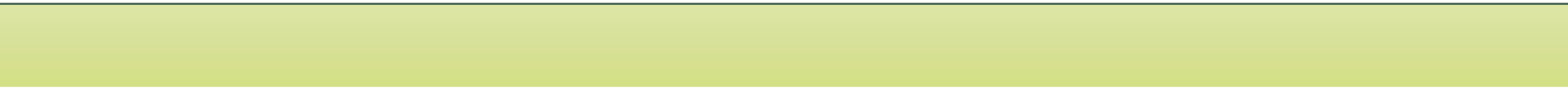




# Status and outlook of the LEIR INJECTION BPMs

M.Bozzolan, R.Scrivens

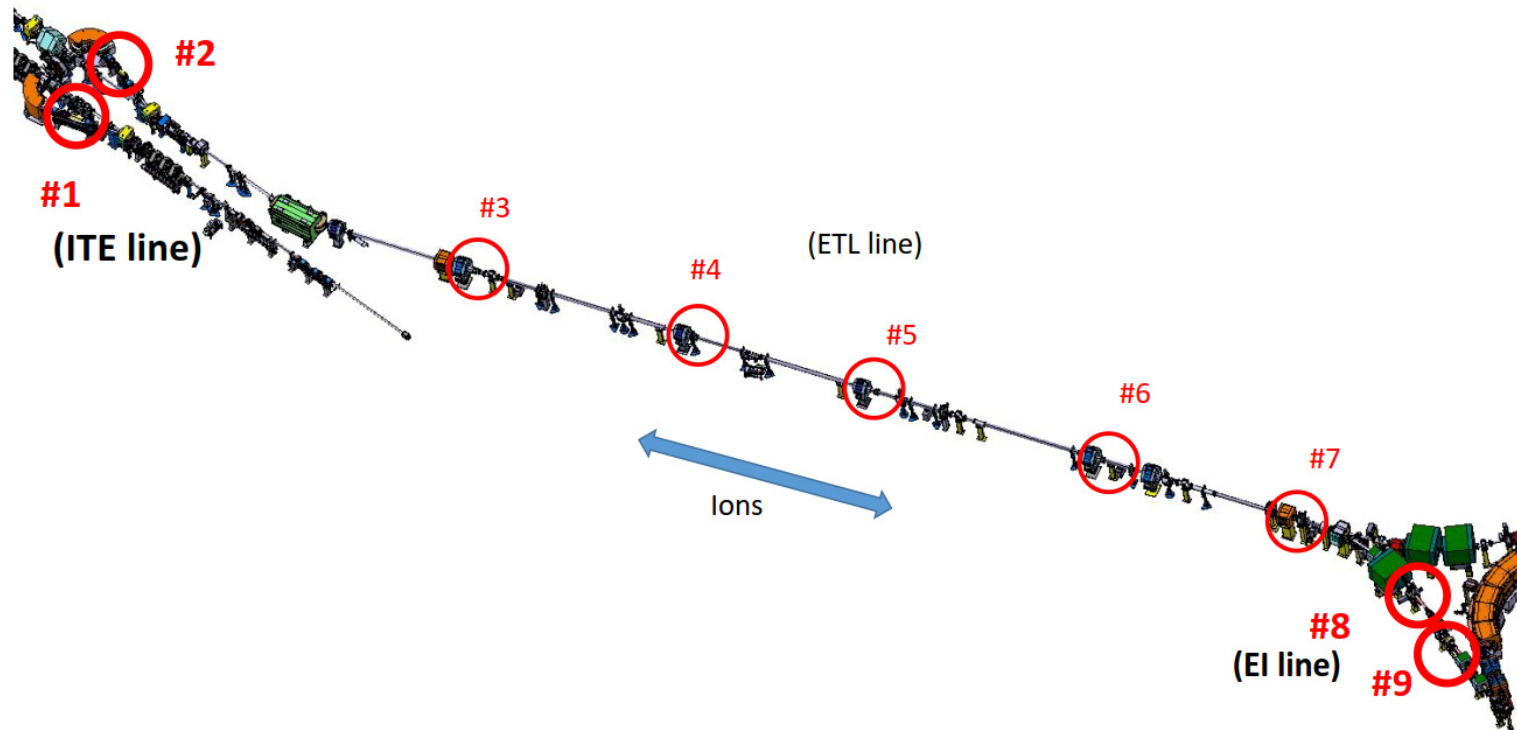




# Agenda

- Installation overview
- Status and issues
- New measurements at 101MHz
- Future outlook

