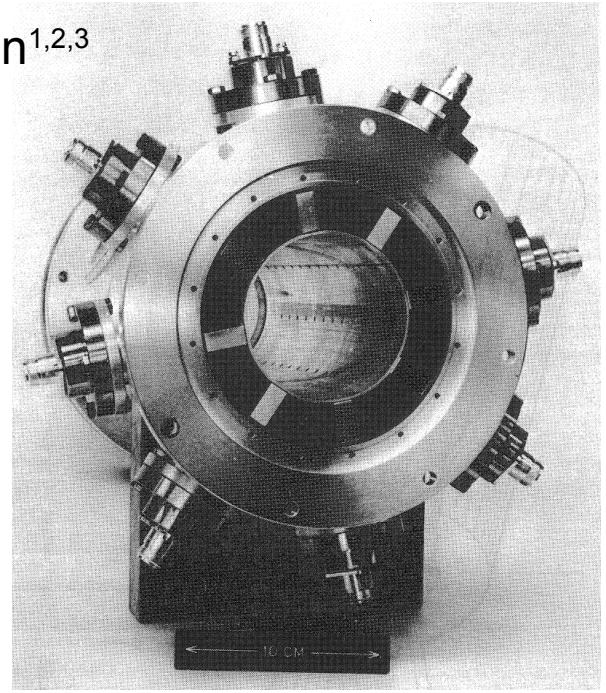
WCM Satellite Measurements for the 2013 VdM Scans

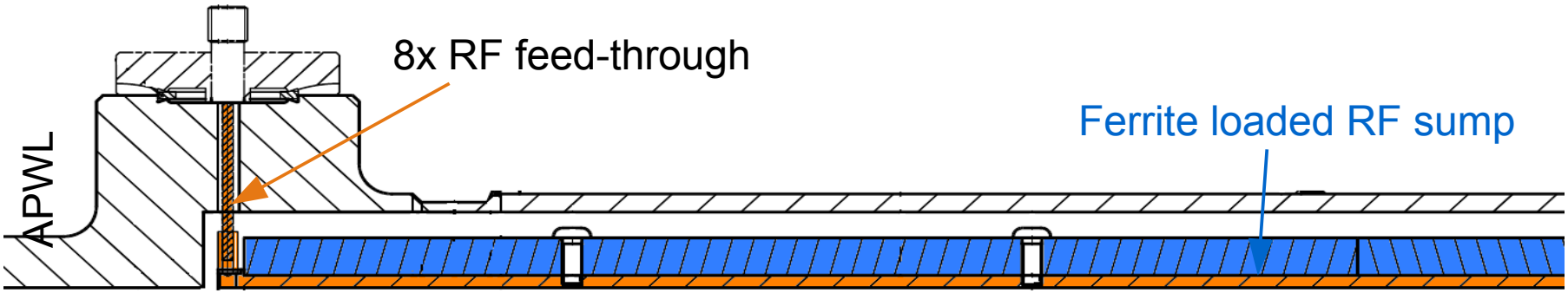
Ralph J. Steinhagen, S. Bart-Pedersen, J. Belleman, BE-BI
T. Bohl, H. Damerau, BE-RF

SPS/LHC Wall Current Monitor Design

- WCM pickup designs based on established 78' design[1,2,3]
- Proof-of-principle: *"What can be achieved/are the limits re-using the existing infrastructure"*



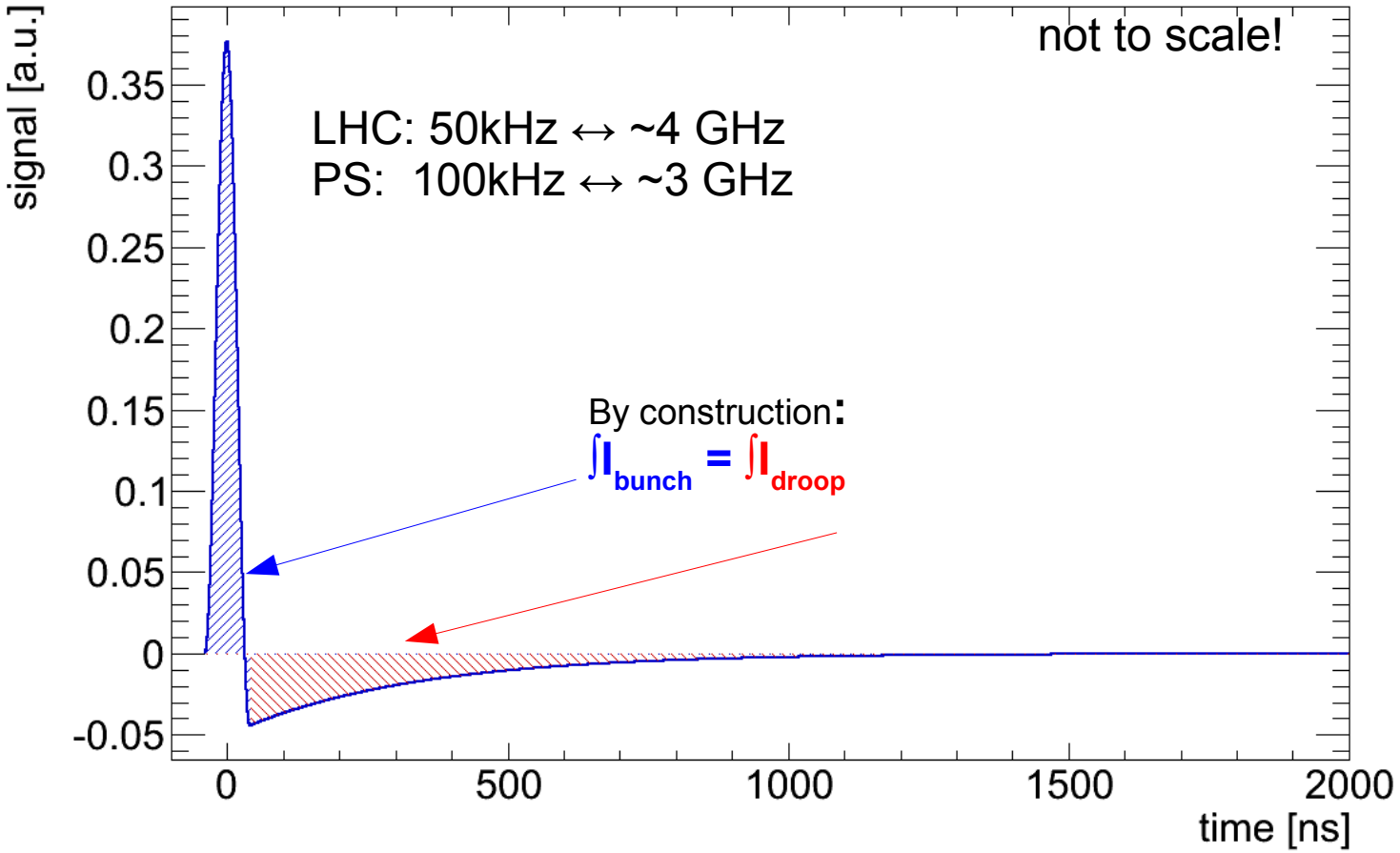
- Simplicity is key necessity to control systematics and reflections below the <10^{-3} level at few-GHz:
  WCM + "star combiner" → 3/8" pig-tail
  → 30 (100) m 7/8" cable
  → 40 dB attenuator → 3+ GHz fast sampling scope
- Intensity etc. measurement relies on beam-based off-/online calibration and signal post-processing



[1]T. Linnecar, "The high frequency longitudinal and transverse pick-ups used in the SPS", CERN-SPS/ARF/78-17, 1978
[2]Th. Bohl, "The APWL Wideband Wall Current Monitor", CERN-BE-2009-006, 2009
[3]R. Cappi et al., "Single-Shot Longitudinal Shape Measurements [..]", CERN-PS-87-31-PSR, PAC 1987, 1987

Signal Reconstruction I/II
Typical WCM response – Low-Frequency Base-Line

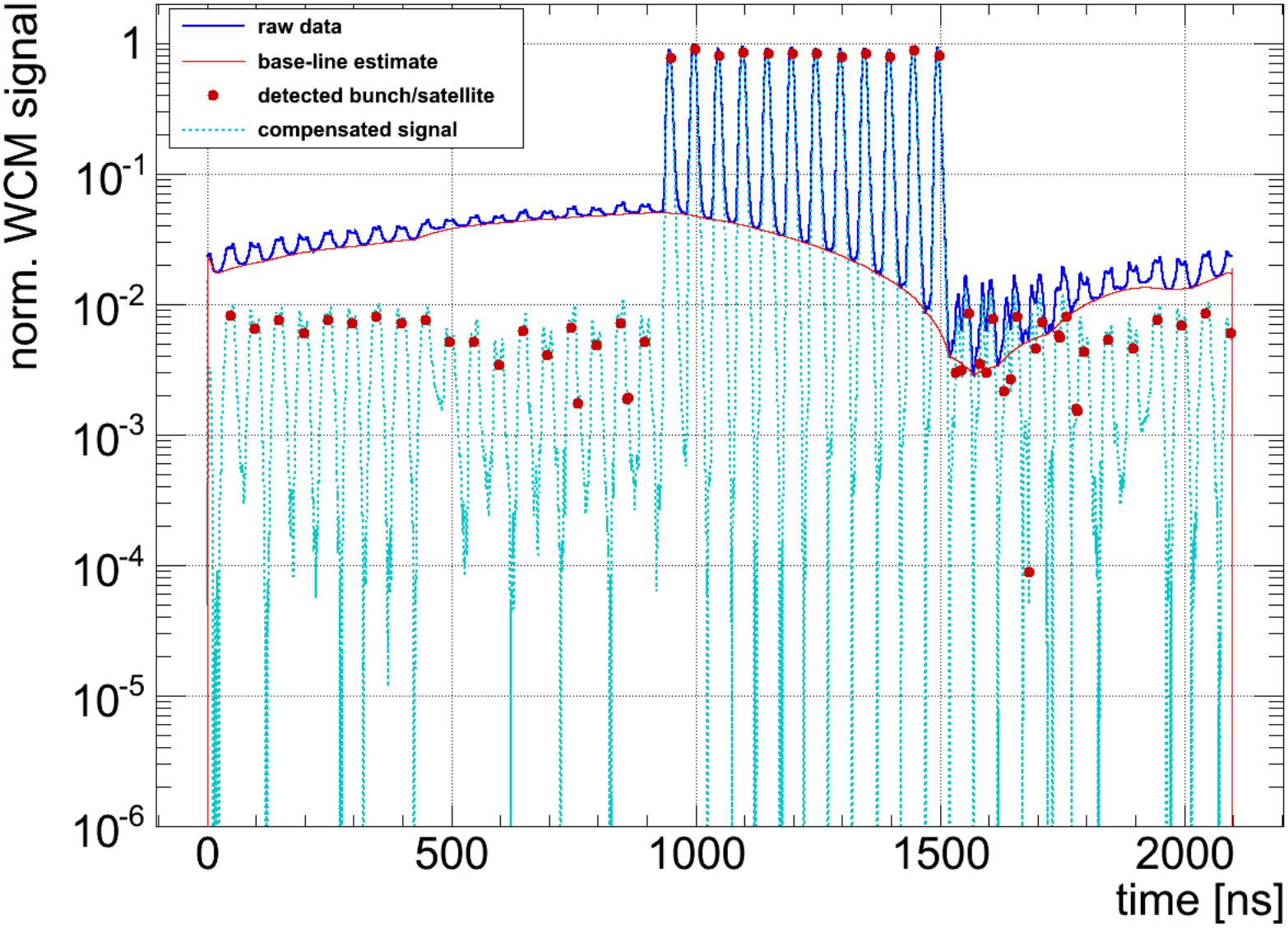
- Naive approach: Fourier Integral definition for 'ω:=0': $F(\omega)=\int_{-\infty}^{+\infty} f(t)\,e^{-i\omega t}\,dt$
- However: DC information is in-accessible:



