First results from the LHC Schottky monitor operated with direct diode detection

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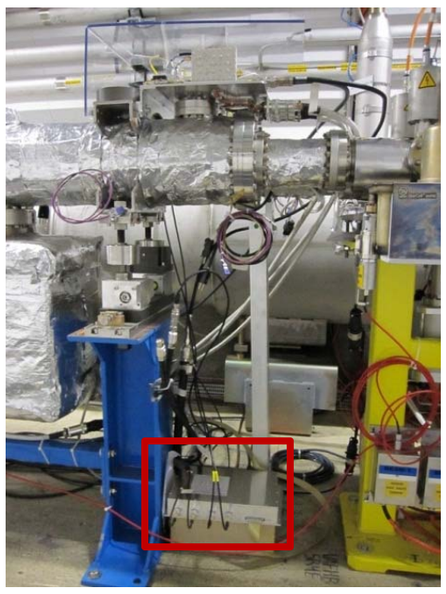
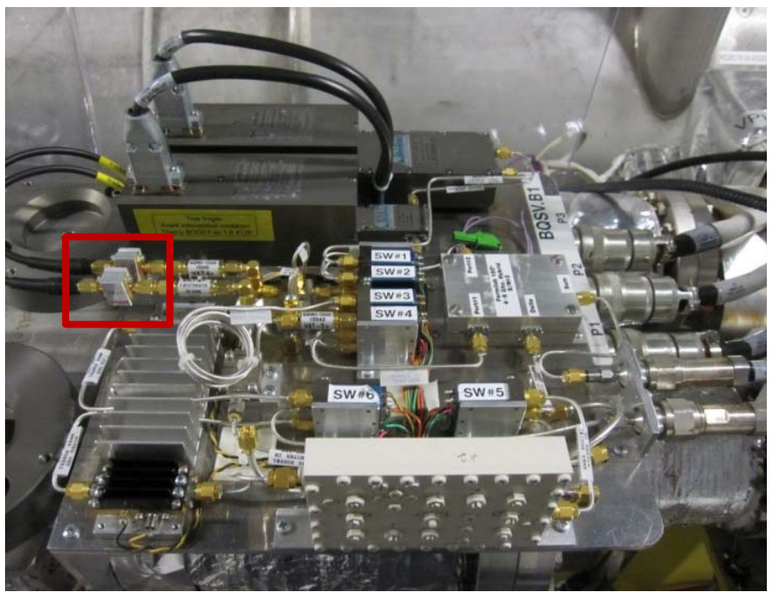
Abstract. The LHC is equipped with a Schottky diagnostic system based on 4.8 GHz resonant pick-ups. Their signals are processed with three-stage down-mixing scheme, working well during stable beam time. However, during the energy ramp coherent part of the beam spectrum perturbs the first stages of the system. To study beam spectra in such conditions the signals from the Schottky pick-ups were split and the second half of their power was processed with the LHC tune measurement hardware, slightly modified for this application. It is based on simple diode detectors followed by signal processing in the kHz range and 24-bit audio ADCs. With such a test system LHC beam spectra were successfully observed. This contribution presents the obtained results.

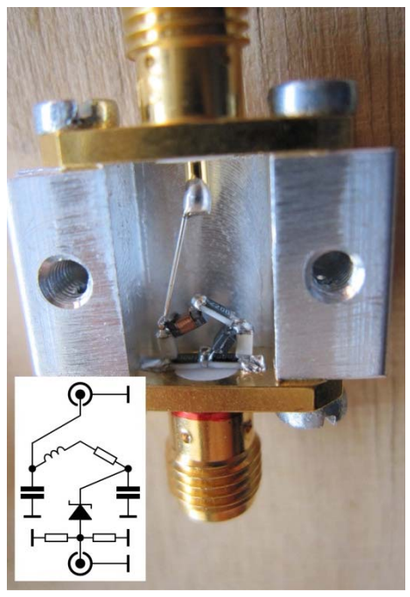
Hardware



LHC Schottky BBQ installation.



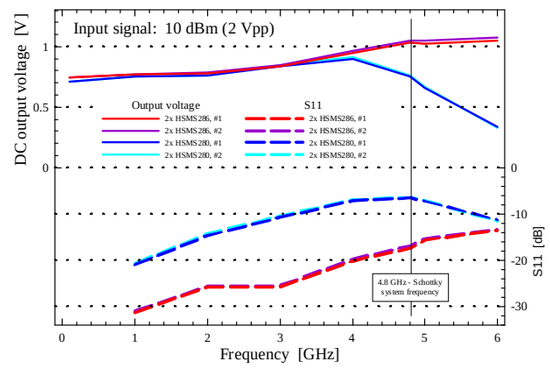
Schottky tunnel electronics and the diode detectors.

