Update on Laser Pulse Width Issues

Test Beam Meeting, ECAL Week

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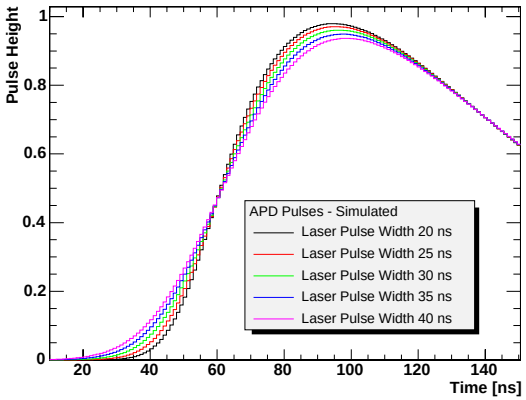
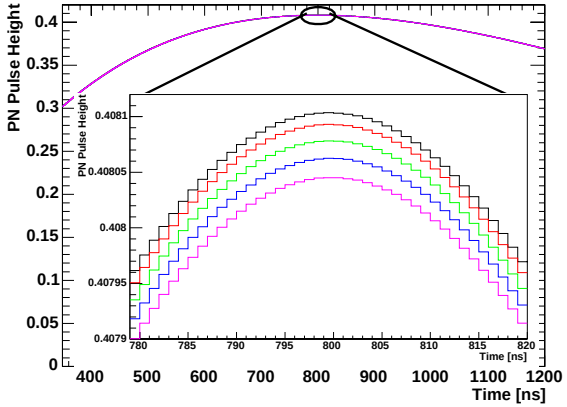
Pulse Shape Convolution

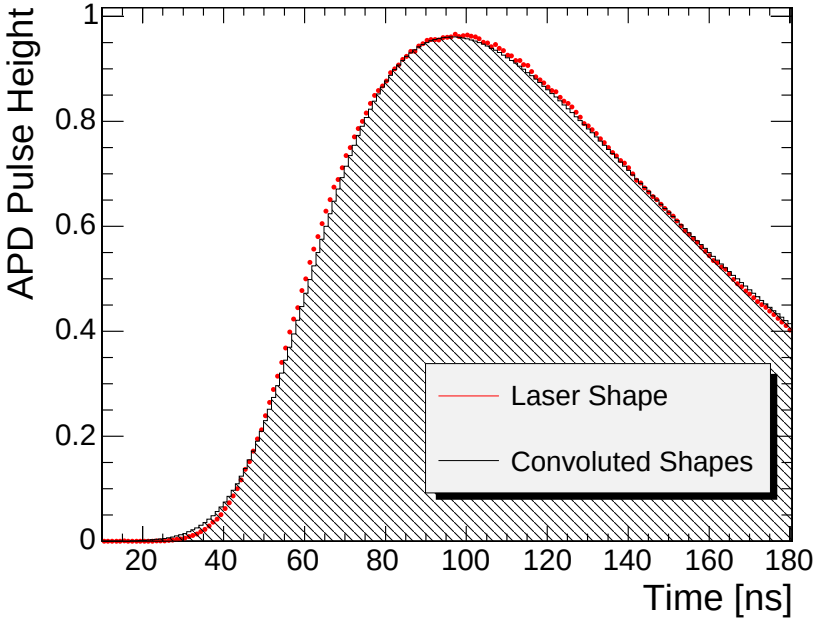




Reminder :

Pulse shape is a convolution of the electronic shape and the 'line shape' of the light. In case of a laser pulse, essentially a gaussian with FWHM of 20 – 40 ns.

Details : See talk on 20 Sep. 2005.



