Supporting MGPA++ Design

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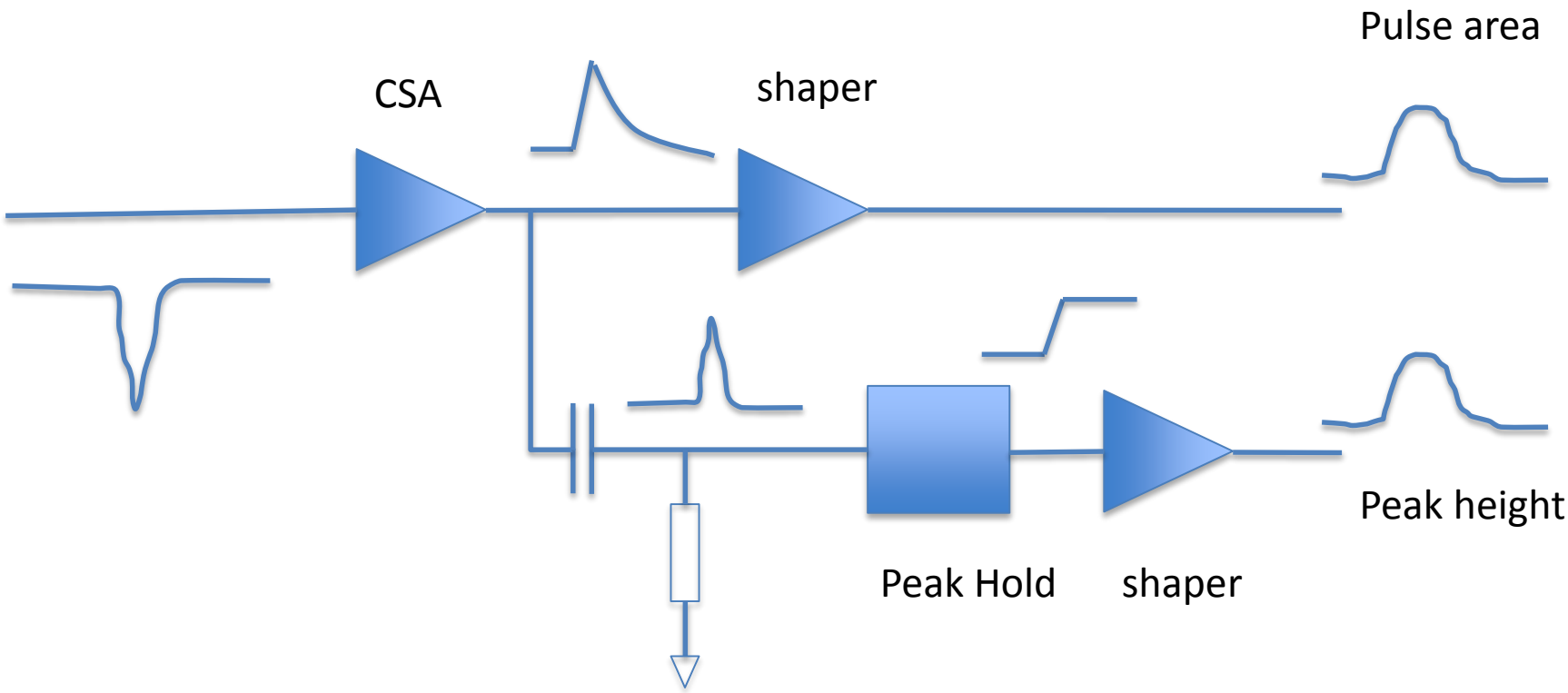
Aims

- Support MGPA++ work at RAL
- Simulation
  - Digitize output of Stephen Thomas' pulses
    - With appropriate time distribution for scintillation and spike signals
    - 80 MSample/s assumed (should work with 40 MSample/s)
  - Make ROC (purity / efficiency) curves for MGPA++ (extend David Petyt's work)
- Model using discrete components
  - Test in lab with APD & flex-circuit cable (Kapton)
  - Produce system ready for beam-test

