

# Status on the construction of the BPS series for the TBL of CTF3

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with the help of the CTF3 Collaboration

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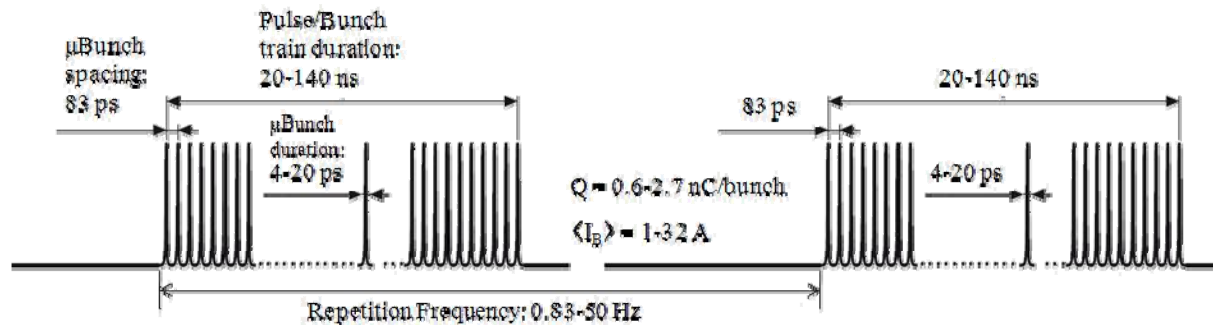
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# TBL + BPM specifications

TBL Beam Parameters	
Beam current range	1-32 A
Bunch train duration	20-140 ns
Injection beam energy	150 MeV
Microbunch spacing	83 ps (12 GHz)
Microbunch duration	4-20 ps
Microbunch charge	0.6-2.7 nC
Repetition frequency	0.83-50 Hz
Radiation level	$\leq 1000$ Gray/year
Emittance	$150 \mu\text{m}$
BPM Parameters	
Analog bandwidth	10 kHz-100 MHz
Beam position range	$\pm 5$ mm (H/V)
Beam aperture diameter	24 mm
Overall mechanical length	126 mm
Number of BPM's in TBL	16
Resolution at maximum current	$\leq 5 \mu\text{m}$
Overall precision	$\leq 50 \mu\text{m}$



2 BPS prototypes has been designed, constructed and characterized.



TBL beam time structure

## BPS: Characterization Table (PCB Ver.1)

BPS1 Sensitivity and Linearity Parameters	
Vertical Sensitivity, $S_V$	41.09 mm <sup>-1</sup>
Horizontal Sensitivity, $S_H$	41.43 mm <sup>-1</sup>
Vertical Electric Offset, $EOS_V$	0.03 mm
Horizontal Electric Offset, $EOS_H$	0.15 mm
Vertical overall precision (accuracy), $\sigma_V$	78 μm
Horizontal overall precision (accuracy), $\sigma_H$	170 μm
BPS1 Characteristic Output Levels	
Sum signal level, $\Sigma$	16.5 V
Difference signals max. levels, $\ \Delta V\ _{\max}$ , $\ \Delta H\ _{\max}$	8.25 V
Centered beam level, $V_{\text{sec}} (x_V = 0, x_H = 0)$	4.125 V
BPS1 Frequency Response (Bandwidth) Parameters	
$\Sigma$ low cut-off frequency, $f_{L\Sigma}$	1.76 KHz
$\Delta$ low cut-off frequency, $f_{L\Delta}$	282 KHz
$\Sigma$ low cut-off frequency calibration, $f_{L\Sigma} [\text{Cal}]$	1.76 KHz
$\Delta$ low cut-off frequency calibration, $f_{L\Delta} [\text{Cal}]$	180 KHz
High cut-off frequency, $f_{\text{high}}$	> 100 MHz
High cut-off frequency calibration, $f_{\text{high}} [\text{Cal}]$	> 100 MHz
BPS1 Pulse-Time Response Parameters	
$\Sigma$ droop time constant, $\tau_{\text{droop}\Sigma}$	90 μs
$\Delta$ droop time constant, $\tau_{\text{droop}\Delta}$	564 ns
$\Sigma$ droop time constant calibration, $\tau_{\text{droop}\Sigma} [\text{Cal}]$	90 μs
$\Delta$ droop time constant calibration, $\tau_{\text{droop}\Delta} [\text{Cal}]$	884 μs
Rise time constant calibration, $\tau_{\text{rise}}$	< 1.6 ns
Rise time constant calibration, $\tau_{\text{rise}} [\text{Cal}]$	< 1.6 ns



