LHC Ionization Profile Monitor (IPM) Impedance measurements

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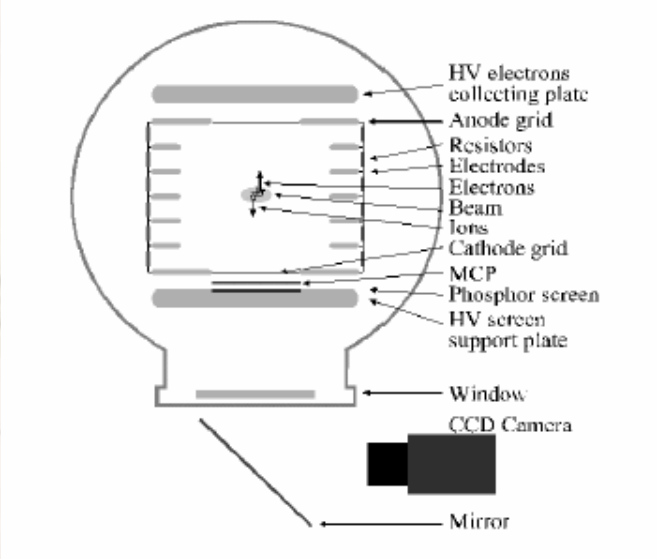
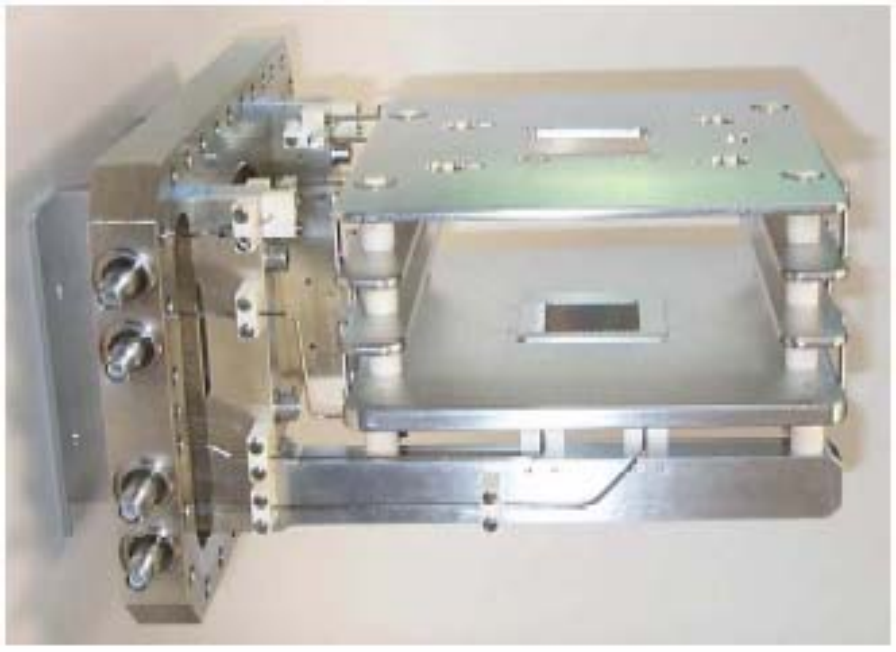
Introduction/Motivations

- The **Ionization Profile Monitor (IPM)** profits of the electrons released by the residual gas ionization for imaging the beam transverse profile
- **Two** IPM monitors are presently installed in the SPS ring
- The tank hosting the monitor setup
  - **Contains high voltage electrodes, MCP plate(s), a phosphor**



