# Filter Monitors and Noise in IP3

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# BLM Filter Monitors with Installed RC-Delay

**8 monitors with:**
**C=47nF, R=150KOhm**
(since startup Feb. 2010)
- Reason: allow for overinjection and test collimation regions (LHC-BLM-ECR-0004 and 0005)

- BLMEI.06R7.B2I10_TCP.A6R7.B2
- BLMEI.06R7.B2I10_TCHSV.6R7.B2
- BLMEI.06R3.B2E10_TCHSH.6R3.B2
- BLMEI.04R8.B2E20_TDI.4R8.B2
- BLMEI.06L3.B1I10_TCHSH.6L3.B1
- BLMEI.06L7.B1E10_TCHSV.6L7.B1
- BLMEI.06L7.B1E10_TCP.A6L7.B1
- BLMEI.04L2.B1E20_TDI.4L2.B1

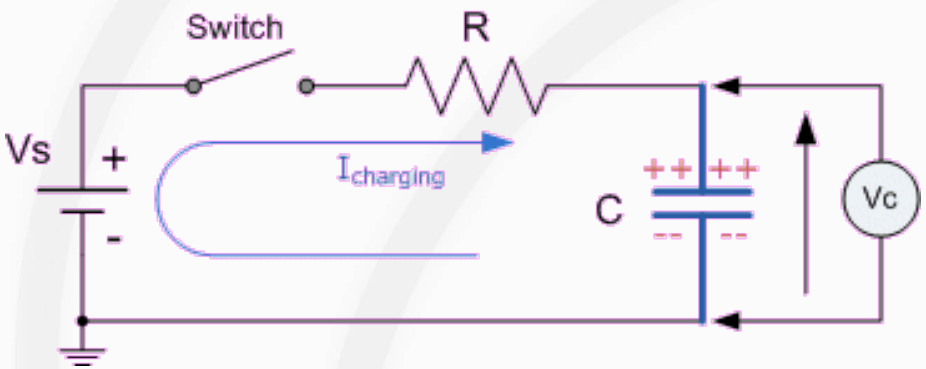
- 2 TDI monitors with is_connected_to_BIS=1
- 6 monitors in collimation regions with is_connected_to_BIS=0

**30 monitors with:**
**C=2.2nF, R=150KOhm**
(since 28.4.2010)
- Reason: allow for high intensity injection (LHC-BLM-ECR-0003)

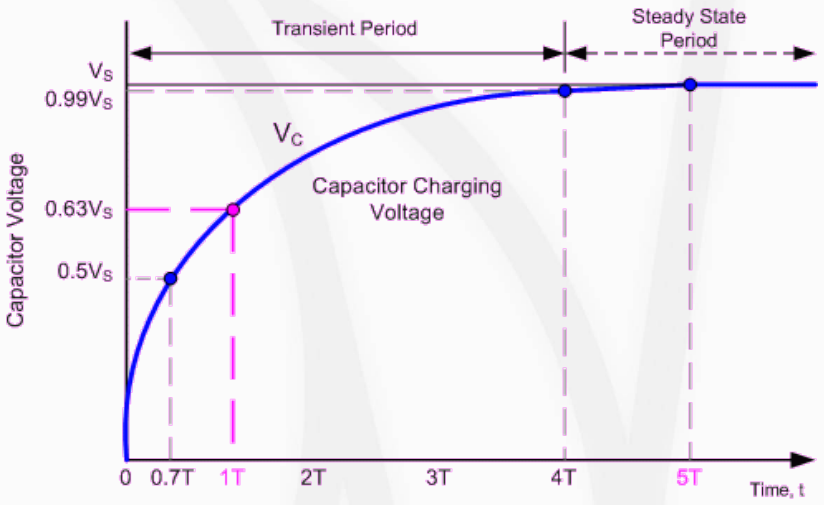
- BLMQI.08L2.B1E10/20/30_MQML
- BLMQI.07L2.B1E10/20/30_MQM
- BLMQI.06L2.B1E10/20/30_MQML
- BLMEI.06L2.B1E10/20/30_MSIB
- BLMEI.06L2.B1E10/20/30_MSIA
- BLMQI.08R8.B2E10/20/30_MQML
- BLMQI.07R8.B2E10/20/30_MQM
- BLMQI.06R8.B2E10/20/30_MQML
- BLMEI.06R8.B2E10/20/30_MSIB
- BLMEI.06R8.B2E10/20/30_MSIA

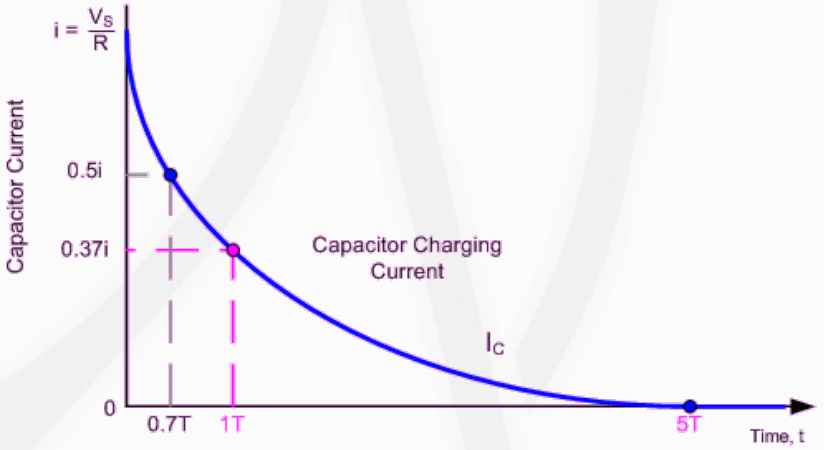
- Only external monitors in L2 and R8
- is_connected_to_BIS=1 for all monitors

# Overview RC-Delay




$$\tau = R.C$$



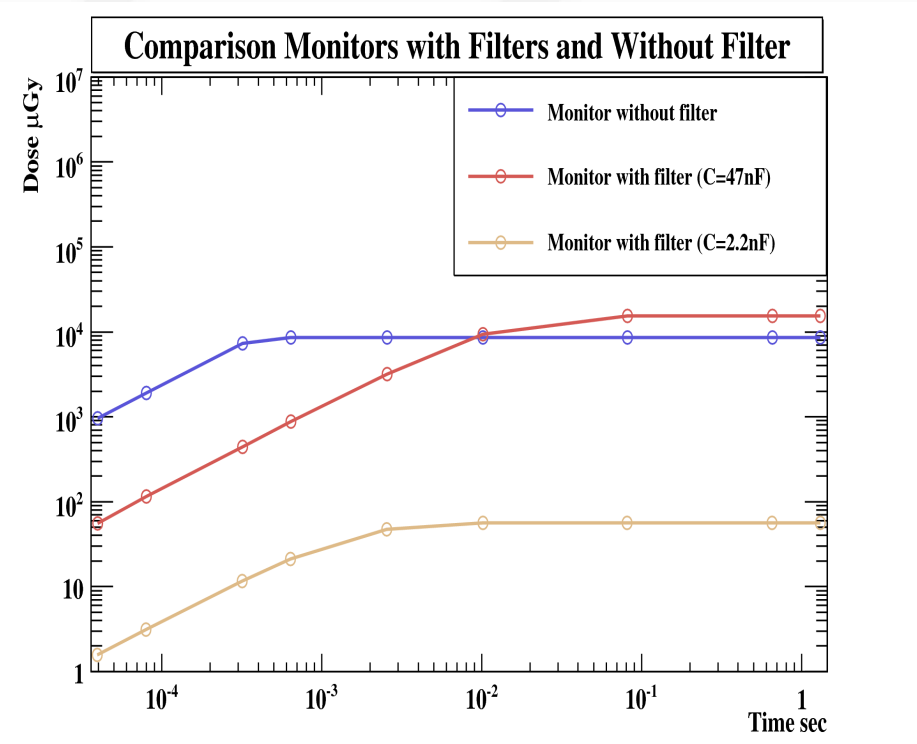

- RC time constant: time needed to charge the capacitor 63% of full charge; or to discharge to 37% of its initial voltage
- Theoretical values for installed filters:

