

Platform for Research
and Applications
with Electrons

PRAE



Projet Emblématique

 île de France

Programme SESAME



BEAM POSITION MONITOR BPM



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With the support of

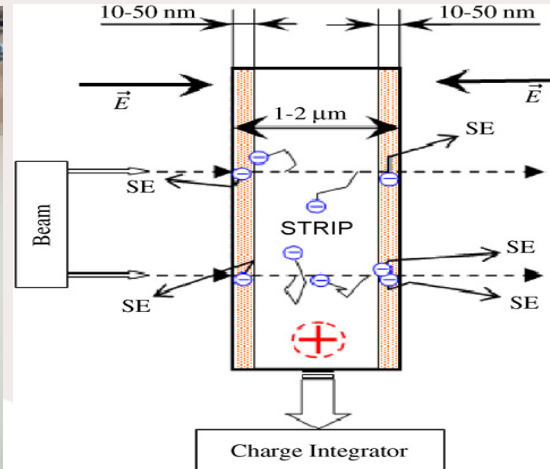


BEAM PARAMETERS	PRAE
ENERGY	50-70MeV (Phase 1)
Charge	0,05pC-2nC
RF frequency	3GHz
Repetition rate	50Hz
Transverse size	0,5mm
Bunch length	<10ps
Bunches per pulse	1