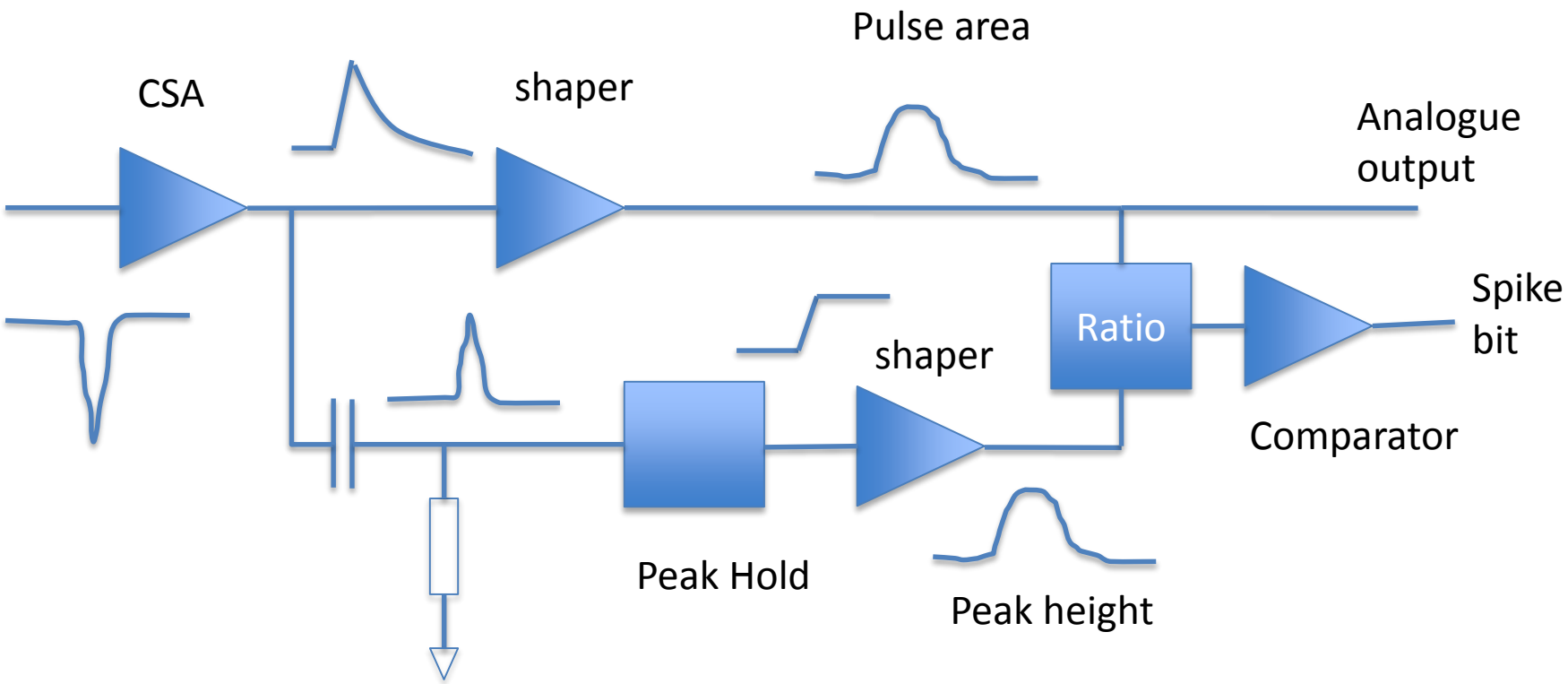
Current Proposal

- Update existing MGPA design
  - Stephen Thomas @ RAL
  - See his talks at EB Upgrade meetings and this w/shop
- Have charge-sensitive pre-amp + Shaper output (peak height proportional to charge), like MGPA
- In addition have output proportional to peak-height of input pulse
- Ratio is proportional to pulse width
- Use pulse-height/pulse-area ratio, together with pulse-area to reject spikes.

