MD on BPM optimisation

- **Beam Energy & Intensity:** 450GeV - Nominal bunch
- **Beam conditions:** RF cogging (RF)
- **Estimated time:** 8h

Goal:

1- Measure with beam the directivity of the strip-line BPMSW with DOROS and WBTN and measure the impact of the presence of one beam on the BPM reading of the other beam as function of beam time overlap (RF cogging) *(complementing what was done during MD 369 in 2015)*.

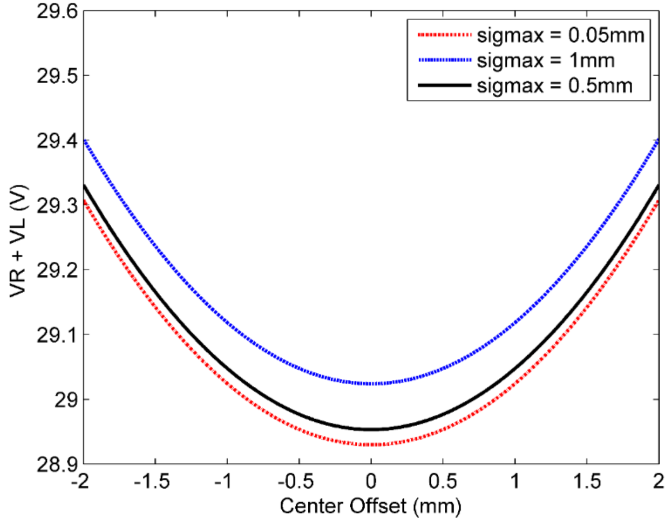
2- Assessing the possibility to use DOROS for Orbit feedback with Q1-Q7 BPMs – comparing the quality of the feedback in terms of orbit stability with DOROS and WBTN

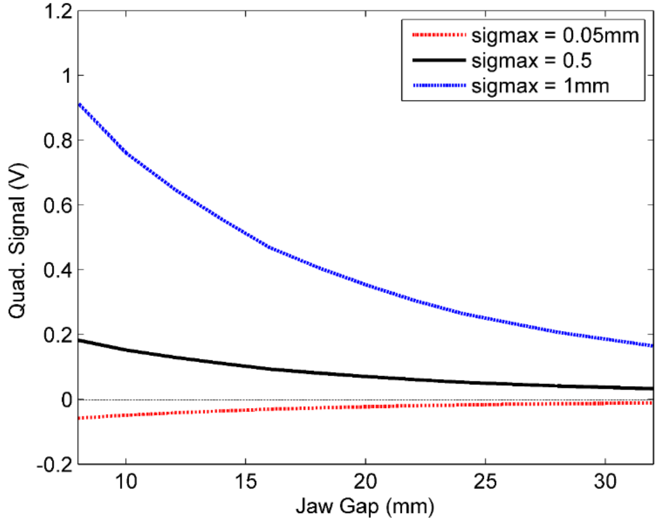
3- Amplitude calibration of HT/Tune/DOR-OS with respect ADT and WBTN - for different energy and beam configuration (single bunch / train of least 10 bunches) –excitation using ADT

MD on quadrupolar beam size measurements using collimator BPM

- **Beam Energy & Intensity:** 450GeV – pilot/nominal
- **Beam conditions:** Emittance blown up using ADT
- **Estimated time:** 4h

Goal: Measuring coll. BPM quadrupolar moments during collimator gap and position scans





LHC Synchrotron Radiation Monitors
MD requests 2017

i) Halo diagnostics: BSRH commissioning at FlatTop in view of the BBLR compensation tests