# Installation overview

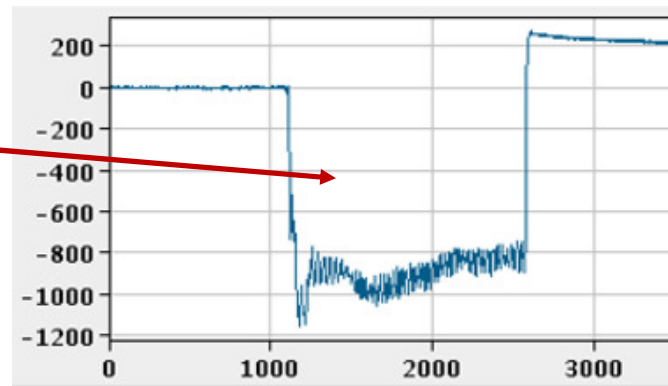


- 9 BPM installed (2 in ITE, 5 in ETL, 2 in EI)
- Electrostatic type (capacitive plates) with charge amplifier on the BPM
- Bunching along the line was unknown at design time

# Electrodes charging issue

## BPM SUM SIGNAL (BEAM CURRENT) AFTER MITIGATION

Positive ions cause  
negative signal

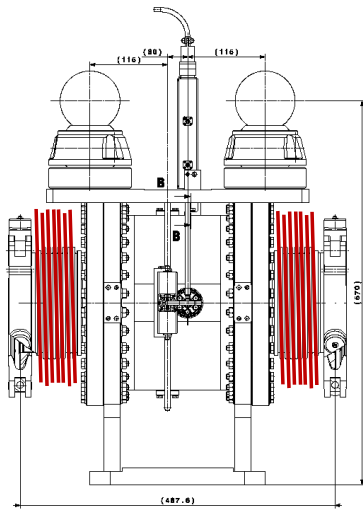


RESIDUAL  
NEGATIVE CHARGE  
AFTER BEAM  
PASSAGE

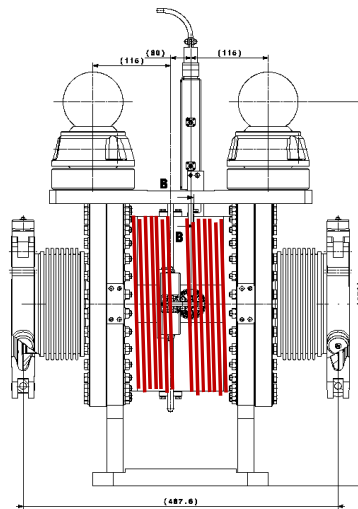
- Almost all the BPMs suffer of charging (ETL.BPMI60 is practically unaffected)
- Application of electrode bias voltage and magnetic field reduce but not solve the problem
- Behaviour is different depending on the BPM location
- Strong dependence on quad settings, slits setting, PS cycle

# Magnetic field patterns

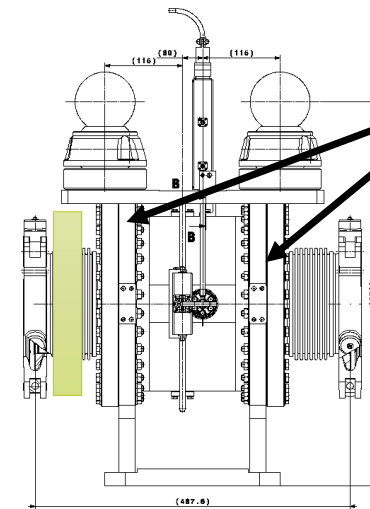
Helmholz coil (longitudinal)