## BPS: Characterization Table (PCB Ver. 2)

BPS1 Sensitivity and Linearity Parameters	
Vertical Sensitivity, $S_V$	44.57 mm <sup>-1</sup>
Horizontal Sensitivity, $S_H$	50.0 mm <sup>-1</sup>
Vertical Electric Offset, $EOS_V$	-0.14 mm
Horizontal Electric Offset, $EOS_H$	0.27 mm
Vertical overall precision (accuracy), $\sigma_V$	61 μm
Horizontal overall precision (accuracy), $\sigma_H$	431 μm
BPS1 Characteristic Output Levels	
Sum signal level, $\Sigma$	10.5 V
Difference signals max. levels, $\ \Delta V\ _{\max}$ , $\ \Delta H\ _{\max}$	5.25 V
Centered beam level, $V_{\text{sec}}(x_V = 0, x_H = 0)$	2.625 V
BPS1 Frequency Response (Bandwidth) Parameters	
$\Sigma$ low cut-off frequency, $f_{L\Sigma}$	1 KHz
$\Delta$ low cut-off frequency, $f_{L\Delta}$	175 KHz
$\Sigma$ low cut-off frequency calibration, $f_{L\Sigma}[\text{Cal}]$	0.709 KHz
$\Delta$ low cut-off frequency calibration, $f_{L\Delta}[\text{Cal}]$	79 KHz
High cut-off frequency, $f_{\text{high}}$	> 100 MHz
High cut-off frequency calibration, $f_{\text{high}}[\text{Cal}]$	> 100 MHz
BPS1 Pulse-Time Response Parameters	
$\Sigma$ droop time constant, $\tau_{\text{droop}\Sigma}$	159 μs
$\Delta$ droop time constant, $\tau_{\text{droop}\Delta}$	909 ns
$\Sigma$ droop time constant calibration, $\tau_{\text{droop}\Sigma}[\text{Cal}]$	224 μs
$\Delta$ droop time constant calibration, $\tau_{\text{droop}\Delta}[\text{Cal}]$	2 μs
Rise time constant calibration, $\tau_{\text{rise}}$	< 1.6 ns
Rise time constant calibration, $\tau_{\text{rise}}[\text{Cal}]$	< 1.6 ns

## BPS prototypes

- A set of two BPS prototypes (BPS1 and BPS2) with the associated electronics were designed and constructed.
- The performed tests in BPS1 yield:
  - Good linearity results and reasonably low electrical offsets from the mechanical center.
  - Good overall-precision/accuracy in the vertical plane considering the low test current; and, a misalignment in the horizontal plane was detected by accuracy offset and sensitivity shift.
  - Low frequency cut-off for  $\Sigma$ /electrodes signals,  $f_{L\Sigma}$ , and high cut-off frequency,  $f_{high}$ , under specifications.
  - Low frequency cut-off for  $\Delta$  signals,  $f_{L\Delta}$ , determined to perform the compensation of droop time constant,  $\tau_{droop\Delta}$ , with the external amplifier.
- BPS1 installed in TBL and BPS2 at IFIC

