Fastsim EMC Model Update

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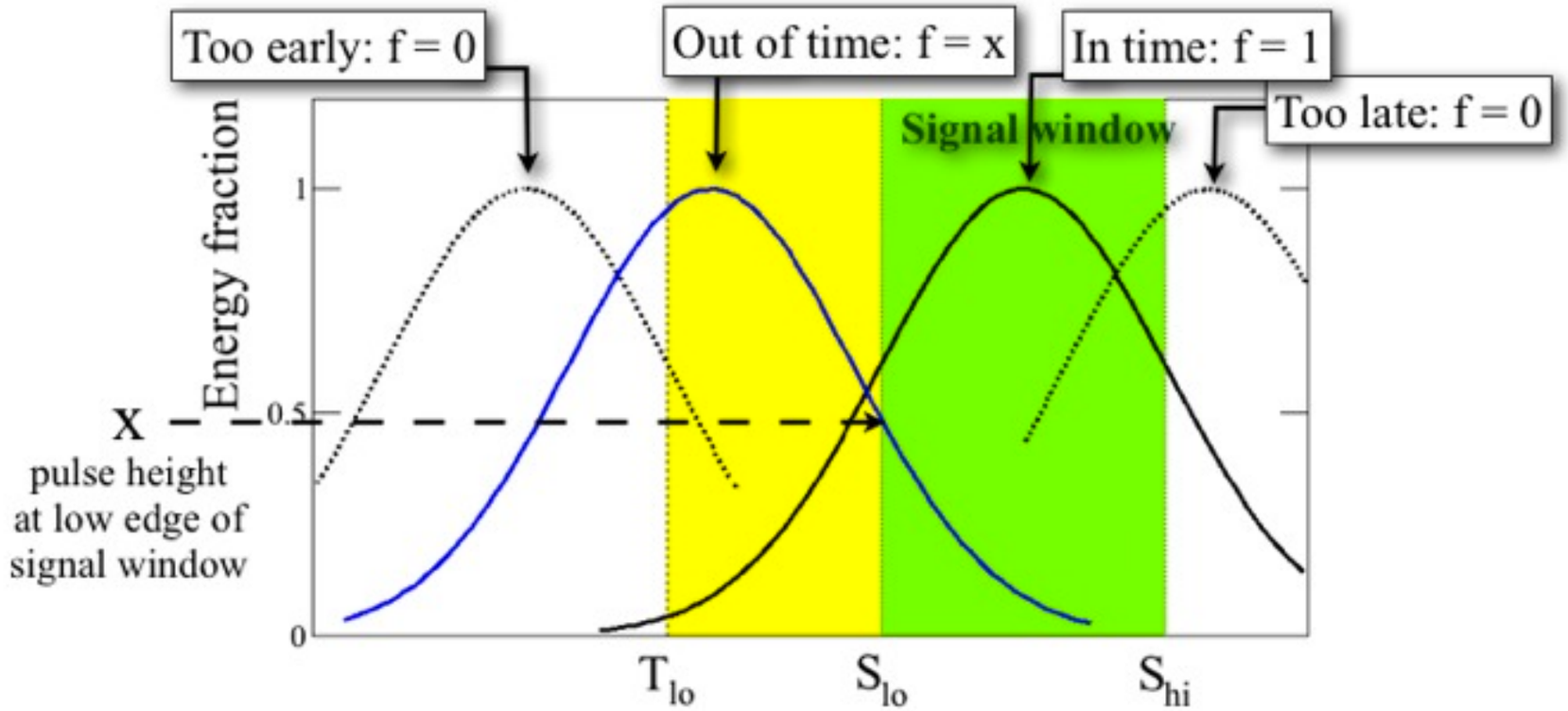
SuperB Fastsim Meeting

