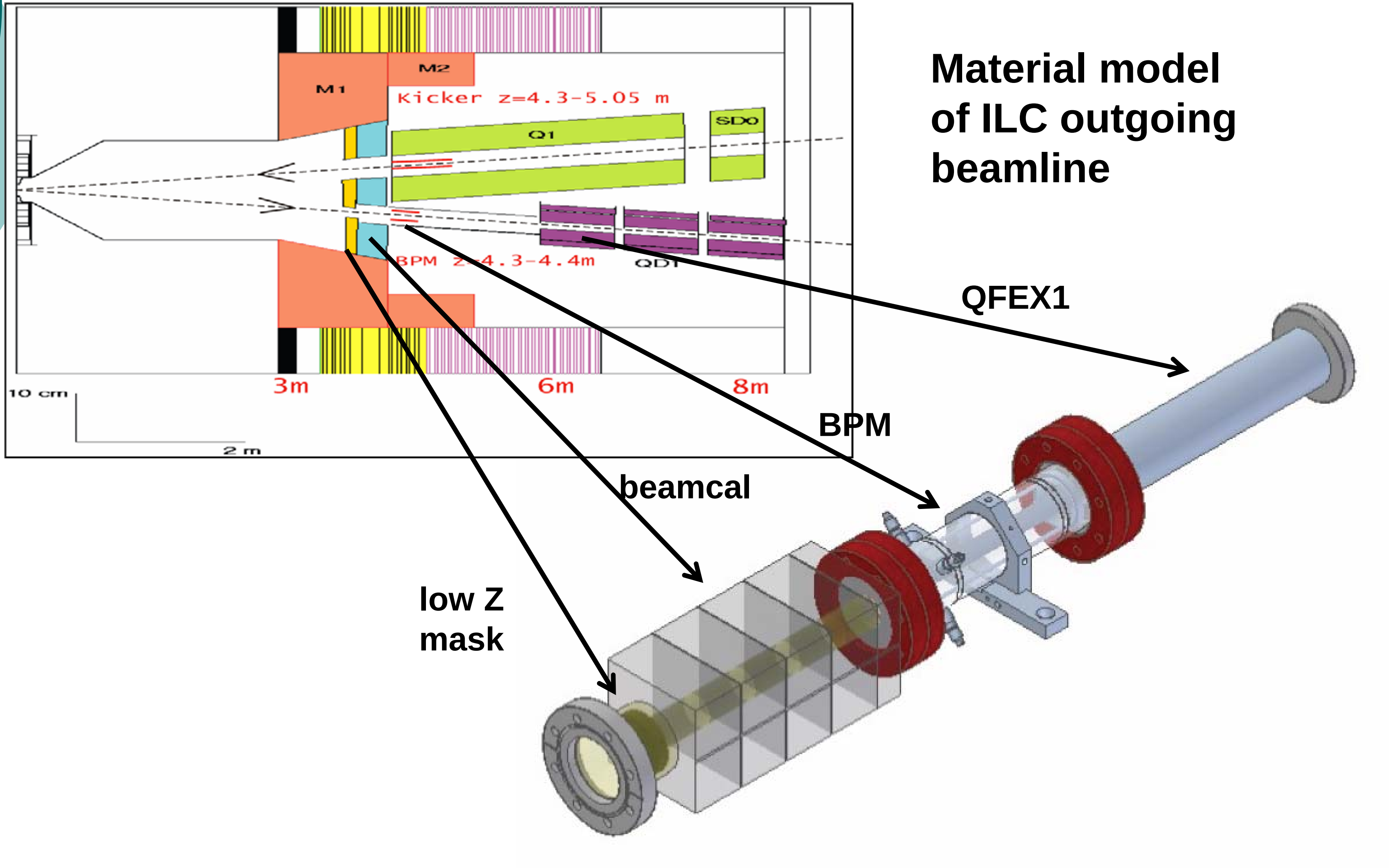
Font@ESA (T-488)