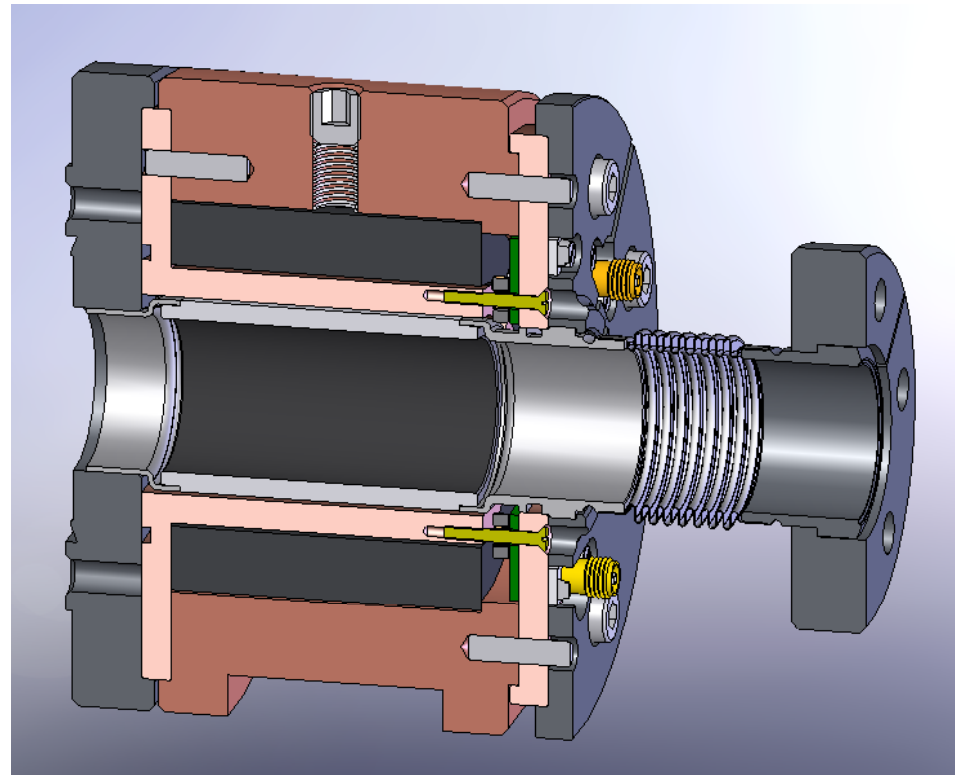
## BPS prototypes

- Issues for improvement in the BPS2 prototype:
  - correct the possible misalignments of the horizontal plane electrodes suggested in the linearity error analysis
  - check if overall-precision below 50 $\mu$ m (under TBL specs), with enough wire current  $\rightarrow$  New wire testbench at IFIC will allow higher currents, accurate (anti-vibration and micro-movement system) and automatized measurements.
  - study the different low cut-off frequencies in the calibration,  $f_{L\Delta[\text{Cal}]}$ , and wire excitation cases,  $f_{L\Delta}$
- Test Beam of the BPS1 in the TBL  $\rightarrow$  Resolution at maximum current.

## BPS series

Quantity: 15 units (BPS1 +15 + 1 spare for testing)

BSP section view

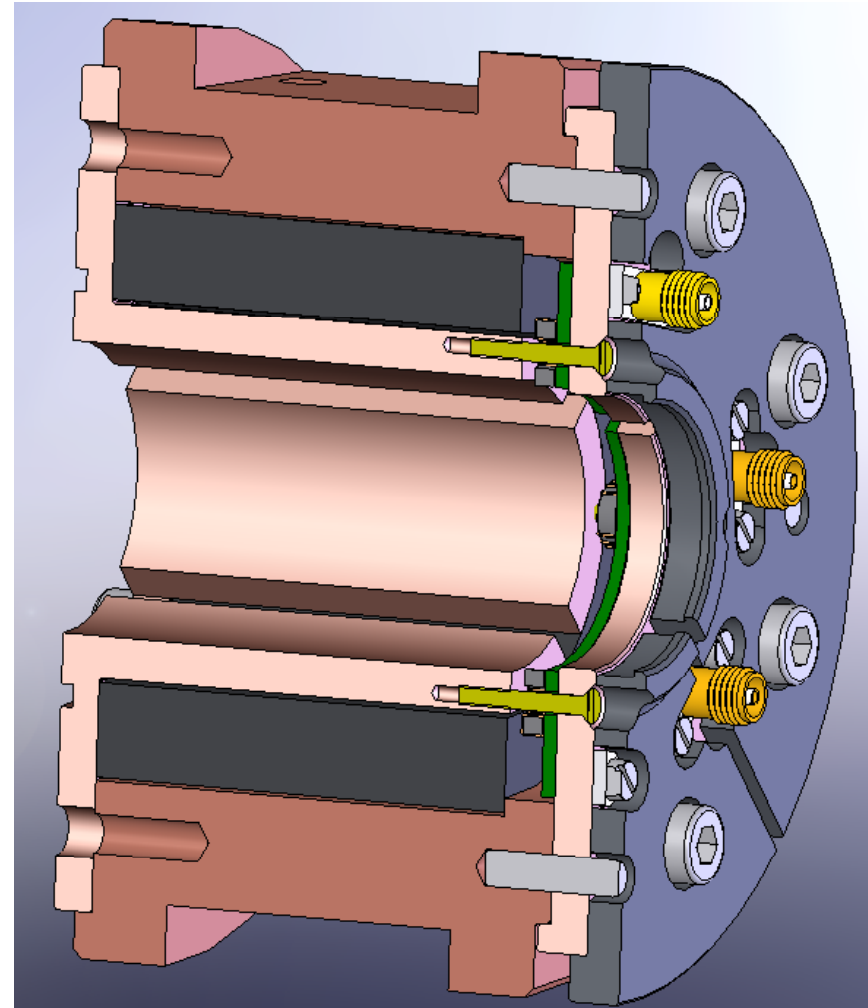


- Paperwork and tendering process → week 37 (Sep 08)
- Main supply contracts signed → week 51 (Dec 08)