ii) Interferometry: BSRI commissioning both at Injection and FlatTop

iii) Imaging: BSRT validation of NUV imaging w.r.t visible light imaging

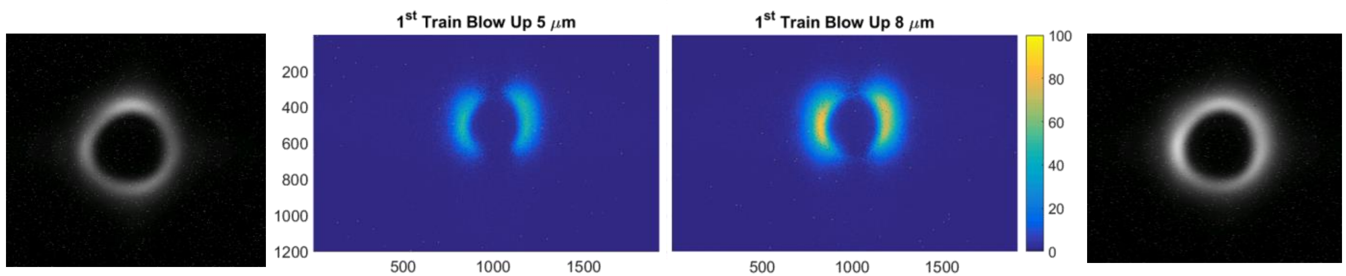
Halo diagnostics

Experience in 2016:

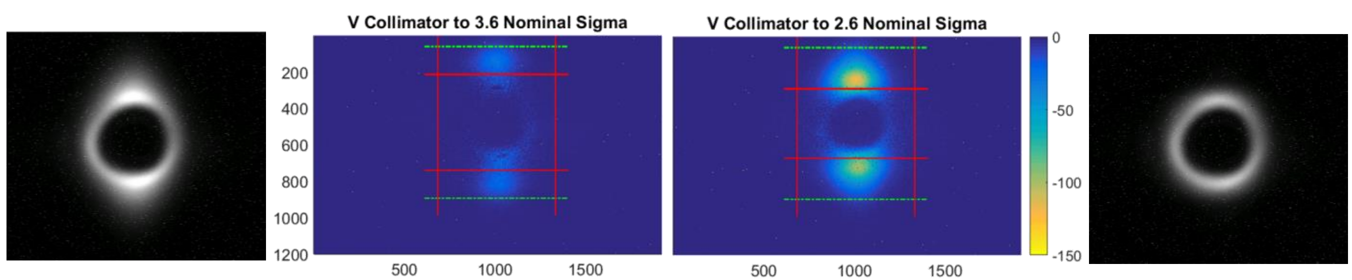
Successful demonstration of halo measurement during MD at 450 GeV

- ❑ Fake “Halo” creation by blowing up the beam using ADT
- ❑ Fake “Halo” removal by scraping using primary collimators

- Coronagraph images during controlled blow-up



- Coronagraph images during controlled scraping



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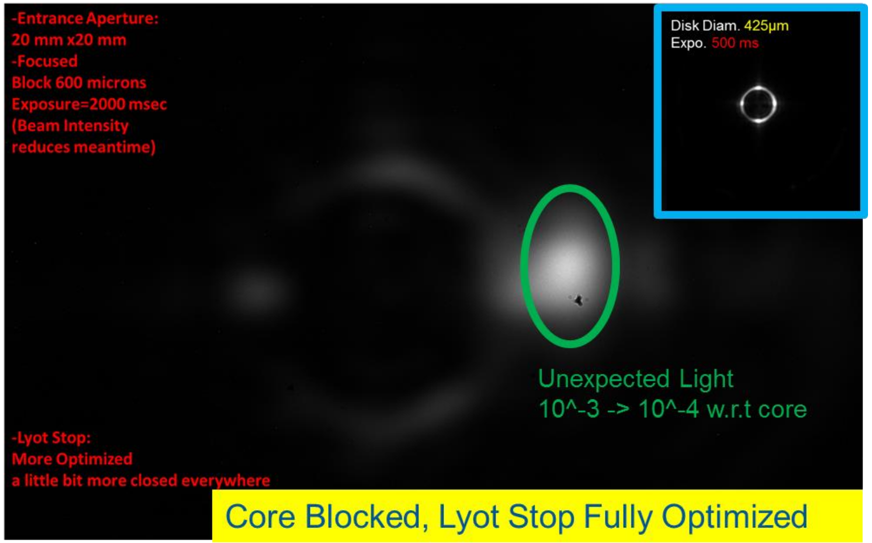
Halo diagnostics