FONT: C Clarke, C Swinson, P Burrows, T Hartin, G Christian, H Dabiri Khah

SLAC: Mike Woods, Ray Arnold, Steve Smith et al

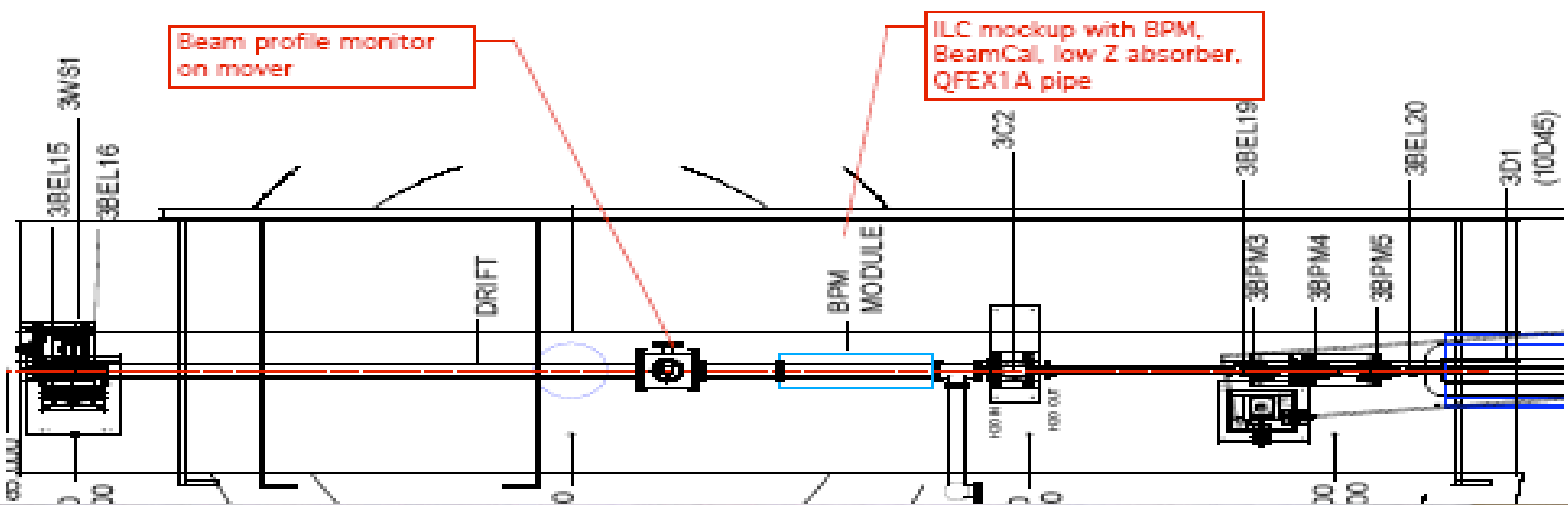
FONT ESA Test Module -design

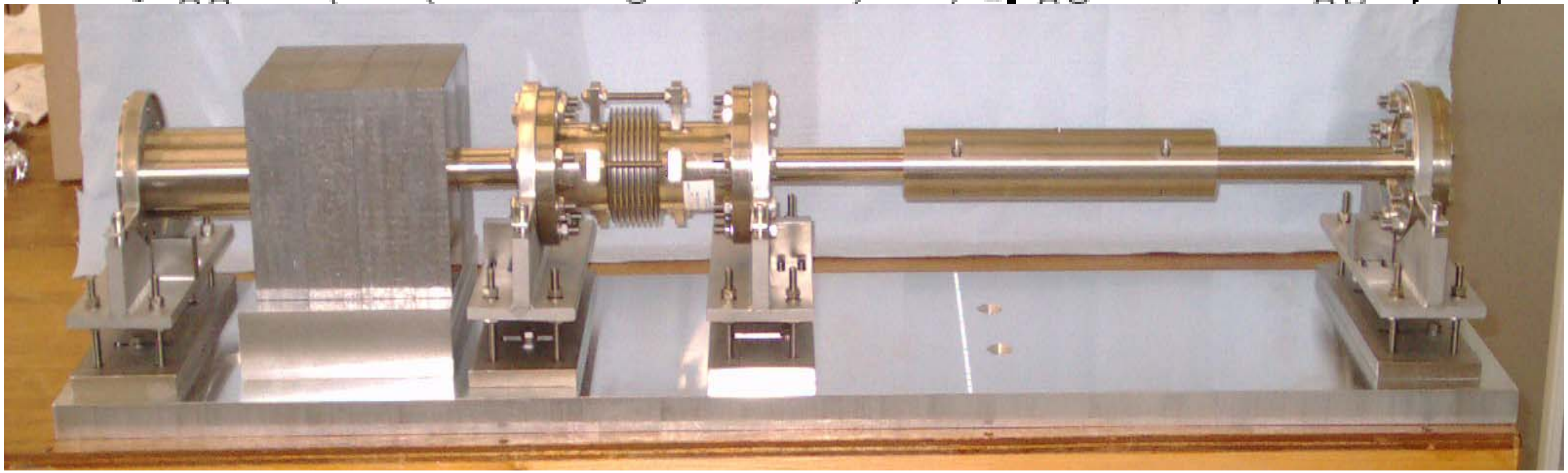
Material model of ILC outgoing beamline



FONT ESA Test Module –in situ

FONT Spray Beam Test Layout in SLAC ESA





Beam test outline