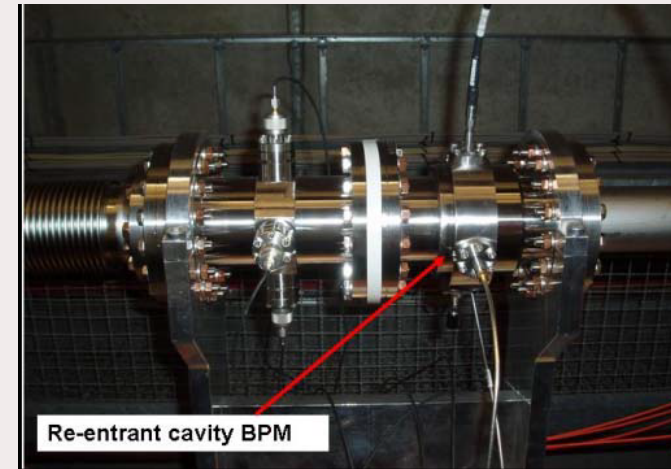
Inductive pickup



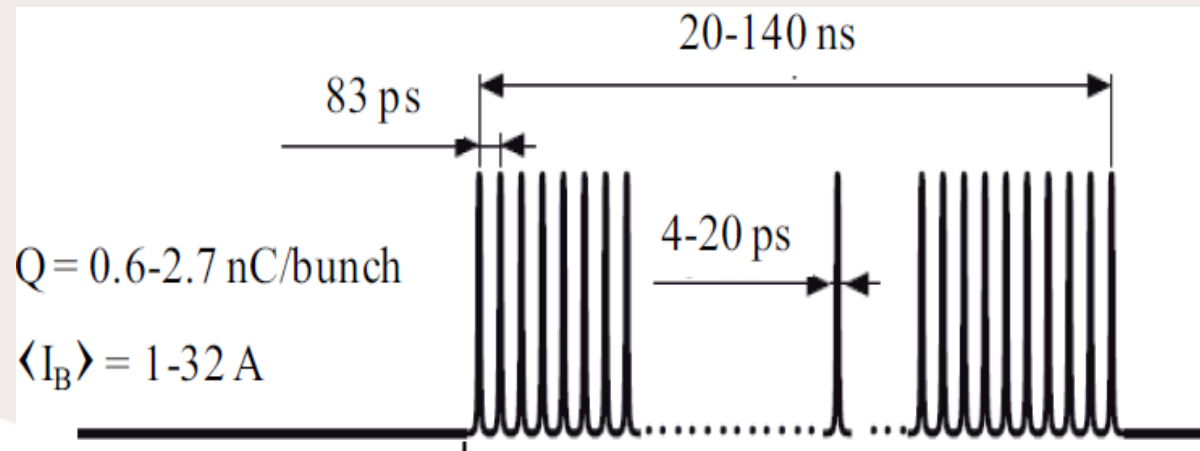
Microstrip metal detector



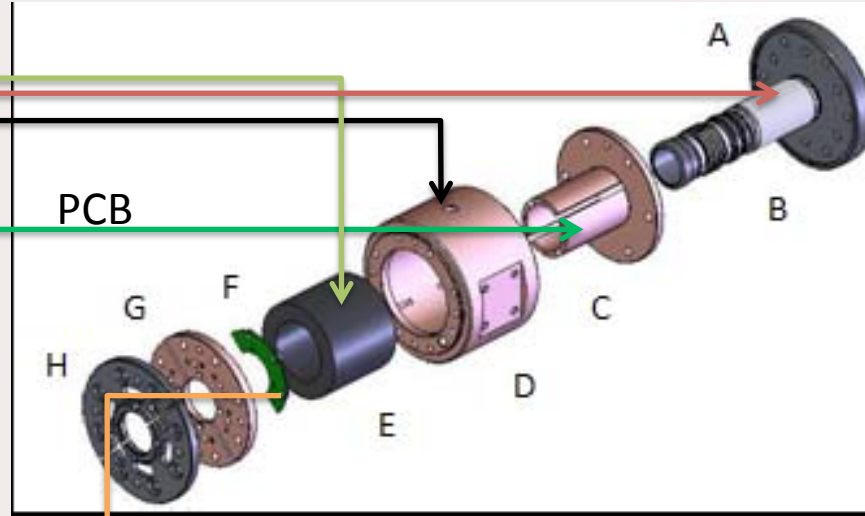
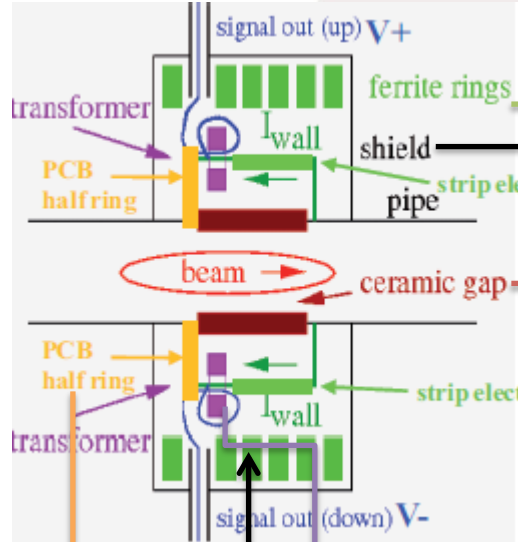
Re entrant cavity



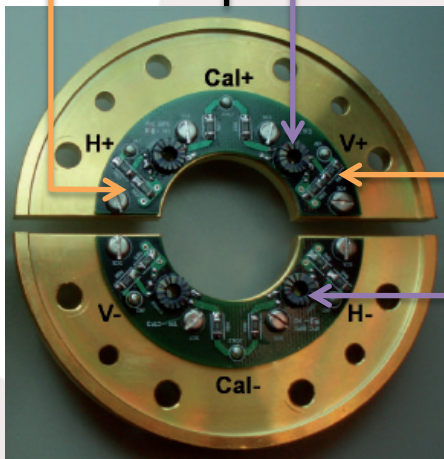
BEAM PARAMETERS	PRAE	CTF3
ENERGY	50-70MeV (Phase 1)	150MeV
Charge	5pC-2nC (optimal 1nC)	0,6nC-2,7nC
RF frequency	3GHz	12GHz
Repetition rate	50Hz	0,83Hz-50Hz
Transverse size	0,5mm	0,5mm
Bunch length	<10ps	4ps-20ps
Bunches per pulse	1	240-1600