MD request in 2017

Probe the possibility of halo measurement during MD at 6.5 TeV
(Potential limitation from parasitic light observed in 2016)

Only B2 is needed



Bunch by bunch detection system installed in YETS 16/17
Fake “Halo” creation using ADT
Halo removal using narrow frequency excitation using ADT
Final scraping with collimators

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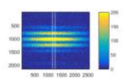
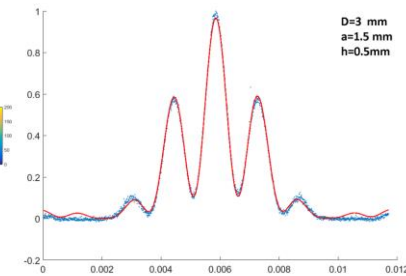
Interferometry

Experience in 2016:

- ❑ We are at a good stage of the Interferometer Commissioning
  - Hardware tested and functional
  - Very good alignment
- ❑ Interferograms recorded at Injection and Top energy
  - Careful studies of possible systematics were carried c
- ❑ Preliminary beam size measurement are very encouraging
  - Consistent, reproducible and robust measurements
- ❑ Good agreement with imaging system at 450 GeV
- ❑ Discrepancy (scaling factor of 1.3-1.4) at 6.5TeV still under investigation
- ❑ 2D interferometer was found feasible





E	= 6.5 TeV
λ	= 560 nm +/-
Expo	= 1ms
D	: 3mm -> 12
a	=1.5 mm
h	=0.5 mm
Filter	: ND1

		bunch 1		bunch 62	
	σ [mm]	H	V	H	V
450 GeV	Imaging	1.22	1.6	1.15	1.4
	Interferometer	1.20	1.53	1.14	1.34

Interferometry

MD request for 2017:

- Motivation:
  - BSRT imaging resolution limited for small beam sizes
    => Big errors on beam emittance measurement for <=1.5 microns
- Only B1 is requested
- Both at Injection and FlatTop, investigate for various beam sizes the systematic discrepancy w.r.t. WS and BSRT
- Eventually sort out a lookup table for beam size determination

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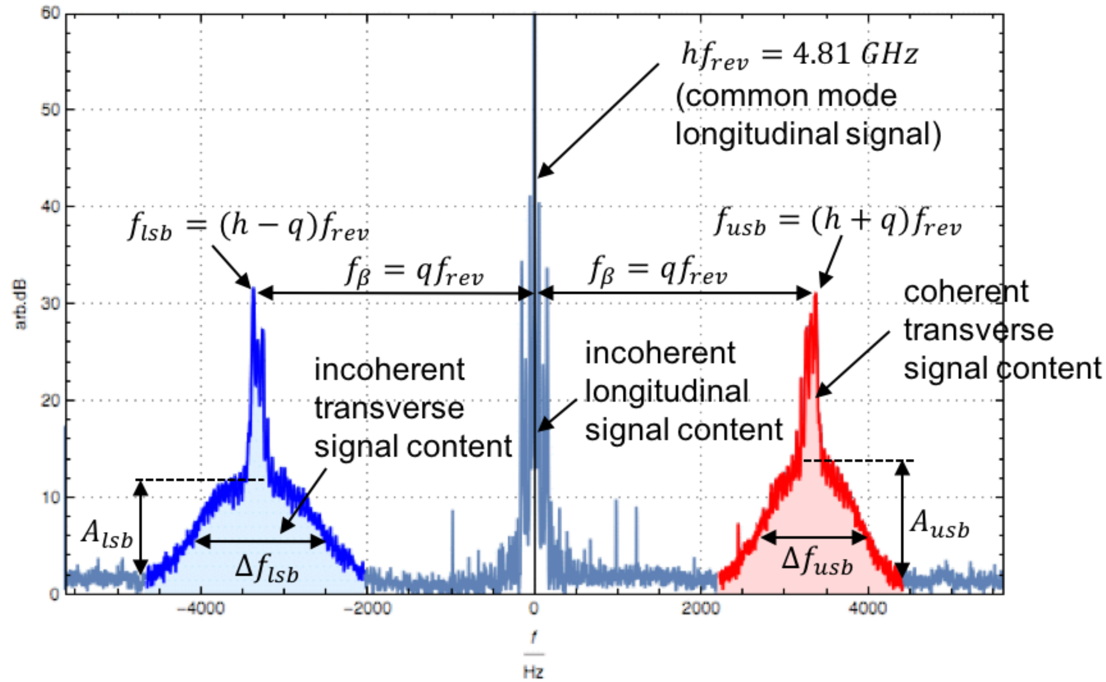
MD1767: Chromaticity Measurements with the *Schottky* Monitors

