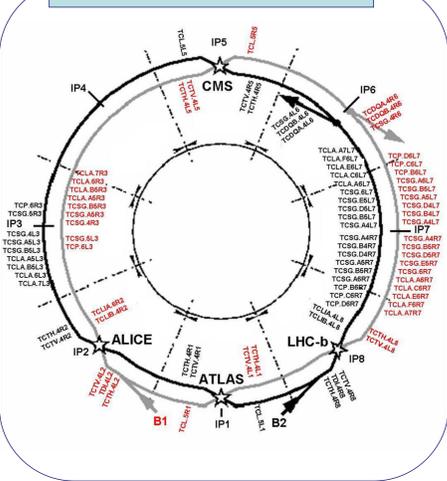


Phase I Collimation



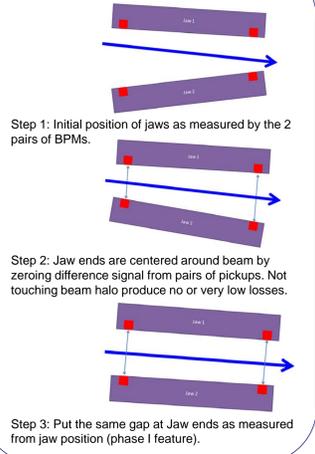
Summary

The LHC collimation system is crucial for safe and reliable operation. Standard collimator set-up is performed by observing beam losses. The procedure is lengthy (~18h shift time per ring) and can only be performed with special low intensity fills. For a drastic reduction of setup time the next generation of the LHC collimators will be equipped with button **beam position monitors (BPMs)** embedded into the collimator jaws.

Motivations

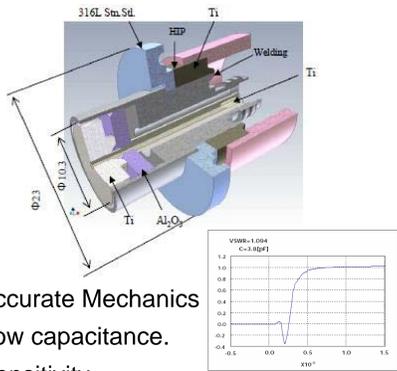
- Non-invasive and more accurate method.
- Allow continuous monitoring of beam offsets.
- Increased passive machine protection as collimators can follow slow orbit drifts.
- Add more flexibility for local orbit changes.

Setup with BPM



Components

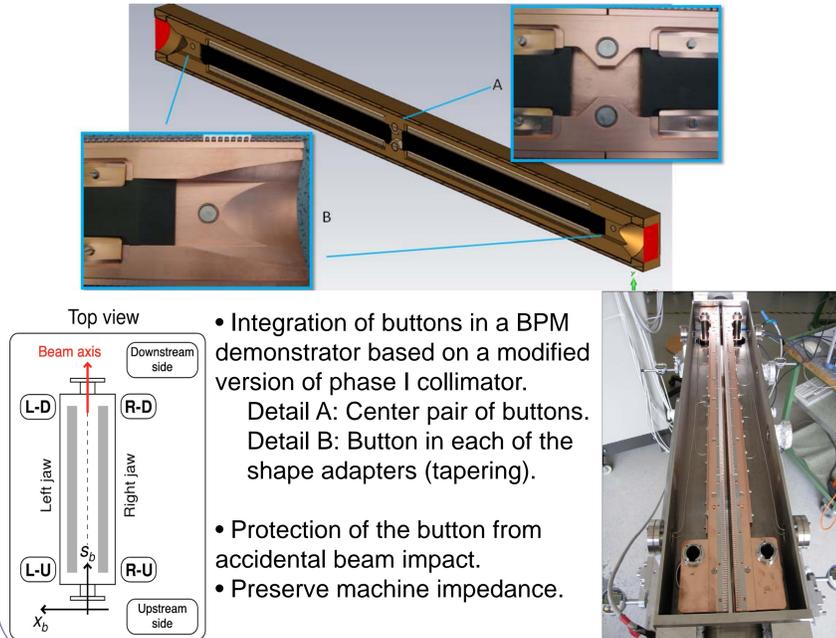
Button



- Accurate Mechanics
- Low capacitance.
- Sensitivity.
- Robustness against LHC beam.