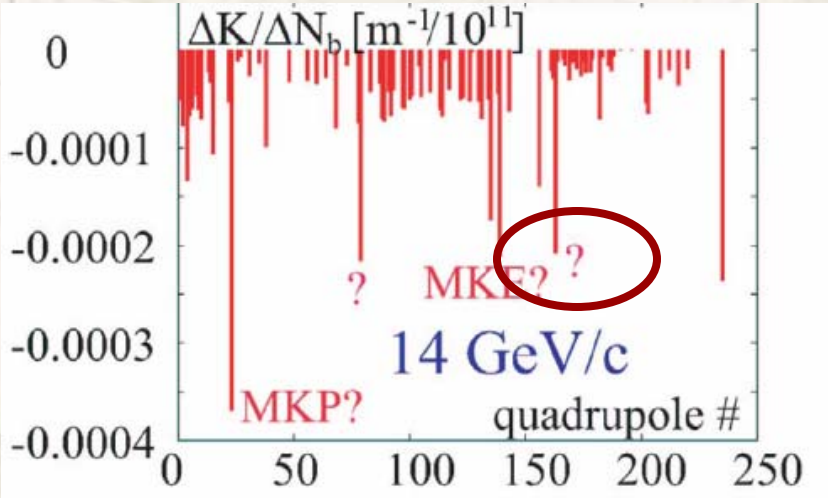
  - **Represents a possible source of impedance due to its geometry and to the components materials**
- **Four** monitors will be installed in the **LHC** ring and are foreseen to have the same mechanical design as the SPS ones

Some pictures



Some worries

- **From F.Zimmermann APC presentation 26-05-05 about evaluation of the source of impedance around the SPS ring:**



- **SPS regions 119 (near MKP kickers), ~301-307 (arc, rf?), 417-421 (near MKE kickers), and 507 (arc?) identified at both beam energies as locations with high impedance.**

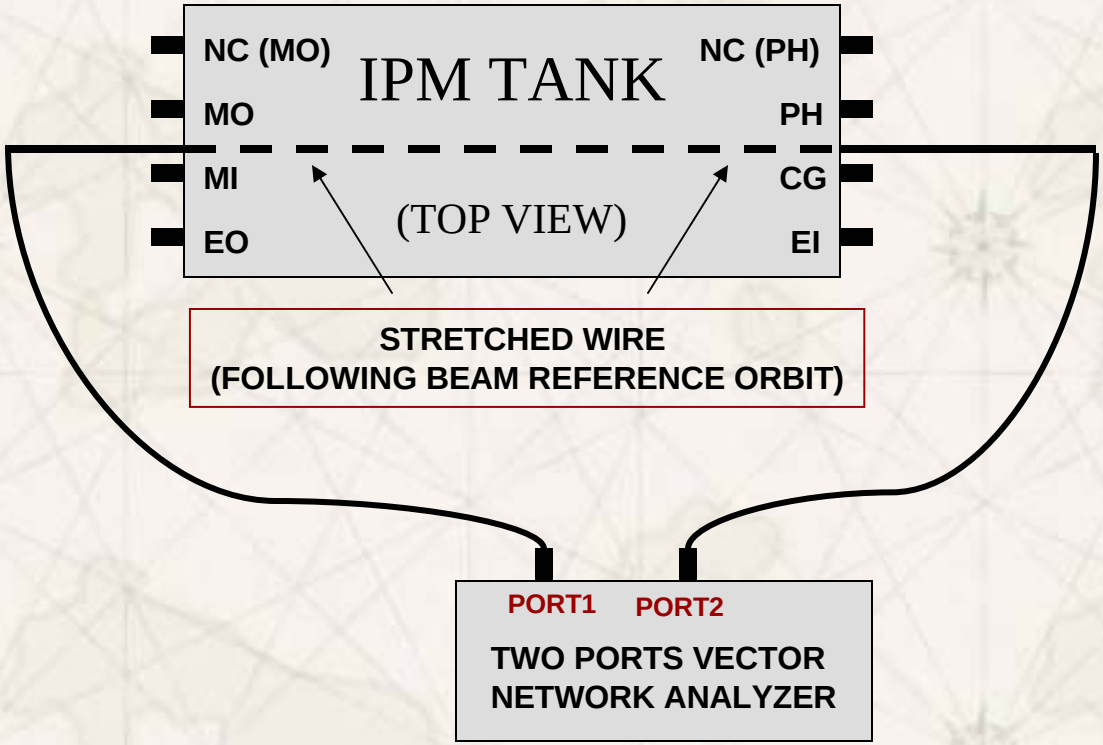
- **Location of one of the two IPMs is 517**

Laboratory Measurements

- The classical ***stretched wire technique*** has been used to
  - **Investigate the properties of the IPM tank**
    - → **See if RF power is stored in the tank**
  - **Verify possible cures with the degrees of freedom allowed by the present design**
    - For the moment we tried to see what happens **when loading the available eight connectors** designed to give the input to and get the output from the various monitors components
    - Loads are 50 Ohm resistors, which well reproduce the signal attenuation/filtering of the long cables connected when the monitor is installed in the tunnel
    - → **See if the stored RF power can be absorbed by the cables + possible additional loads**
- I will present results from **two** different **setups** employing a vector network analyzer