Remaining issue :

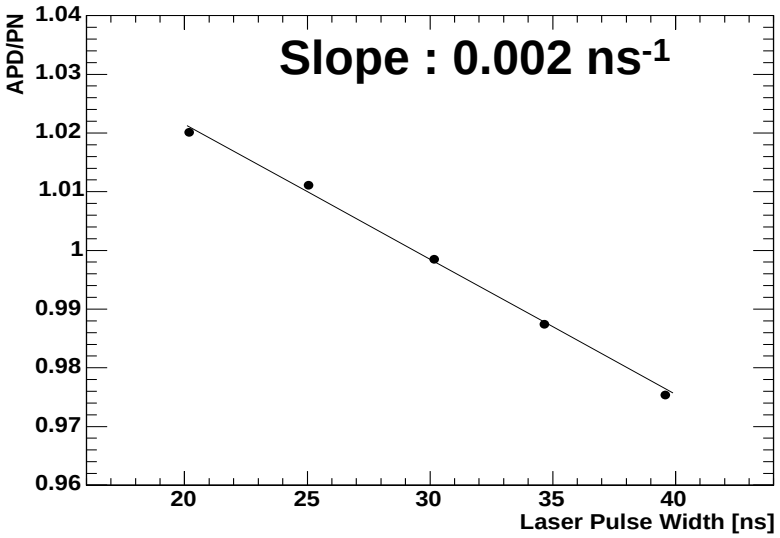
The pulse width dependency extract from simulated shapes depends strongly on the a priori unknown electronic shape. This makes it difficult to predict the actual pulse width dependency.

Solution :

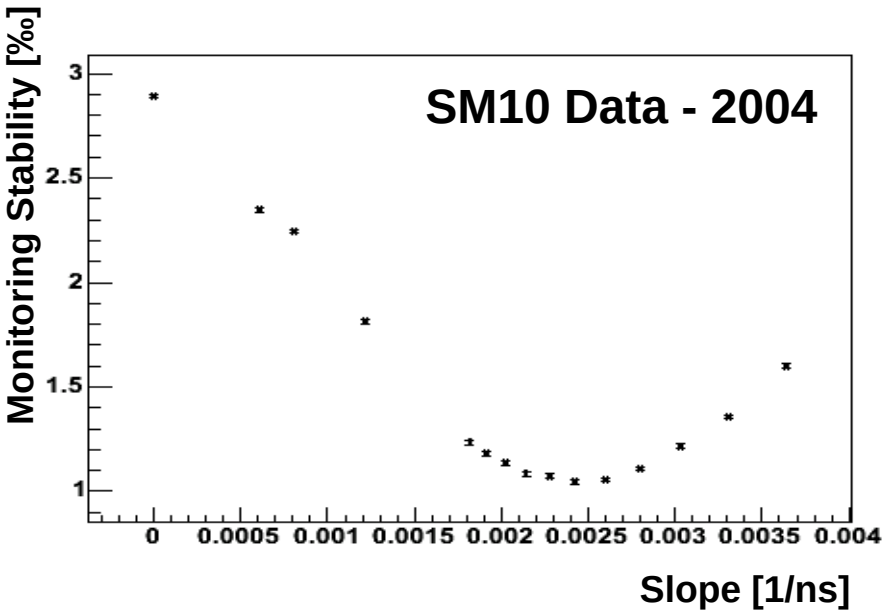
Tune the convoluted shape such that it matches the shape in data.

Pulse Width Dependency – Simulated / Data

Pulse width dependency from 'optimized shape' (Simulated)



Pulse width dependency vs. stability (SM10 Data)