Block diagram



Block diagram – with spike bit



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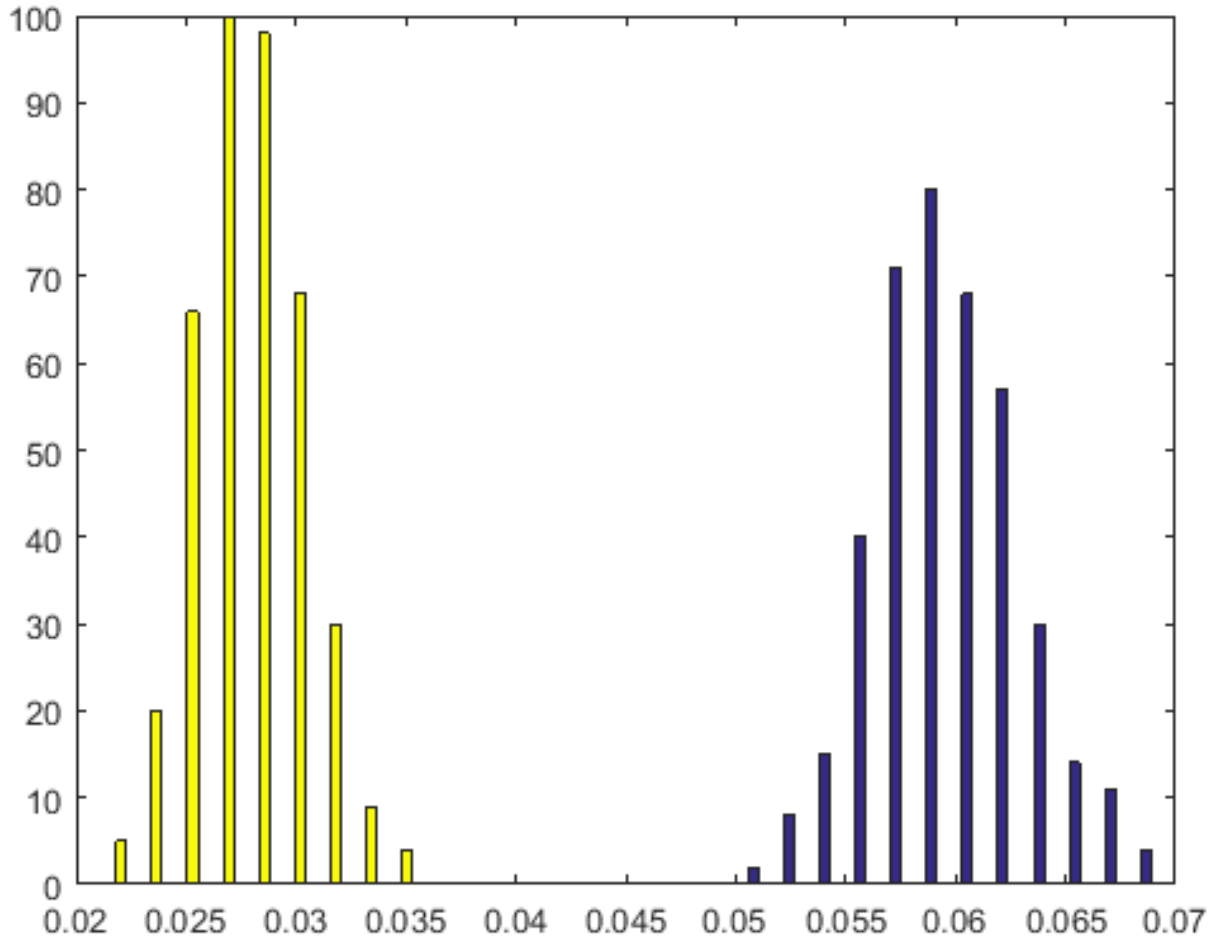
Simulated Pulses (no digitization)

- See Stephen's talk
- Change w.r.t. previous talk - Starting to add more detail to peak-hold circuit
- So far, see separation of scintillation signals and spikes.
  - More realistic simulations will almost certainly degrade separation.