Setup 1

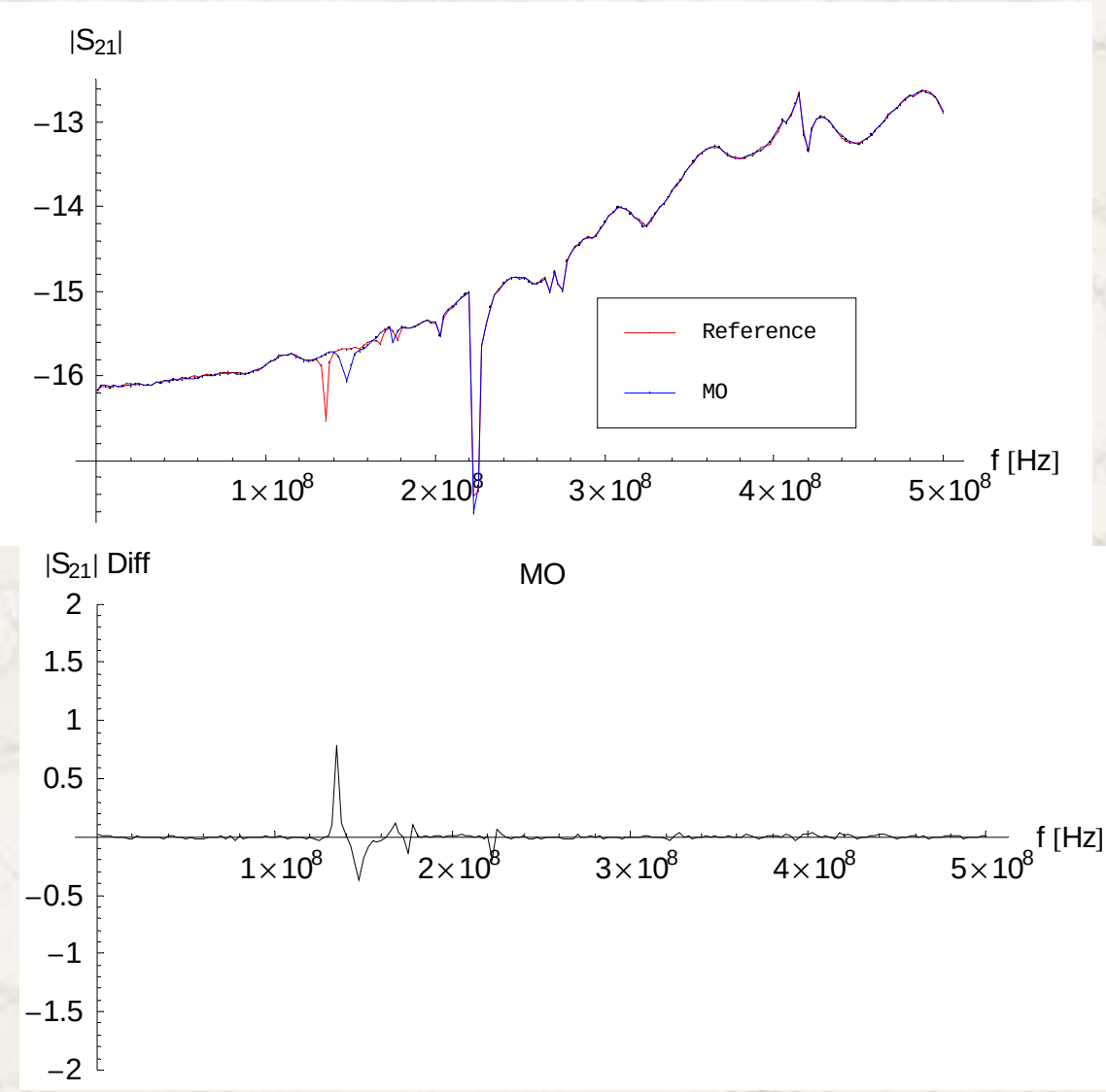
- Connection of the two ports at the stretched wire extremities and observe the magnitude transmission signal (S21) as function of frequency
  - With all the connectors open (reference signal)
  - With individual connectors loaded with 50 Ohm
  - With all the connectors loaded