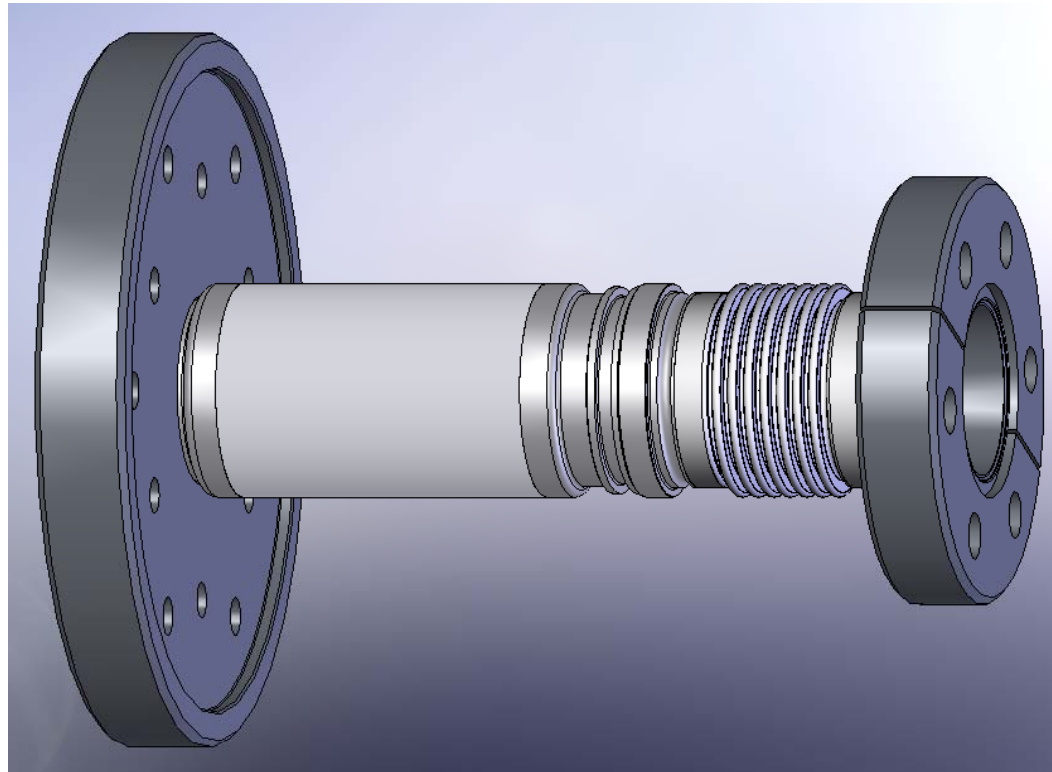


# Non-Vacuum Parts Production

- Copper body, electrode and bridge
  - Cu OFE procurement → week 5 (2009)
  - Manufacturing and metrology → week 12
  - Flash gold plating → week 13
- Cu-Be screws
  - Manufacturing and metrology → week 12
  - Flash gold plating → week 13
- Ferrites → week 5
- Steel split flange → week 12
- RF contacts → week 5



