Stripline Beam Position Monitors for the High Luminosity LHC

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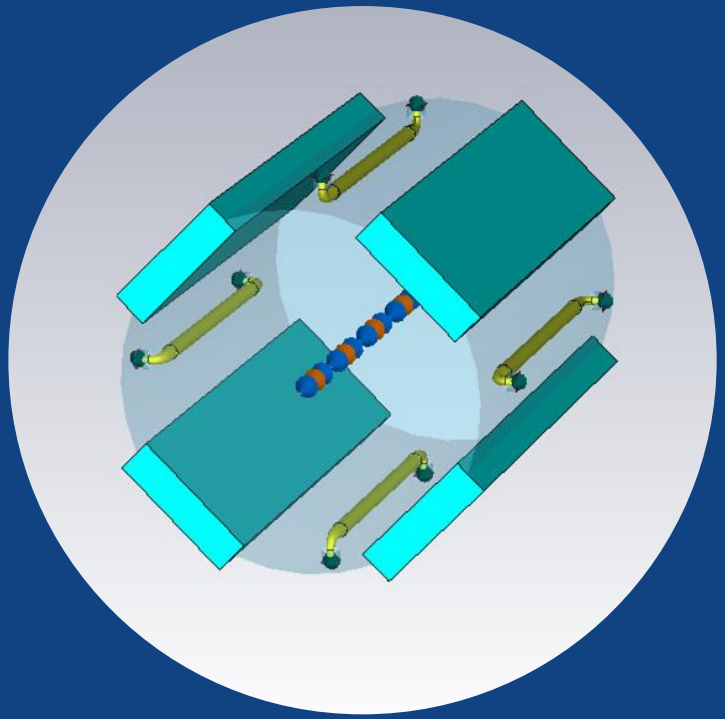


Design of Stripline BPMs for the High Luminosity LHC

- Optimizing the strip-line directivity to provide the best possible accuracy for counter propagating beams
- Studying the effects of Tungsten-Inermet180 absorbers installed to reduce the amount of collision debris

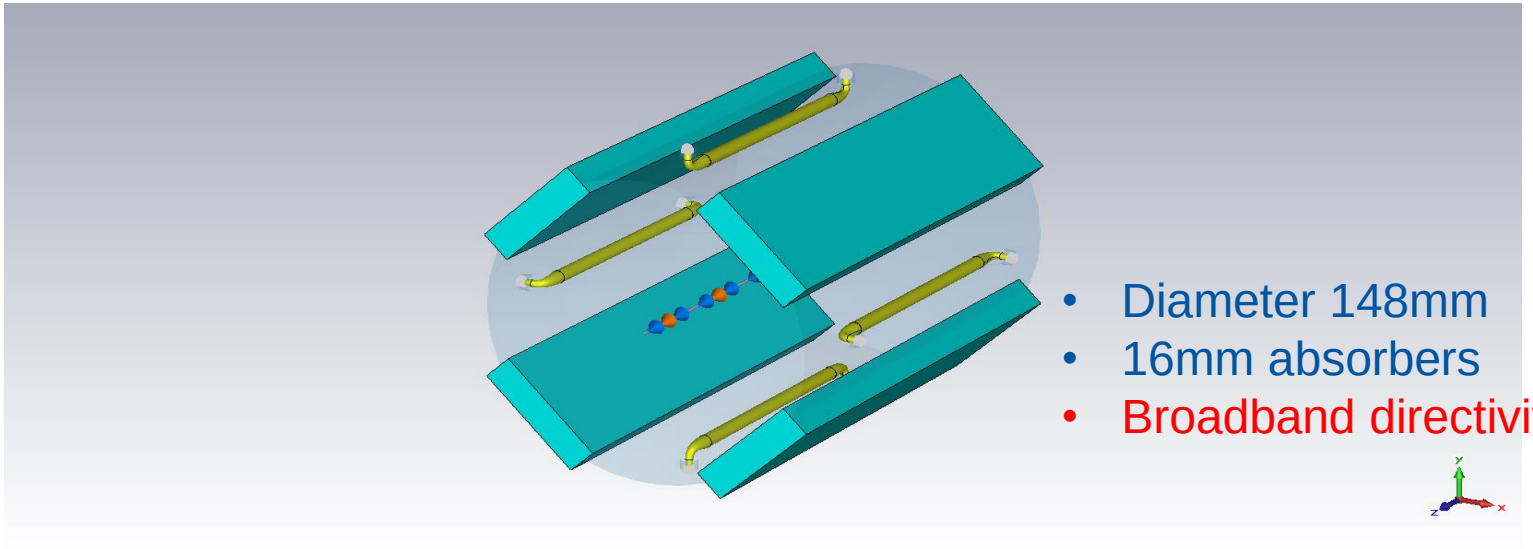
Directivity: Ratio of signal power at the upstream and downstream ports in response to a beam current.