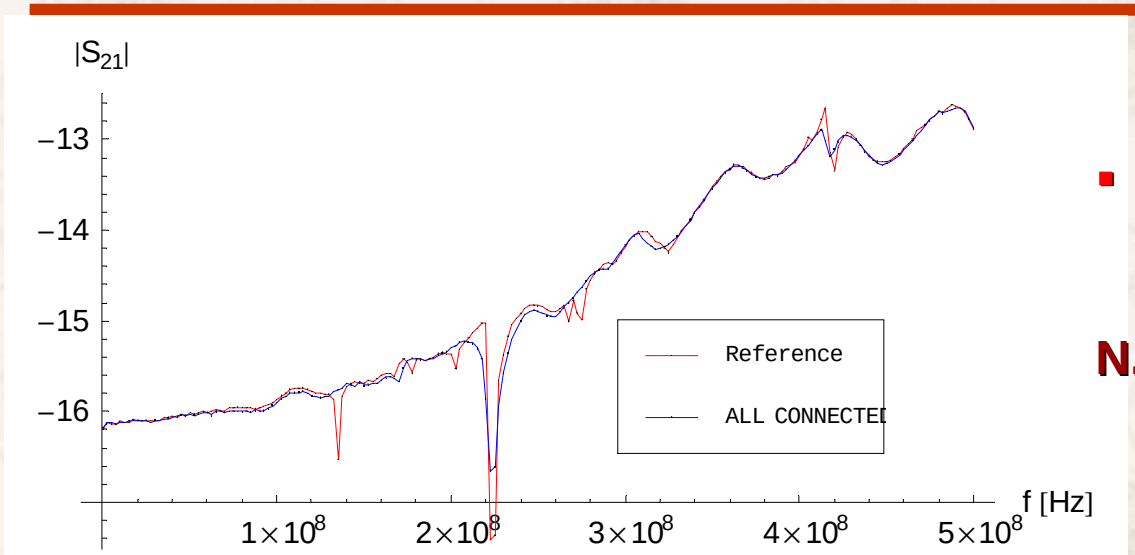
$$Z \propto Z_C \frac{1 - S_{21}}{S_{21}}$$

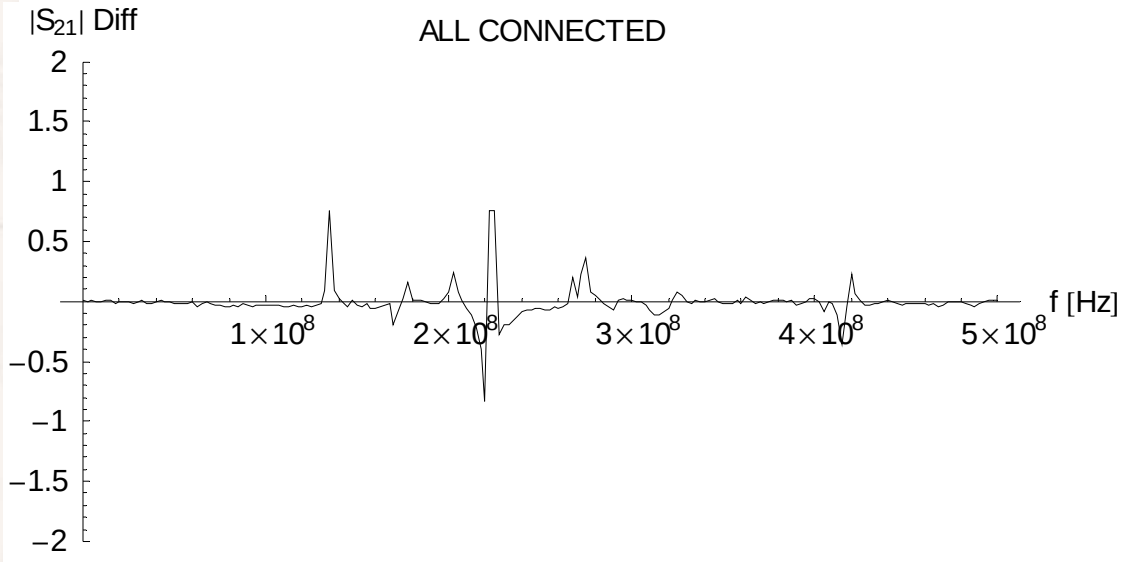
Results Setup 1

- Negative peaks:
- → **Power absorbed in the cavity**
- **Reference signal** = no cable connected
- Connecting the **MO** cable
  - **Dumps the mode at about 140 MHz**
  - **Leaves unchanged the mode at 220 MHz**