Operation principle



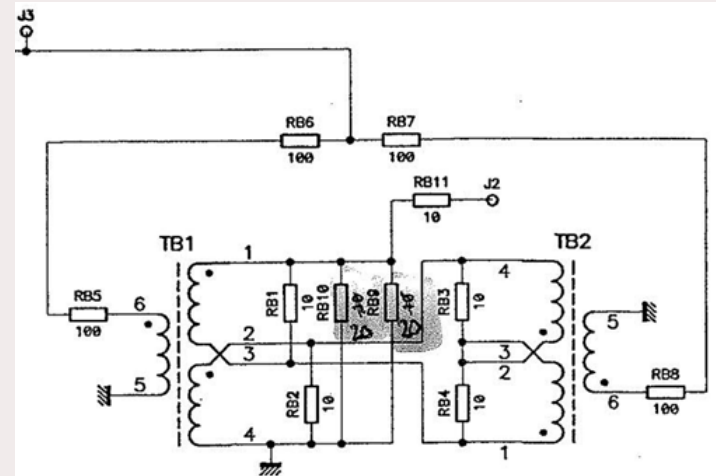
PCB

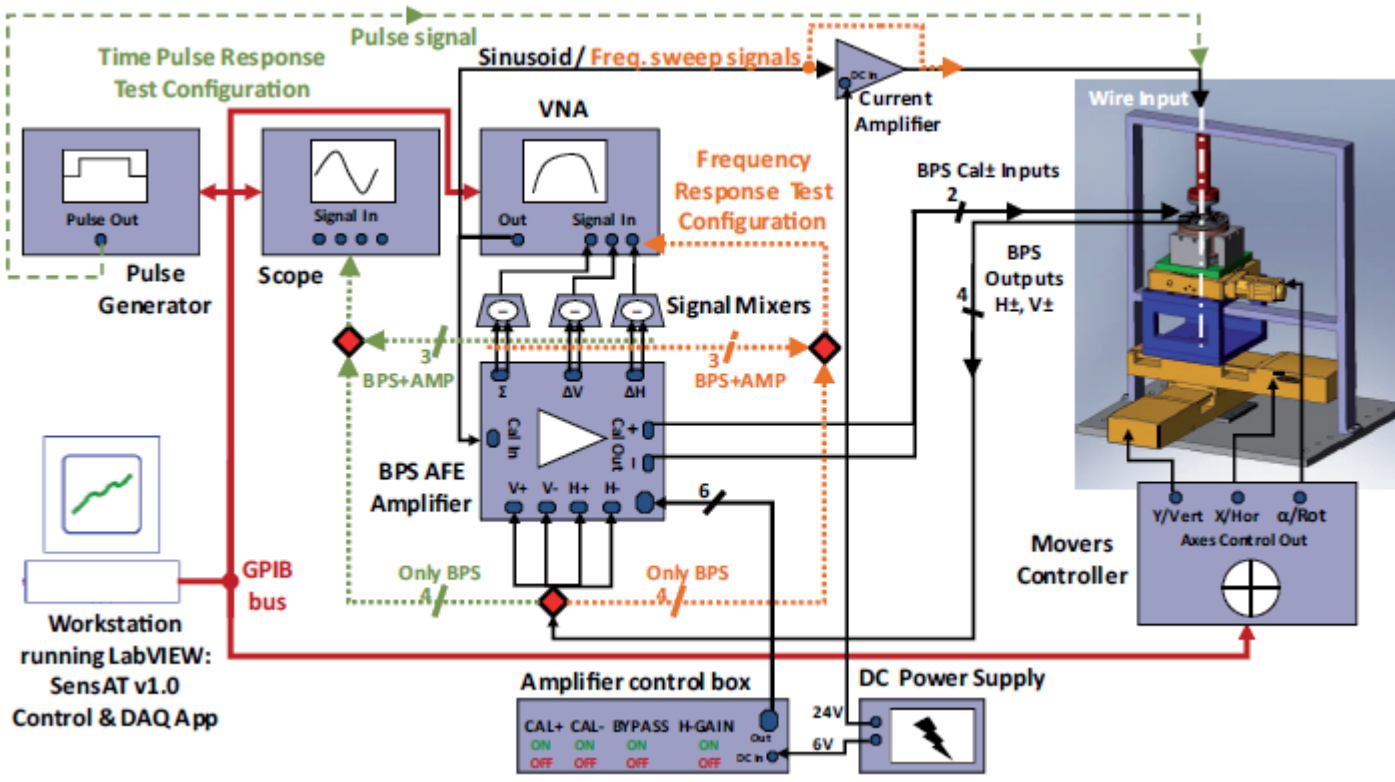


Tore + Windings



PCB CALIBRATION CIRCUIT

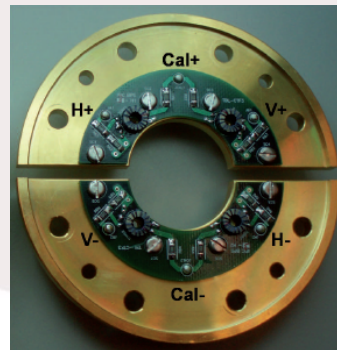




X,Y displacements
Rotation over the
Z axis

Calibration goals:

- Gain Equalization
- Frequency and impulse responses for centered beam



Qualification tests:

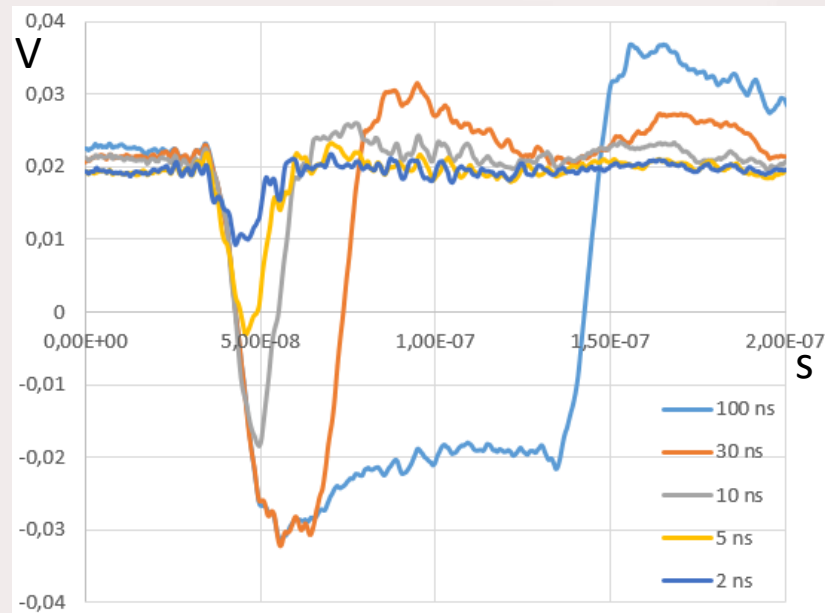
- Frequency response
- Impulse response