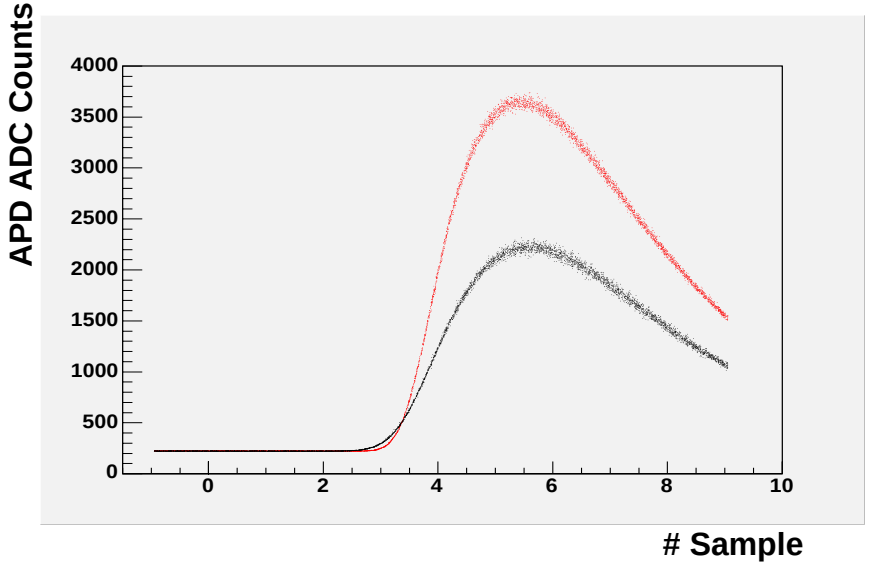


Details : See talk on 20 Sep. 2005.

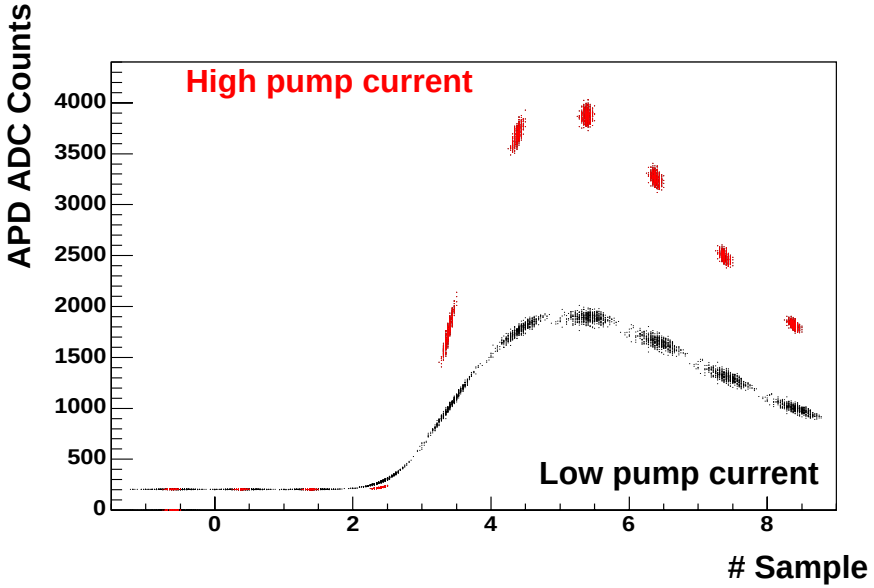
With optimized shape, 'simulated' pulse width dependency very close to the one found to optimize monitoring stability in SM10 data.

Pulse Width Scan on SM5 - 2005

SM10 Pulse Width Scan - 2004



SM5 Pulse Width Scan - 2005



Differences in triggering the laser :

2004 : random phase with respect to 25 ns clock cycle - samples evenly distributed over pulse

⇒ essentially no pulse reconstruction issues if averaged pulse height is reconstructed for all samples

2005 : fixed phase with respect to 25 ns clock cycle – samples clustered with 25 ns spacing