Spikes/Scintillation Separation at 5GeV

Scintillation Signals



Spike Signals

Peak Height/ Pulse Area

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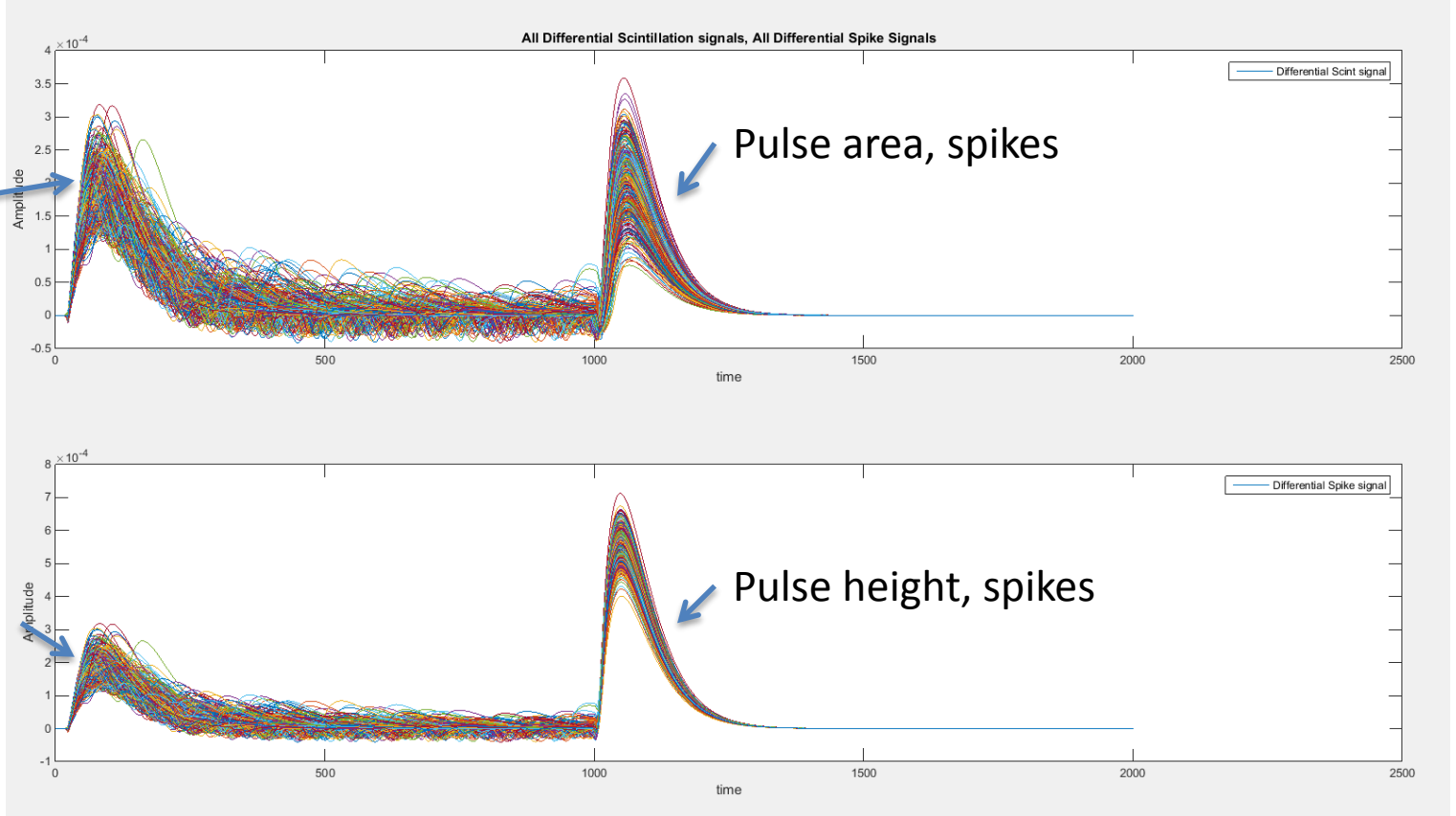
Plots of differentiator output and charge output