- Directional couplers used for detection of LHC beams can typically achieve 20 dB of directivity.

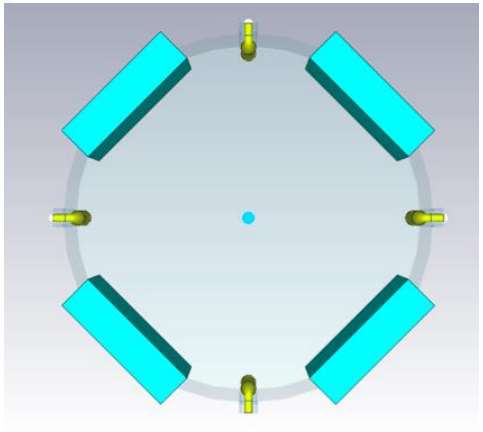
Work in progress:

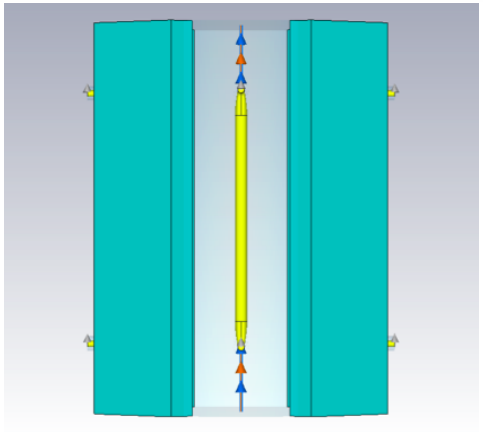
- Redesign of electrode shapes
- Redesign of transitions between the electrode and coax connector to minimize return loss
- New design with absorbers and new beam screen shape

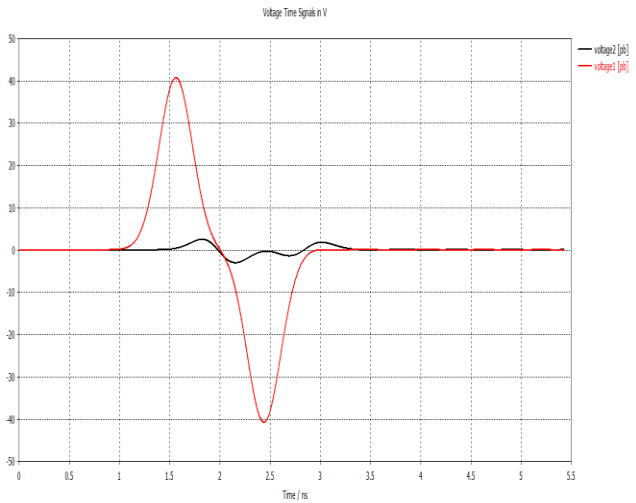
Design with circular cross-section and tubular electrodes



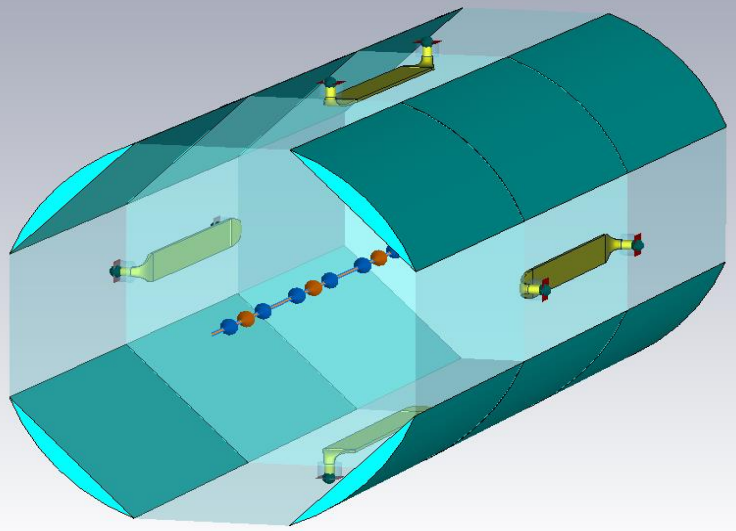
- Diameter 148mm
- 16mm absorbers
- Broadband directivity 24dB