Solenoid (longitudinal)



Dipole (transverse)



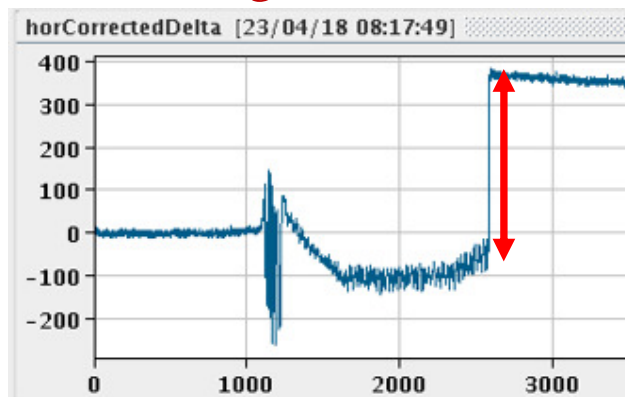
BPM flanges

- Solenoid around BPM body is the most effective scheme with  $B \sim 1..10\text{mT}$  depending on the BPM
- In some case the required current cannot be applied all the time for thermal reasons
- Effects on the primary beam to be checked

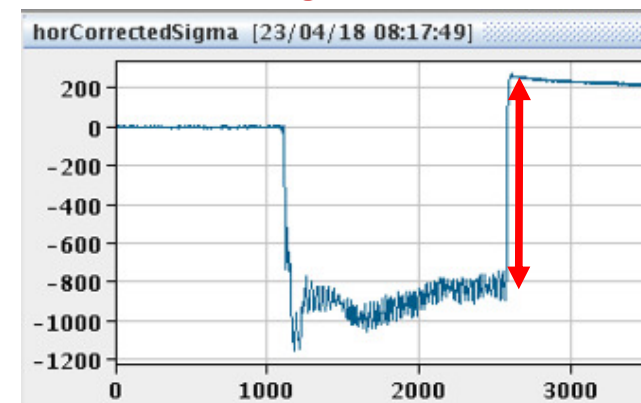
# Status of the system

- Bias voltages and solenoid currents applied to avoid signals saturation
- 7 of 9 BPMs measure a single point position at the end of the LINAC pulse using the sharp rising edge