Pulse area, scintillation



Pulse height, scintillation

Note the amplitude difference between the scintillation and spike signals

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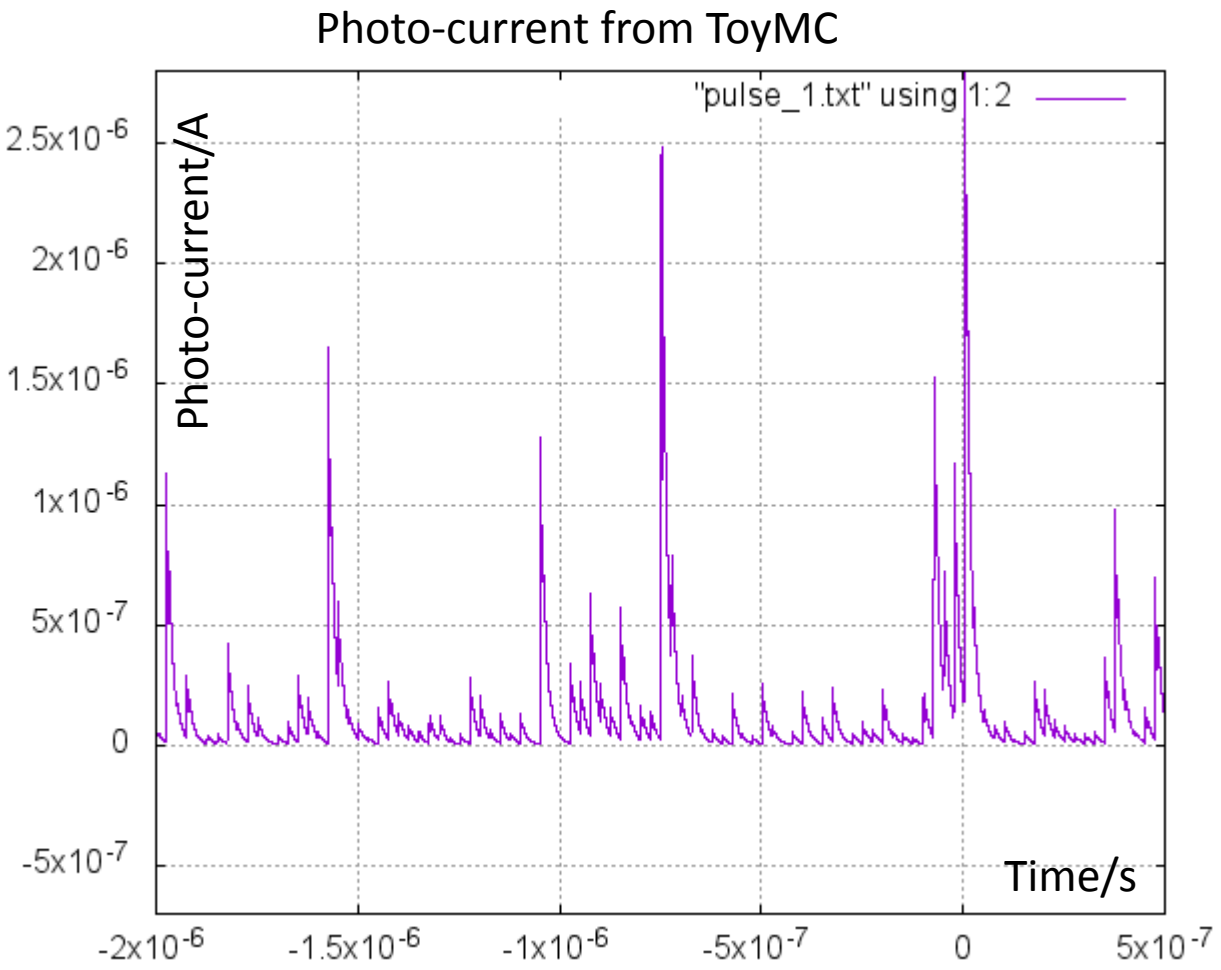
Simulation with Pile-Up