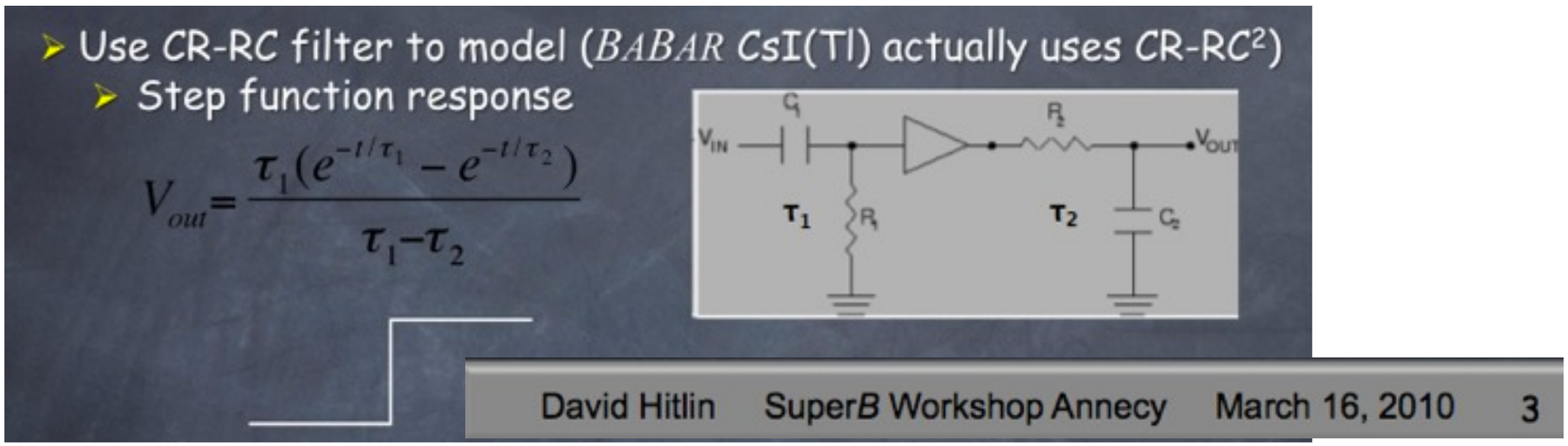
Old model



unit = ns	Fwd	Barrel	Bwd	
σ	100	500	10	
S_hi	100	500	10	$+1\sigma$
S_lo	-100	-500	-10	-1σ
T_lo	-250	-1250	-25	-2.5σ

New model, use more realistic waveform

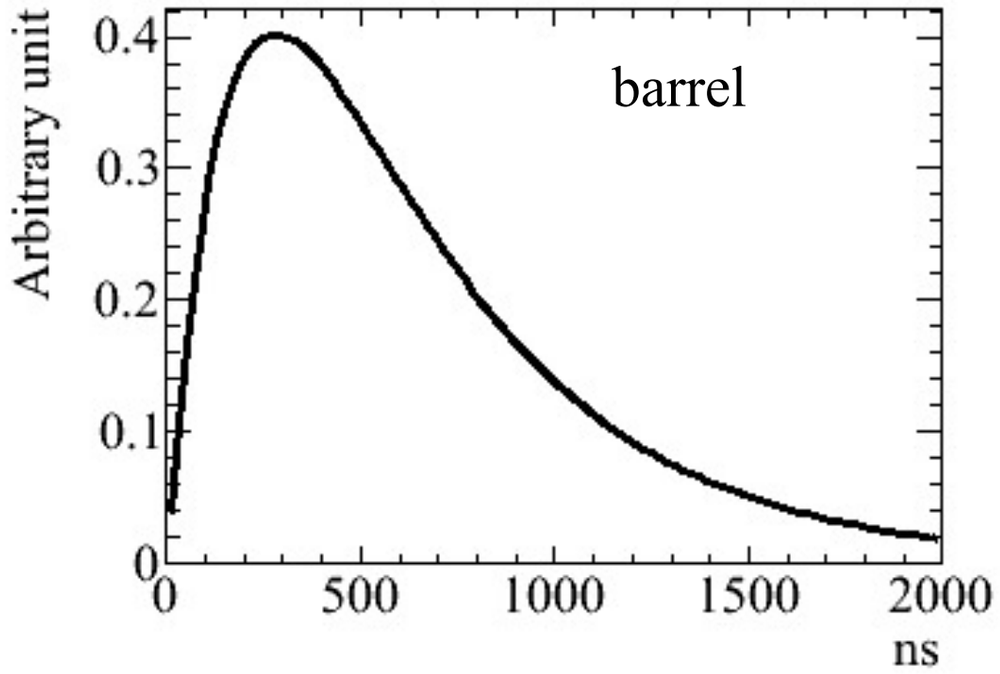
- Use scintillating light decay time(s), and filter time constants.