⇒ same pulse reconstruction issues as for electron events

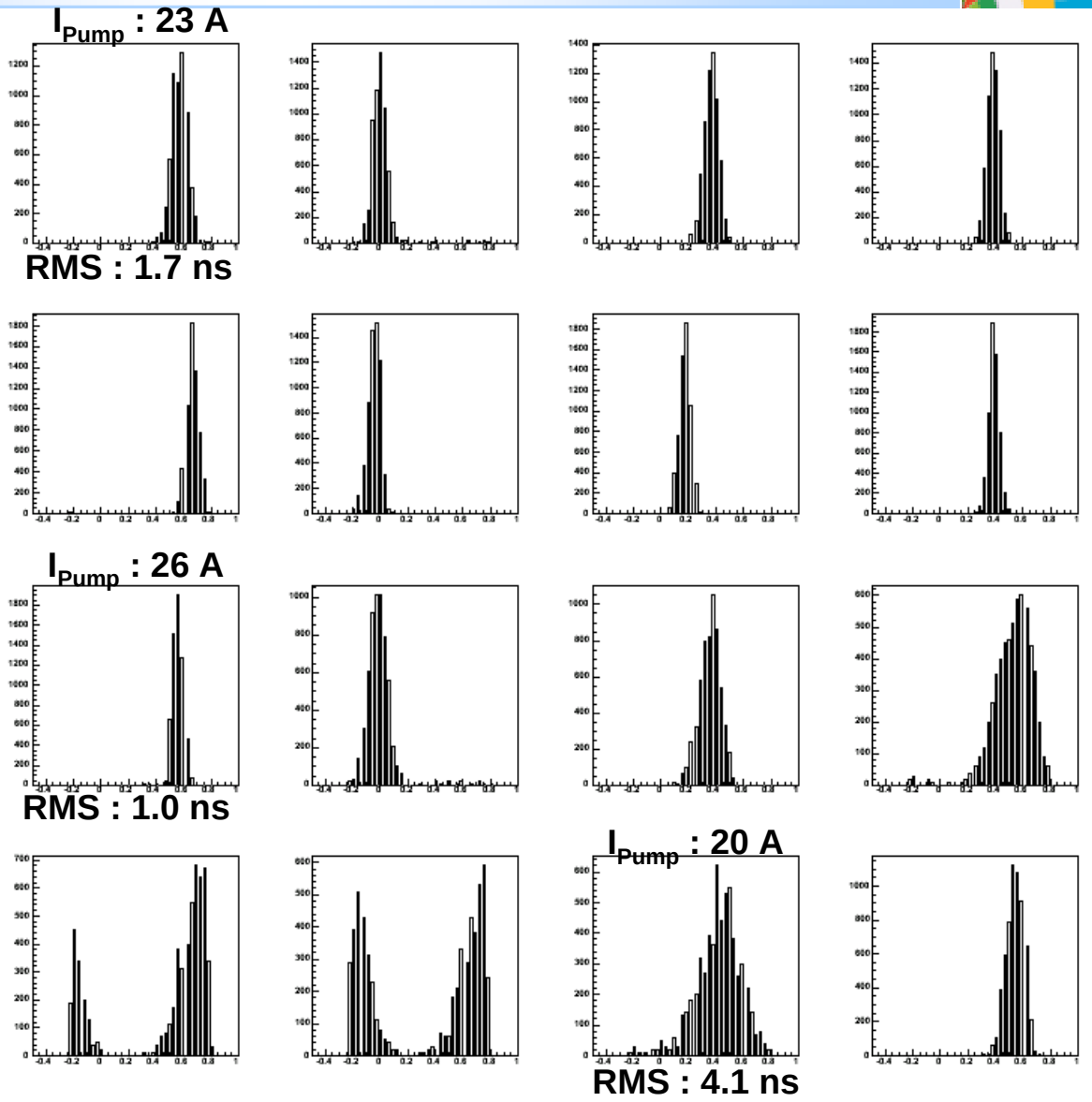
The 2005 mode of operation is more closely to what is envisioned for CMS.

⇒ Maybe adding additional laser jitter to mimic the random phase is a way to avoid pulse reconstruction issues in laser events.

Laser Jitter vs Pump Current

Reminder :

Pump current is anti-correlated with the pulse width and the pulse timing jitter, correlated with the pulse energy.