- Starting to run Sasha L's simulation
  - Sasha has modified to output photo-current (unfiltered)



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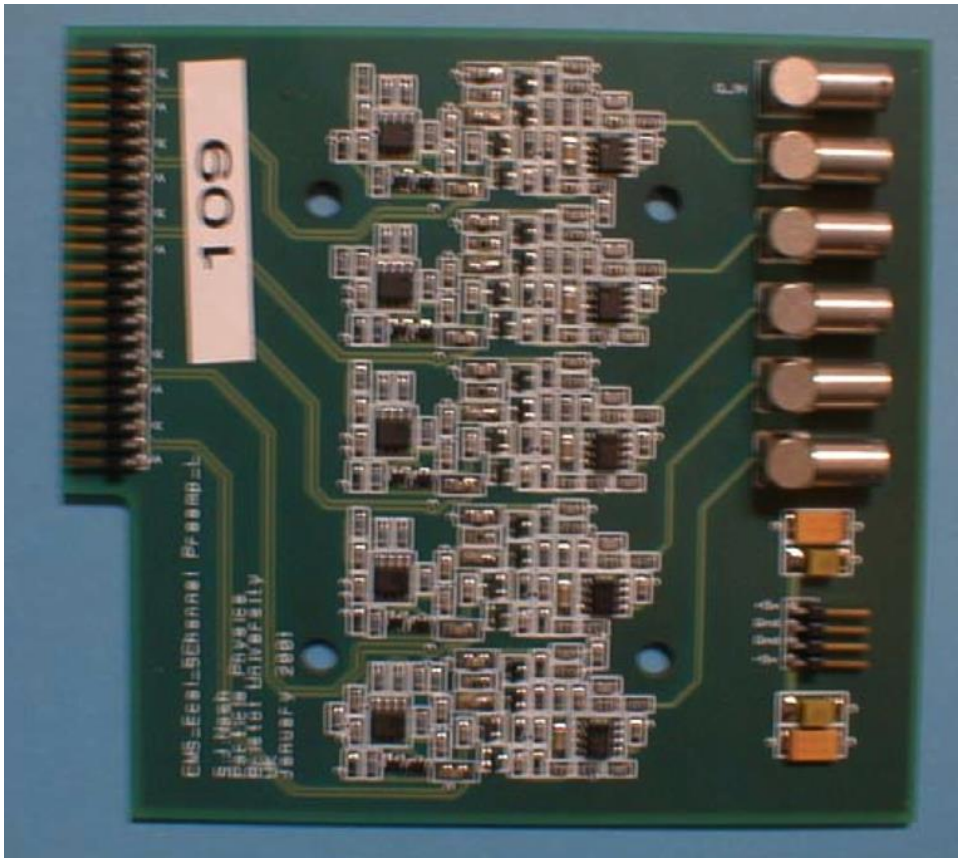
Assumptions

- Have assumed 80 MSample/s
  - Reduced shaping time to re-optimize noise with increased leakage current, so increase sample rate
  - However, spike-finding scheme would still work with 40 MSample/s sampling.
  - No point using this approach for 160MSample/s – just use direct sampling.
- Have assumed digitization of peak-height (as well as peak-area) signals.
  - With care taken over pulse shape and delay could use analogue ratio and comparator
    - 1-bit “spike” output

Model with Discrete Component

- Aim for circuit that matches predicted MGPA++ performance
- Test performance of spike-finding
- Test performance with new(faster) shaping time

Discrete component pre-amplifier
Use for EE beam-tests



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Current Activities & Plans

- Finding suitable gain for peak-height output
- Putting analogue simulations through simulated ADC
  - Check spike finding still works with digitized signals (in approach with ADC on peak-height as well as peak-area output)
- Then, spike-finding purity and efficiency with digitized signals.

People

- Sema Zahid (Brunel) – analogue simulation
- Helen Heath (Bristol) – physics simulation
- David Cussans (Bristol) – physical “mock up” using discrete components