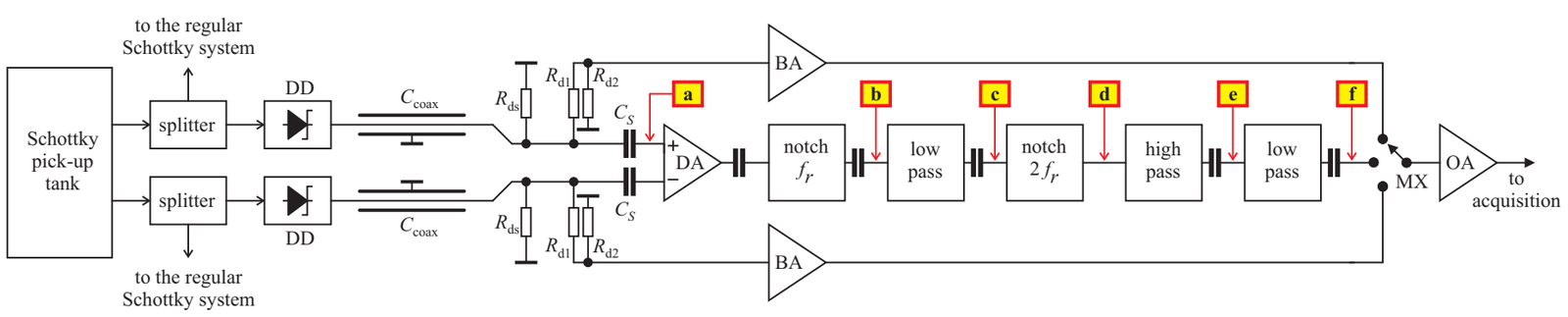


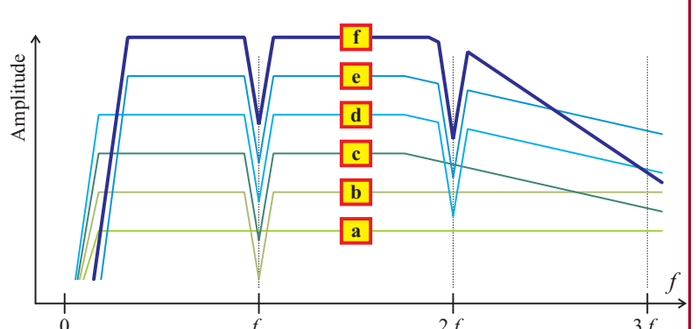
A Schottky BBQ diode detector.

BBQ diode detectors optimised for 4.8 GHz operation.
Parameter table and measurement examples.

Detector diode	V_{max} [V]	4.8 GHz Vo [V]	4.8 GHz S11 [dB]	1 GHz Vo [V]	1 GHz S11 [dB]
BAS283	70	0.723	-6.8	0.740	-20.8
HSMS286	4	1.486	-9.3	0.871	-27.5
2x HSMS286	8	1.031	-17.4	0.771	-31.4
HSMS282	15	1.642	-2.9	0.865	-18.4
HSMS286+280	70	1.662	-10.8	0.781	-23.0
2x HSMS280	140	0.749	-6.6	0.750	-21.0

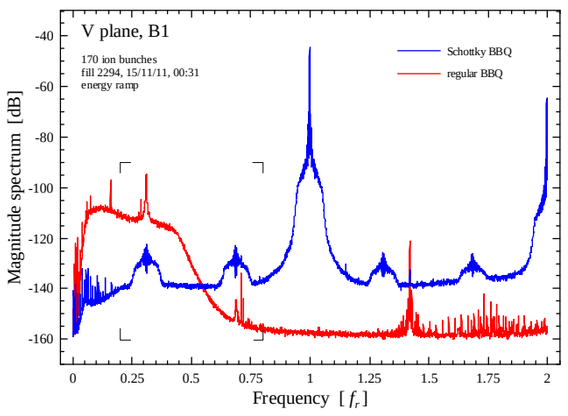




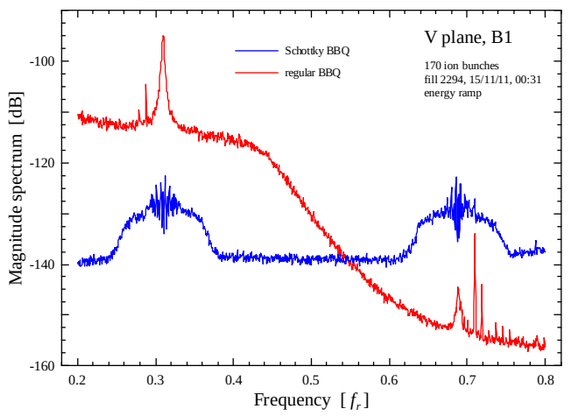


Block diagram of the Schottky BBQ development system and simplified frequency characteristics in key nodes of the filtering chain. Legend:
DD – diode detector, DA – differential amplifier, BA – buffer amplifier, MX – multiplexer, OA – output amplifier, C_{coax} – capacitance of the coaxial cable connecting the diode detectors to the analogue front-end box, R_{ds} – discharge resistor, R_{d1}, R_{d2} – resistance of the DC voltage divider.