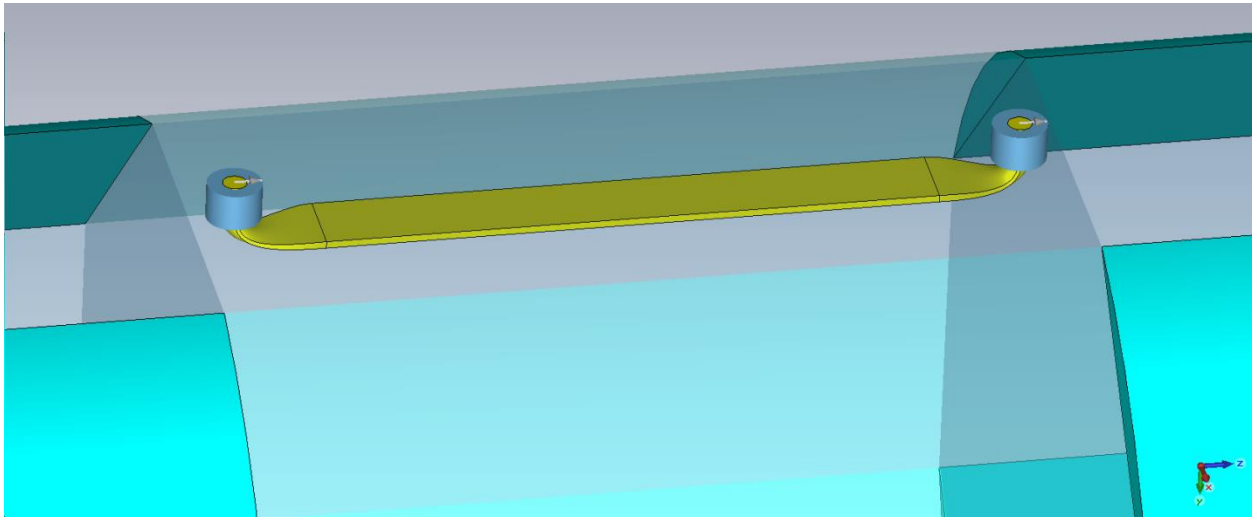




Design with new octagonal cross-section, 6 mm thick absorbers and flat electrode

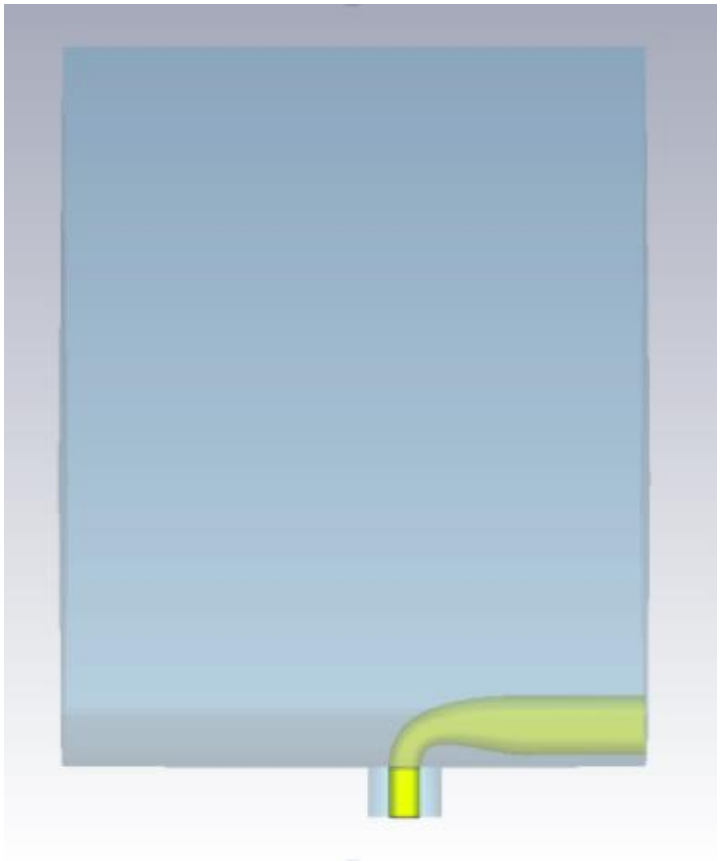


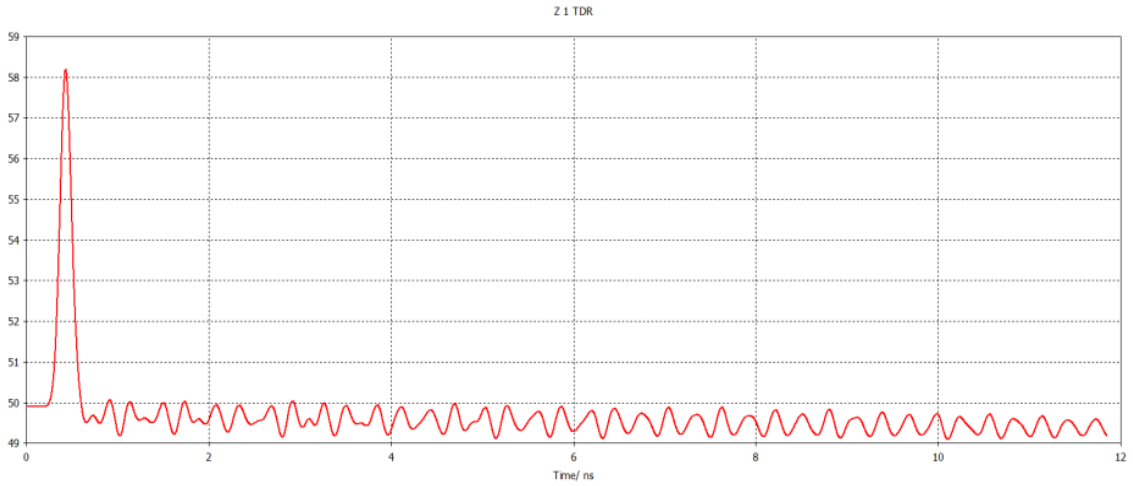
- Diameter 138mm
- 6mm absorbers
- Broadband directivity 27dB