- Bunch response
- Sensitivity measurements

Frequency response

Hz



Impulse response



Conclusion:

Cutoff frequencies: Low=2KHz; High=80MHz

⇒ $T_{\text{droop}} = 560\text{ns}$; $T_{\text{rise}} = 2\text{ns}$

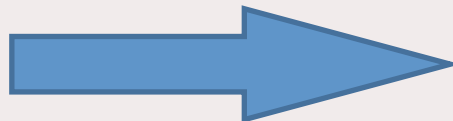
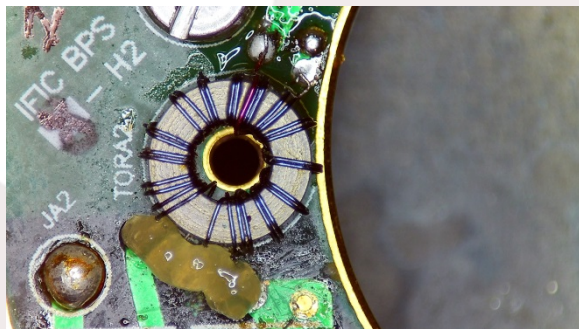
⇒ Low output for bunch with length $< 10\text{ps}$

Setup: 4V impulse with impulse length varying from $2\mu\text{s}$ to 2ns
Impulse rise time = $0,8\text{ns}$