- Intrinsic AC-coupling → requires base-line restauration

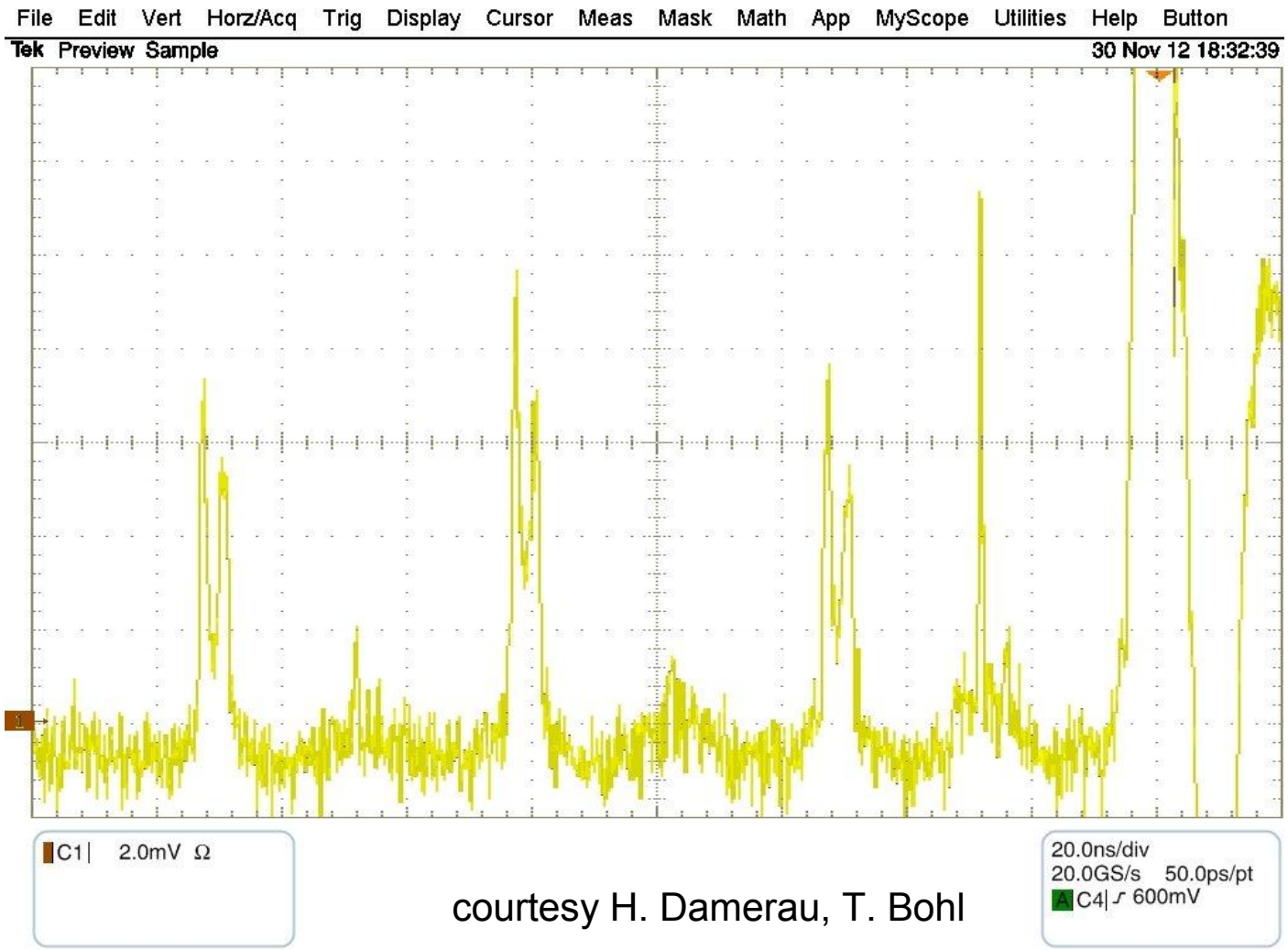
Signal Reconstruction II/II – SNIP Algorithm
Example PS WCM Signal

- Satellites have been deliberately produced for better proof-of-principle:



A note on 30 & 20 ns Satellites

- … caused by hollow bunches from the PS
- distribution frozen-in by SPS 200 MHz during injection capture



courtesy H. Damerau, T. Bohl

2012-11-09 modifications of WCM (APWL) B1 & B2

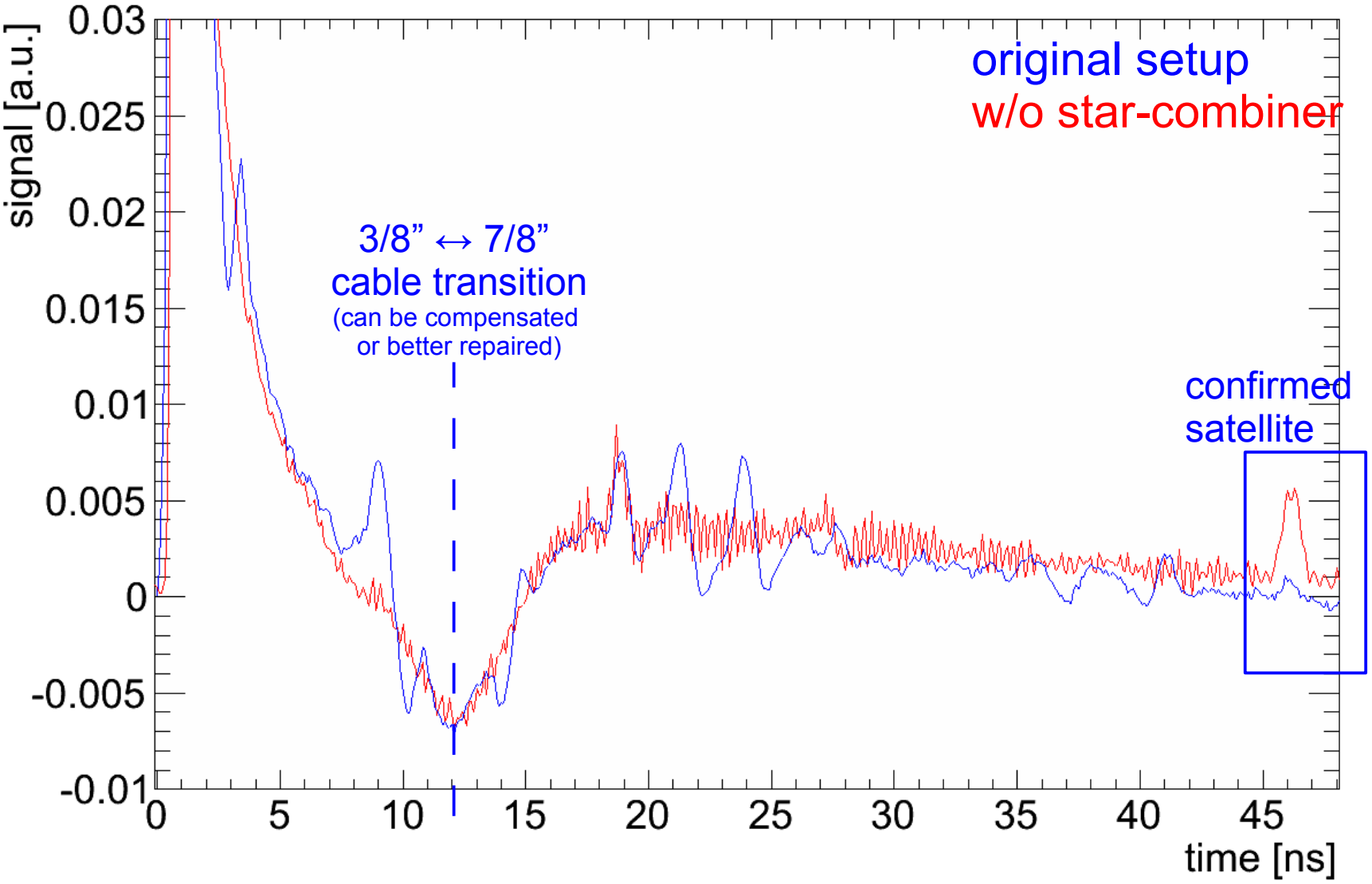
- Removed star-combiner
  (since not a matched 50Ω system)
  → will increase the sensitivity to position
  but should be acceptable (N.B. Orbit-FB)

- loaded 7 out of 8 ports at source, matched to ~ -30 dB
  → needs to be redone during next TS/LS1

- Noticed a 7/8 cable termination that was a bit loose
  → need to check redo this during the next TS

- Further plans: shift/split 40 dB attenuation to WCM (will add some back-matching to the otherwise reflective pick-up)

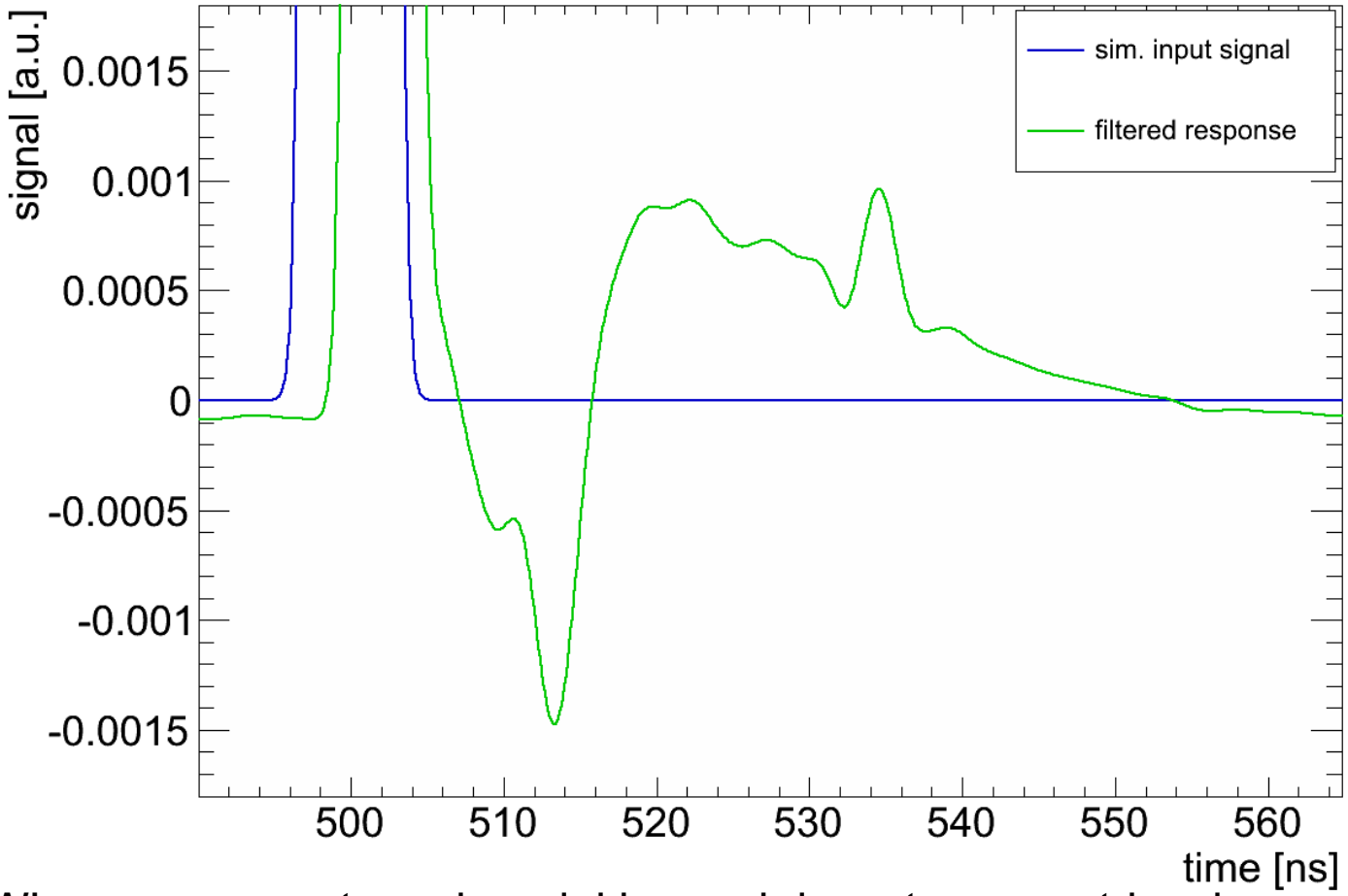
For comparison: LHC WCM Installation I/II
Since 2013: Identical B1 & B2 Installation