$\Delta$  signal

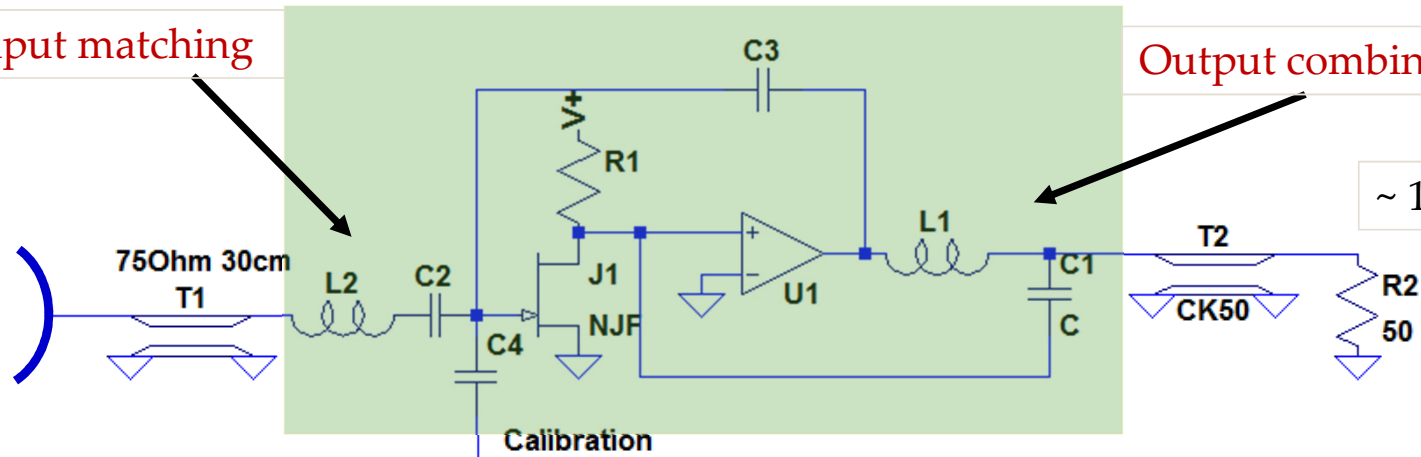


$\Sigma$  signal



# Modified head amplifier

101MHz Input matching



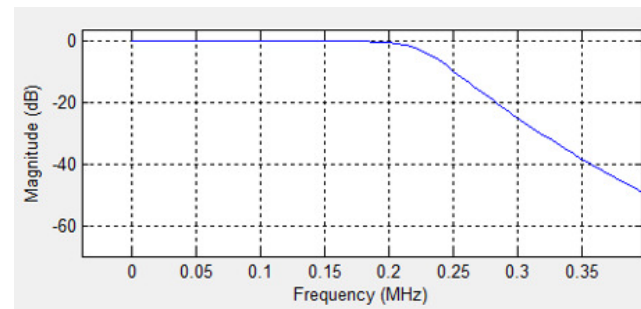
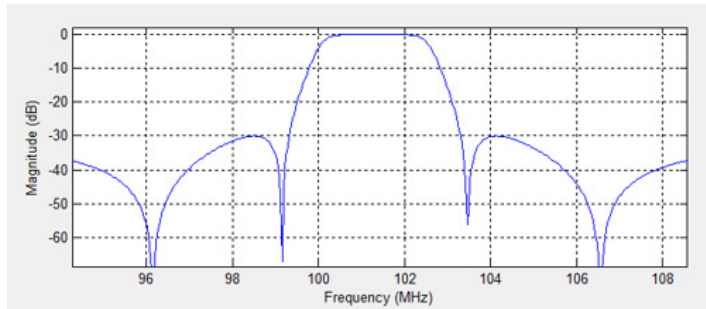
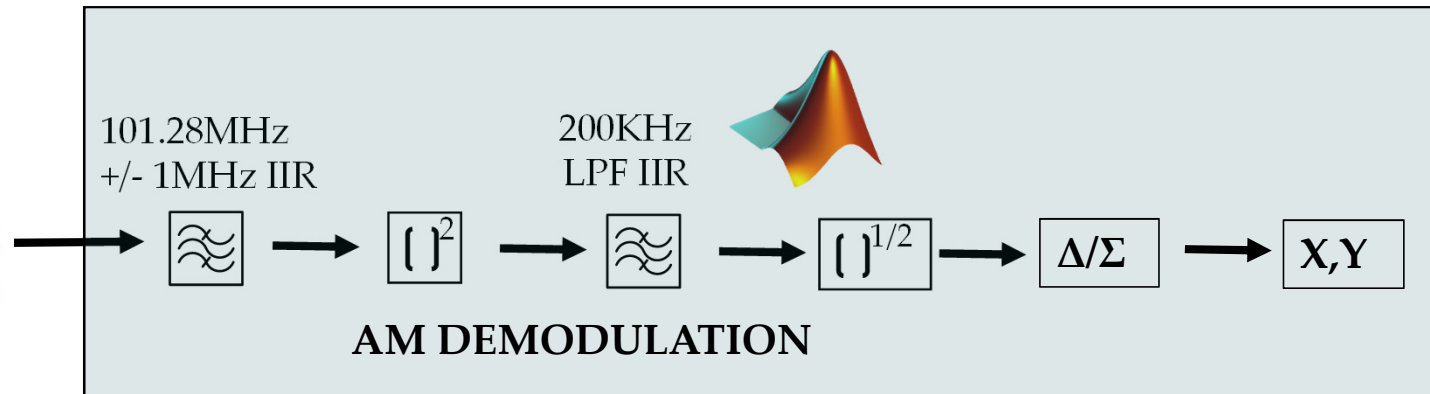
Output combiner