Optimization of stripline-to-coaxial transition

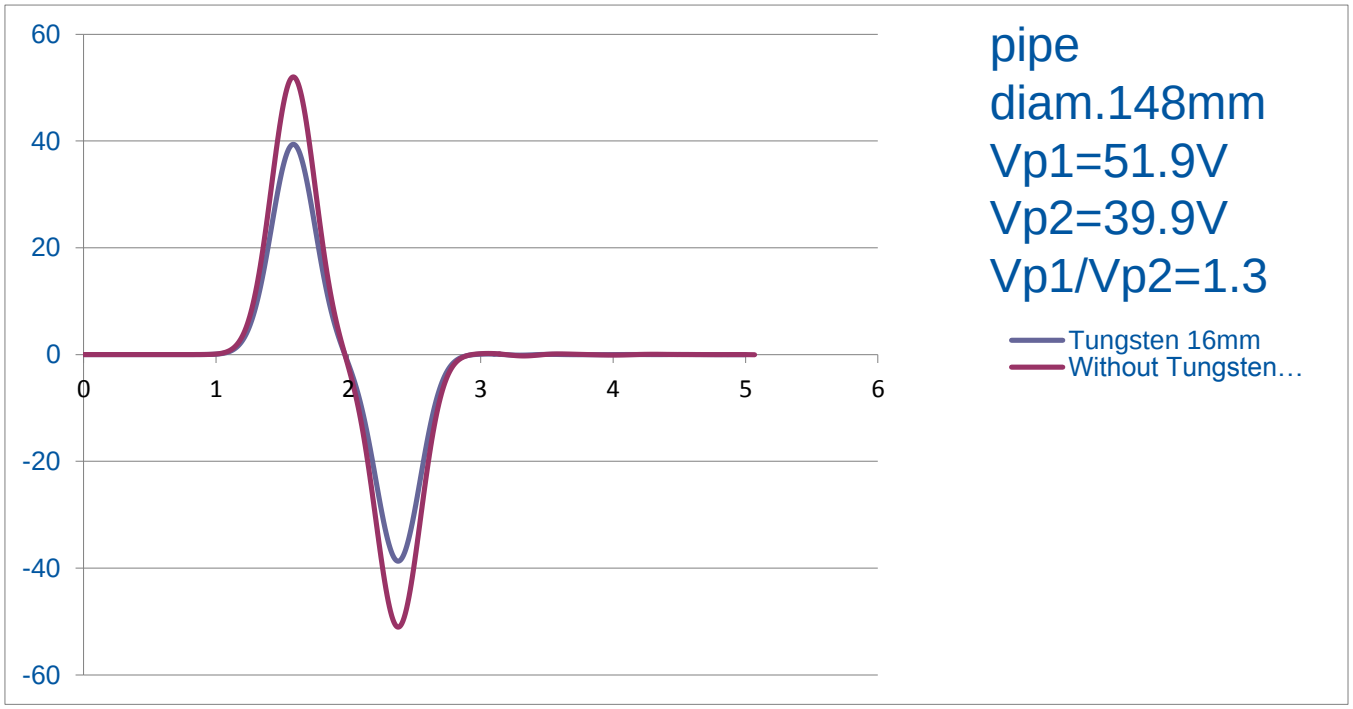
(CST Microwave Studio Time-Domain Reflectometry Analysis of different transition curvatures)





Best impedance match (50 Ohms) achieved with smooth transition.

Decrease in voltage signal level due to Tungsten absorbers presence