- Gain by post-compensating the reflections but limited overall to factor ~10
  → should be fixed in HW

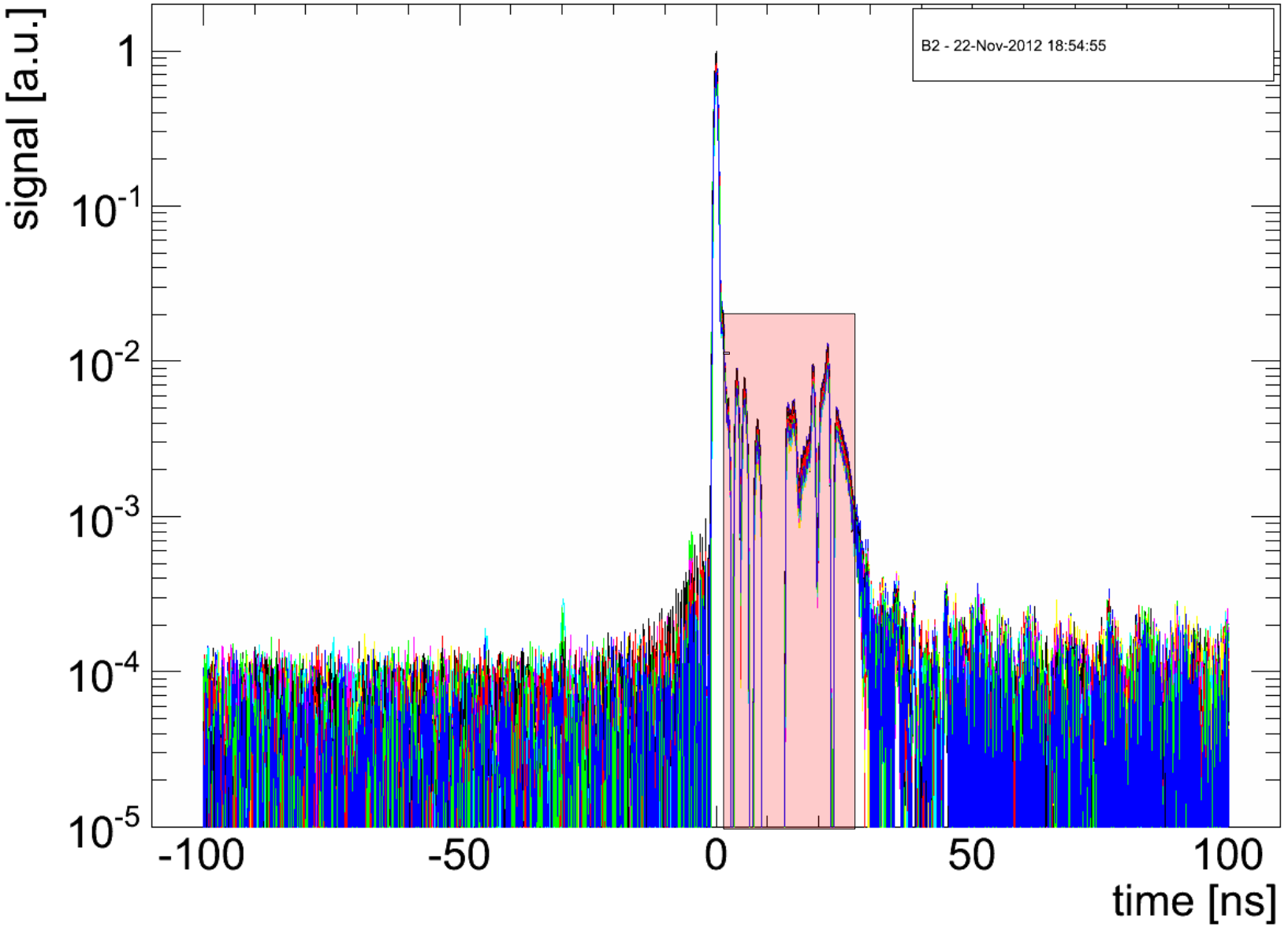
For comparison: LHC WCM Installation II/II

- LHC APWL lab-based measurements (T. Bohl, 2006)

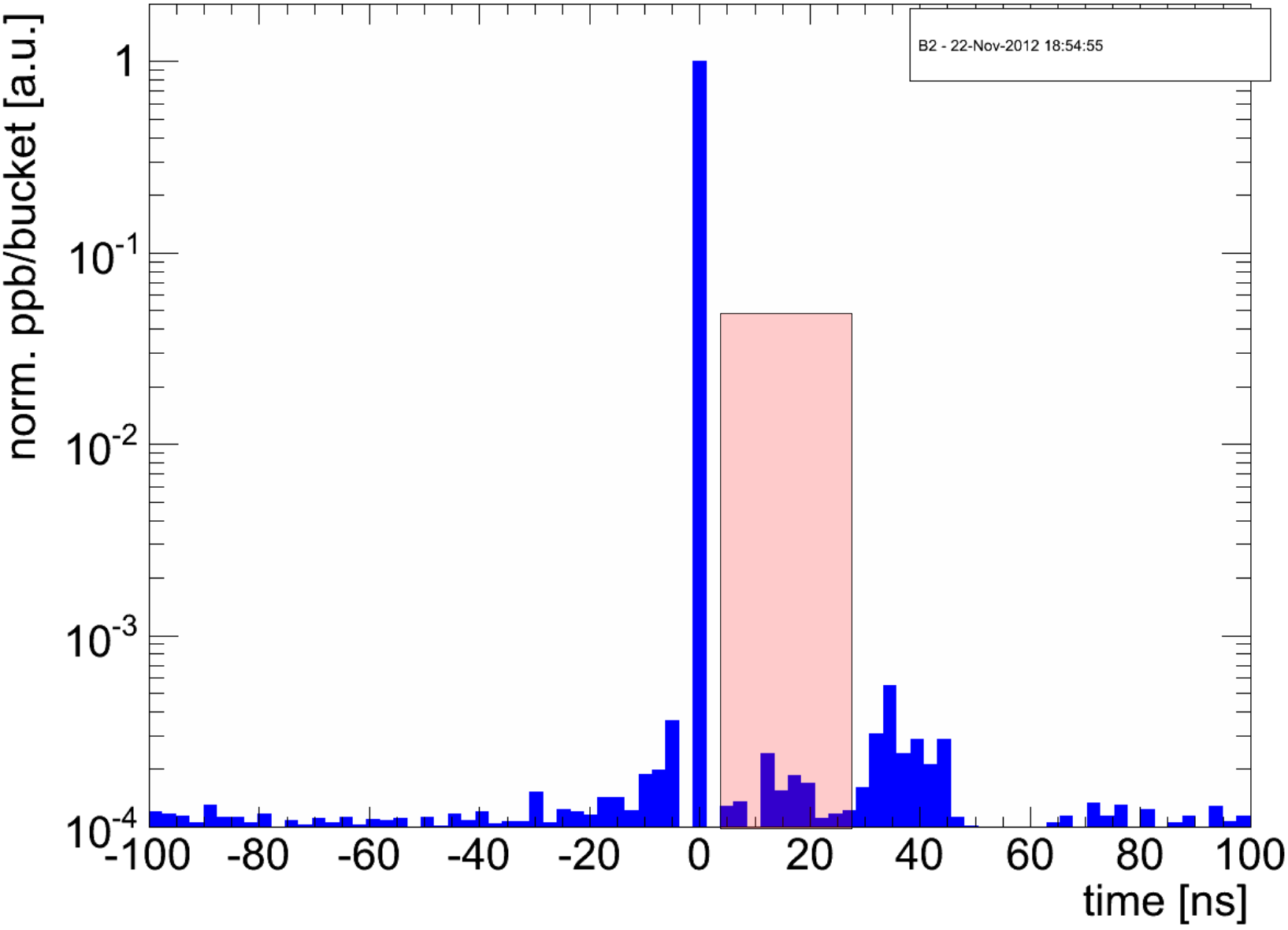


- APWL measurements and model is good down to percent-level
  → to be refined for higher accuracy during LS-1 (also of BE-RF interest)

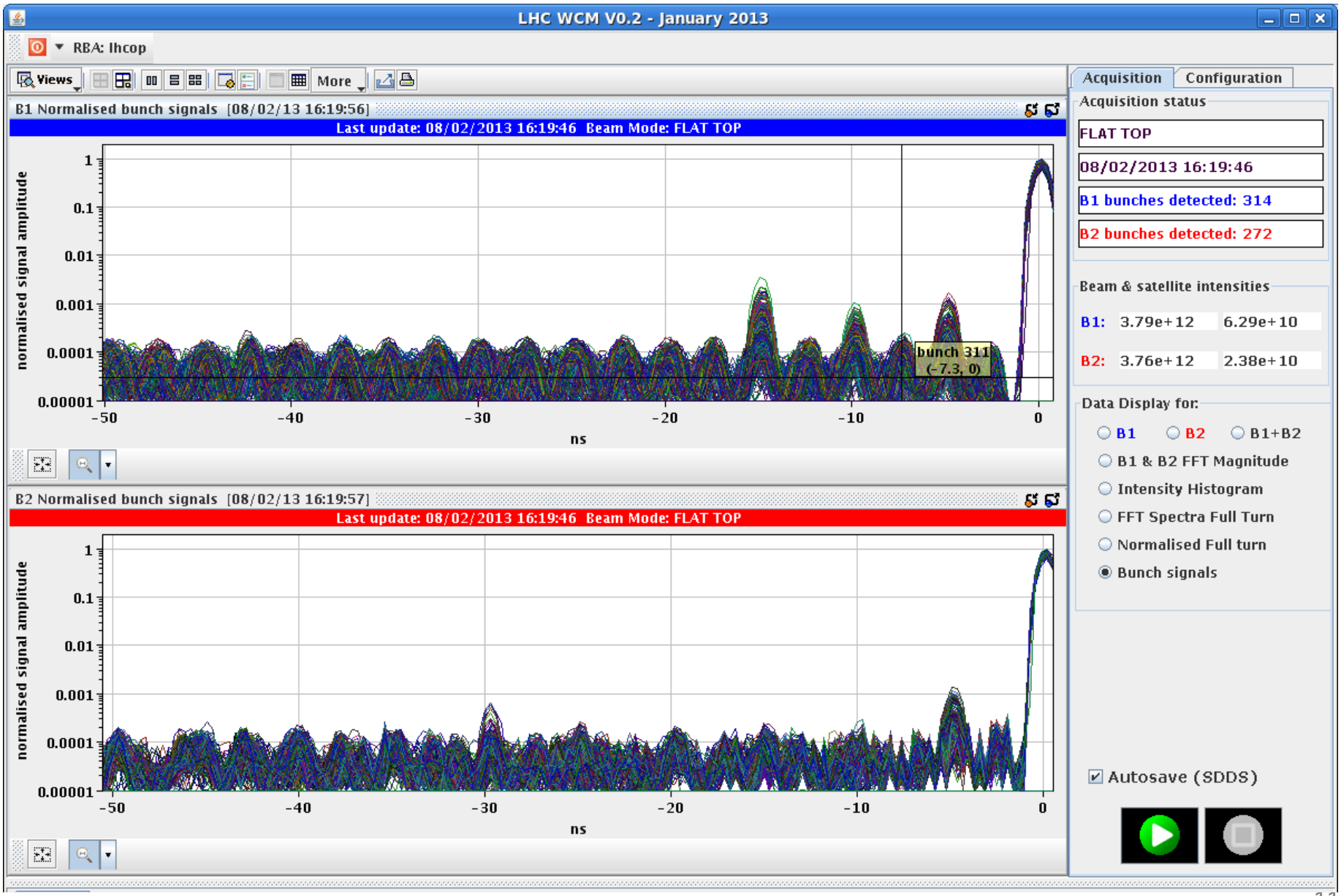
VdM Scan 21th November – B2 I/II
Superimposed Raw Traces