M. Betz **and** ***M. Wendt***

Objective:

- **Compare the *Schottky* monitor based chromaticity evaluation with the RF modulation method at injection energy**
  - The actual chromaticity value was evaluated off-line, applying different methods
- **Check a range of 0…+20 for the chromaticity setting**
  - In steps of 5
- **Check different beam conditions**
  - Single nominal bunches
  - Typical bunch trains as available

MD1767: Theory



- Extract the chromaticity from the measured *Schottky* sidebands:

$$Q = \eta\left(h\frac{\Delta f_{lsb} - \Delta f_{usb}}{\Delta f_{lsb} + \Delta f_{usb}} + q\right) \approx \eta h \frac{\Delta f_{lsb} - \Delta f_{usb}}{\Delta f_{lsb} + \Delta f_{usb}}$$

$\eta h \simeq -136$

with: $\eta = -3.184 \cdot 10^{-4}$ (phase slip factor)

$h = 4.28 \cdot 10^{5}$ (harmonic number at $f = 4.81\ GHz$)

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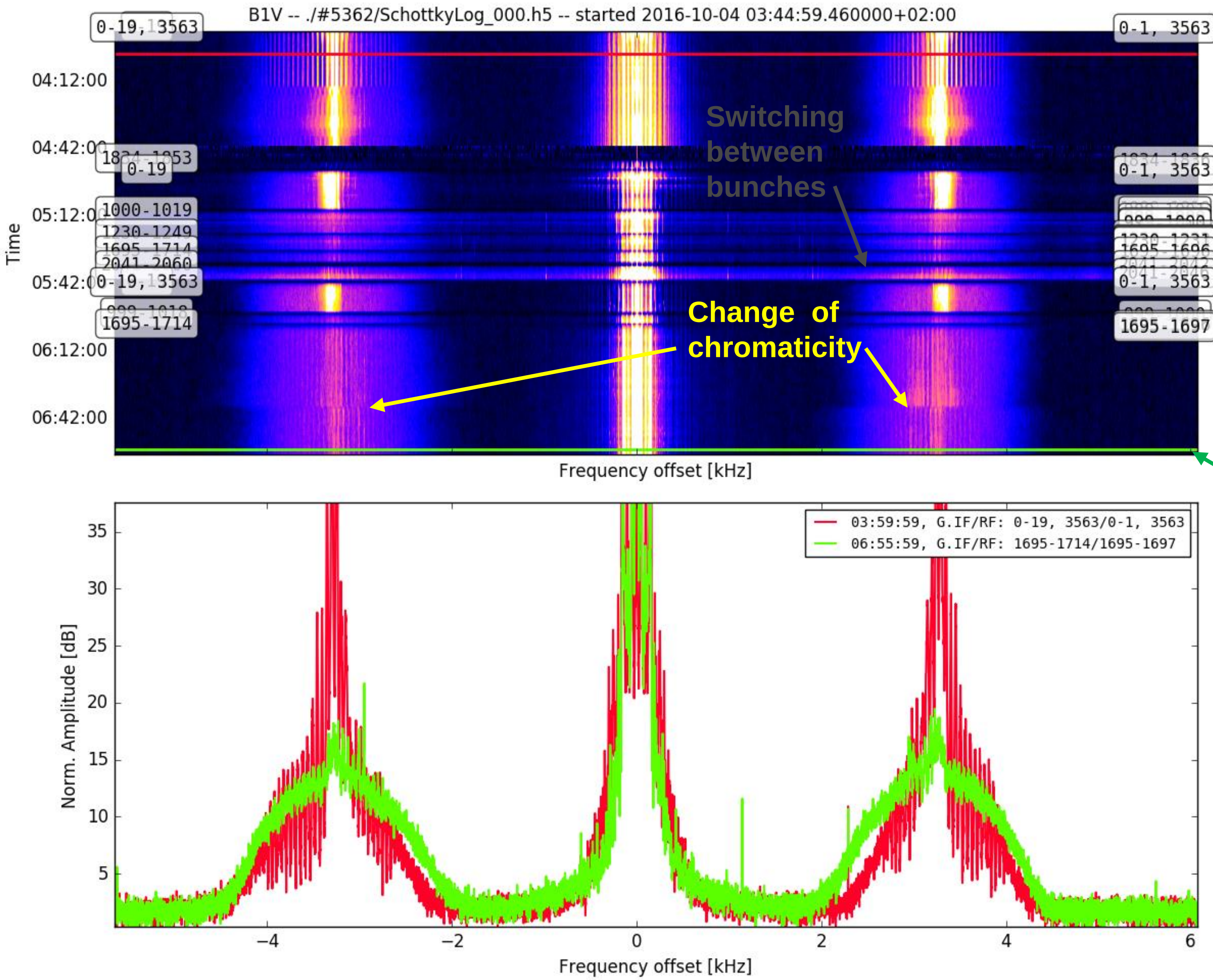
MD1767: Overview