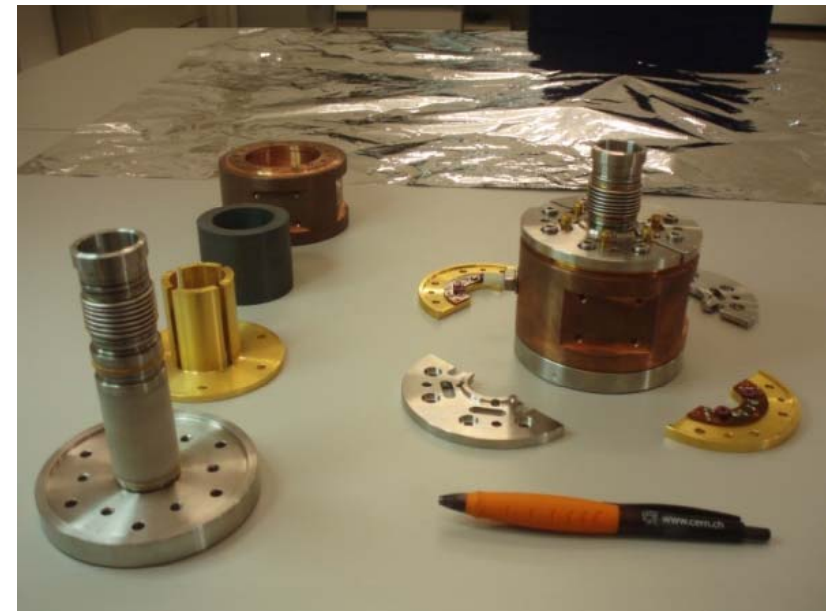
## Vacuum Parts Production



- Ceramic with metallic collars brazed & vacuum tests → week 12
- Ti sputtering at CERN → week 14
- Welding to bellow and flanges (EBW and TIG) and vacuum tests → week 16

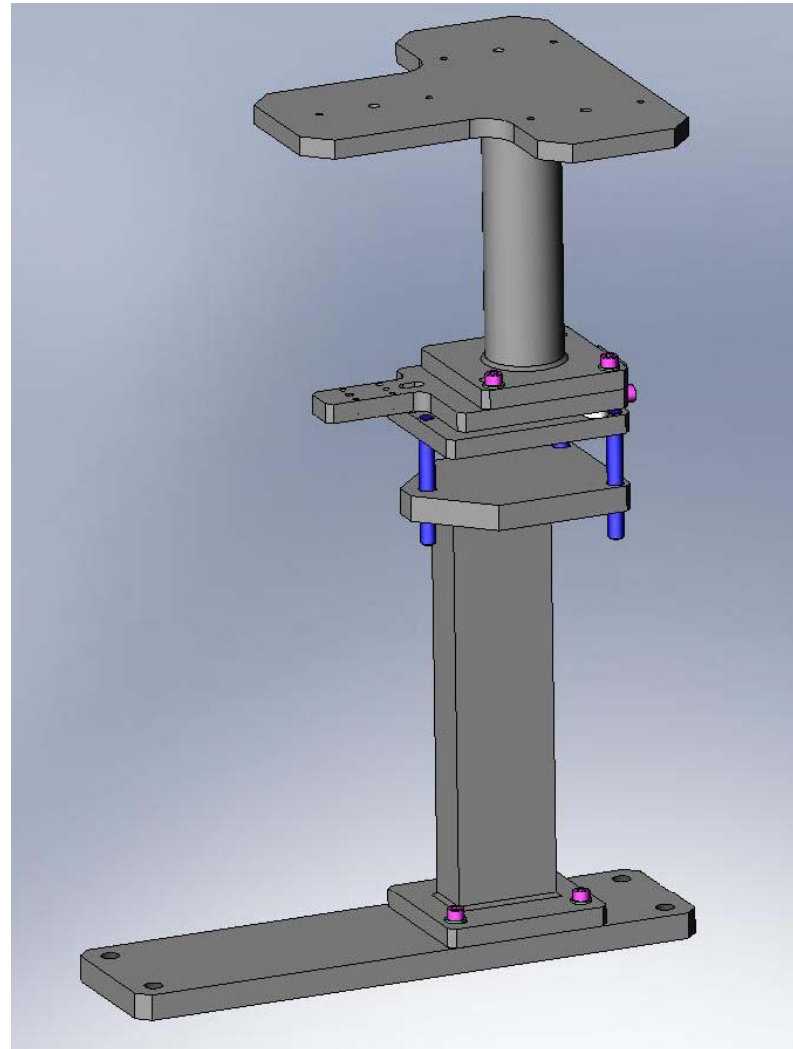
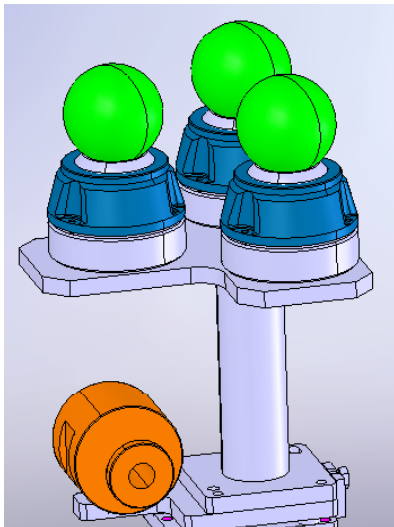
# PCBs manufacturing/validation and BPS' parts assembly