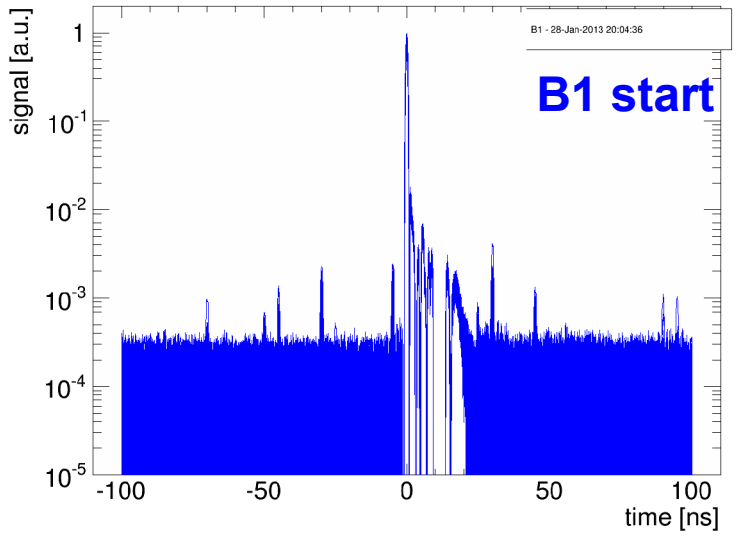
VdM Scan 21th November – B2 II/II
Integrated over RF Bucket

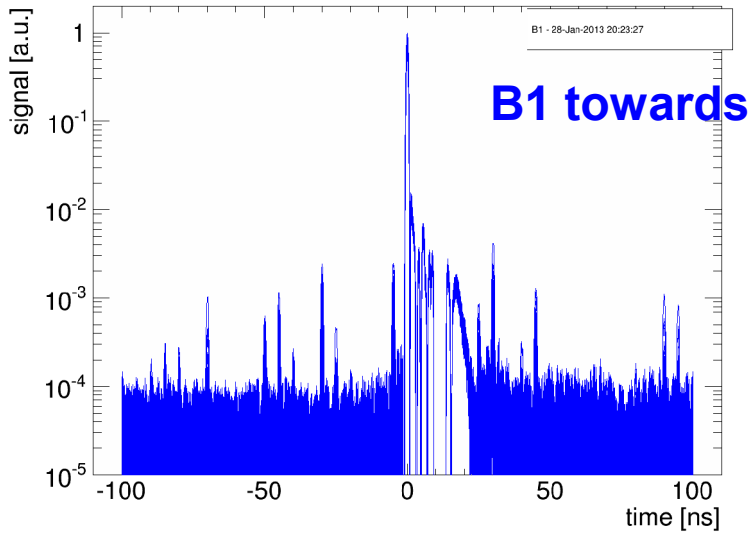


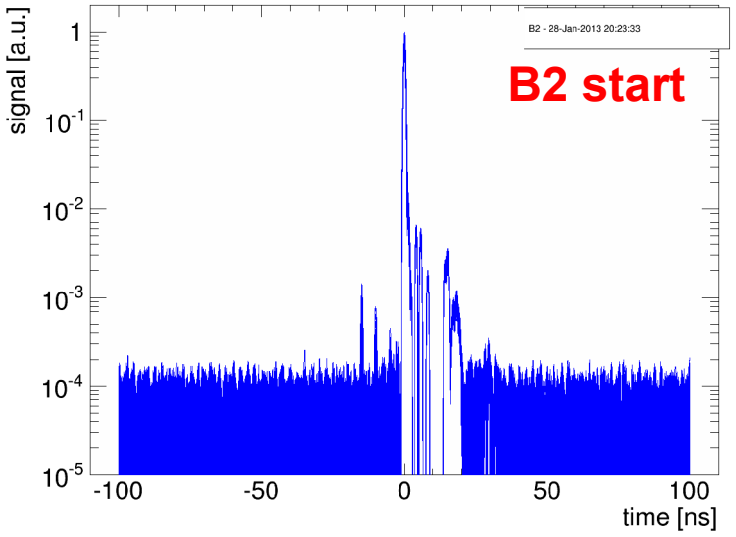
CCC GUI impressions – LHC
Courtesy M. Albert