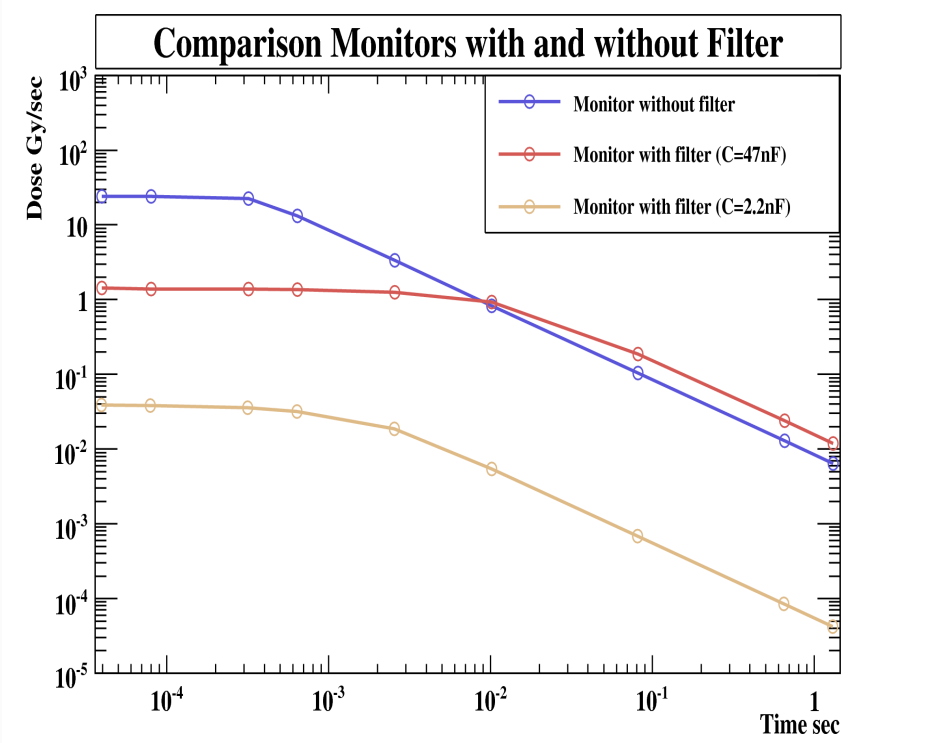
  t=7.0ms (C=47nF, R=150KOhm)

  t=0.3ms  (C=2.2nF, R=150KOhm)

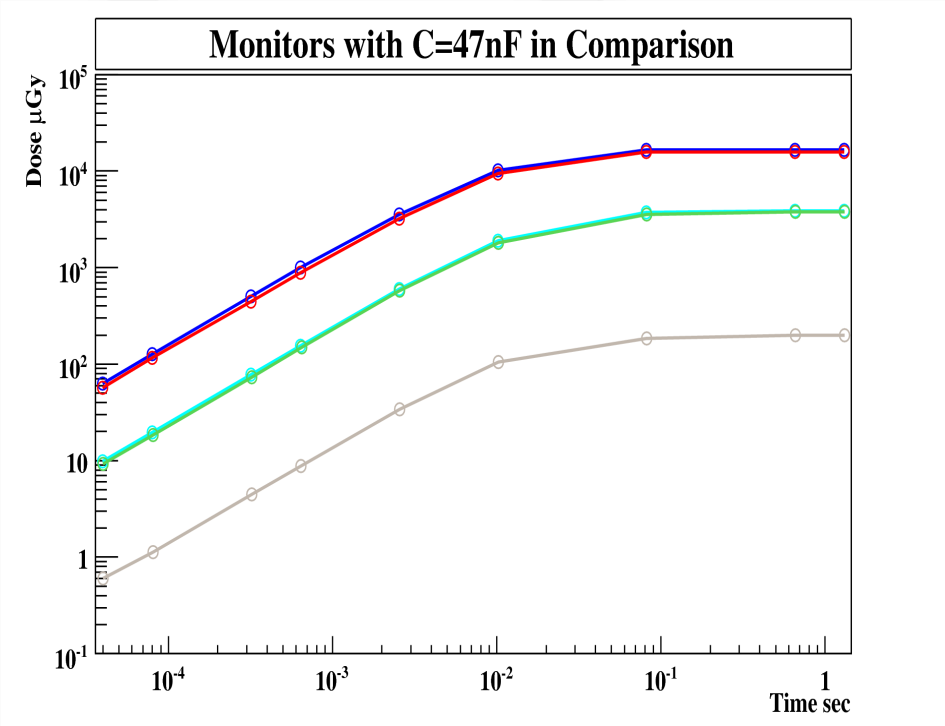
$$Vc = V(1 - e^{-t/RC})$$

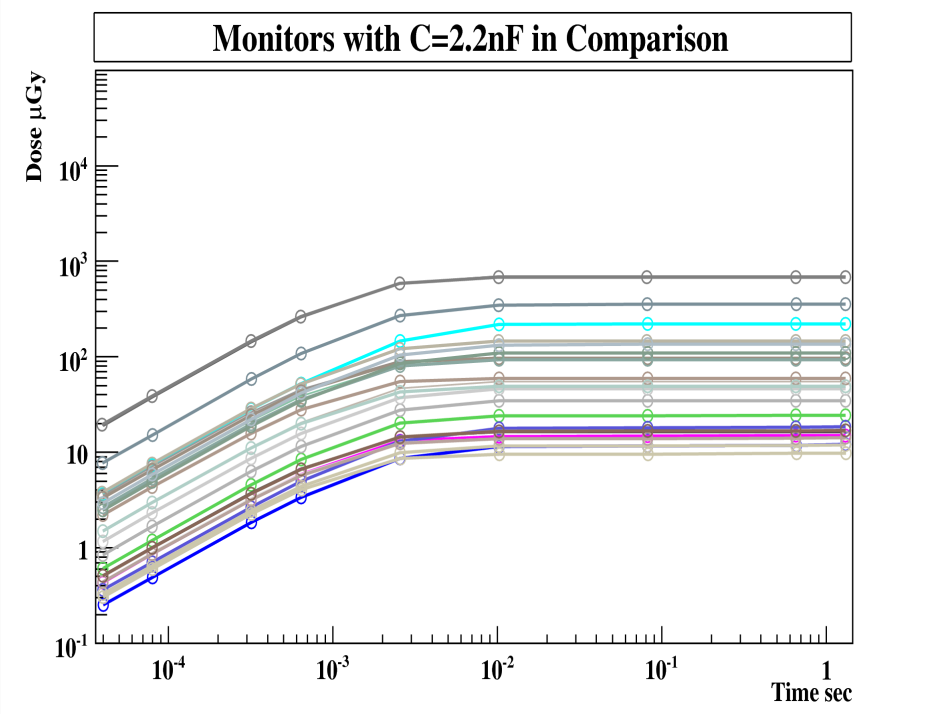
# Beam Loss Measurements with Filter Monitors



