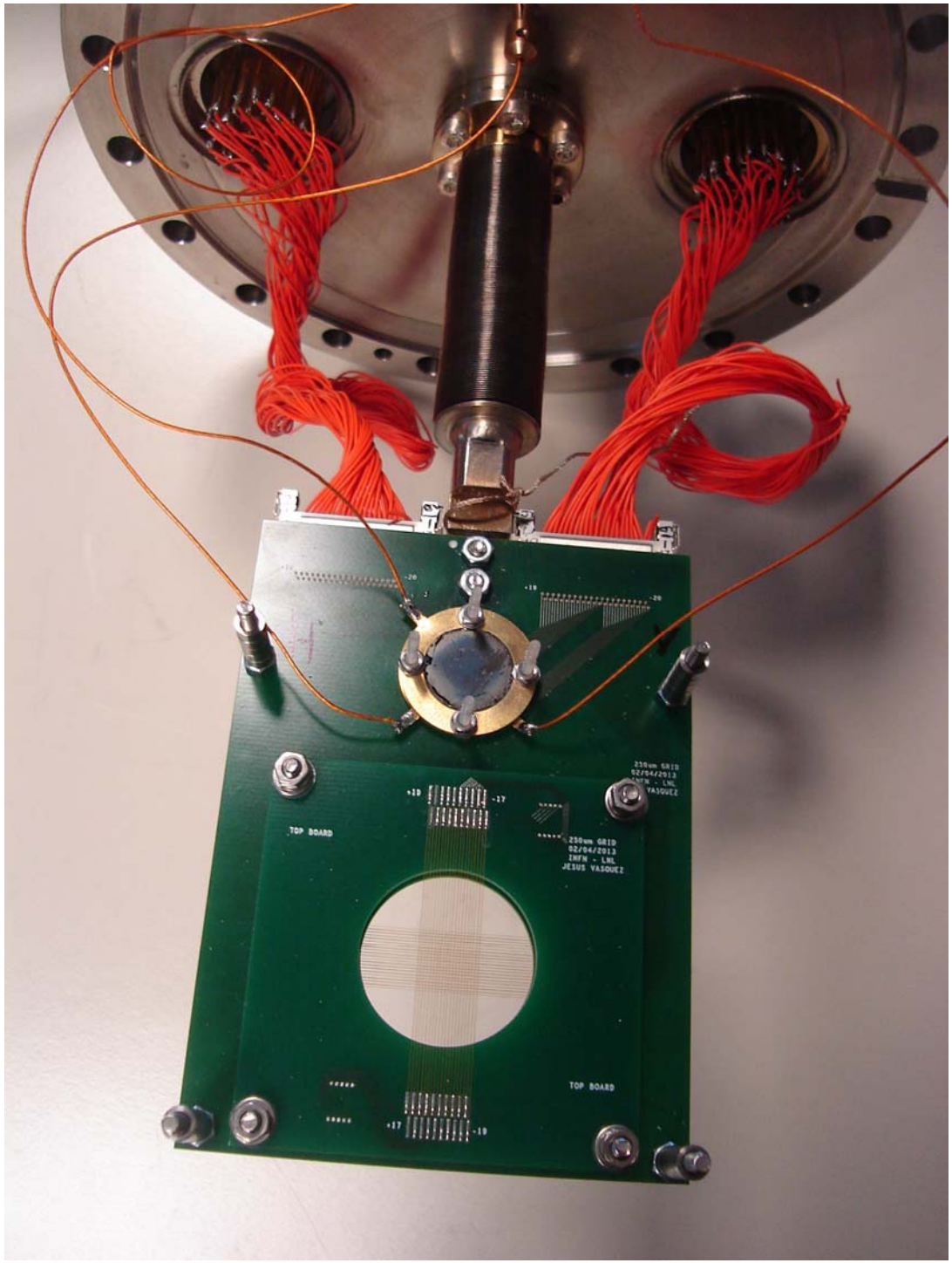


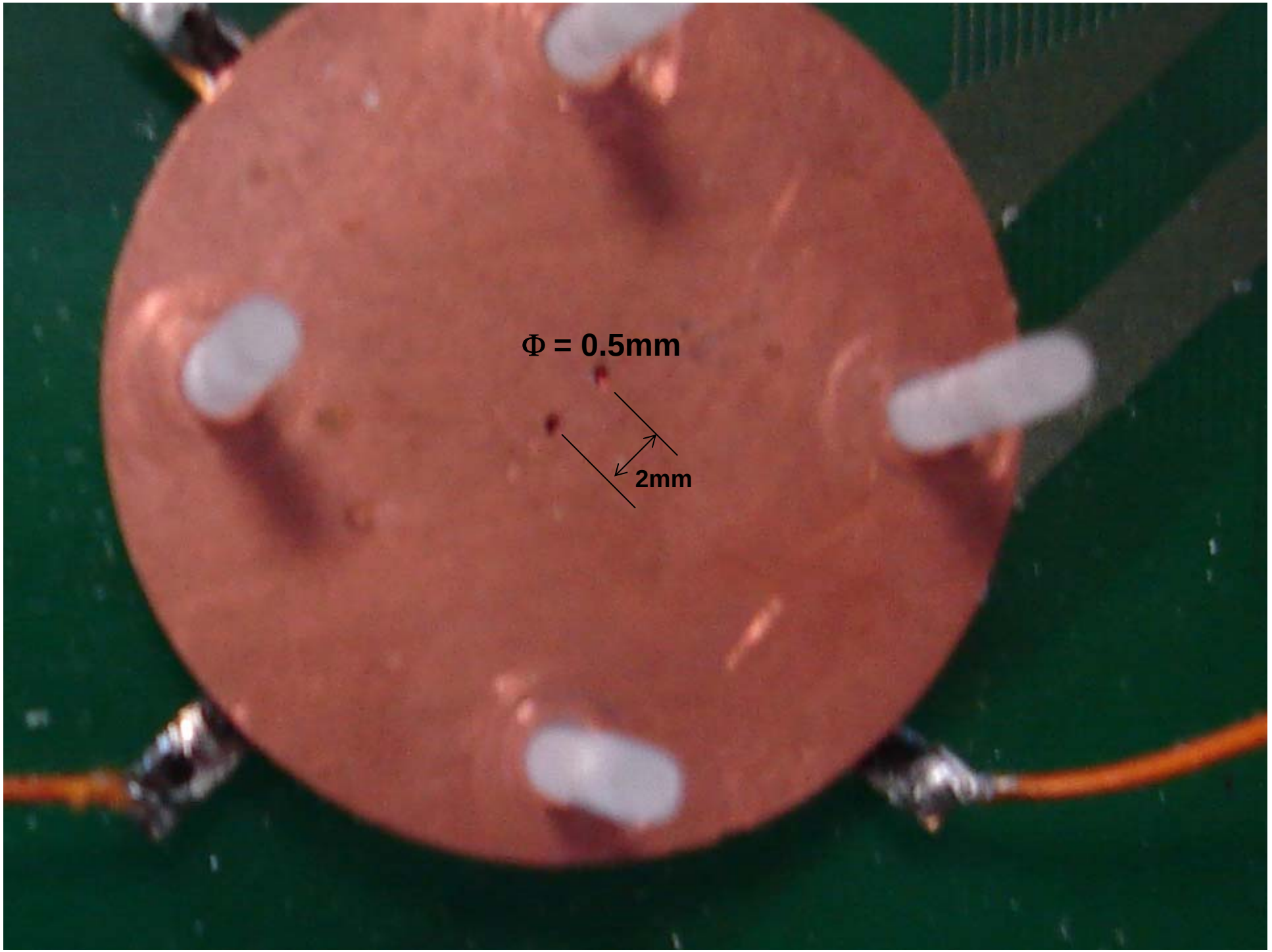
Test with 10 fA 40Ca

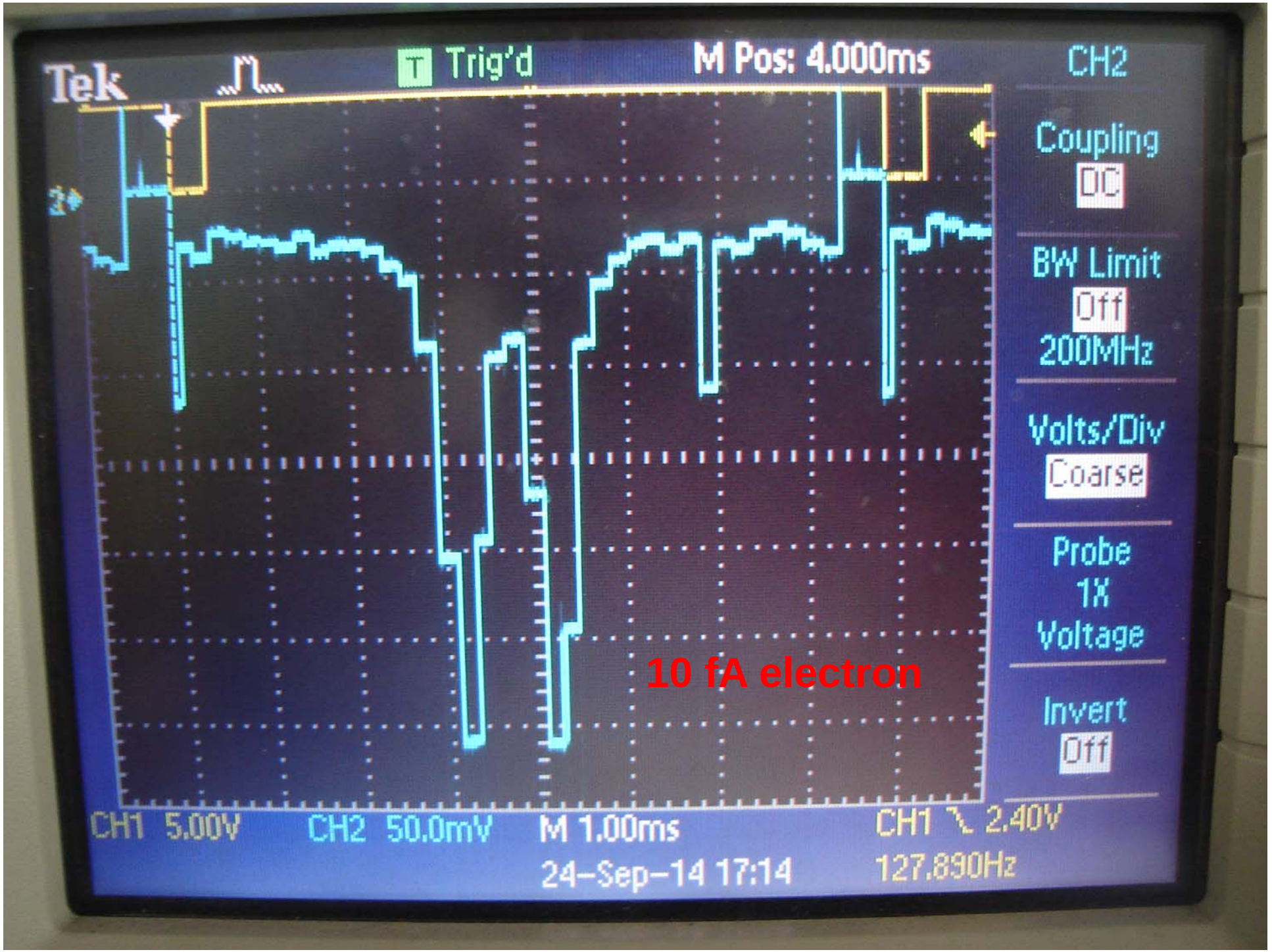



MCP ANODE
GRIDS


MCP ANODE
GRIDS
250um GRID
02/04/2013
INFN - LNL
JESUS VASQUEZ
TOP BOARD


TOP BOARD
250um GRID
02/04/2013
INFN - LNL
JESUS VASQUEZ
TOP BOARD


Φ = 0.5mm
2mm


Tek
Trig'd
M Pos: 4.000ms
CH2
Coupling
DC
BW Limit
Off
200MHz
Volts/Div
Coarse
Probe
1X
Voltage
Invert
Off
10 fA electron
CH1 5.00V
CH2 50.0mV
M 1.00ms
CH1 2.40V
24-Sep-14 17:14
127.890Hz

SPES DIAGNOSTICS

CURRENT MEASUREMENT: using **Faraday cup** Piave-like

Designed, constructed and tested a new front-end electronics that can measure down to 1 e-pA . Good signal to noise ratio (J.Vasquez).

Next goal: 100fA

Less than 100fA: beam direct on MCP in counting mode (to test)

TRANSVERSE EMITTANCE: pepper-pot system?

TIMING DETECTOR: Silicon detector