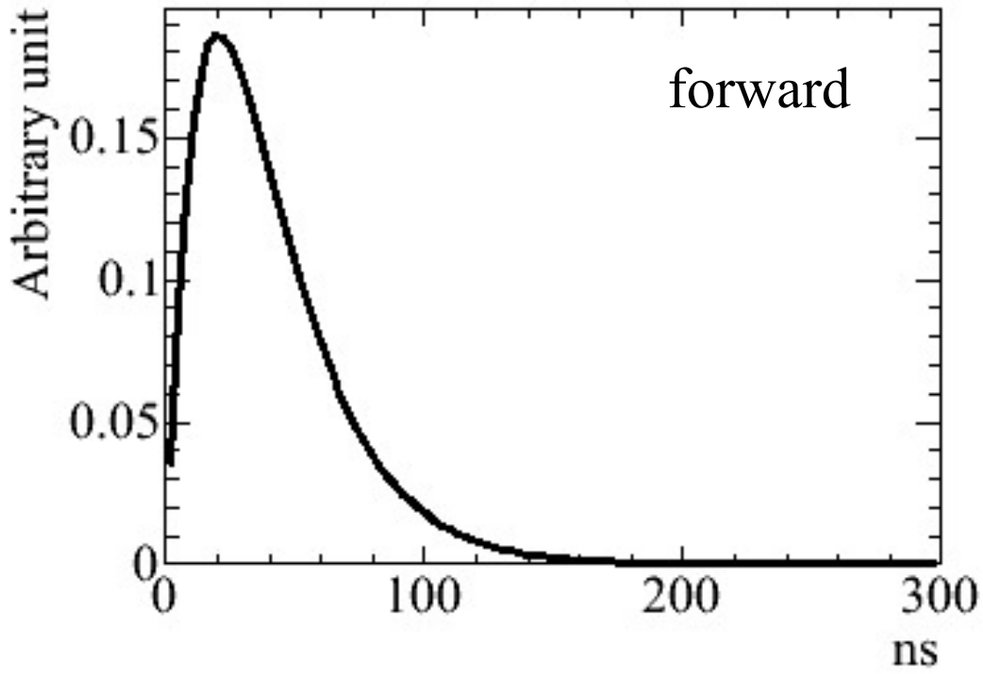


- If $\tau_1=\tau_2$, V_{out} reduces to $V_{\rm out} = (t/\tau)e^{-t/\tau}$
- In out case the light has an exponential decay time (or two)
- CsI: 64% @ 680 ns + 36% @ 3340 ns
- LYSO: 41 ns.

$$V_{\rm out} = e^{-t/\tau}\,\frac{\tau_1(e^{-t/\tau_1} - e^{-t/\tau_2})}{\tau_1 - \tau_2}$$