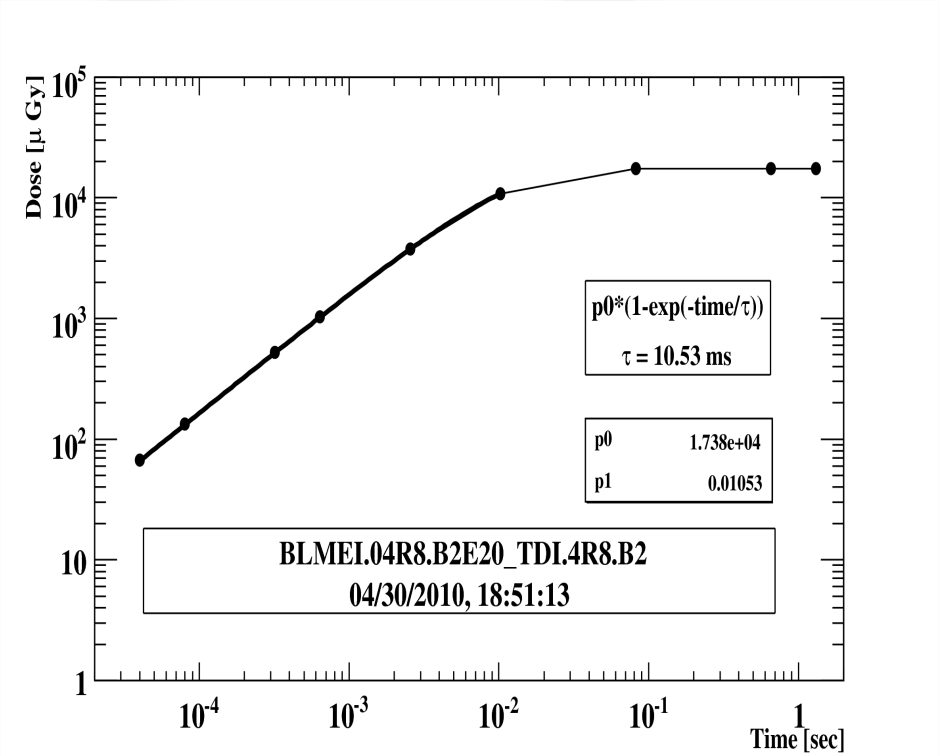
# Performance of Filter Monitors

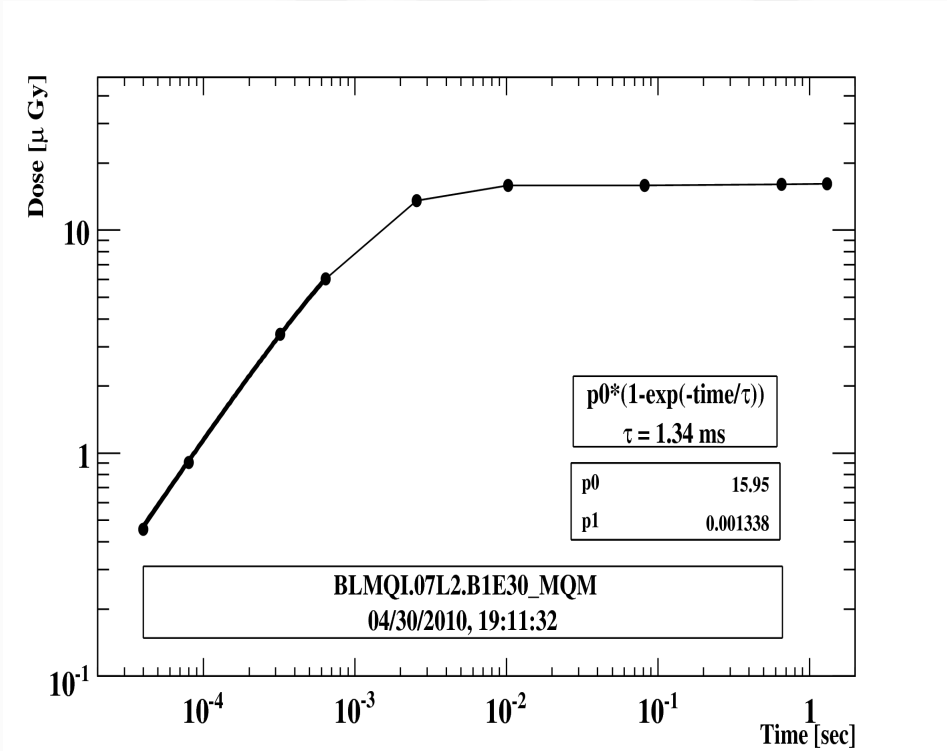


# Determination of the Time Constant

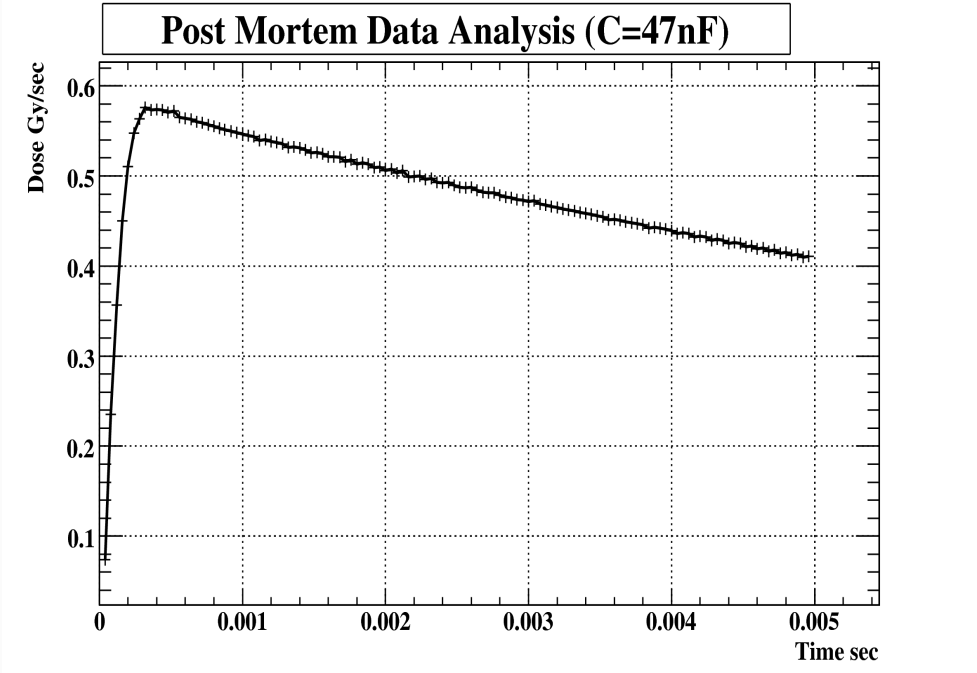
Use data from measurement DB