Results Setup 1





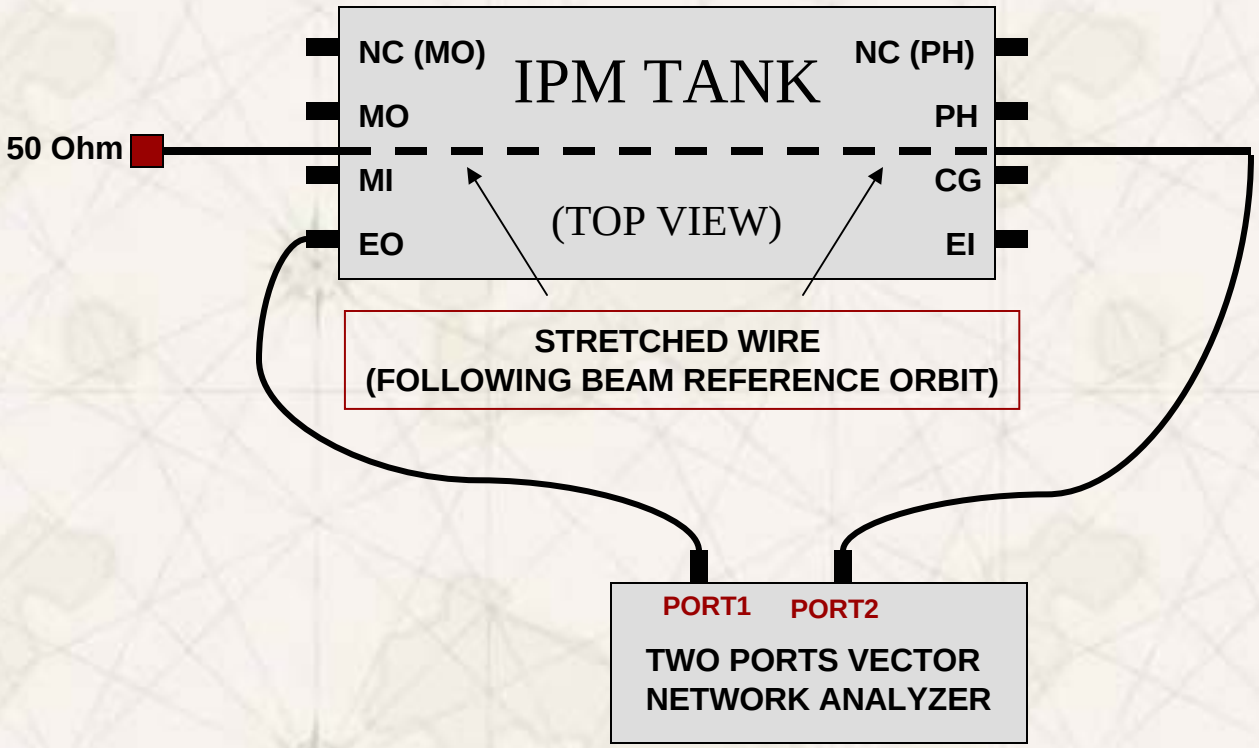
- **Connecting all the cables surely improves the situations**

N.B. : the two connectors labeled NC (MO) and NC (PH) are left open during operation (spare)