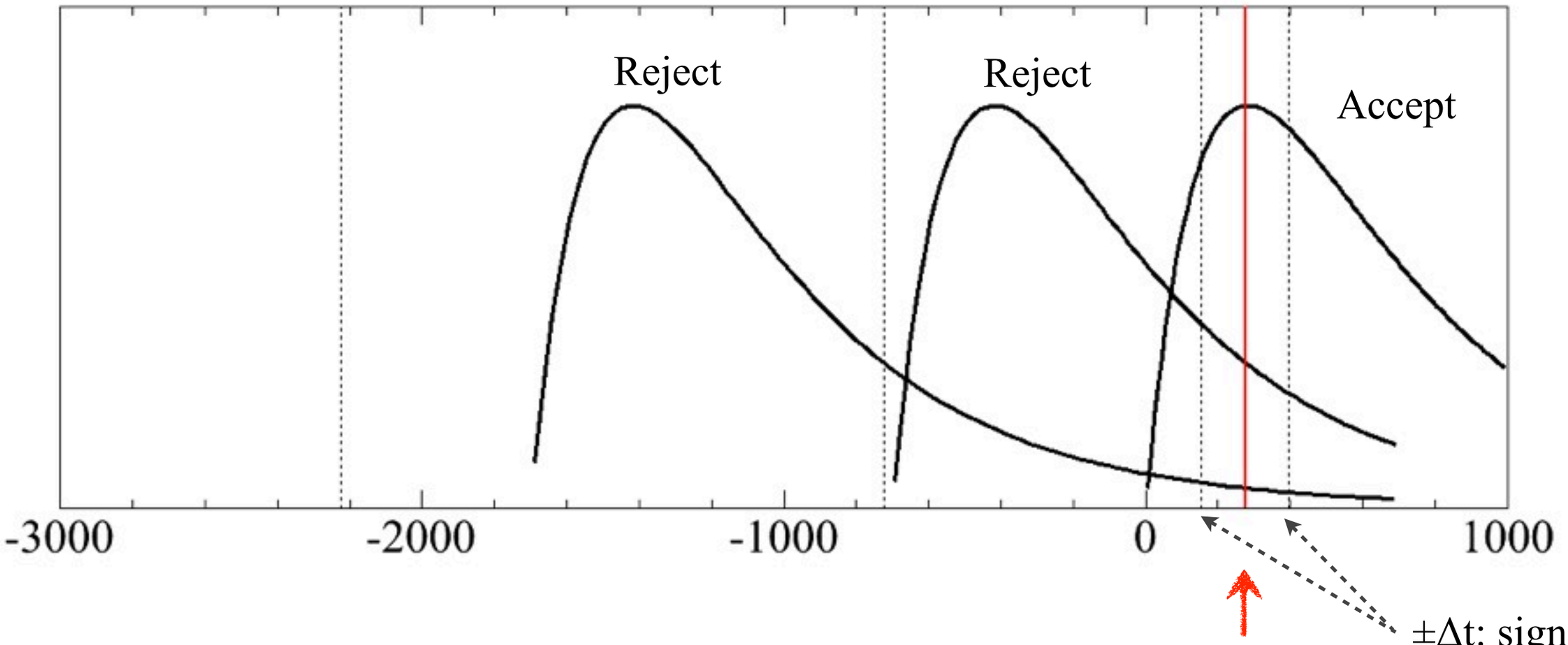
Shapes





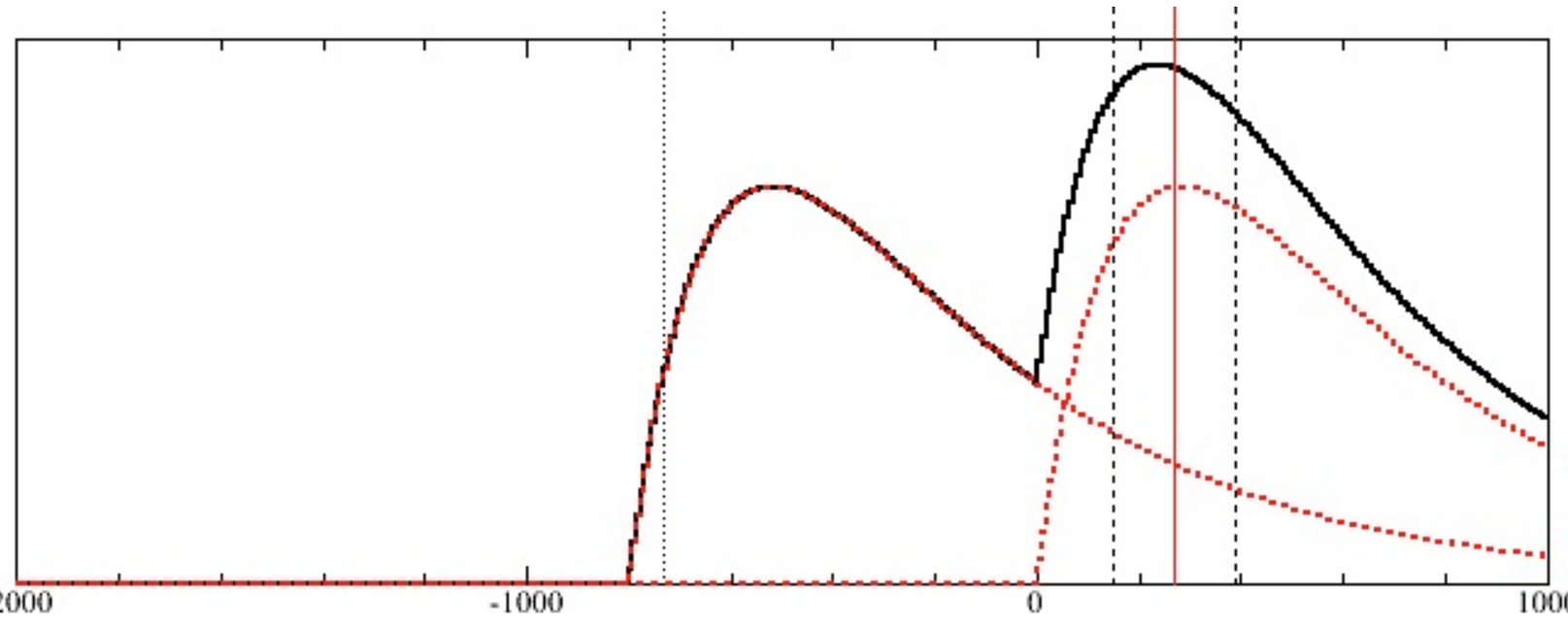
- Barrel: CsI, Babar shaping: τ_1=680 ns, τ_2= 250 ns.
- Forward: LYSO: shaping: τ_1= τ_2 = 40 ns.
- Backward: lifetime 10 ns (?): shaping: τ_1= τ_2 = 10 ns (?).
- No attempt to model loss of light yet. Shape will be normalized. And peak is proportional to the energy.