~ 15dB gain @ 101MHz

- Both charge amplifier output and 101Mhz bunching components available in LEIR CCC
- For the current acquisition system modification is transparent
- LF output  $\Sigma$  and  $\Delta$ , HF output electrode signal
- 5 BPMs equipped

# 101MHz acquisition

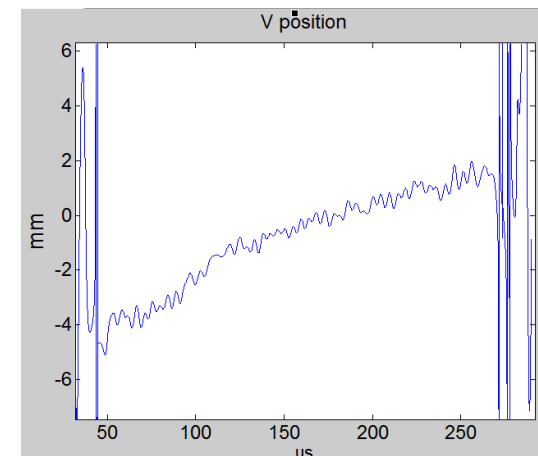
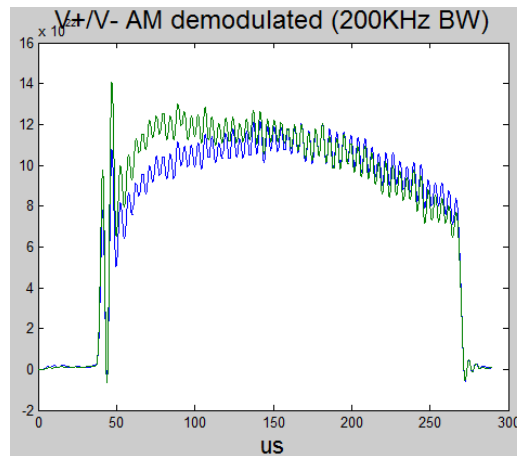
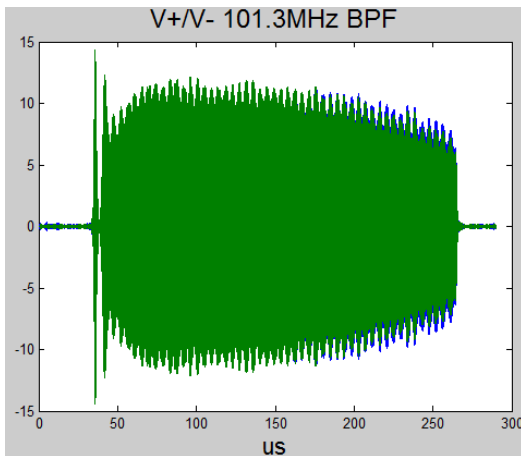
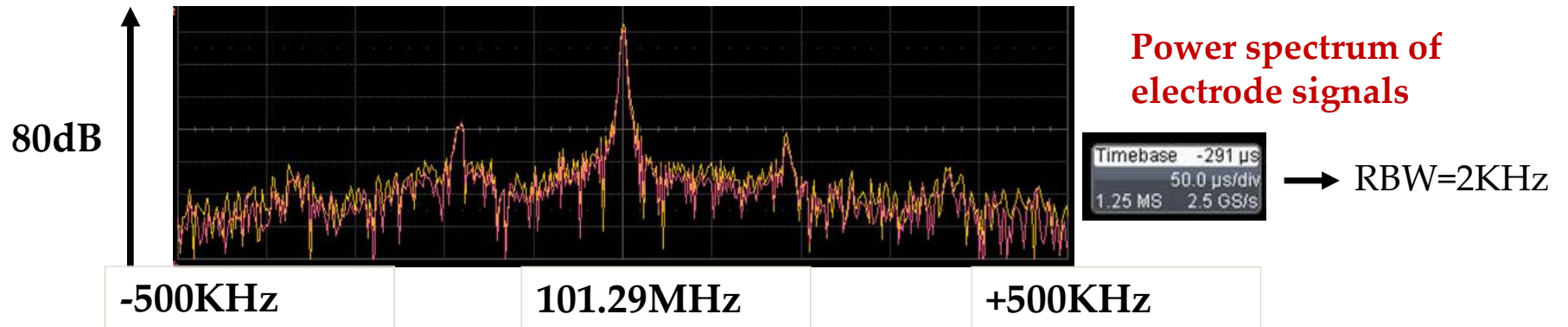
8bit, 500Msps