→ loading them with 50 Ohm charge helps

Setup 2

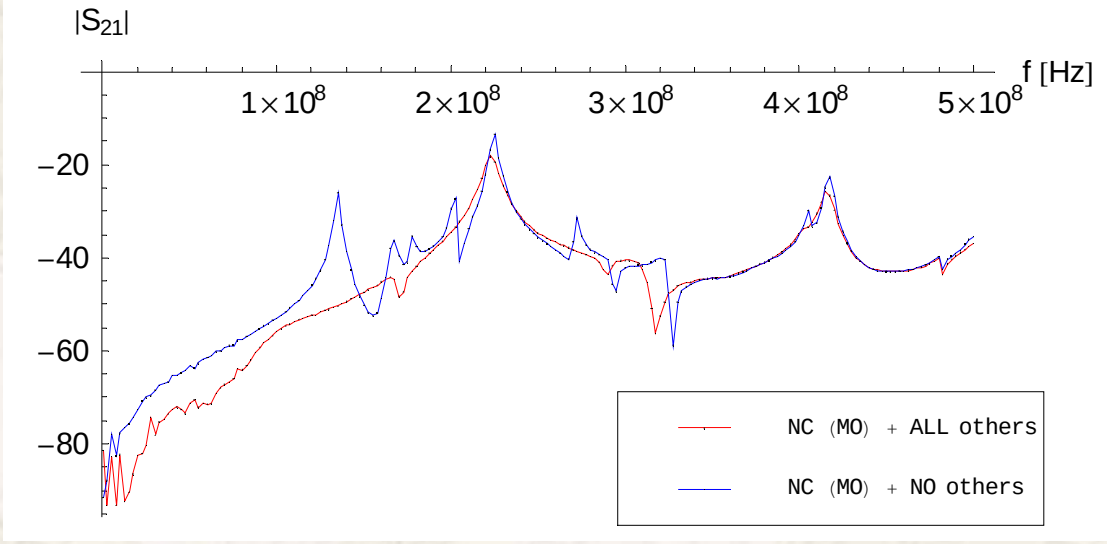
- **Connections:**
  - **Port 1 → one wire extremity**
  - **Port 2 → on the different connectors**
    - » With all the other connectors open
    - » With all the other connectors loaded
  - **Second wire extremity matched to 50 Ohm**



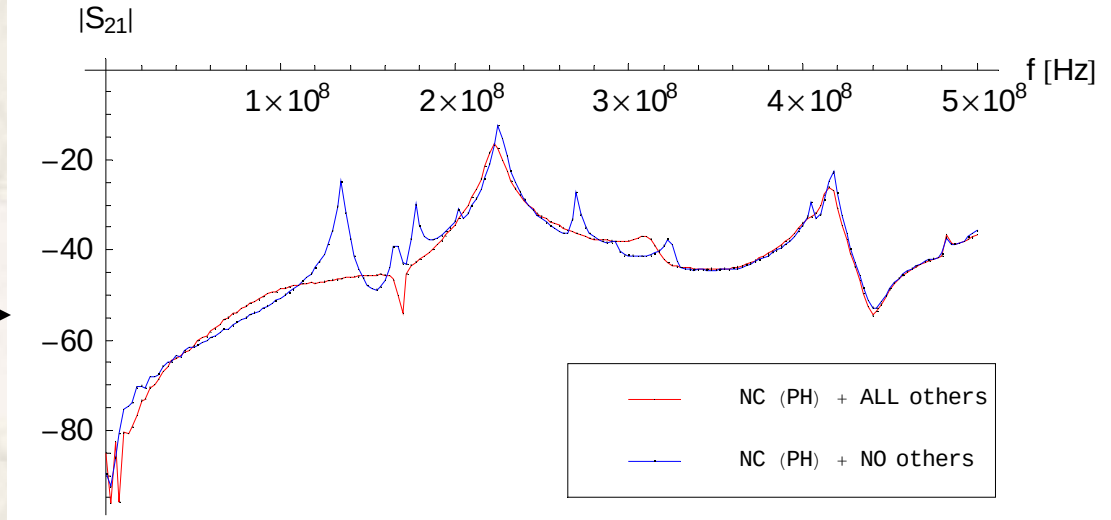
Results Setup 2

- **Positive peaks :**
- → **Power extracted from the cavity**

NC (MO) connector →



NC (PH) connector →



Conclusions

- IPM tank may well explain impedance observations in the SPS and 4 of them will be installed in the LHC
- **Loading spare connectors helps**, but no quantitative calculations have been performed yet
- The monitor is installed inside a **dipole magnet** and insertion of ferrite absorbers is problematic
- Possible **modifications** of the monitor (**in order to minimize the effects on the LHC impedance budget**) are under investigation (**Fritz Caspers**) and have to be discussed with **BDI experts**