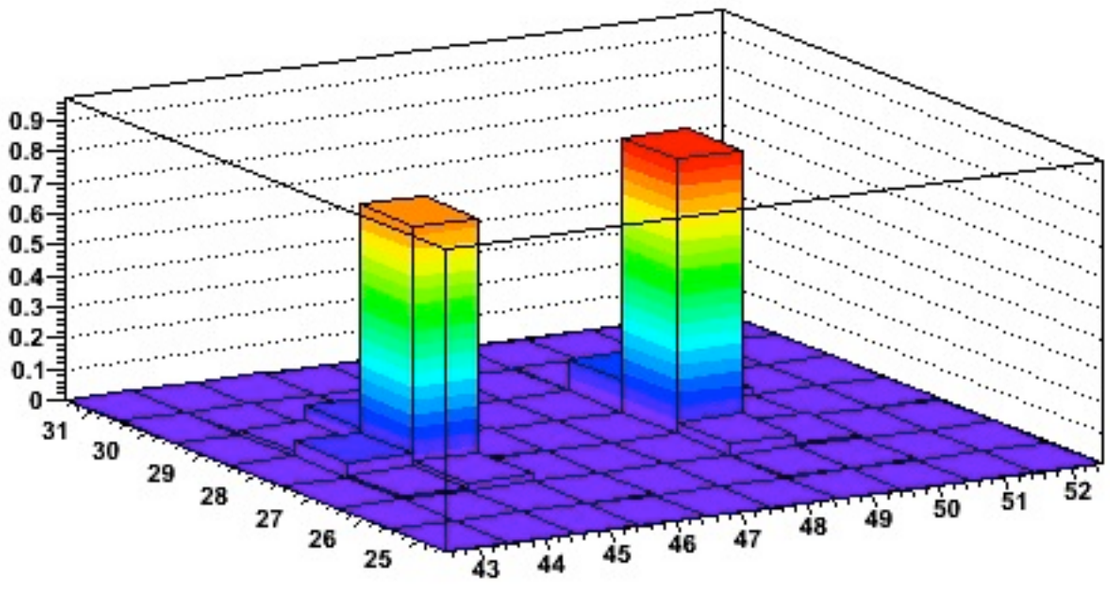
Selection criteria



- If a crystal only has one simtrack contributing to it, either accept the full energy, or reject the crystal entirely.