- BPS PCBs → week 9
  - Manufacturing 40 PCBs and components insertion (Resistors and Transformers)
- PCB gold plate mounting and validation → week 10
  - SMA connectors soldering with PCB mounted on golden plate.
  - PCB validation Test
- BPS Assembly process → week 18
  - Integration and alignment of the non-vacuum and vacuum parts, jointly with PCBs mounted on golden plates.



# BPS supports

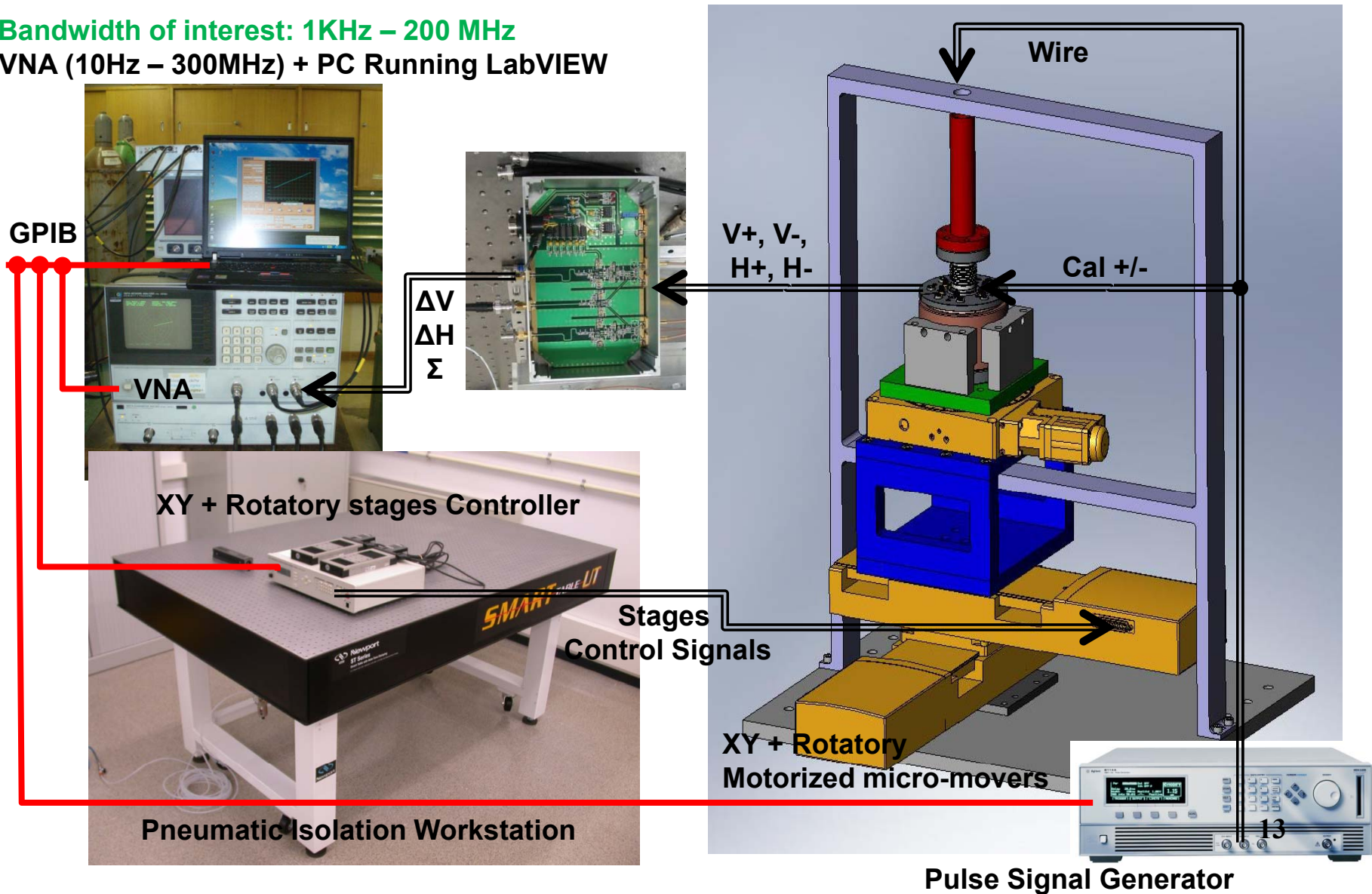
- Materials procurement → week 5
- Manufacturing → week 10
- Fix alignment spheres and make the metrology at CERN