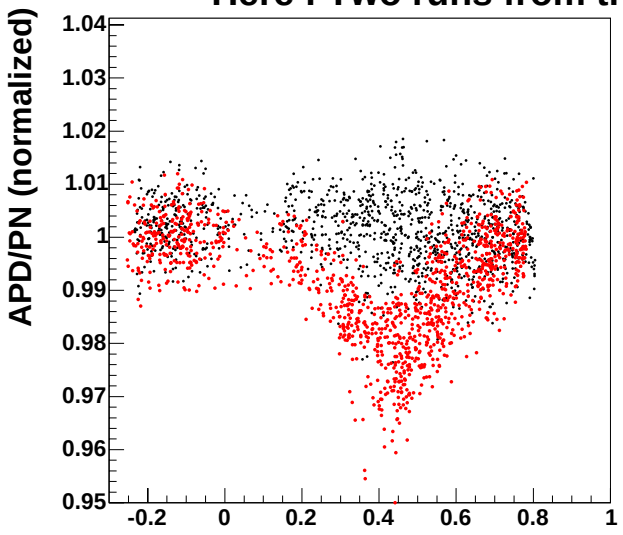


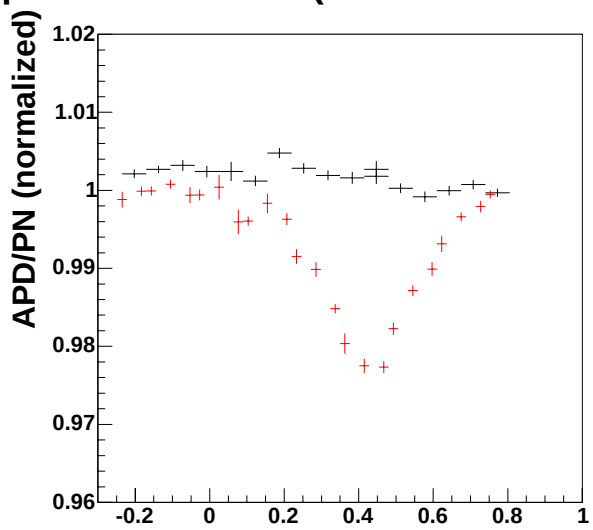
Pulse Width Scan on SM5 - 2005

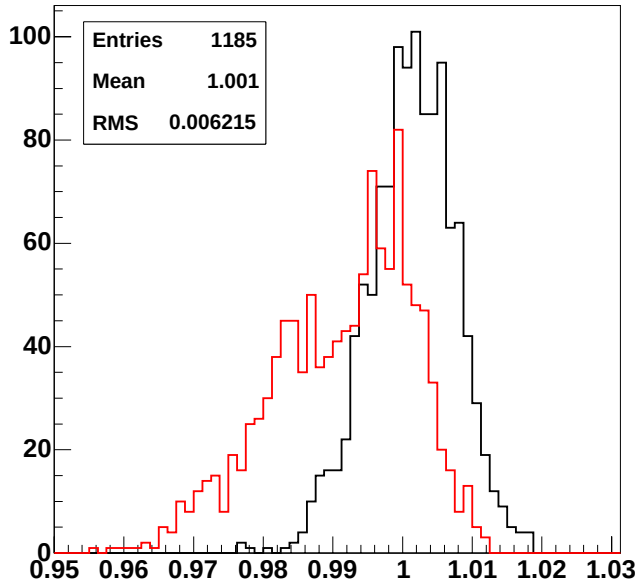
For SM5 data, have to use pulse reconstruction as for electrons (here : H4PulseFitWithFunction) .

The pulse reconstruction is known to be very sensitive to the pulse timing.

Here : Two runs from the pulse width scan (20 A and 20.5 A – largest spread in pulse timing)