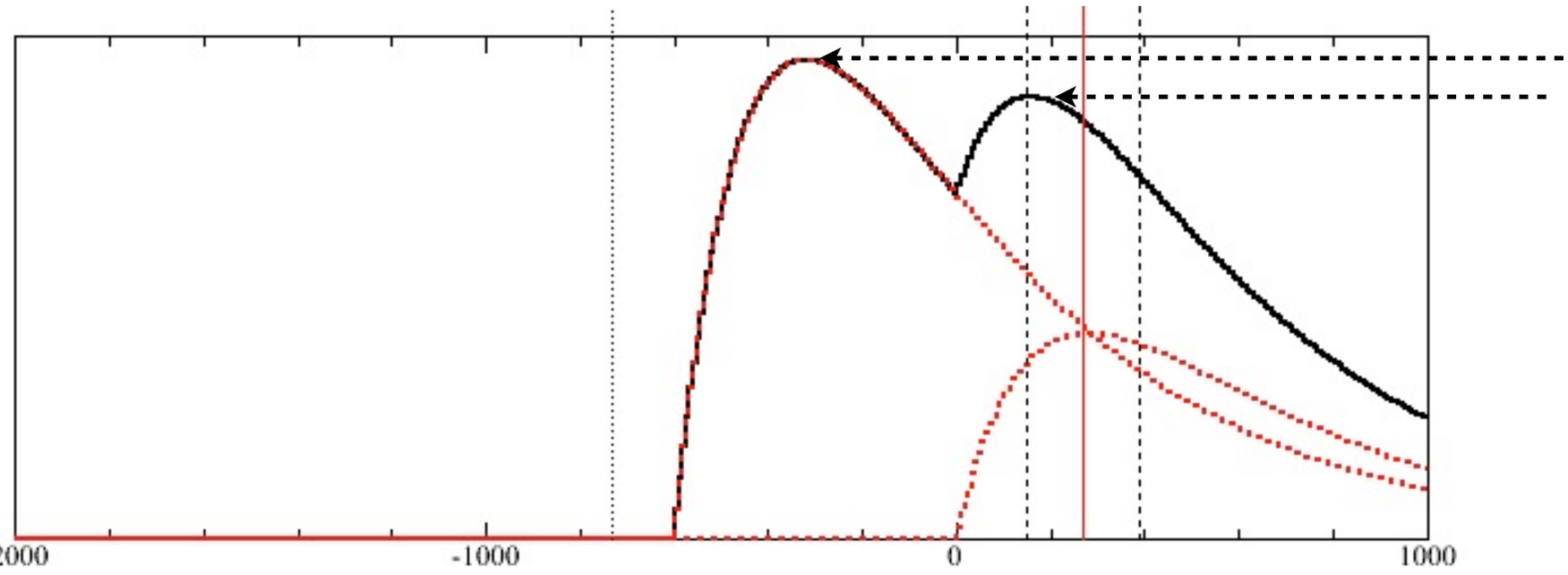
Merged, case 1

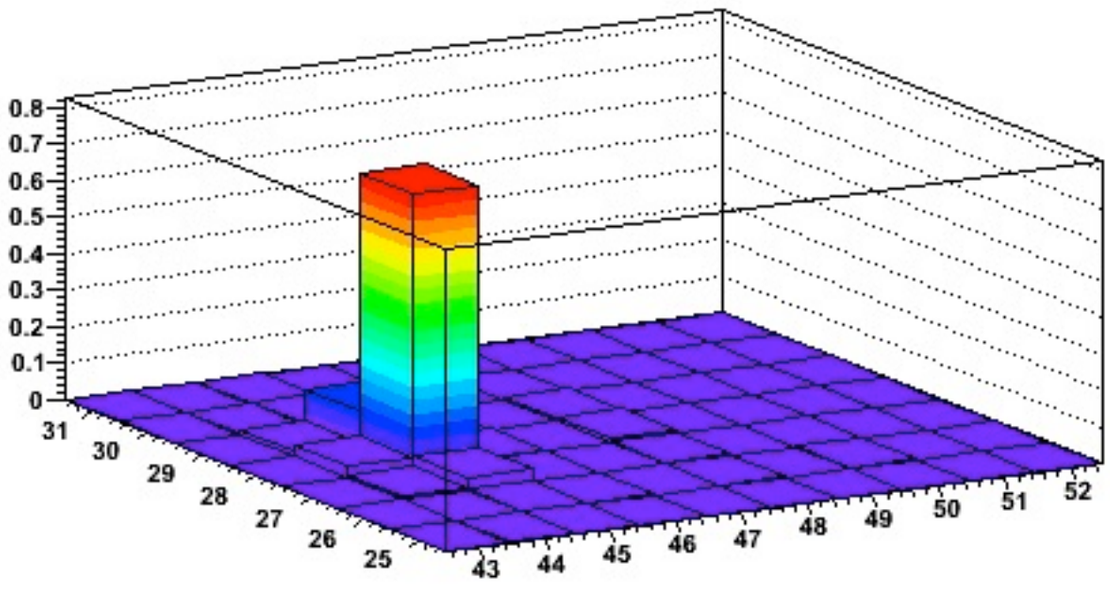




- Left: reference, one 1-GeV γ.
- Right: a 1-GeV γ at t=0 and a 1-GeV γ at t= −800 ns.
  - result: in time, E= 1 + tail at expected t-peak.