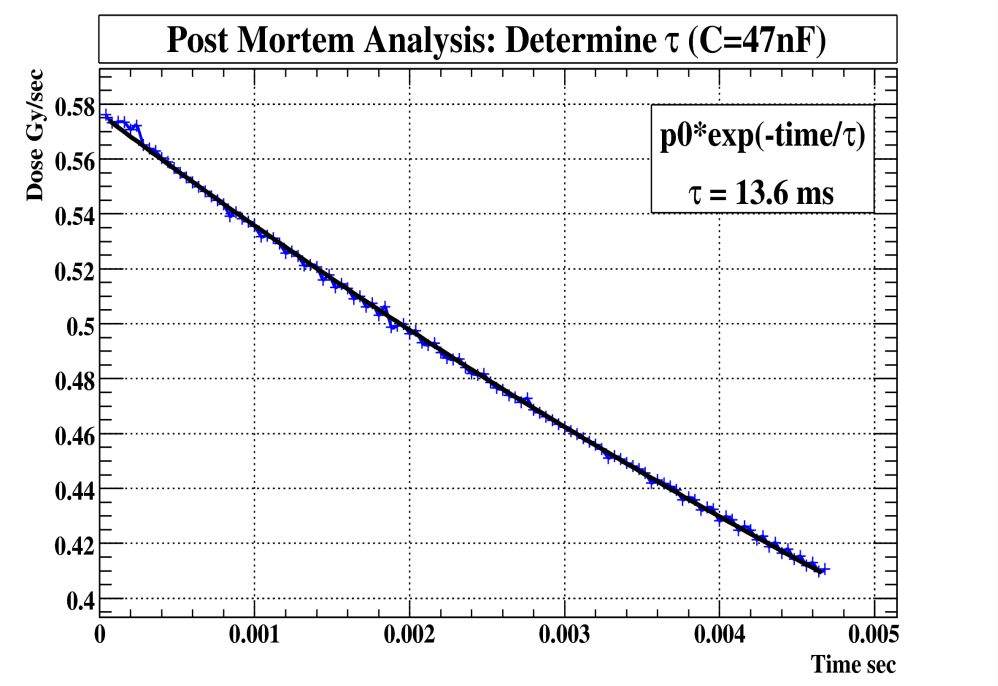


# Determination of the Time Constant

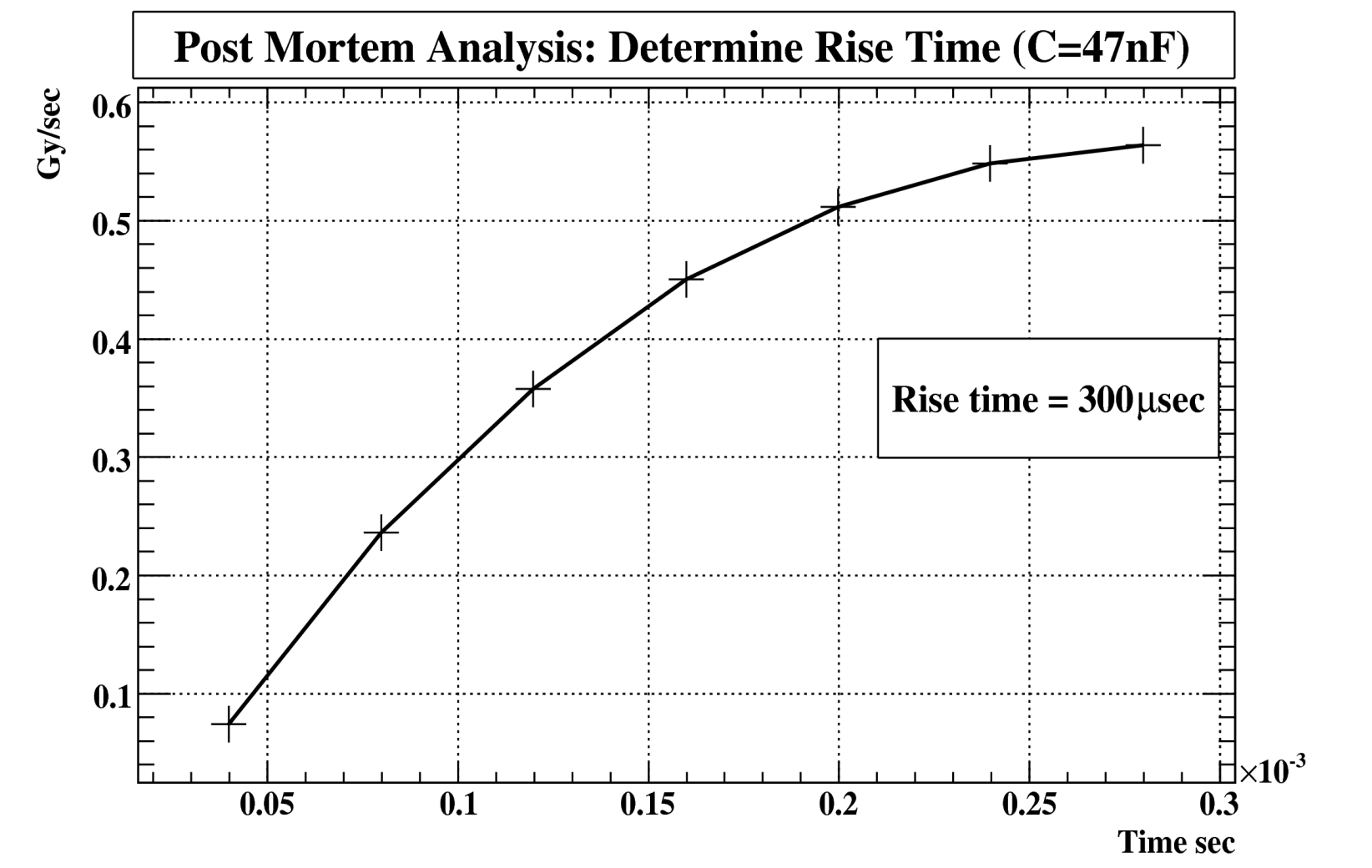
Use Post Mortem data



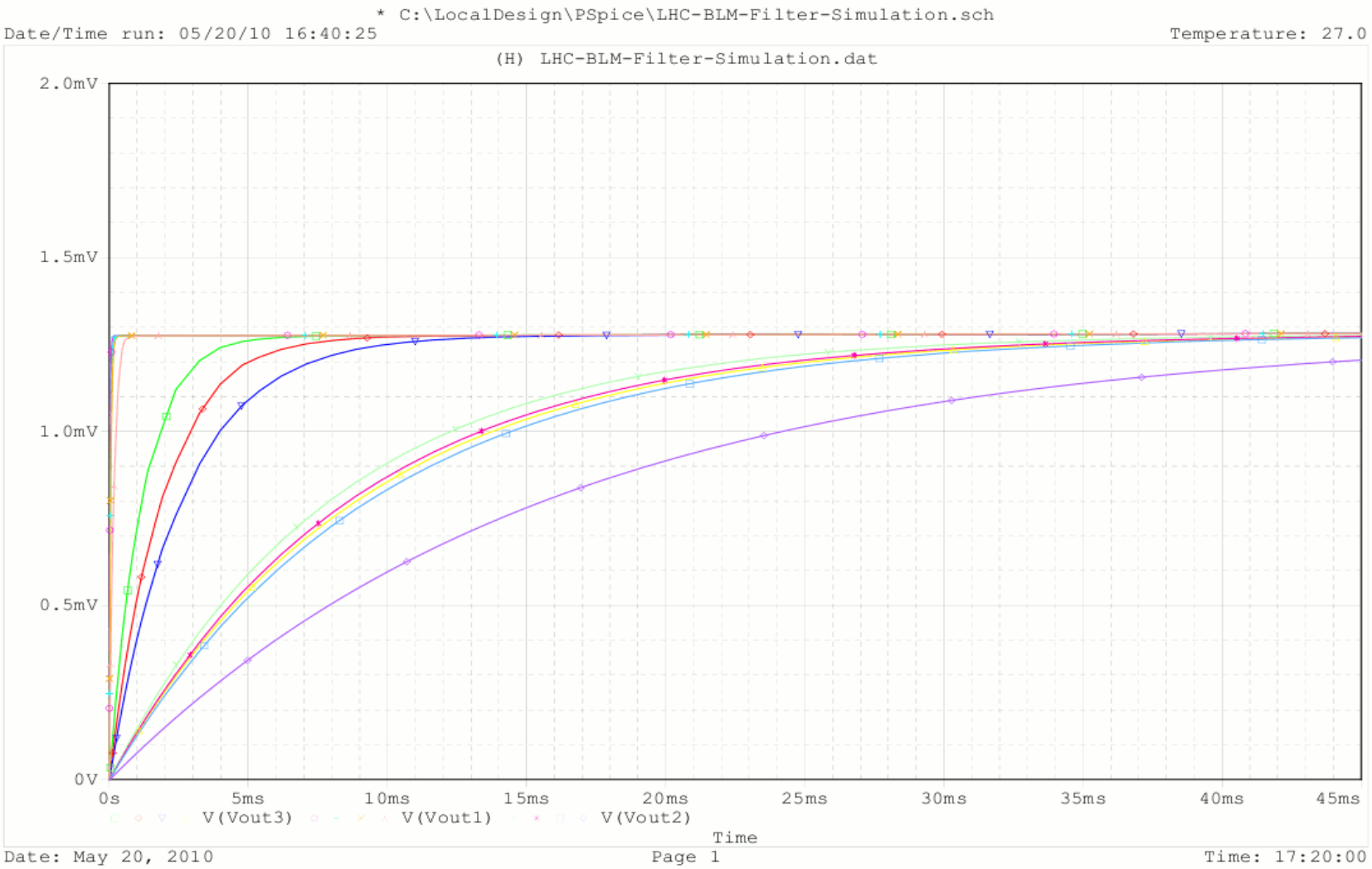




Example for BLMEI.06R3.B2E10_TCHSH.6R3.B2:
t=13.6ms (PM)
t=13.9ms (Meas DB)