- LECROY 8 bit scope running @ 500Msps + matlab DSP
- 20dB amplifier in front of the scope to have sufficient signal level
- S/N ratio probably dominate by the scope (12bit scope, now broken, should perform quite better)



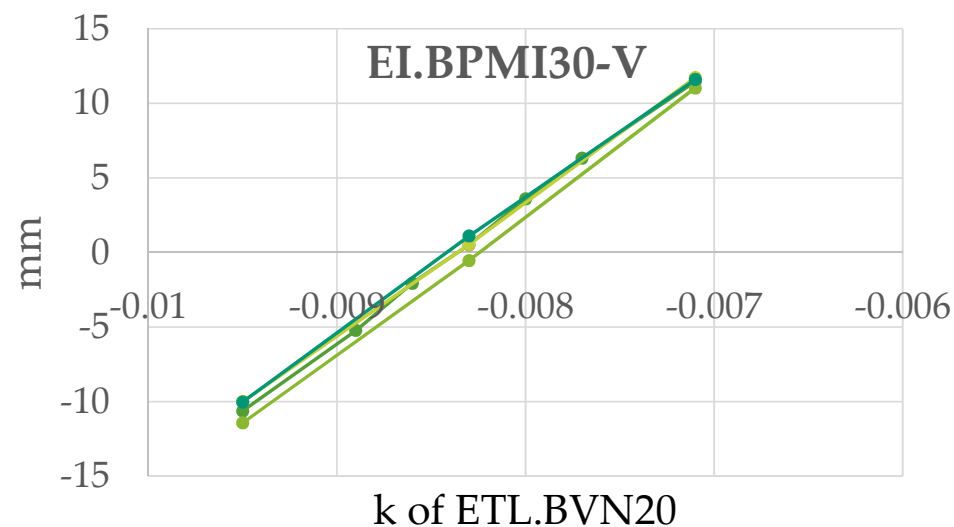
# ELBPMI30 signals (last BPM in the line)



- Bunching stay almost constant all along the line
- At this conditions, resolution expected to be better than 0.5mm over 5 $\mu$ s time average

# Dipole scan (HF measurement)

Dipole scan ( $\pm 10\text{mm}$ ) for different settings of the debuncher (actually working as rebuncher)  
(phase off up to  $20^\circ$  and amplitude down to 80%)



- Position values are the average over the central region of the LINAC pulse
- Measurements are (at first sight) independent of clearing voltage and magnetic field
- BPM response stay linear over the range
- With the debuncher off the signals become very weak (not shown)
- Similar scans for ITE.10, ITE.20, ETL.20 and EI.10 were successful

# LF & HF measurement comparison

## LF

- Generally not reliable for an intrapulse position measurement
- Not available when line setting are much off
- Independent on the bunching
- Absolute current intensity measurement

## HF

- Amplitude is function of beam intensity and bunch shape
- Resolution likely less than the LF case
- Insensitive to the electrodes charging
- Acquisition system to be developed

# Few (of many) possible configurations

## A. HW demodulation

- only HF available
- acquisition system and FESA class basically unchanged

## B. Downconversion and SW demodulation

- HF & LF measurement at the same time possible
- Signal processing necessary → Major upgrade of FESA class

- In both cases, 4 HF amplifiers directly connected at the feedthroughs should deliver better noise performance



# Outlook

- Bunching operational specifications to be defined (ABP / OP action)
- HF performances (resolution) to be better evaluated (BI action)
- Measurement mode (HF / HF & LF) to be agreed
- Upgrade of the acquisition system to be evaluated in terms of timeline and resources
- HF acquisition system for all the line to be ready by the end of LS2