Pipe diam.148mm -30%, Pipe diam. 100mm -35%

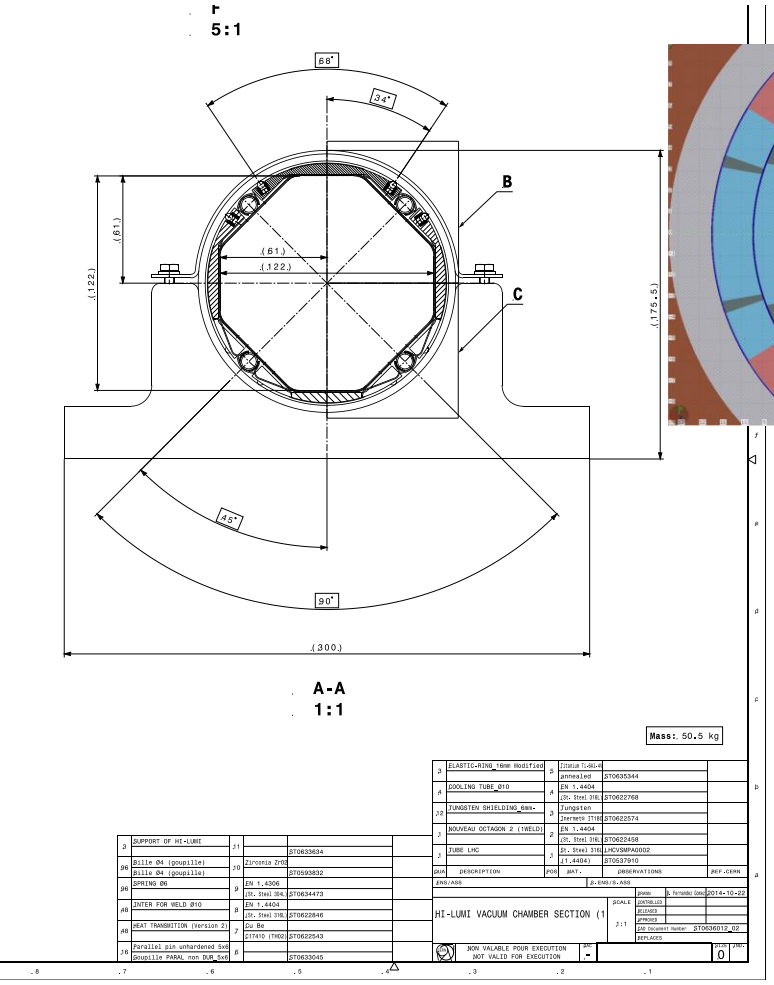
- However, voltage levels are too high for existing pick-up electronics, so it is not going to be an issue
- As both Vu and Vd levels are decreasing, change in directivity is small