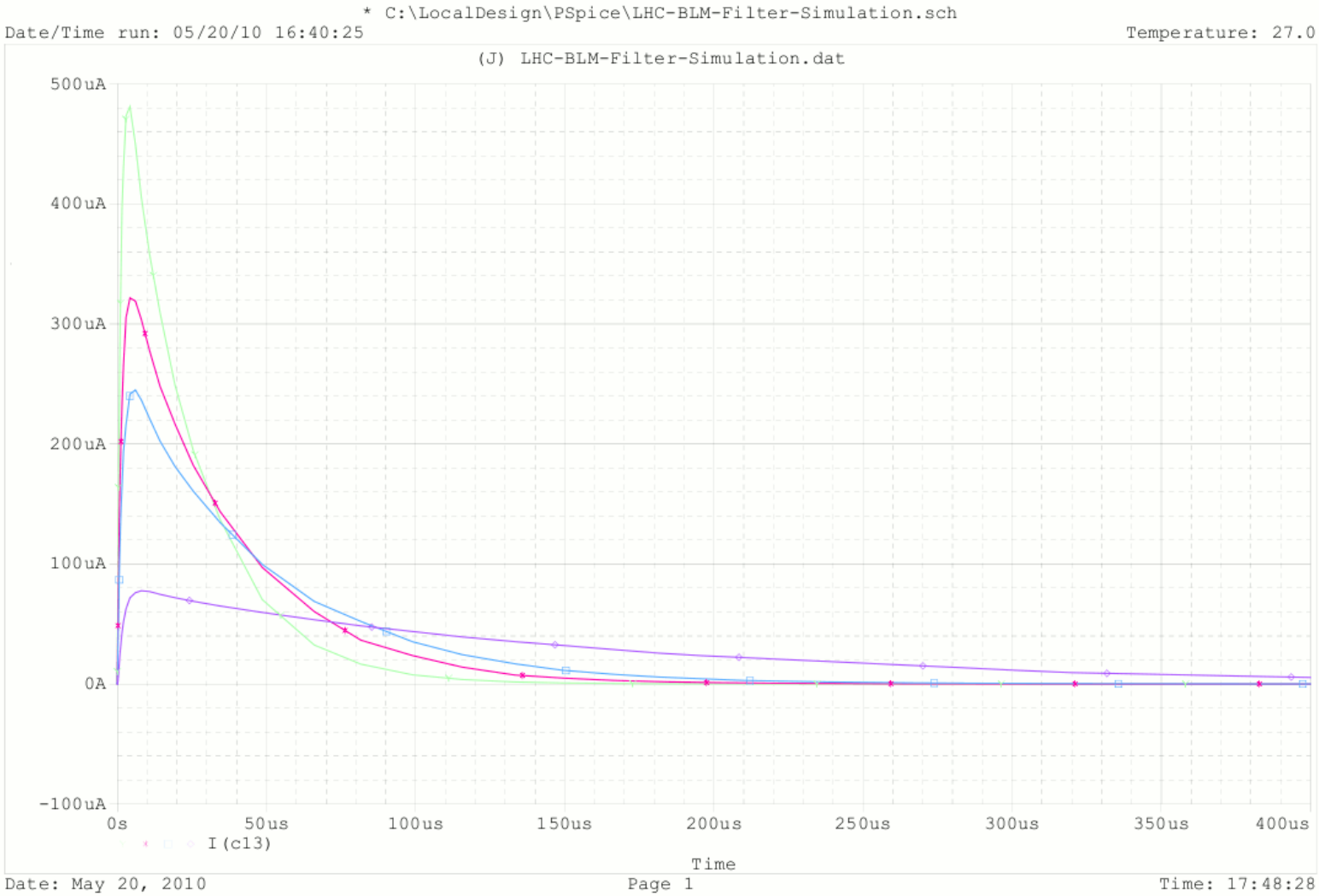
# Determination of the Rise Time



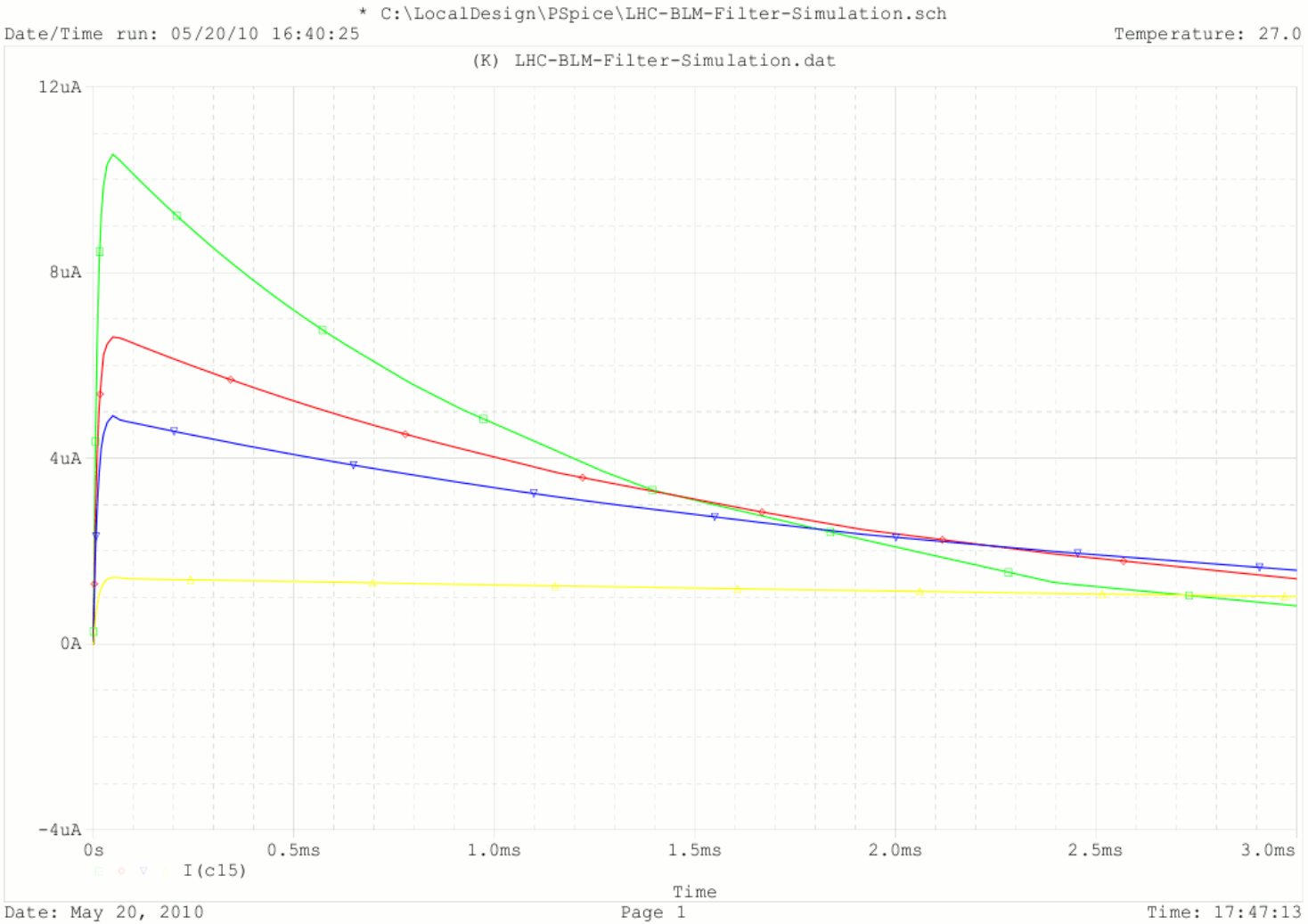
# Simulations Results