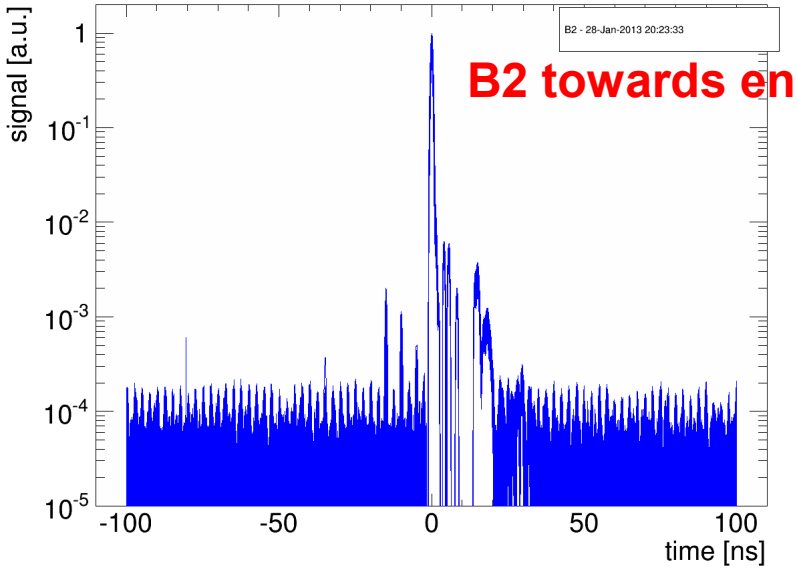


VdM Scan #1: 2013-01-28 Fill 3503 – p-Pb

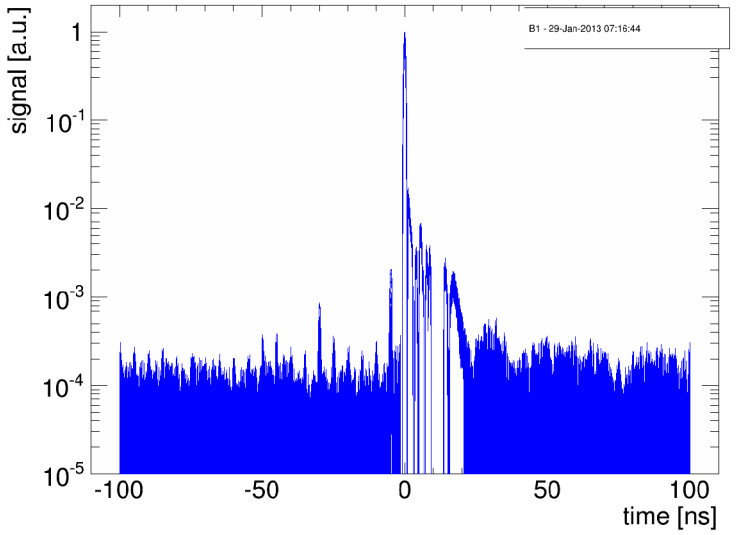


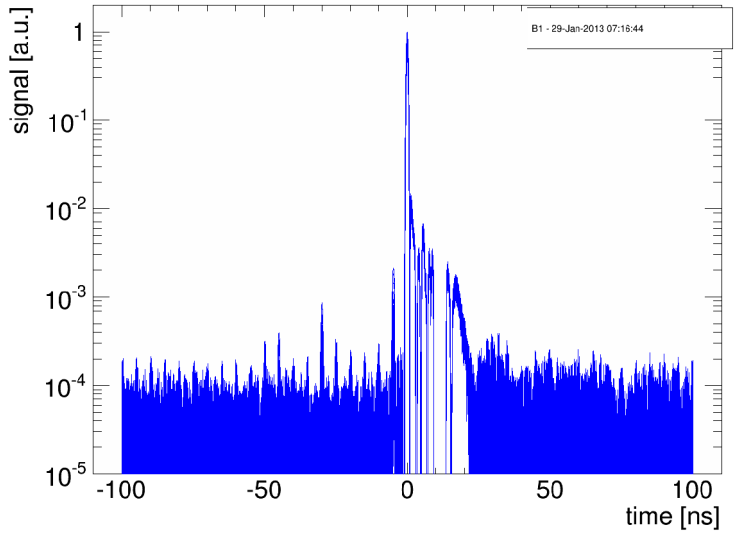


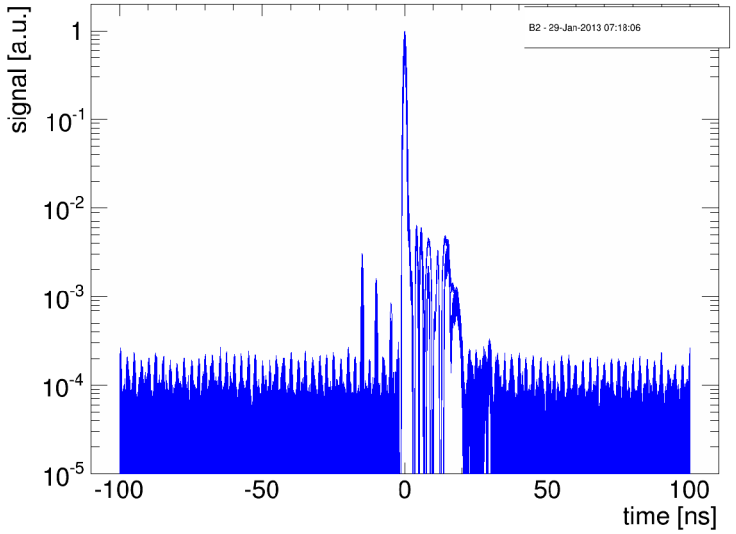


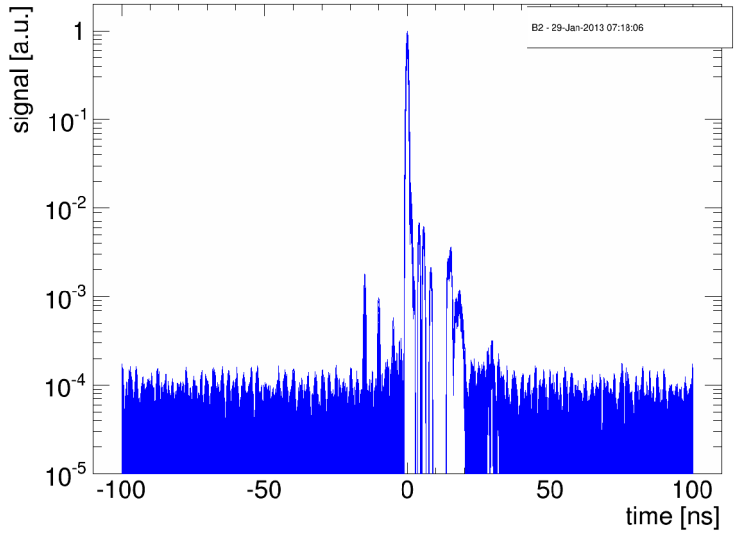


VdM Scan #2: 2013-01-29 Fill 3505 – p-Pb

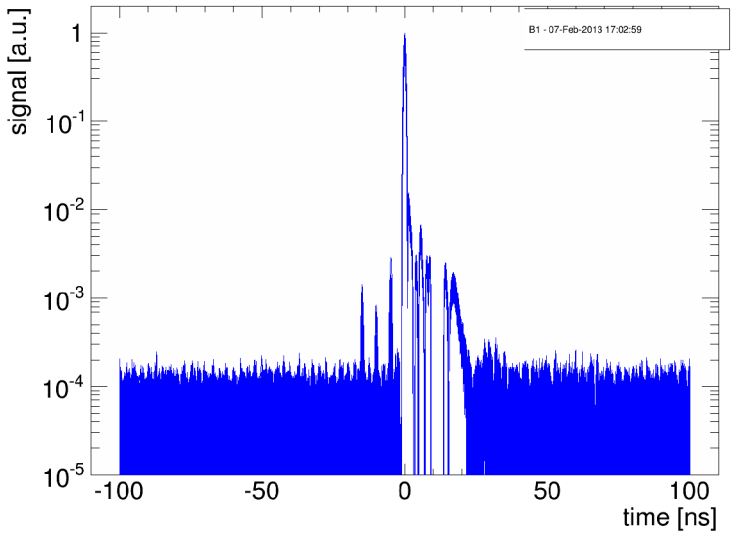


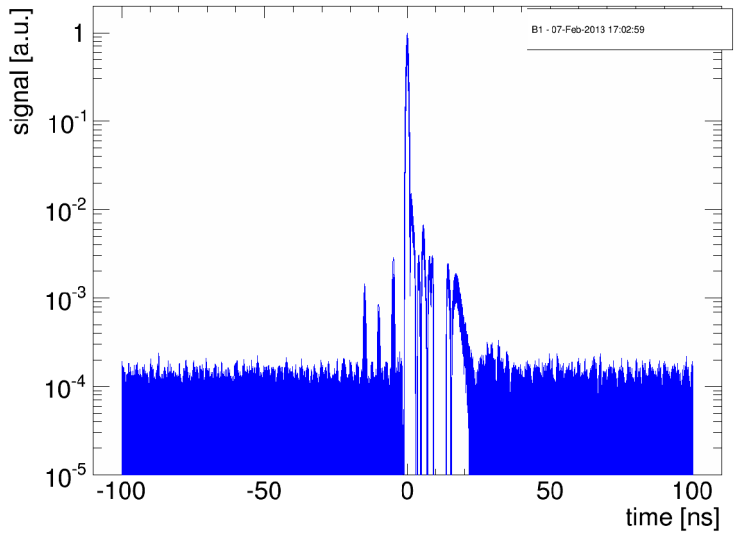


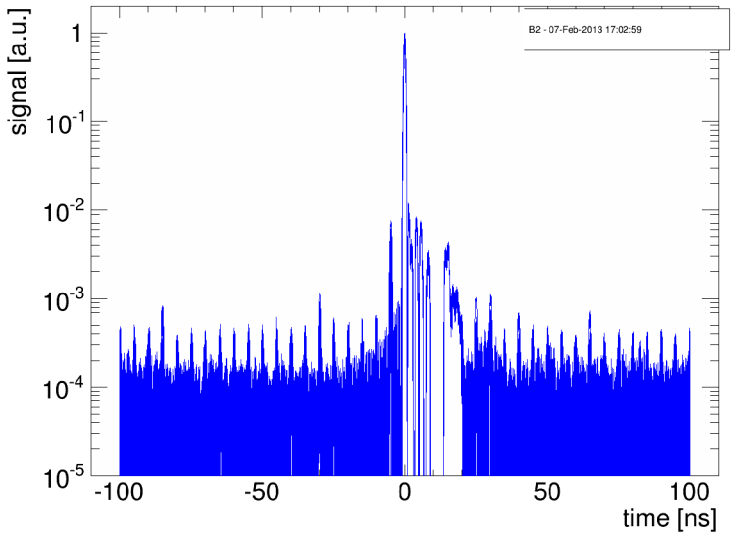


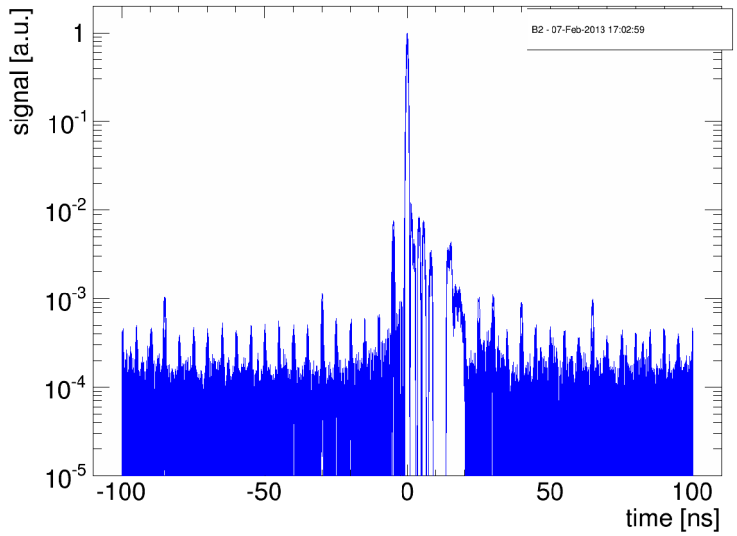


VdM Scan #3: 2013-02-07 Fill 3537 – Pb-p

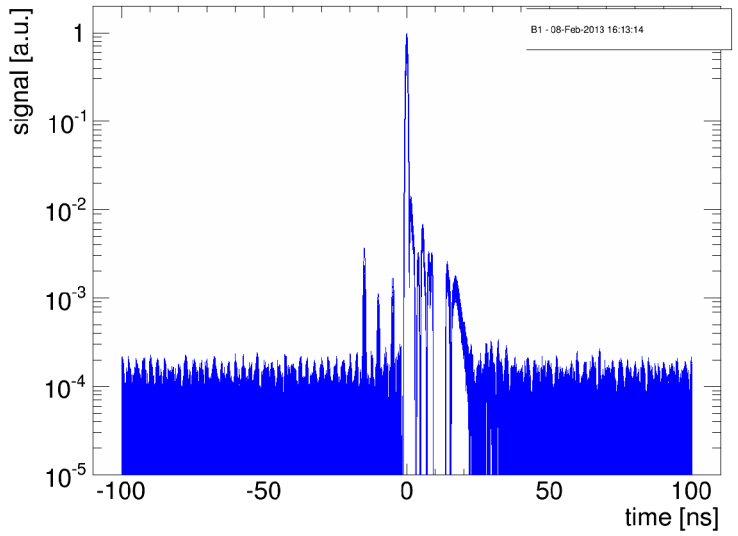