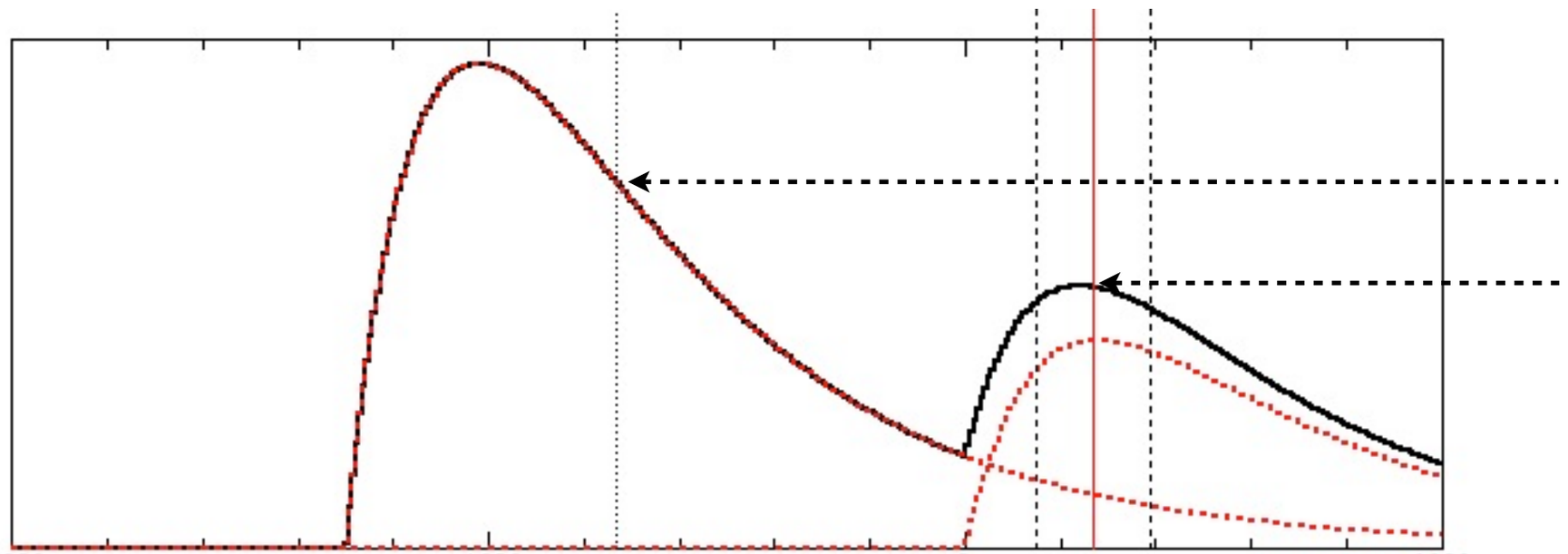
Merged, case 2

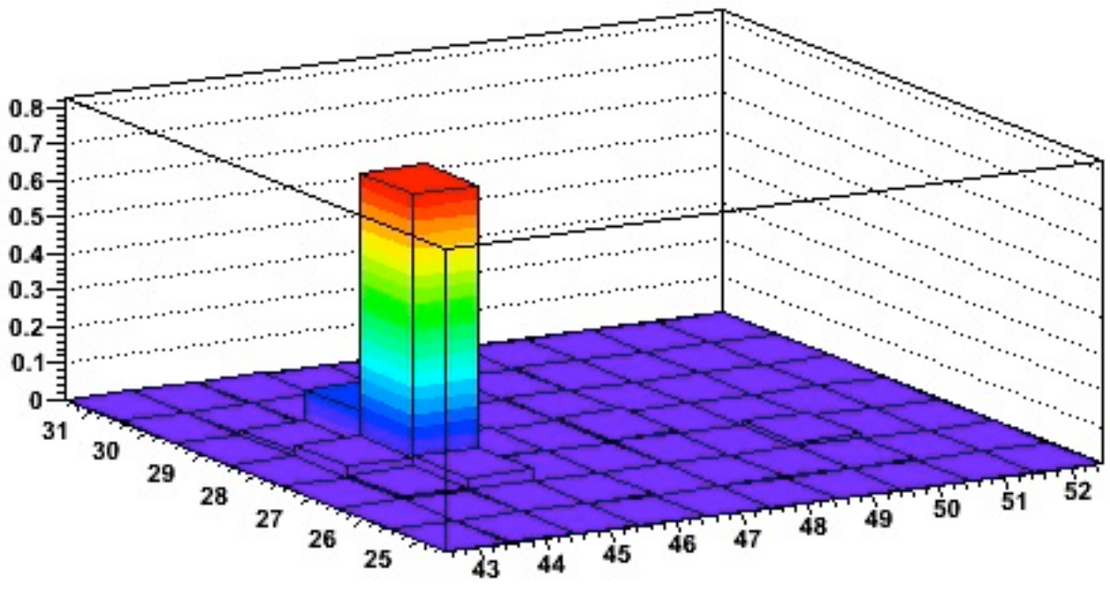




- Left: reference, one 1-GeV γ.
- Right: a 1-GeV γ at t=0 and a 2.33-GeV γ at t= −600 ns.
  - result: out of time (background peak is higher)