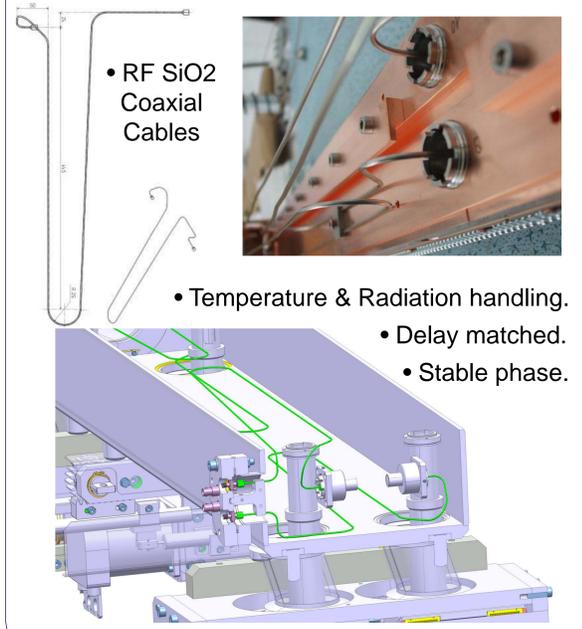


Implementation in Jaws



- Integration of buttons in a BPM demonstrator based on a modified version of phase I collimator.
- Protection of the button from accidental beam impact.
- Preserve machine impedance.

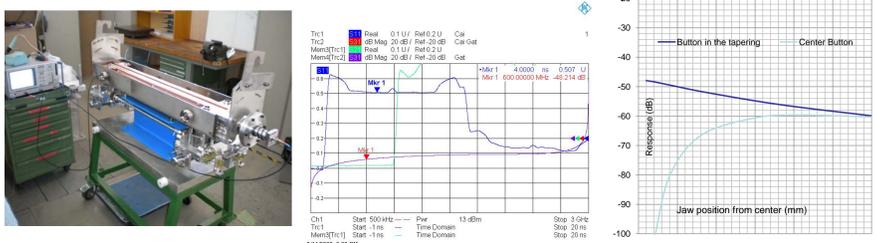
Cables & Feedthroughs



- RF SiO₂ Coaxial Cables
- Temperature & Radiation handling.
- Delay matched.
- Stable phase.

Measurements

From Laboratory ...



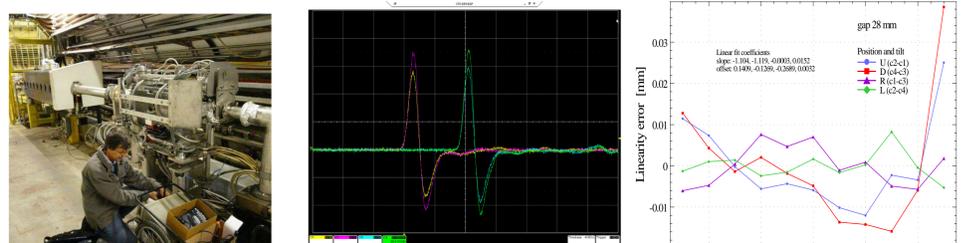
Test bench.

- S11 in Time Domain.
- Button frequency response
- Buttons Sensitivity vs Jaws position.

Wire measurements on the test bench :

- We checked position linearity, buttons sensitivity, characteristic impedance vs jaws aperture with a synthetic pulse.
- Comparison with simulation models.

... to the SPS Machine



SPS slot 51939

response to a LHC type bunch of some 1.7e10 protons.

Linearity error shifting the jaw gap center

Experiments on the SPS machine with beam:

- We were able to measure up to 10um steps and reproducible position.
- No noise on the BPM buttons when making losses by scraping away a large part of the beam (max. losses per step ~ 1e10p)

Conclusions

- The wire test bench is a good tool for measuring the transfer characteristics of buttons. The central pair of buttons proved to be inefficient for small apertures and this kind of configuration will not be kept.
- Embedded BPM will be an advanced feature of next generation collimators. We should be able to center the jaws with a resolution below 1 um even with the jaws fully open.

Future Work

- Integration into Tertiary, Dispersion Suppressor and Phase II collimators series.
- Start in production for first installation of TCTP in LHC during next long shutdown.