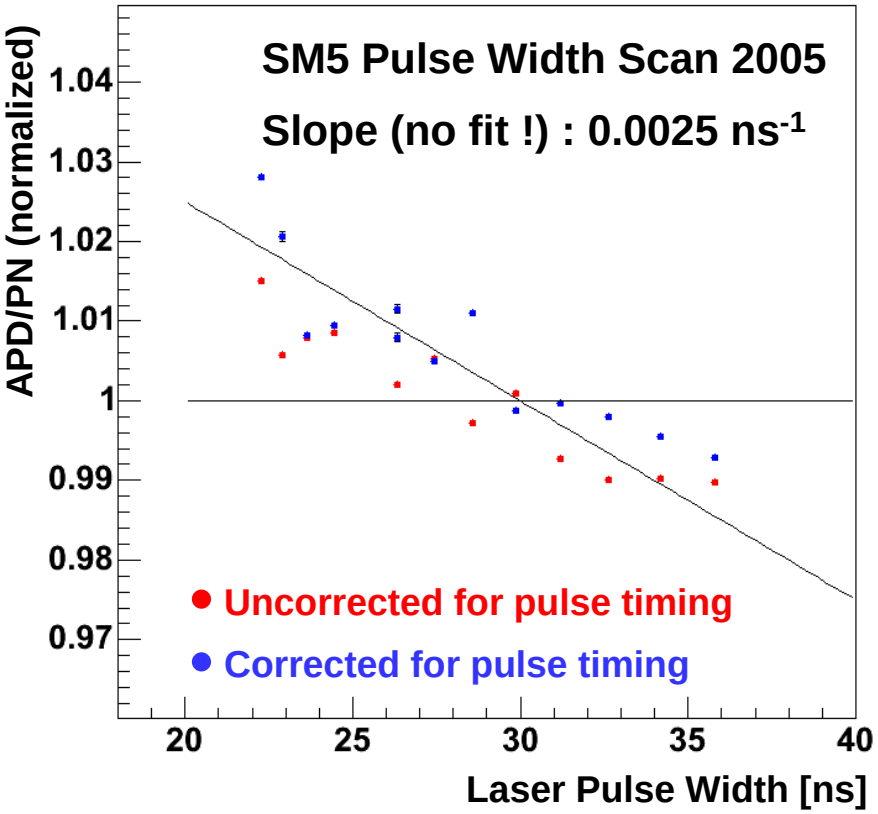


$\Rightarrow$ **Correcting pulse timing effect on the pulse reconstruction.**

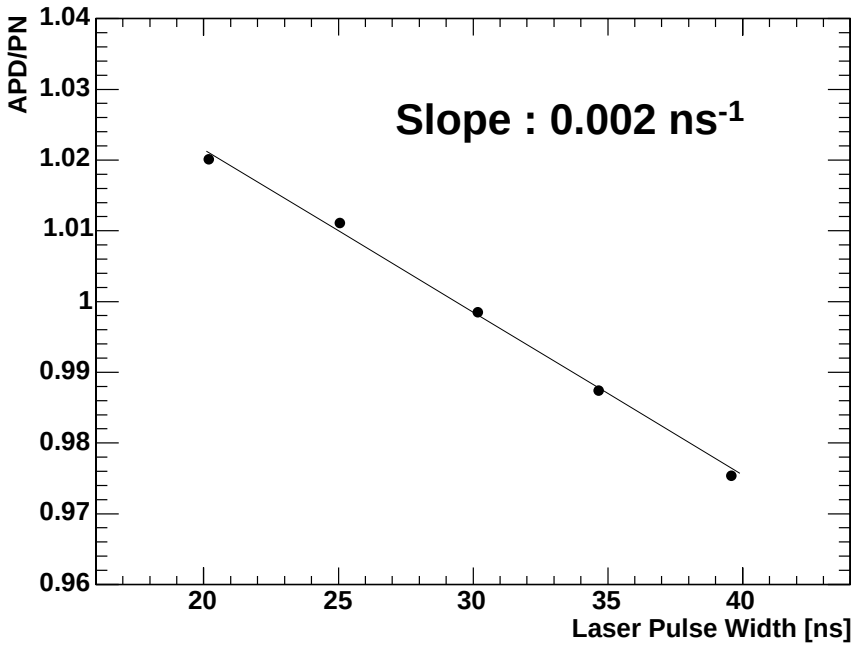
$\Rightarrow$ **Problem : Most runs of the pulse width scan are in a very specific timing range (see previous page) , thus systematic effects are large.**

Pulse Width Scan Results

APD/PN vs Pulse Width – Single Channel



APD/PN vs Pulse Width – 'Simulation'



⇒ **SM5 Pulse width scan seems to indicate similar pulse width dependency as in SM10 data and in simulation.**

⇒ **Need to better control systematics.**

Summary

- **APD/PN dependency on laser pulse width can be described purely based on the shape convolution.**
- **With proper tuning of the shapes, the 'simulated' dependency and dependency optimizing the monitoring stability in SM10 data agree.**
- **Pulse width scan on SM5 indicates agreement with the 'simulated' as well as the dependency optimizing the monitoring stability in SM10 data.**