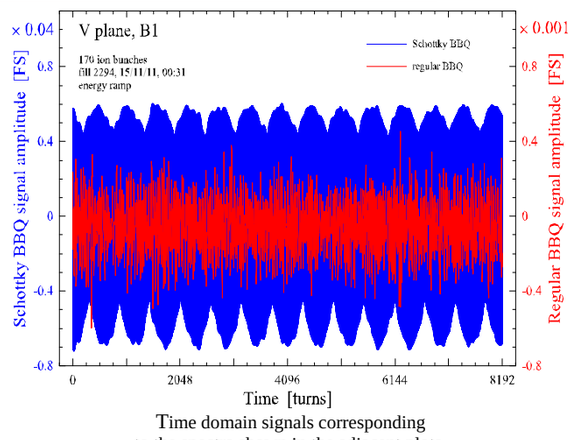
Measurements



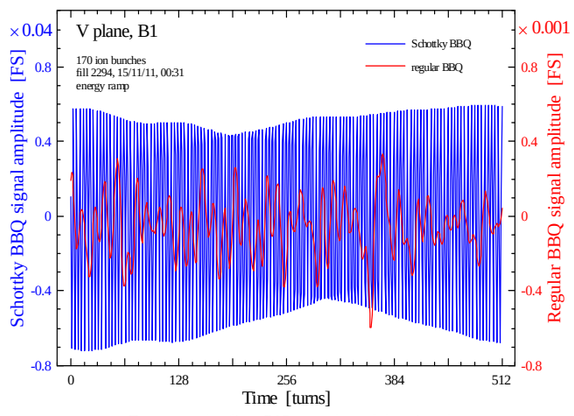
Vertical beam 1 (V.B1) ion spectra during the energy ramp, as seen by both, the regular and BBQ Schottky systems.



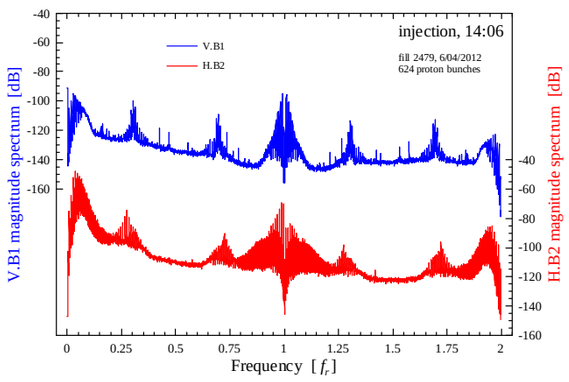
Zoom on the V.B1 spectra of the adjacent left plot.



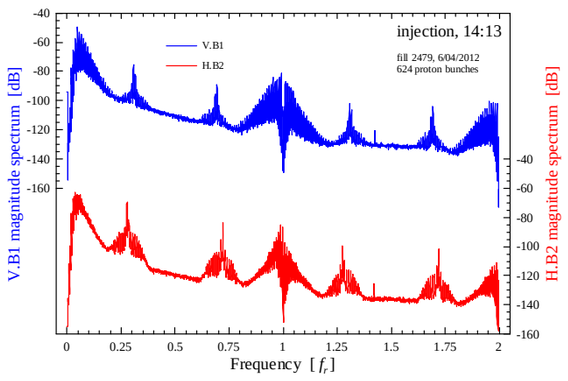
Time domain signals corresponding to the spectra shown in the adjacent plots.



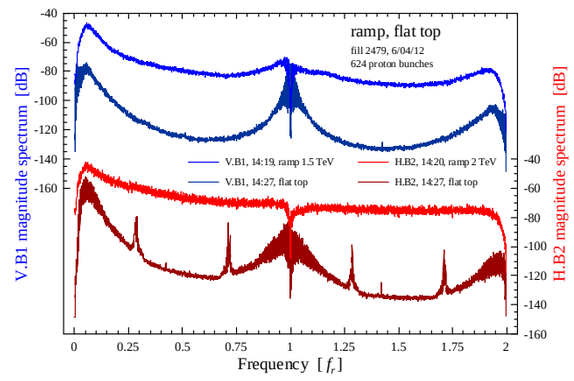
Zoom on the first 512 samples of the signals in the adjacent left plot.