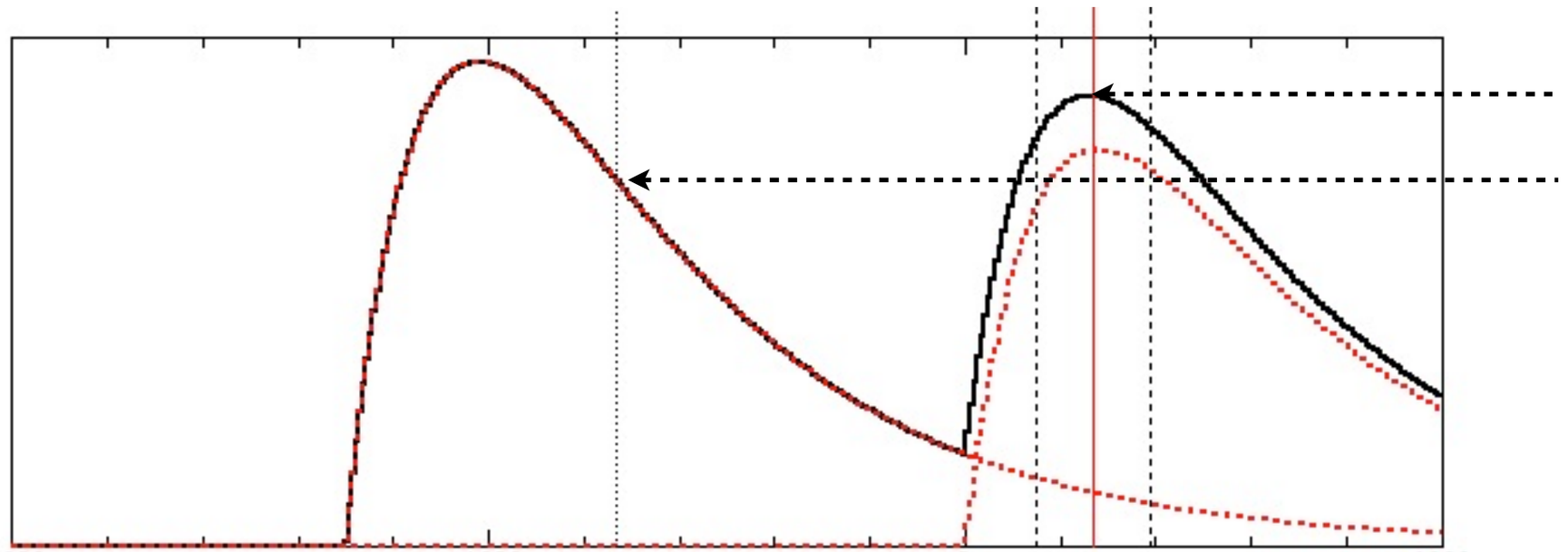
Merged, case 3

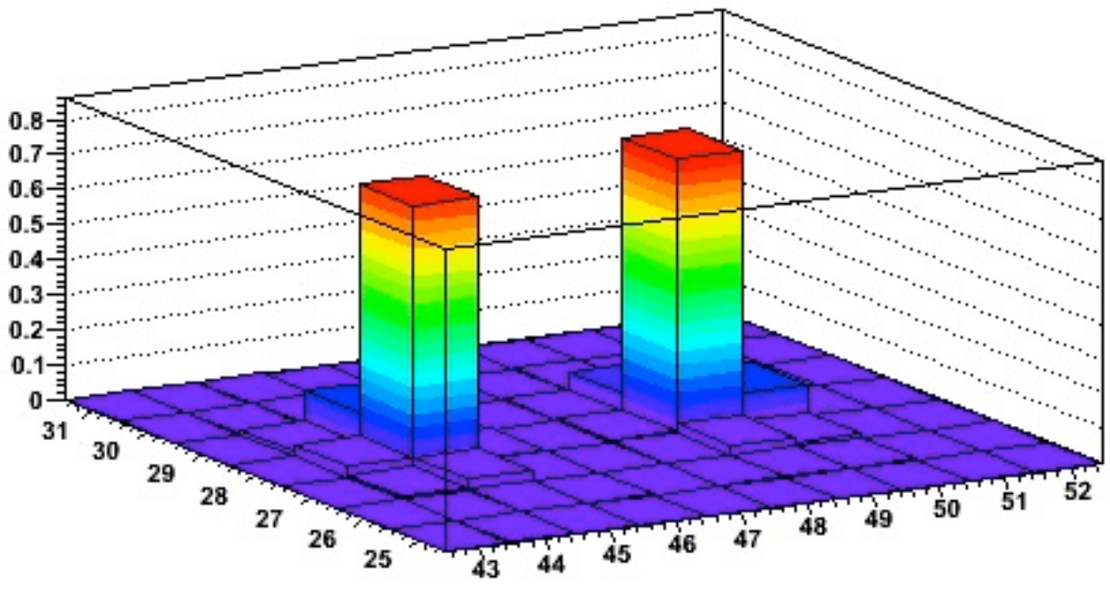




- Left: reference, one 1-GeV γ.
- Right: a 1-GeV γ at t=0 and a 2.33-GeV γ at t= −1300 ns.
  - result: out of time (background max is higher)

Merged, case 4





- Left: reference, one 1-GeV γ.
- Right: a 1-GeV γ at t=0 and a 1.22-GeV γ at t= −1300 ns.
  - result: in time (background max is lower)

Parameters

unit = ns	Fwd	Barrel	Bwd
S_hi	50	120	10
S_lo	-50	-120	-10
Bkg region	-250	-1000	50
Simulate	-500	-2500	-100

- Background and simulate region may be too wide, given the narrow peak.

Summary

- New waveform model uses physical parameters (scintillator decay time, preamp shaping time); can adjust according to the hardware.
- Assume we know the exact physics event time.
- Signal region is narrower than before.
- Timing model allows merging of different times.
- Assume we will look for background peak, and reject the digi if the background peak is high.
- The cost is that we need to simulate/reconstruct for a much wider time range than the signal selection region.