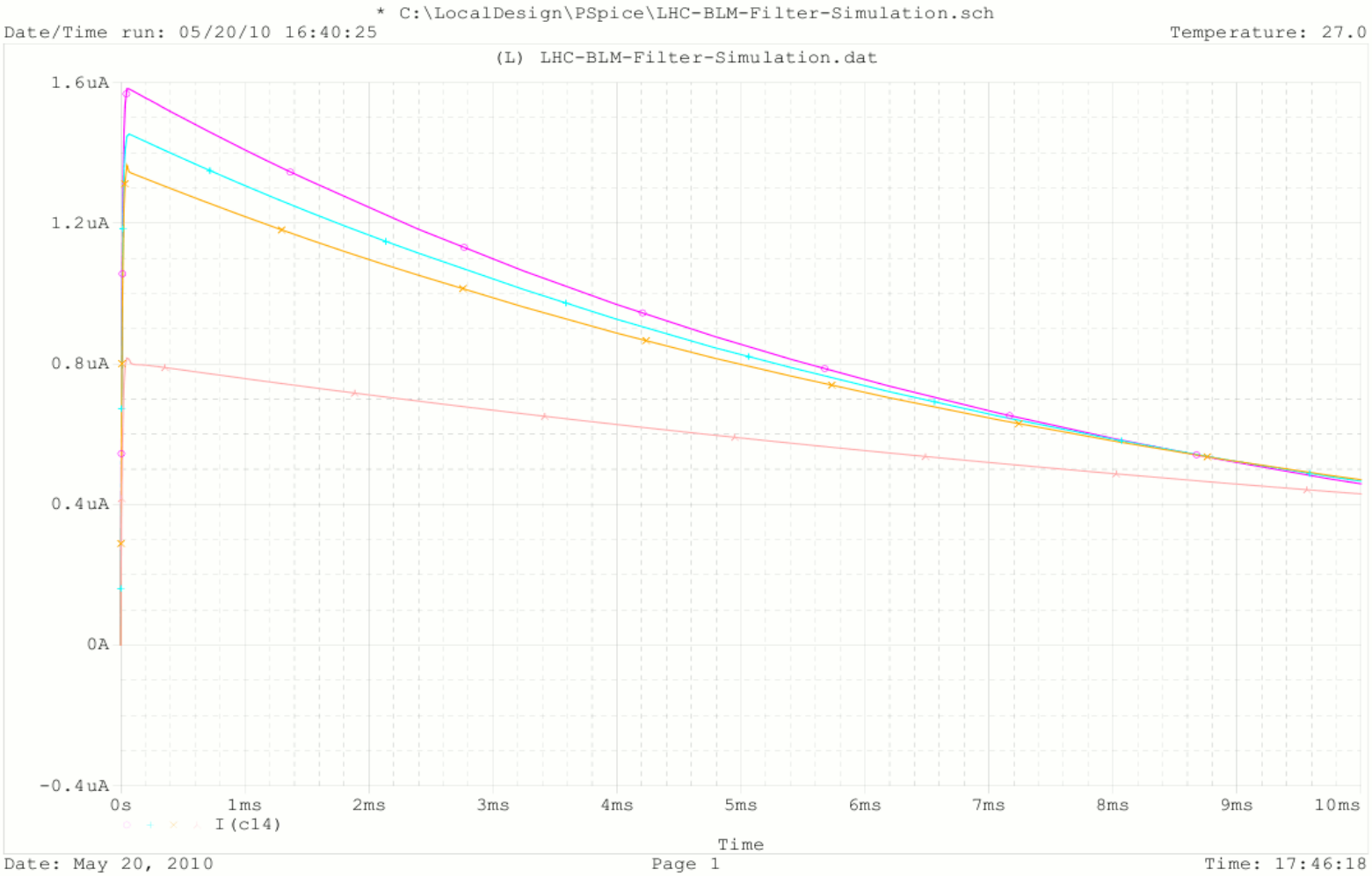
# Simulations Results: Current (no Filter)



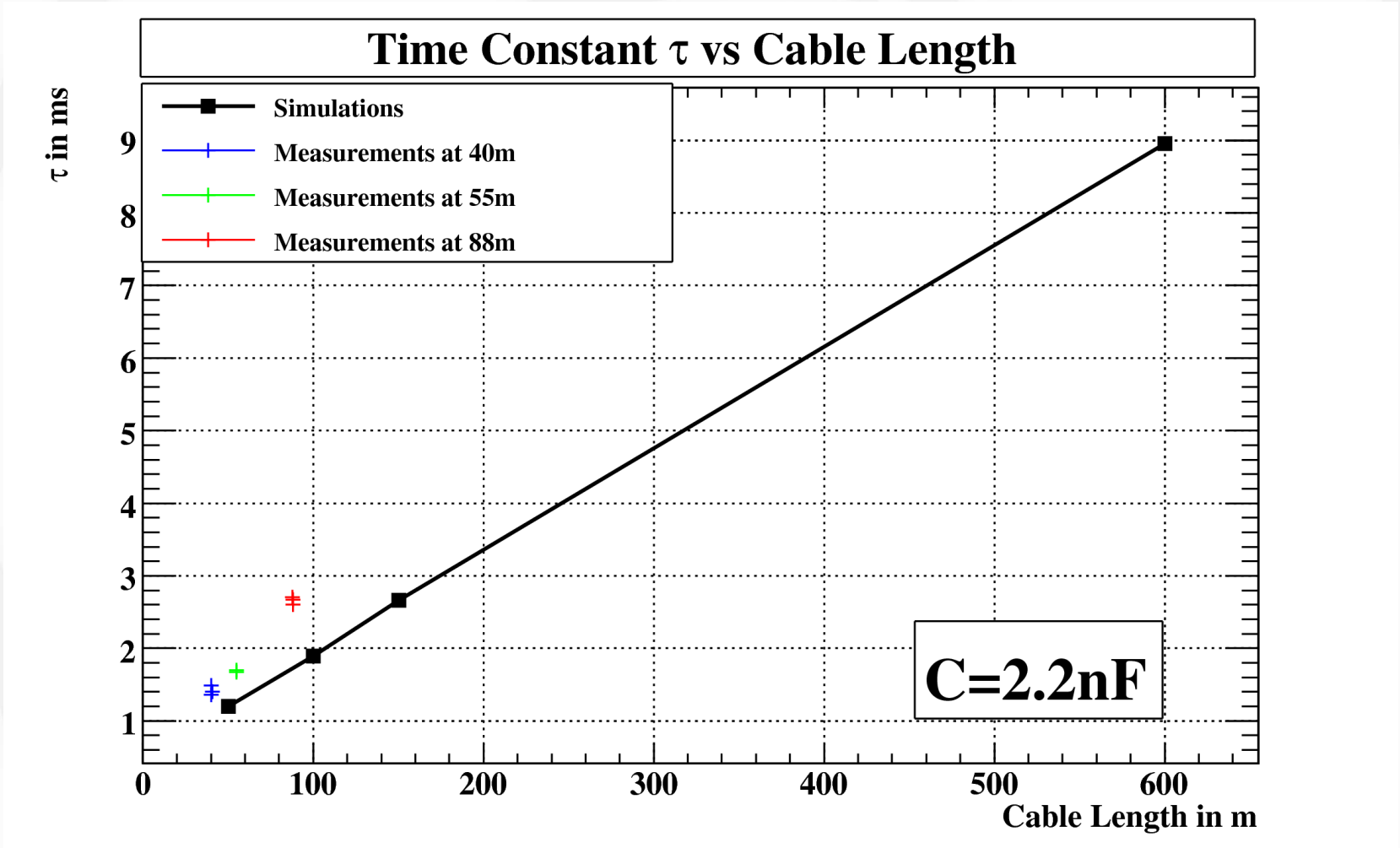
# Simulations Results: Filter (C=2.2nF)