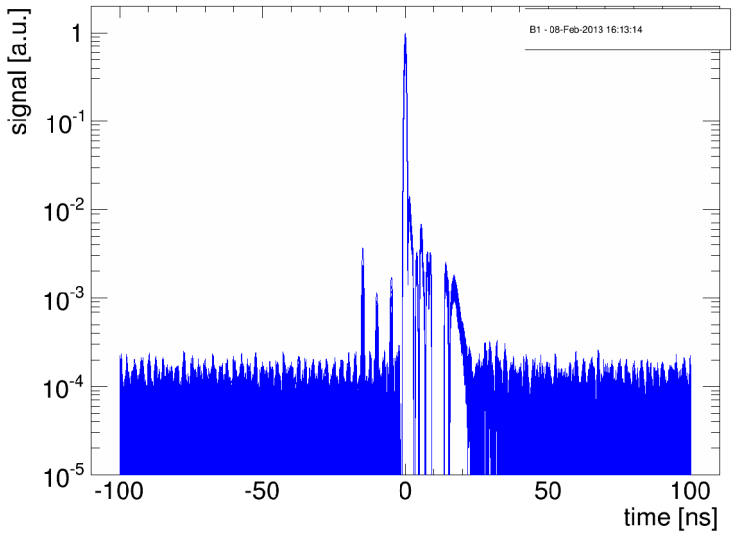


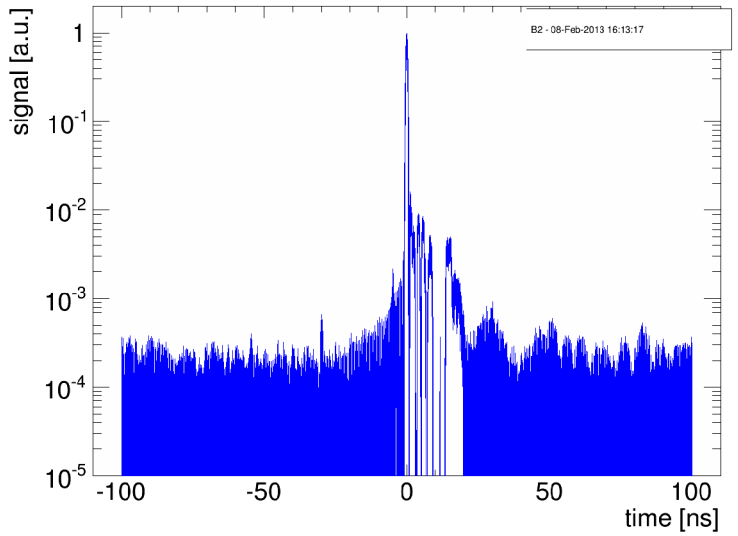


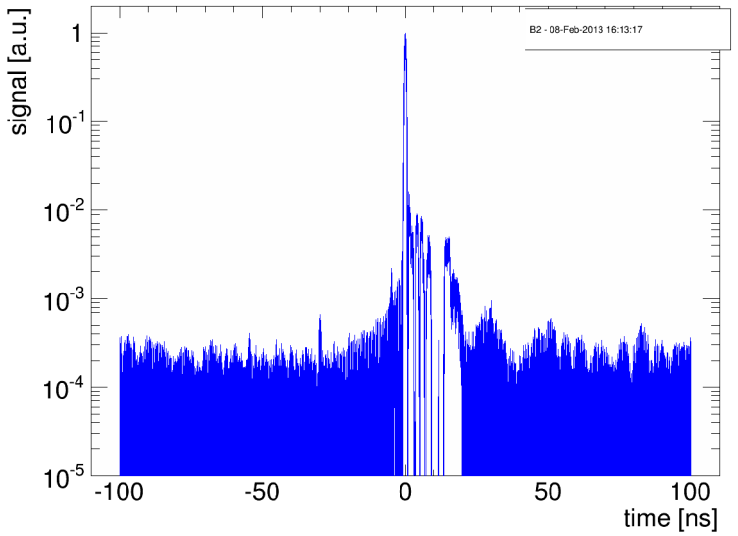


VdM Scan #4: 2013-02-08 Fill 3540 – Pb-p

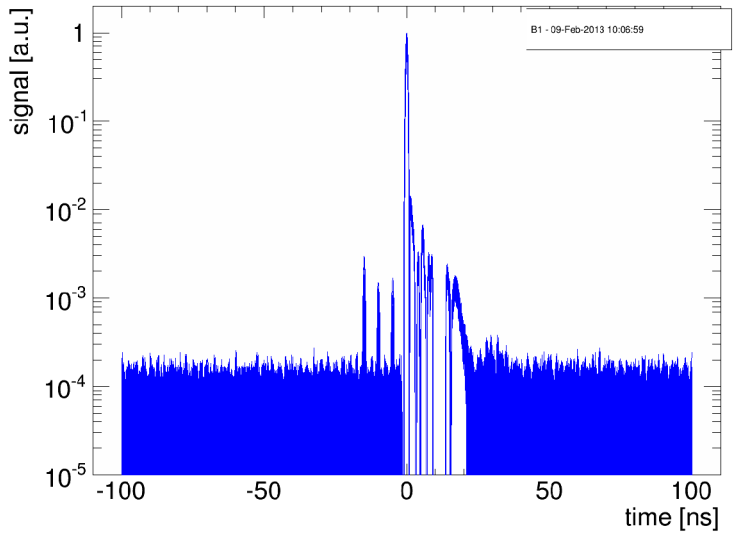


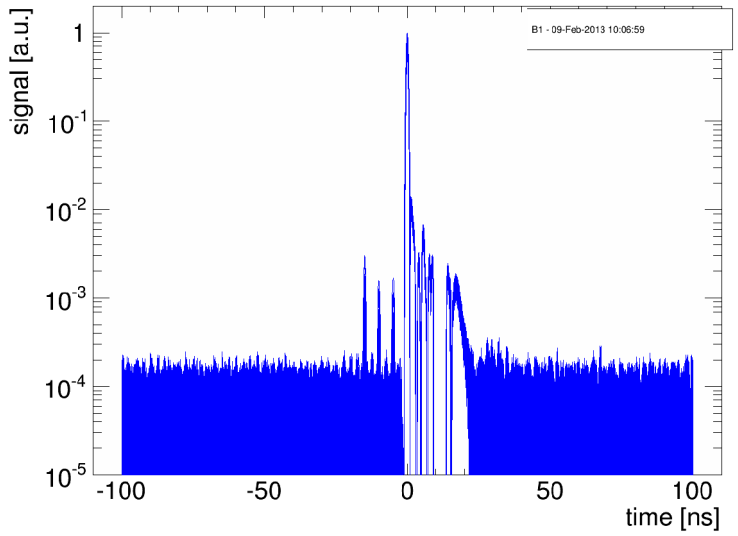


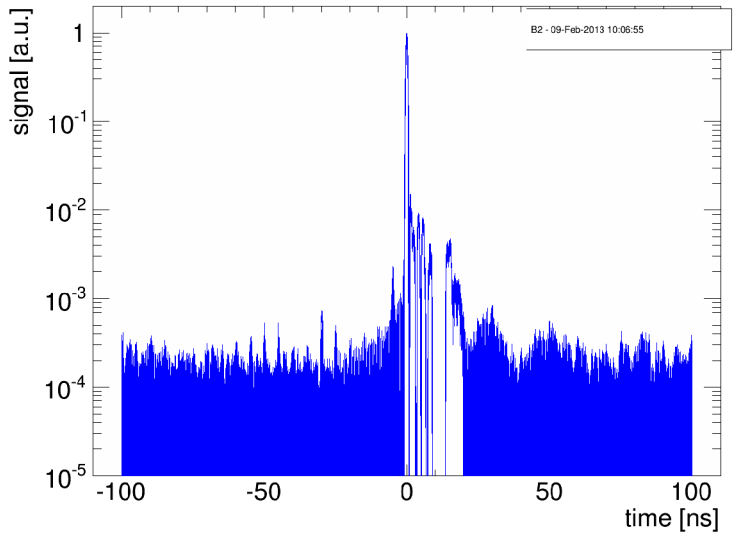


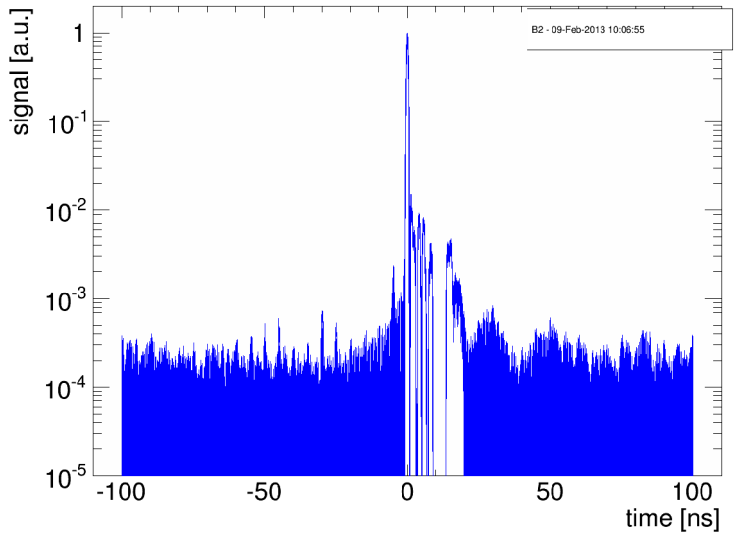


VdM Scan #5: 2013-02-09 Fill 3542 – Pb-p

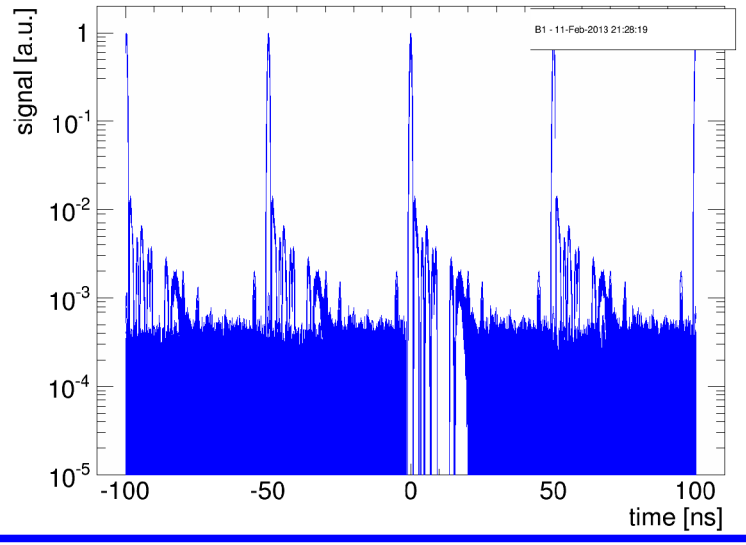


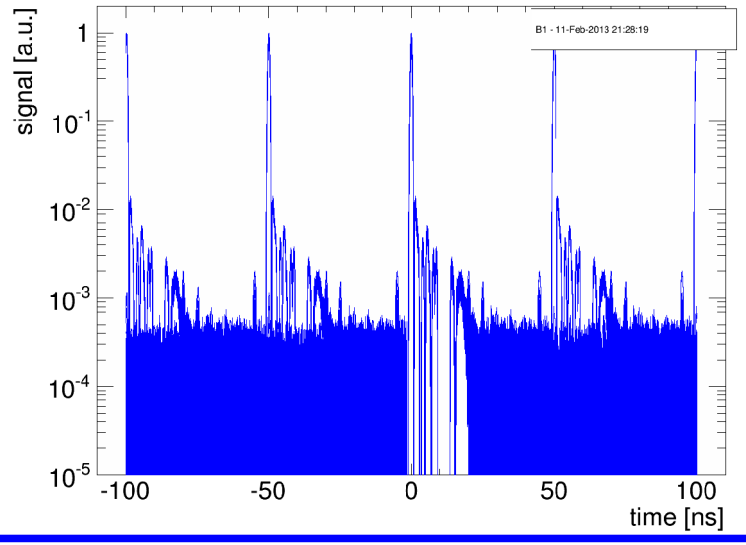


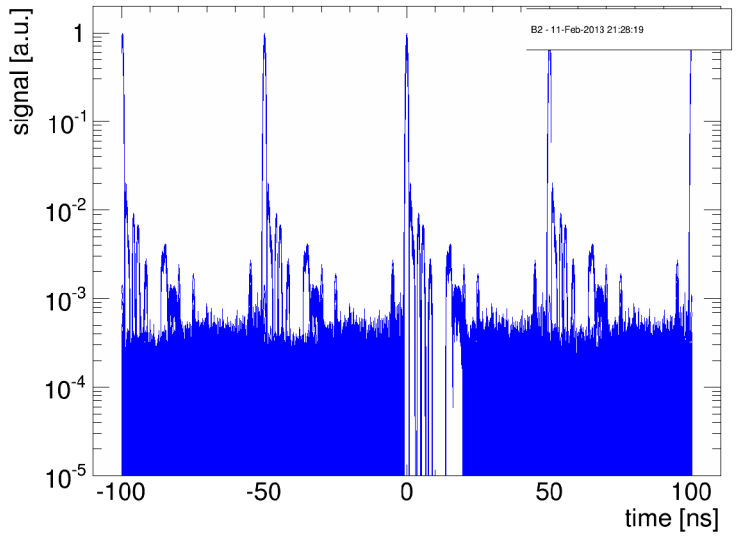


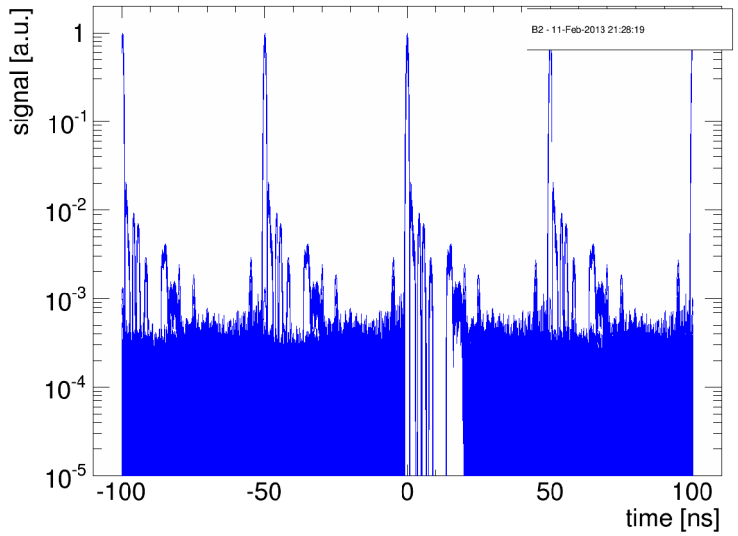


VdM Scan #6: 2013-02-11 Fill 3555 – Pb-p