Shift start

Single nominal
Octupoles off
Chroma +5…+20

Trains: 1x12b, 6x96b
Octupoles on
Chroma 0…+20

Shift end

- Good signals during the shift
  - Stayed at injection energy
- Symmetric chroma settings
  - Same for B1&B2, h&v

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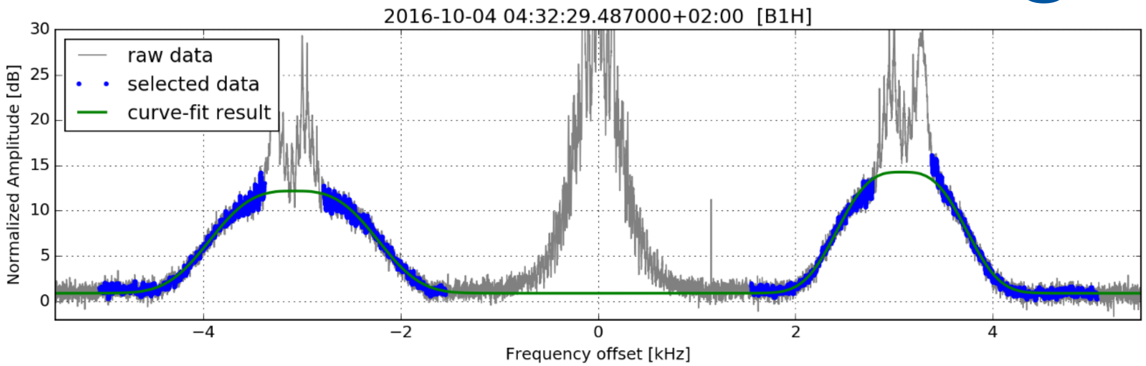
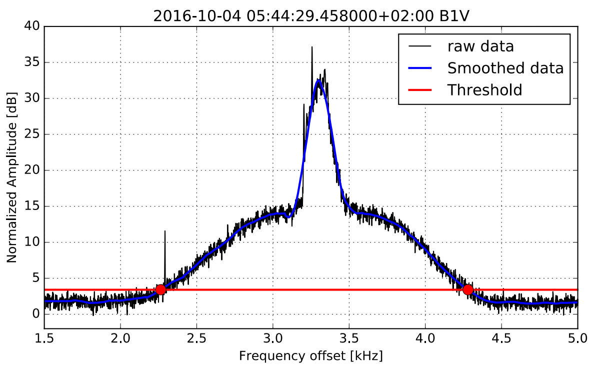
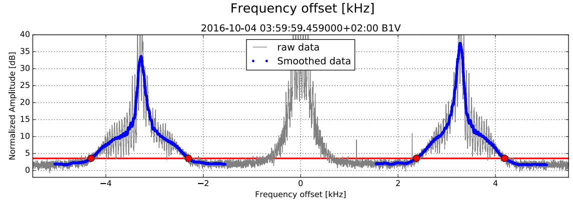
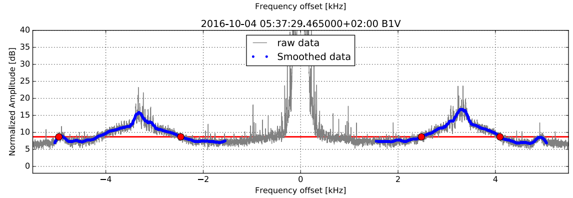
MD1767: Fun with Fitting