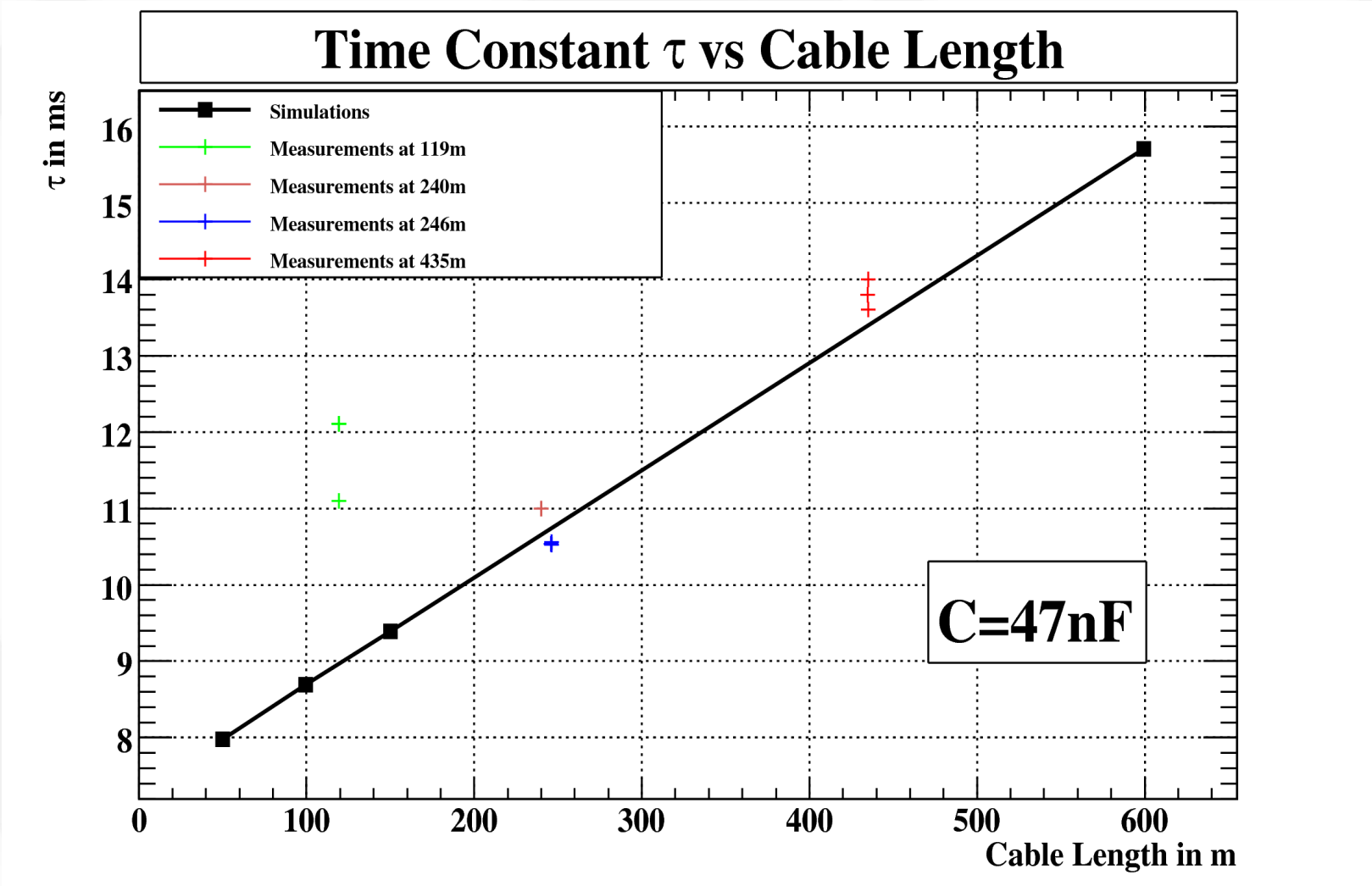
# Simulations Results: Current (C=47nF)