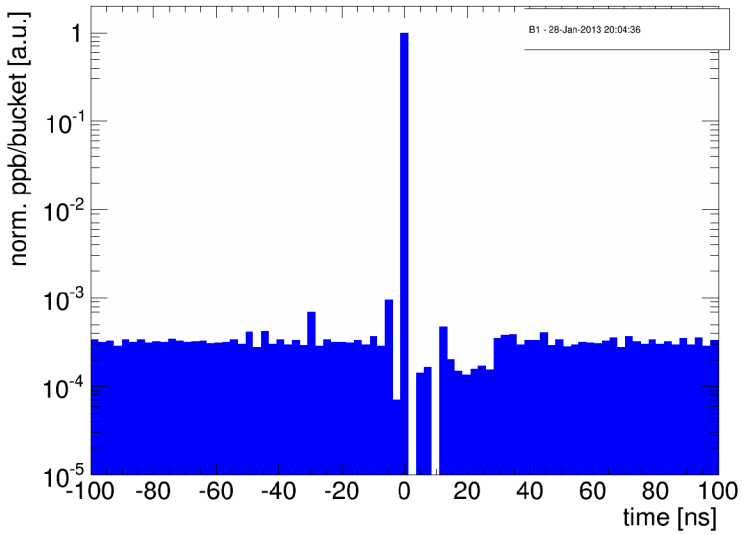


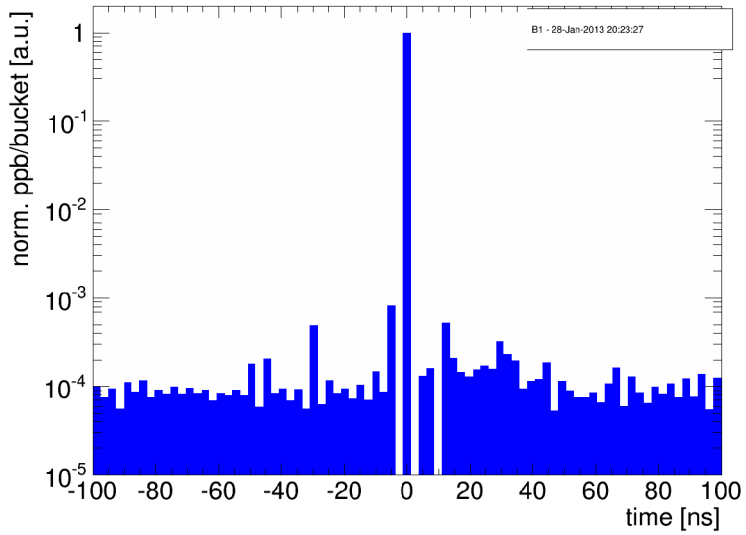


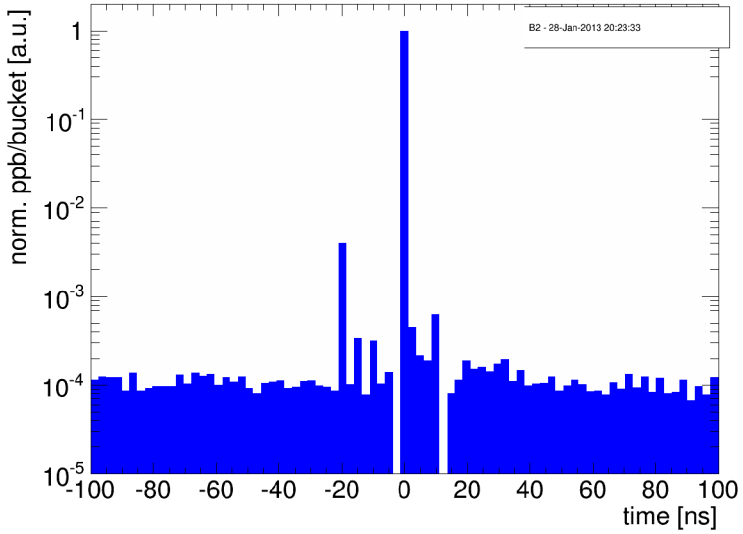


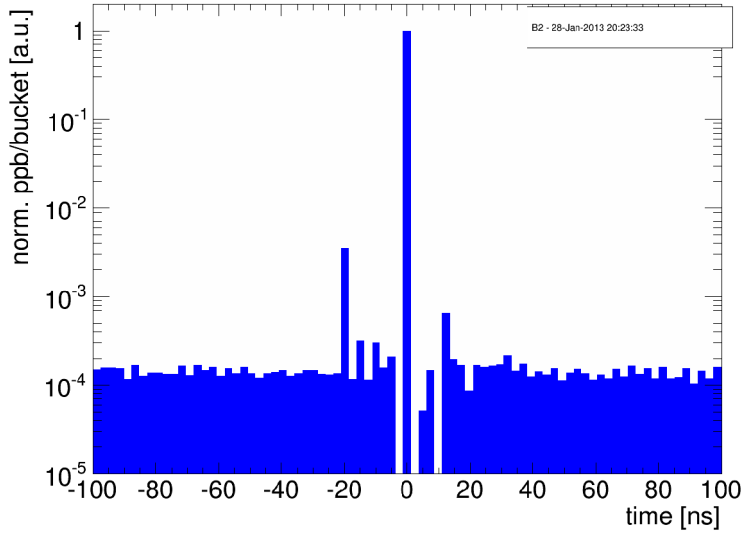


VdM Scan #1: 2013-01-28 Fill 3503 – p-Pb

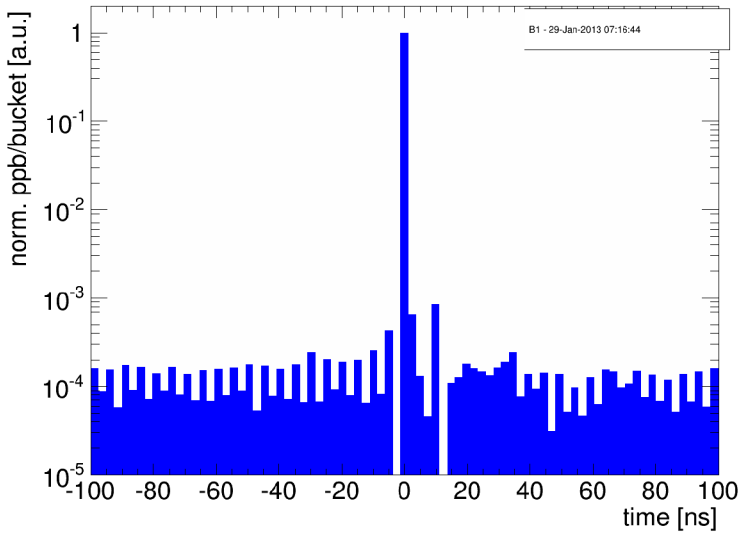


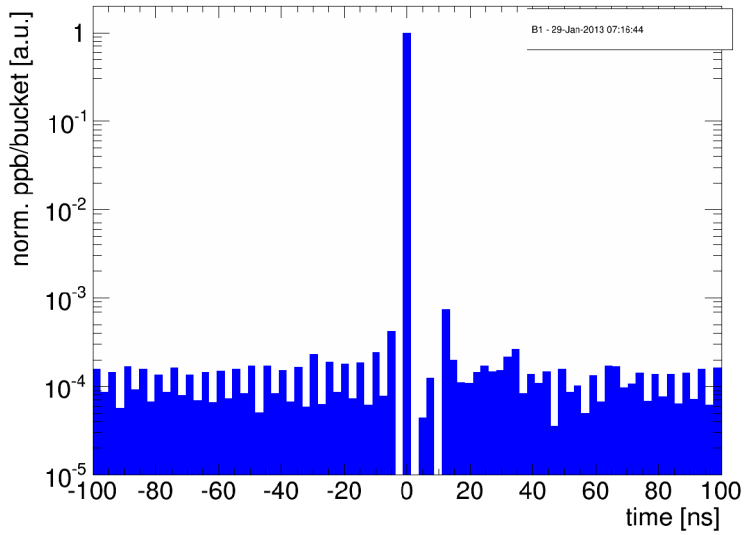


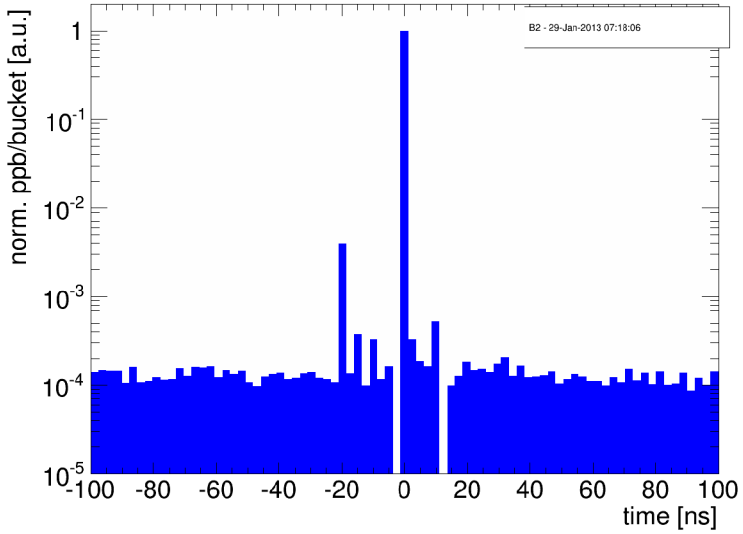


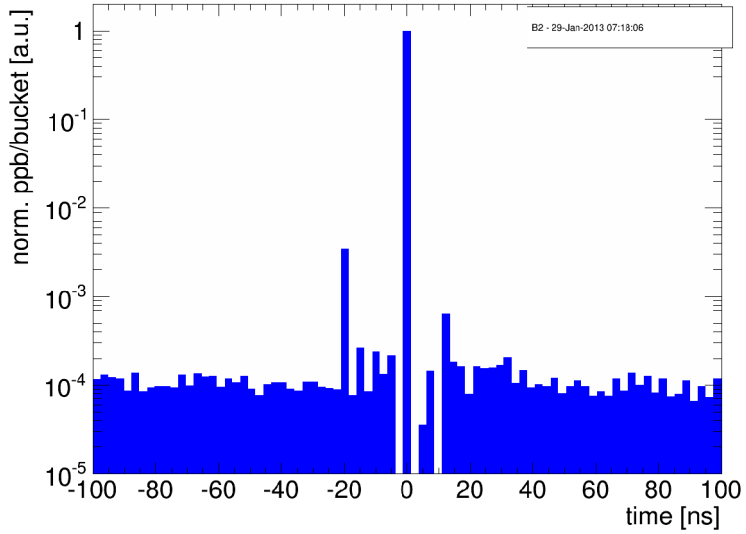


VdM Scan #2: 2013-01-29 Fill 3505 – p-Pb

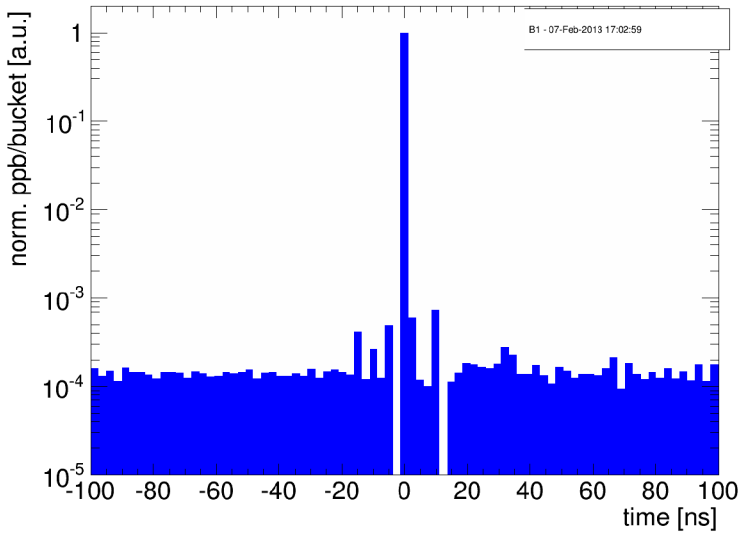


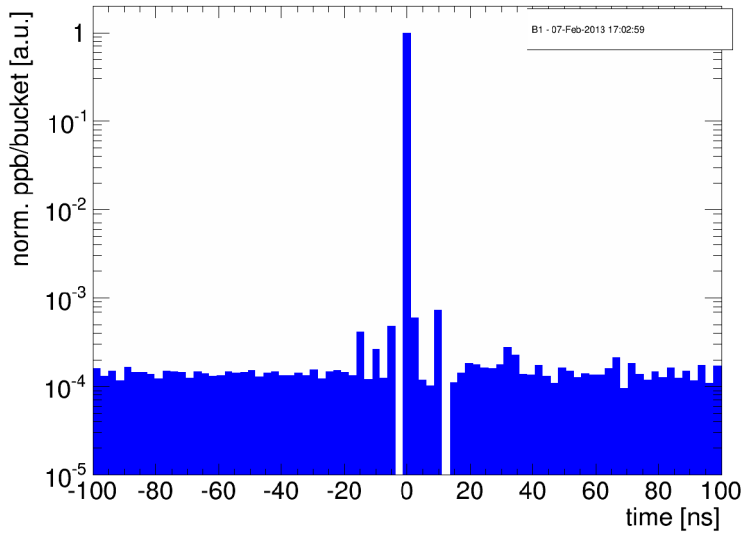


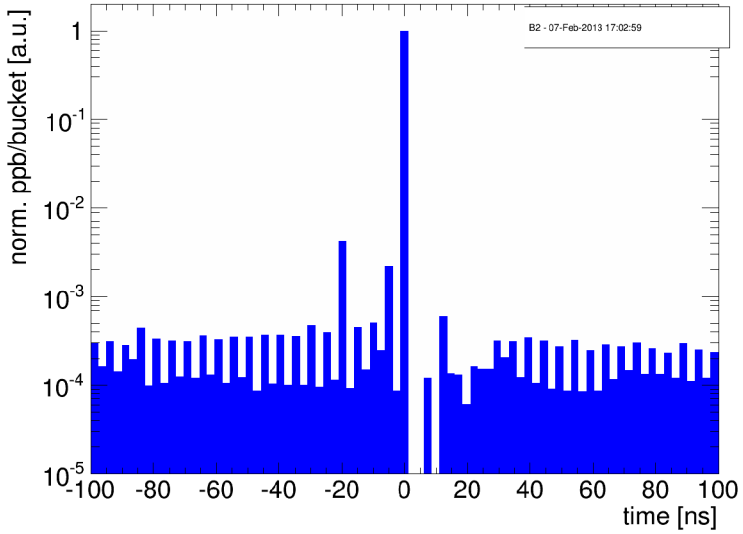