# Low frequency set-up and Characterization Tests

- BPS testbench manufacturing and assembly → week 10
- BPS series (15 units) characterization tests → week 20

Bandwidth of interest: 1KHz – 200 MHz  
VNA (10Hz – 300MHz) + PC Running LabVIEW



Pulse Signal Generator



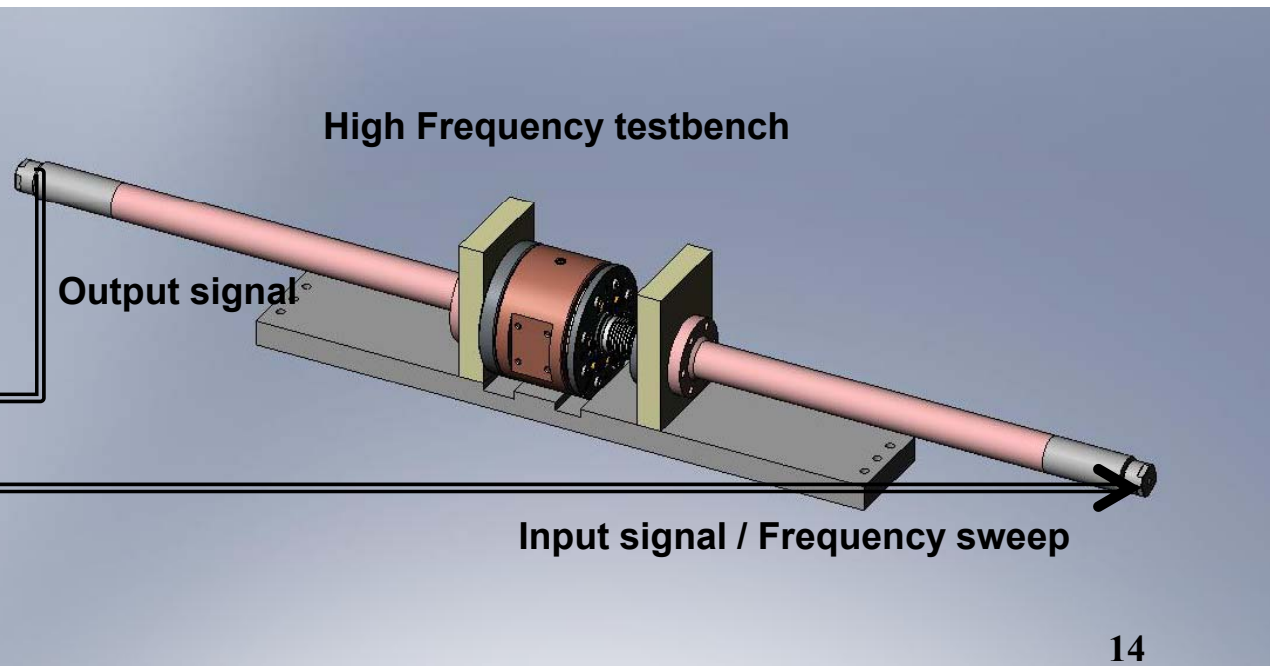
# High frequency set-up & Longitudinal Impedance Test

- BPS HF testbench manufacturing and assembly → week 14
- Longitudinal impedance determination test.  
Performed to BPS2 prototype → week 20

VNA (100MHz – 20GHz) + PC Running LabVIEW



Bandwidth of interest: 100MHz – 12 GHz





# Summary and Production Schedule

- Production of 15 BPS's already started.
- LF & HF Test Set-ups.
- Supports.

Week # (2009)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Non-vacuum parts																					
Ceramics with collars																					
Ti sputtering (proposal)																					
Electronic PCB's																					
BPS welding & integration																					
BPS supports																					
Metrology of supports at CERN (proposal)																					
Low frequency setup																					
High frequency setup																					
BPS tests																					

(BPS2 + 2 units) could be delivered at week 12 using spares parts from prototypes production