# Simulations Results vs Measurements



# Simulations Results vs Measurements

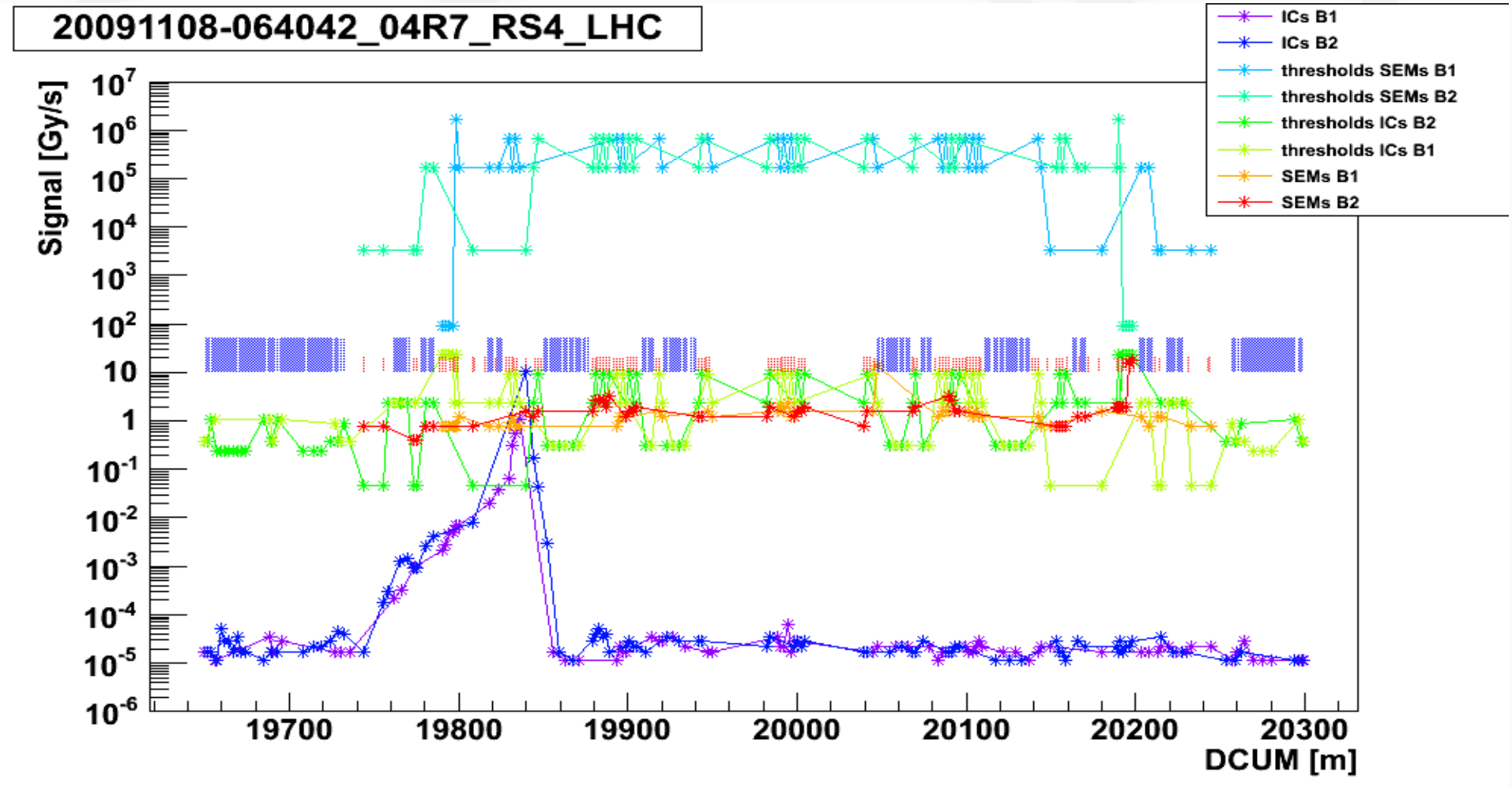


# Simulations Results vs Measurements

| length | Tau, C=2.2n F Sim | Tau, C=2.2n F Meas. | Rise Time, C=2.2n F Sim. | Ratio Filter/ no Filter S. | | Tau, C=47n F Sim. | Tau, C=47n F Meas. | Rise Time, C=47n F Sim. | Ratio Filter/ no Filter S. |
|---|---|---|---|---|---|---|---|---|---|
| 50 | 1.2e-3 | 1.4e-3 | 4.9e-5 | 45.7 | | 8.0e-3 | x | 4.9e-5 | 304 |
| 100 | 1.9e-3 | 1.8e-3 | 4.9e-5 | 48.7 | | 8.7e-3 | 1.2e-2 | 4.9e-5 | 221 |
| 150 | 2.7e-3 | x | 4.9e-5 | 49.9 | | 9.4e-3 | 1.1e-2 | 4.9e-5 | 182 |
| 600 | 9.0e-3 | x | 4.9e-5 | 54.3 | | 1.6e-2 | 1.4e-2 | 4.9e-5 | 95.2 |

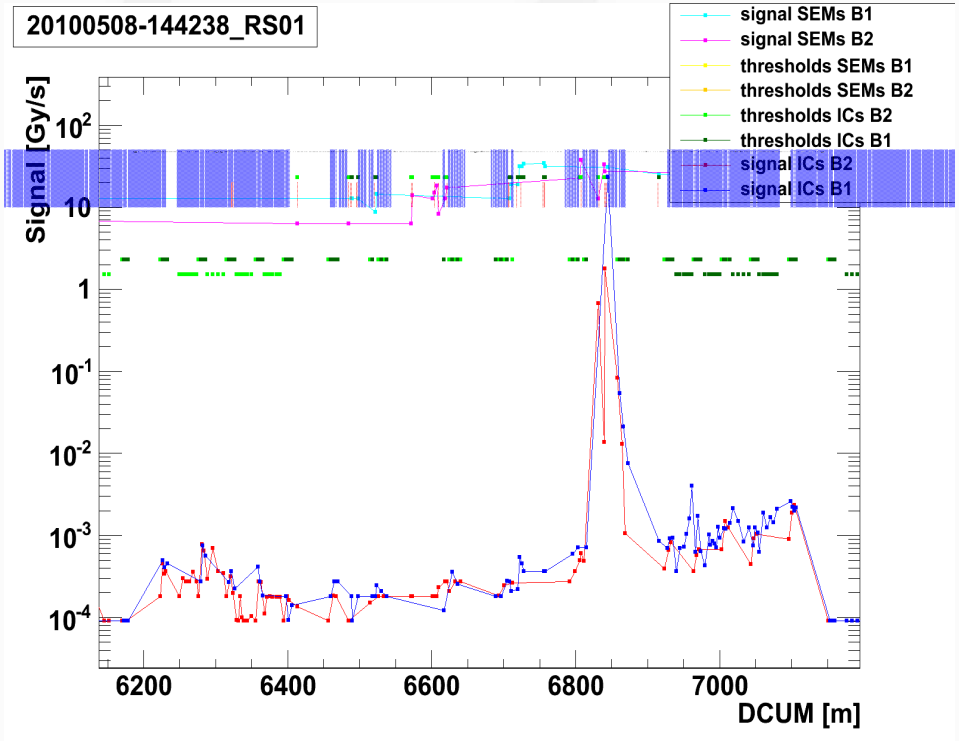
# Noise in IP7

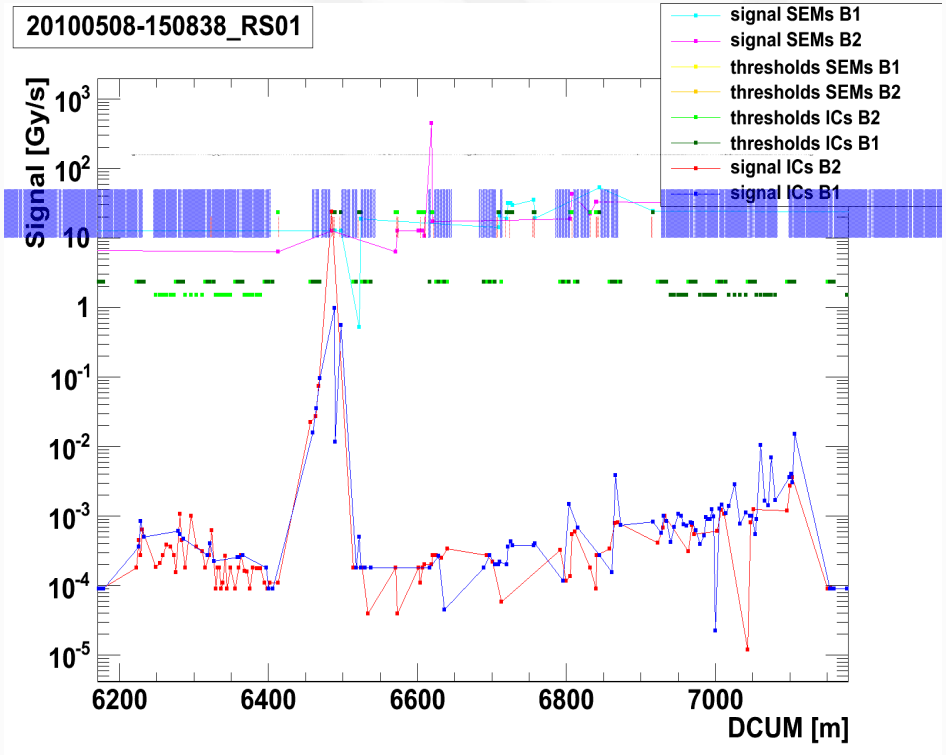
## Shooting on TCLA



# Noise in IP3

Shooting on TCLA (beam 1 and beam 2)



# Actions being Taken

- Checked network structure
- HV on the front ends is stable
- No dependence on HV box found
- It can be not excluded that the effects come from signal cables
- Expected non-conformity in HV distribution
- Expected difference in cable types
- Investigations and analysis ongoing

The measured losses are equal in IP3 and in IP7 and they are equal for Left and Right side in IP3

→ Functionality of the system is given and protection can be assured

# Thresholds

- Two errors in threshold settings:

- Family: THRI_TDI_RC (2 filter monitors)
- Wrong during 30.4.-6.5.2010
- Family: THRI.06_7_TCLA_A and THRI.06_7_TCLA_B
- Wrong during 30.4.-20.5.2010

- Consequences:
- 1 person to introduce thresholds
- 1 person to check settings
- Software changes, more safety and automatic checks (protocols, reports)