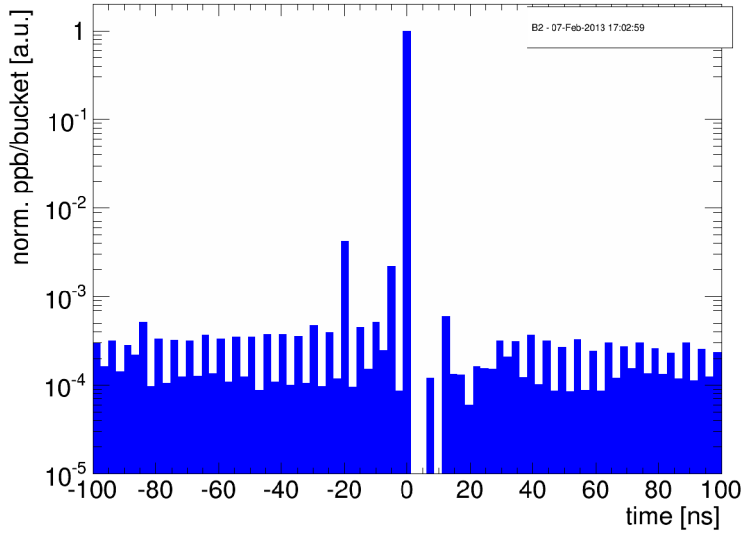


VdM Scan #3: 2013-02-07 Fill 3537 – Pb-p

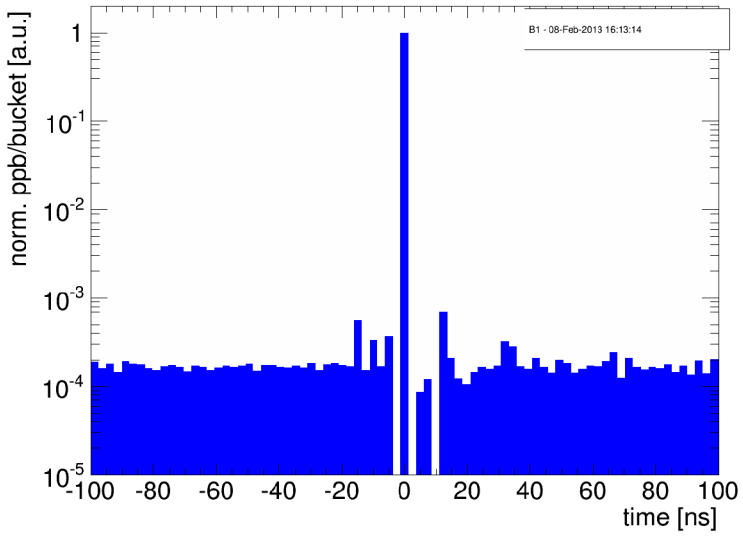


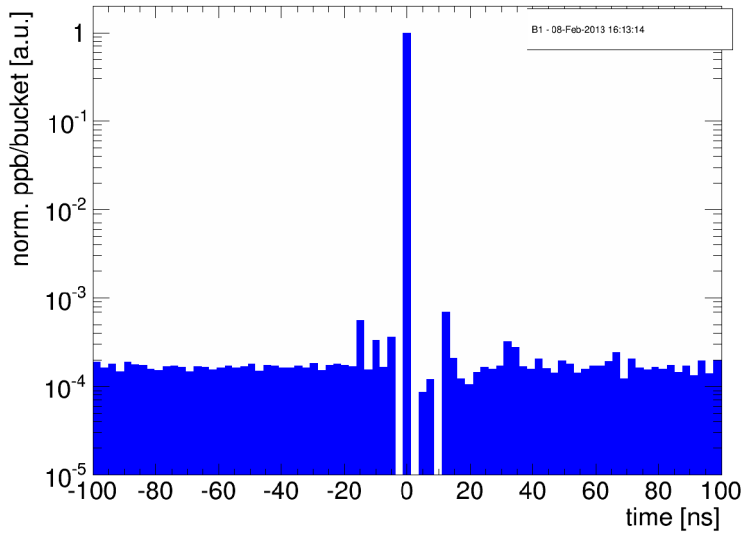


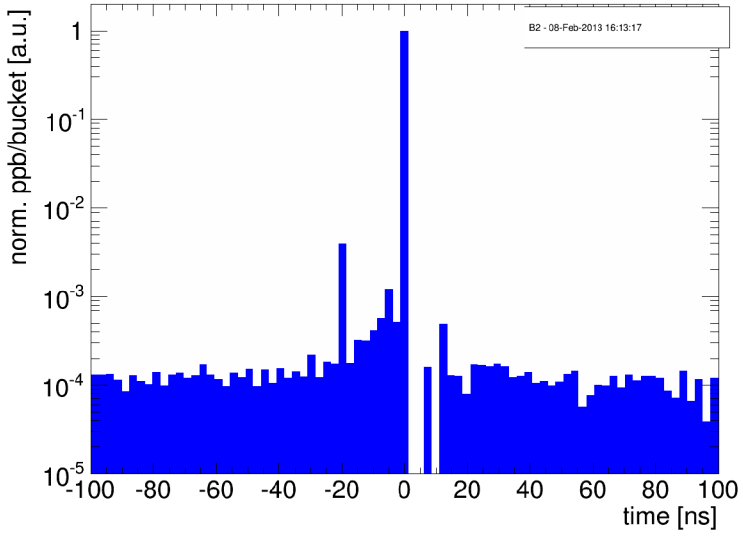


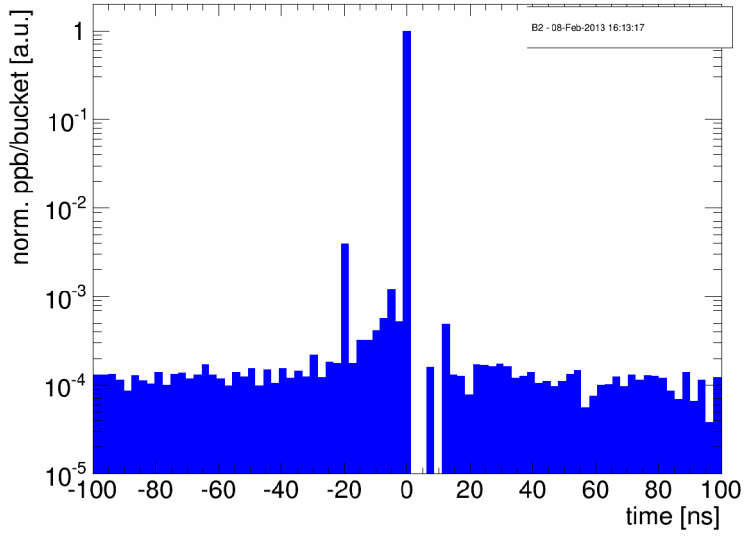


VdM Scan #4: 2013-02-08 Fill 3540 – Pb-p

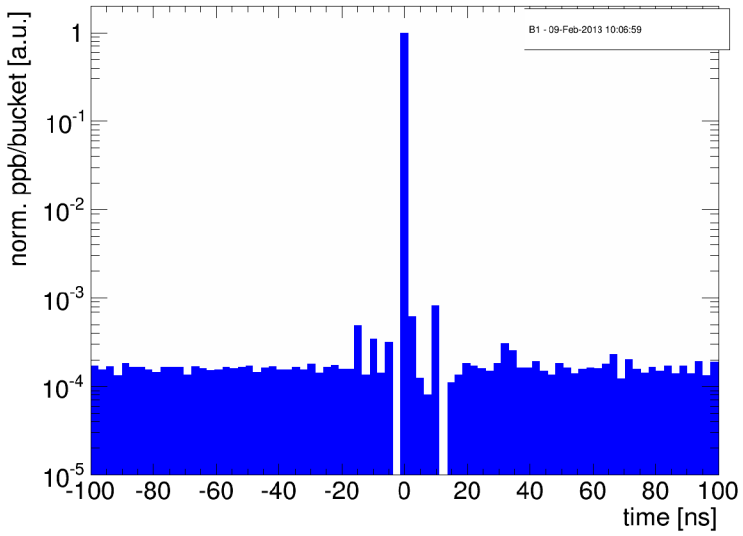


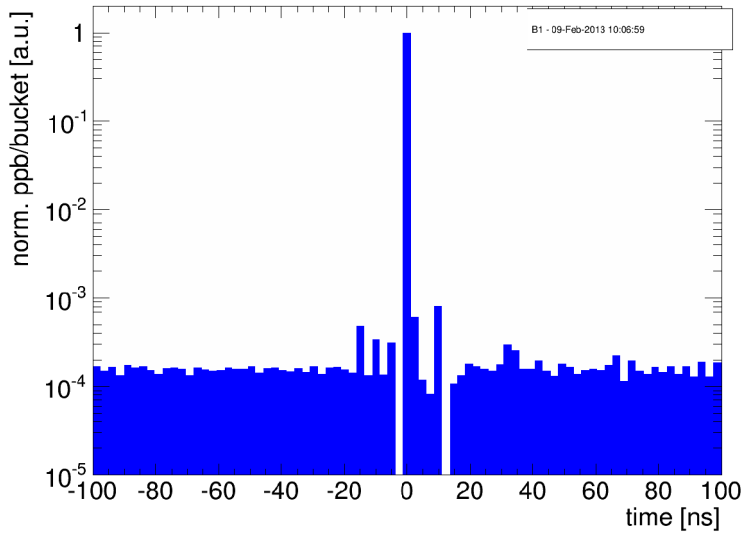


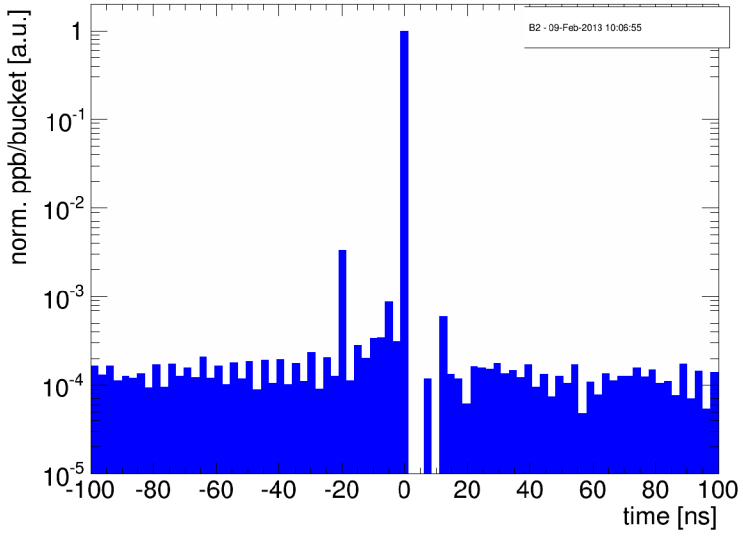


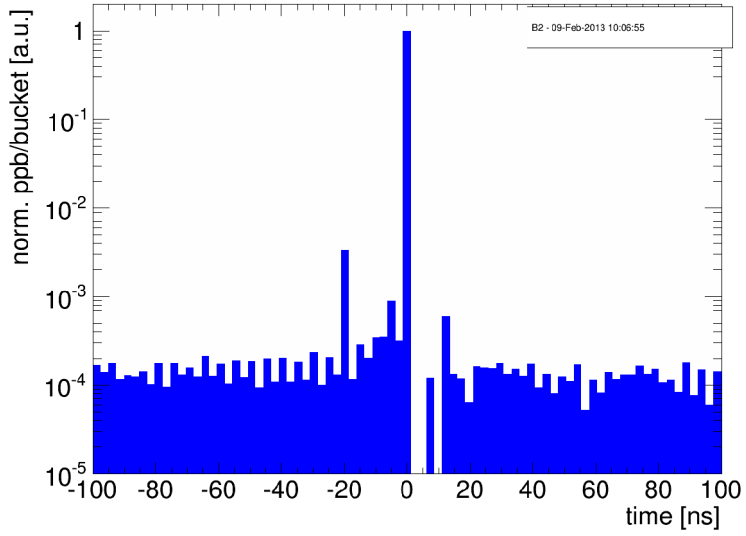


VdM Scan #5: 2013-02-09 Fill 3542 – Pb-p









VdM Scan #6: 2013-02-11 Fill 3555 – Pb-p