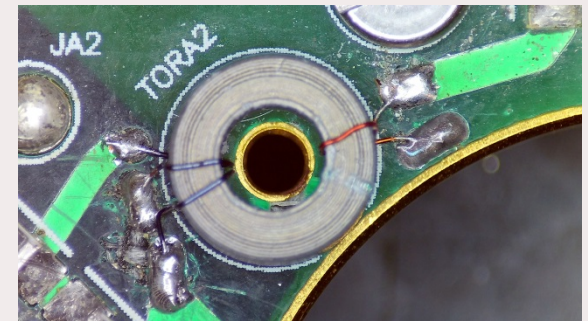
Impulse length(ns)	2000	100	30	10	5	2
Attenuation(dB)	3	36	38	40	46	52

- Frequency response:
 - BPM dynamic range = 20dB
 - Very low BPM response = 62 dB attenuation
 - Impulse response: very low BPM response
 - Calculated Sensitivity: 60mV/nC
 - Actions: Modify the tore windings,
30 turns in the secondary winding → 1 turn in the secondary windings
- Expected Goals:
- Decrease of 30dB in BPM attenuation
 - Sensitivity improved to 2V/nC

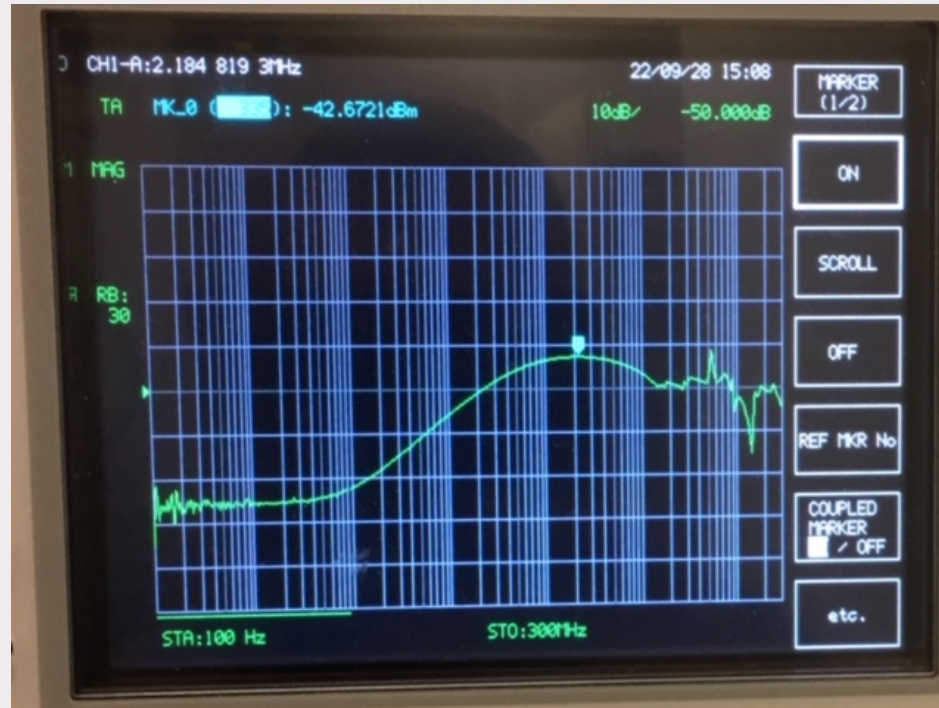
Previous Windings



Present Windings



Frequency response



**20dB decrease in BPM attenuation
Cutoff frequency decreased**

Actions

1. Frequency response:
 - Matching study : (PCB electronics and setup configuration)
 - Decreasing BPM attenuation
 - Increase BPM cut off frequency $\Rightarrow T_{\text{rise}} \downarrow$
2. Impulse response: need for short pulse generator for testing
 - Improve BPM sensitivity (Goal : 2V/nC)
 - Test of the BPM in configuration close to final operation
3. Electronics to improve the BPM output signal in real time operation
 - Design of a charge pump
 - Study of up-to-date solutions
4. BPM position sensitivity: Measurement with the test bench

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