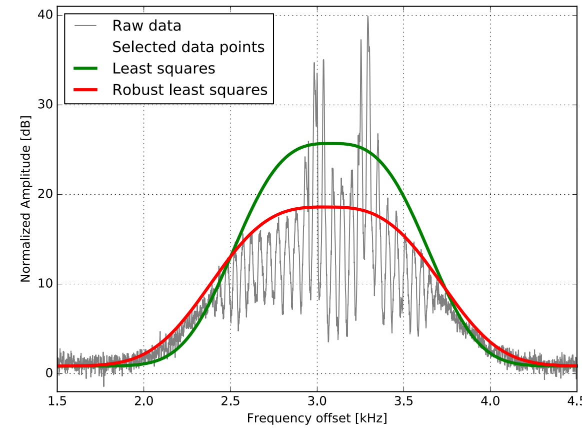








- Different fitting methods
  - Gaussian fit
    - Least square
    - Robust least square
  - Threshold fit
    - With box-car smoothing filter
  - ...
  - The all need tweaks
    - Baseline, noise-reduction, synchrotron lines, coherent signal contribution, etc.



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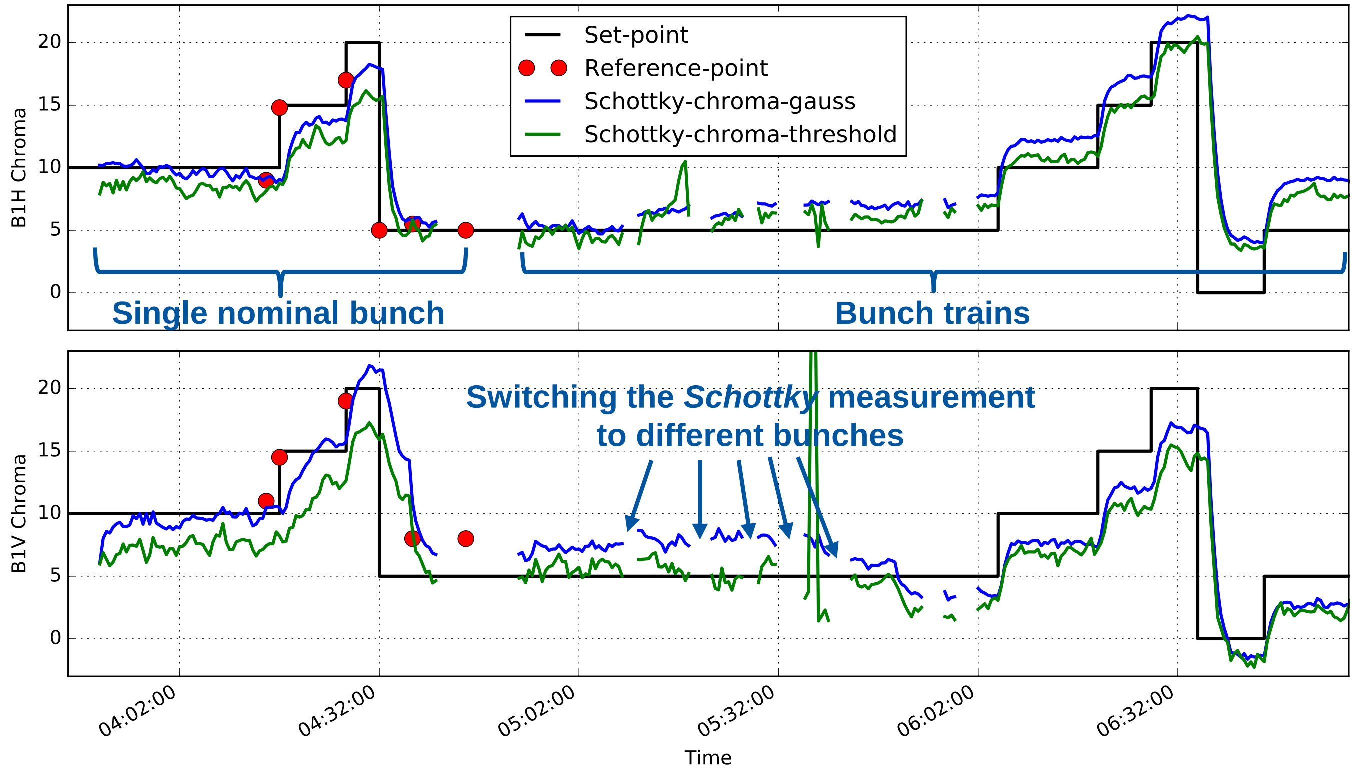
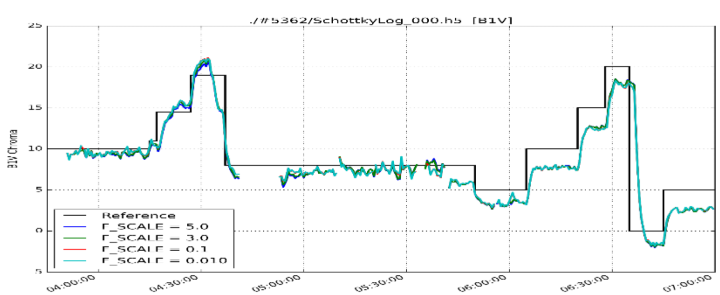
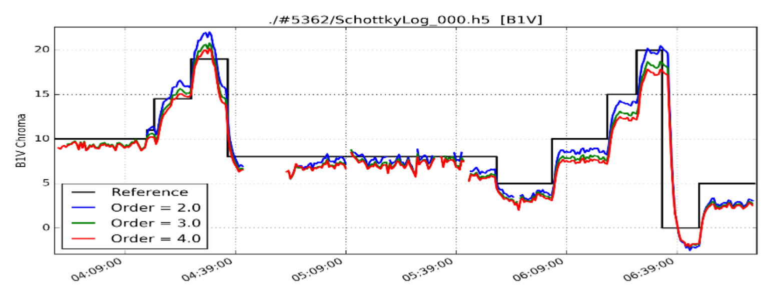
MD1767: Beam 1 Results







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MD1767: Summary

- At injection energy the *Schottky* monitors deliver reasonable good signals
  - Still, require baseline gymnastics, noise reduction, smoothing of synchrotron sidebands, exclusion of coherent signal parts.
- The chromaticity measurement seems to be robust to the bunch selection
  - Signals are very similar
- The results vary to some extend depending on the fitting method and their parameters
  - Effects in the range of 5…10 %
- Results match reasonable good with the RF modulation method
  - The RF modulation method is limited to low beam intensities
    - Even then the phase response sometimes was rather noisy
    - Set-point and RF mod. measurement can differ substantially, up to 50 %
  - The *Schottky* based method is non-invasive and operates continuously, but has a rather long time constant
    - Depends on the BBQ FFT settings for this study high resolution with 64kpoints was selected, the time constant was in the order of 1…2 minutes