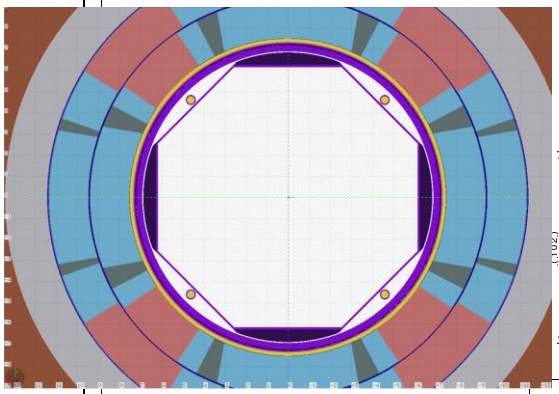
Conclusions

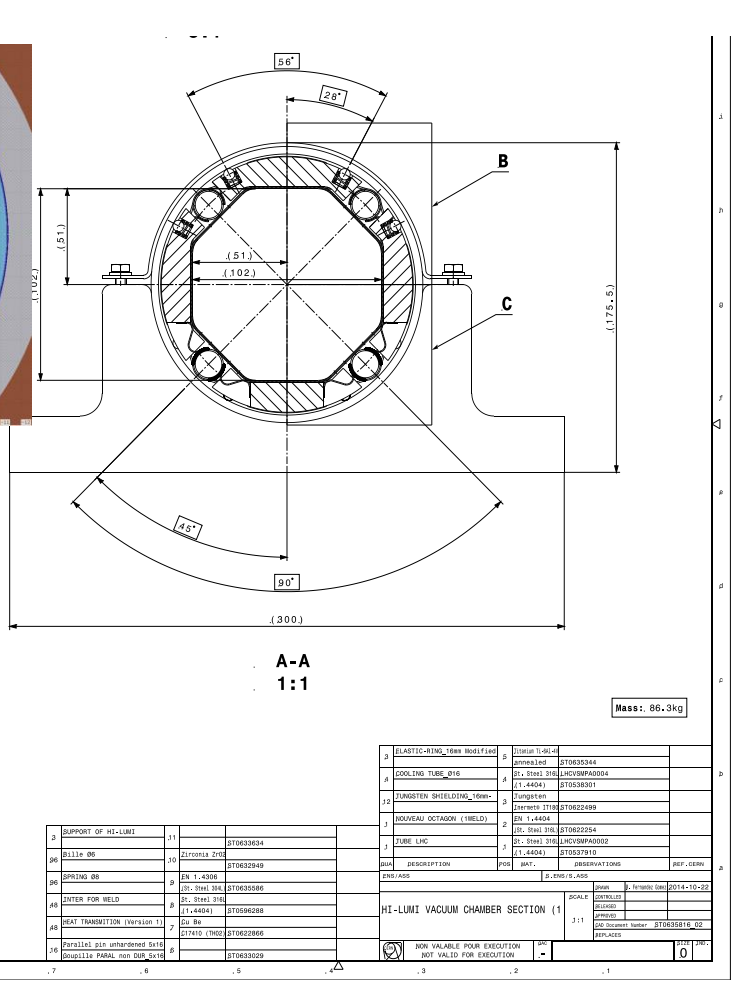
- First iteration of the optimization of the IR strip-line design has been done for two geometries
  - Latest version of the beam screens
  - Second iteration based on realistic mechanical design to be launched in a second phase