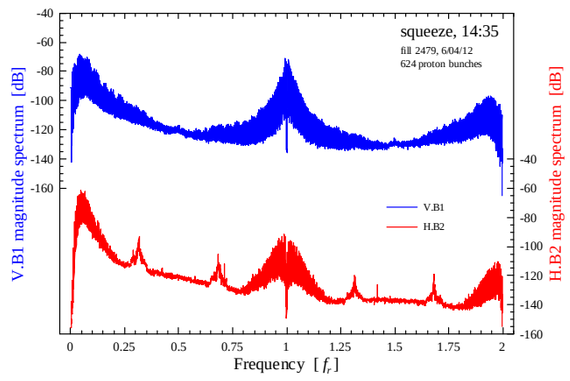
Vertical beam 1 (V.B1) and horizontal beam 2 (H.B2) spectra from the development BBQ Schottky system, injection of proton bunches.



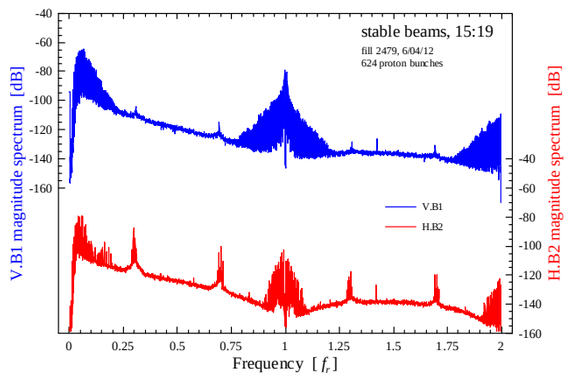
V.B1 and H.B2 BBQ Schottky spectra during filling the LHC with 624 proton bunches.



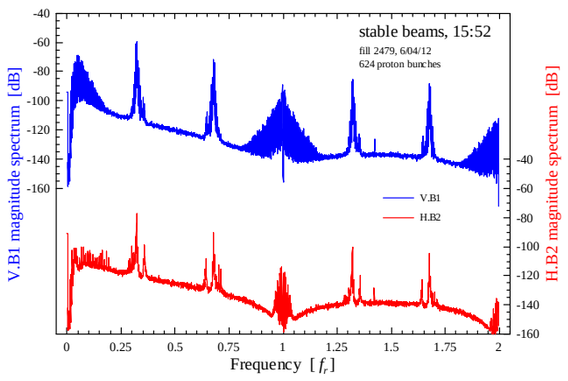
V.B1 and H.B2 BBQ Schottky spectra during the energy ramp and at the flat top energy of 4 TeV.



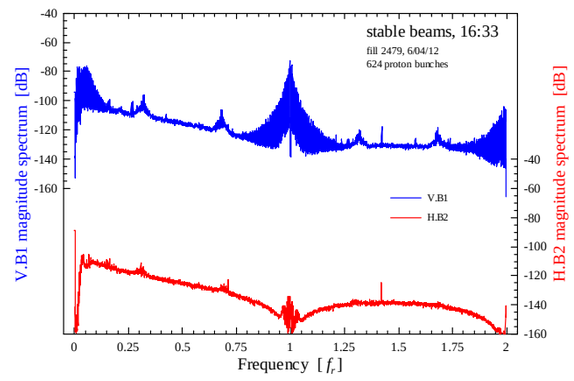
V.B1 and H.B2 BBQ Schottky spectra during squeeze.



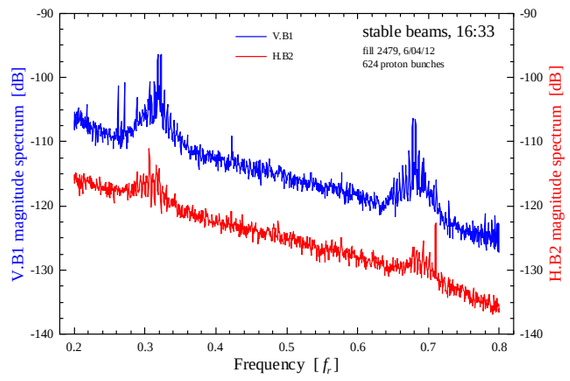
V.B1 and H.B2 BBQ Schottky spectra during. physics data taking, so called “stable beams” period.



V.B1 and H.B2 BBQ Schottky spectra in “stable beams”; an activity seen in the V.B1 pane.



V.B1 and H.B2 BBQ Schottky spectra in “stable beams”.



Zoom on the V.B1 and H.B2 BBQ Schottky spectra of the adjacent left plot.

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