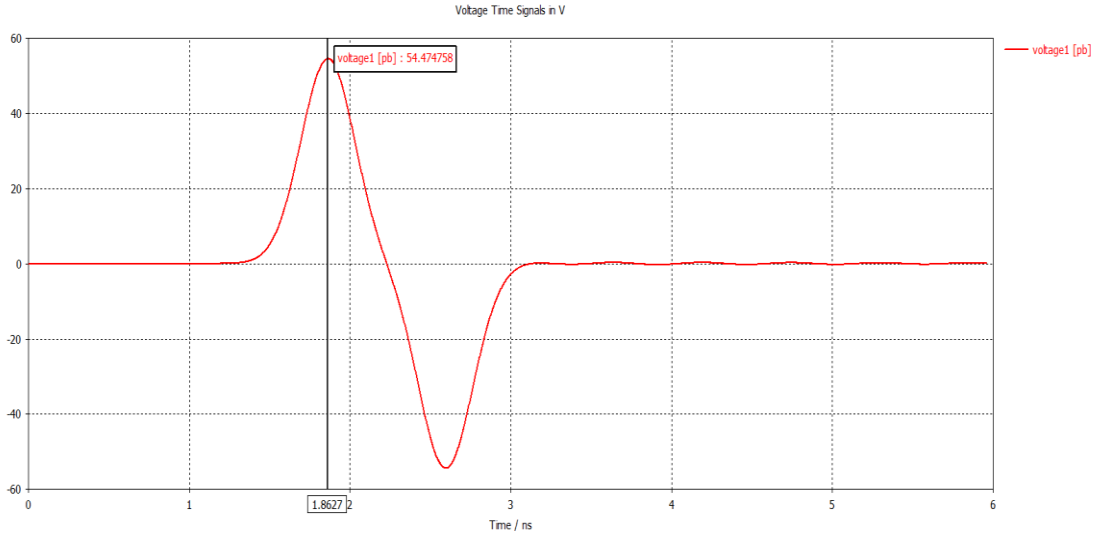
- Mechanical work just starting with EN/MME
  - Study the feasibility of the current BPM design
    - New stripline design with an improved directivity (manufacturing of a very special shape of stripline)
    - Insertion of Inermet absorber : complexity, cost, robustness, continuity of absorbers, question whether we should keep them ?
  - Design of the BPM connection to the PIMS and capillary I/O

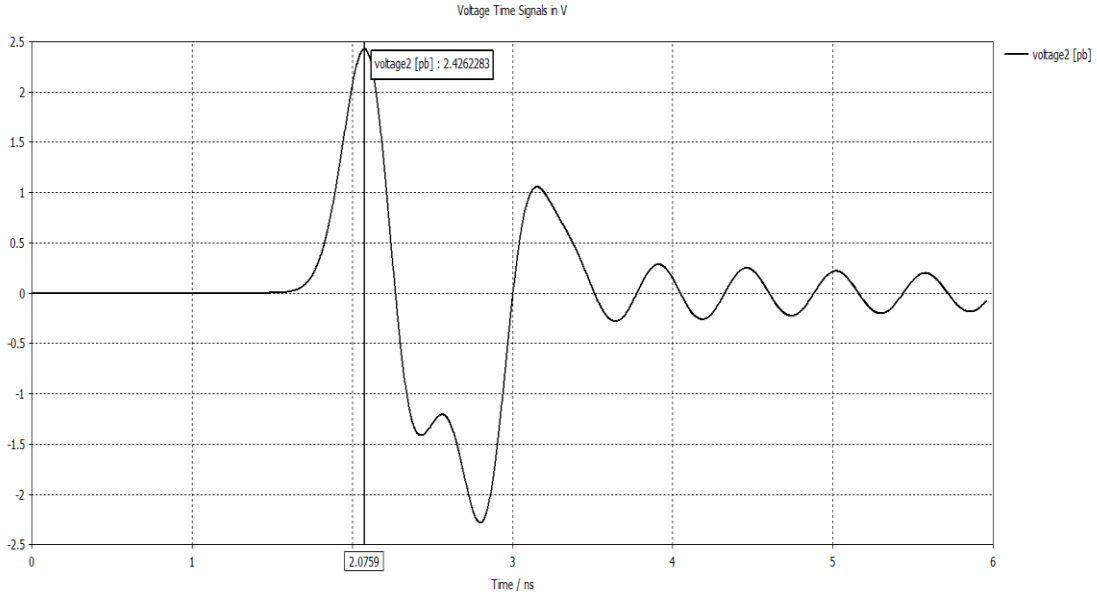
Latest version of the two beam screens











The peak values of voltages at the upstream and downstream ports are 54.47V and 2.42V

Broadband directivity achieved is 27.04 dB