AIM:Recreate ILC-like background hits on BPM

- **Pass 30 GeV main beam through Be radiator, select momentum bites and transport to A-line**
- **bunch charge $10^6 \rightarrow 10^{10}$ obtained by varying transmission at slits**
- **x,y shift beam to impinge on lowZ mask and produce spray**

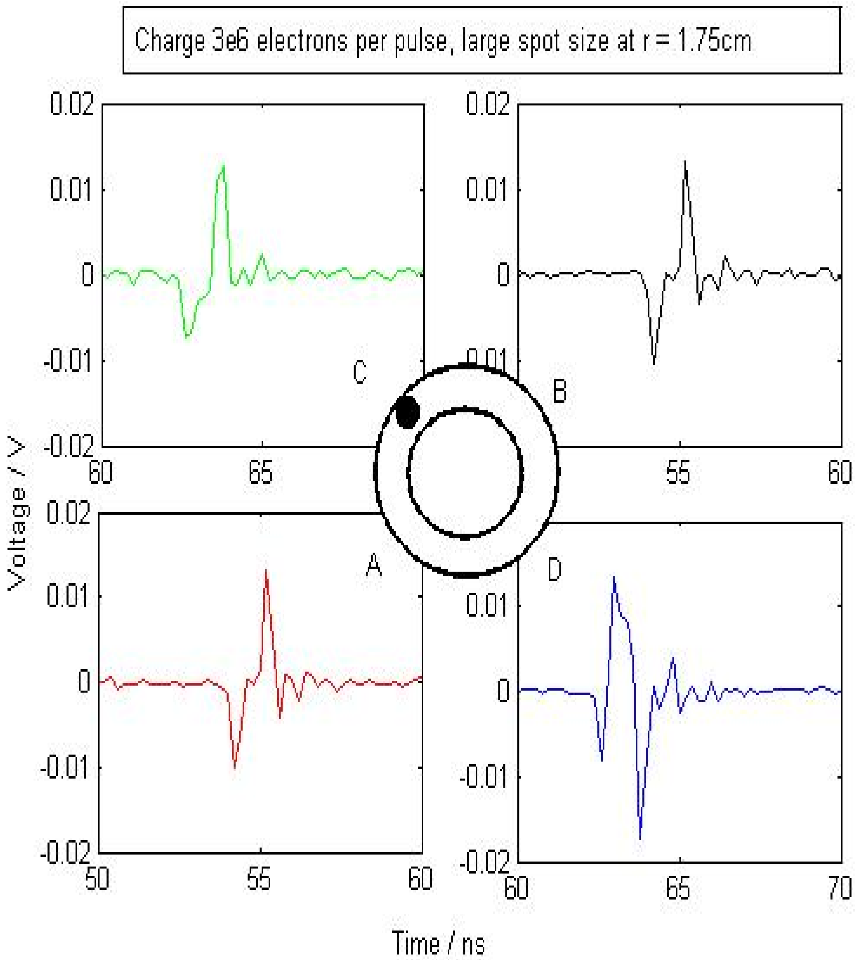
ILC/ESA Comparison

ESA: initial 10^6 charge bunch produces ~2×10^6 e^+e^- per strip

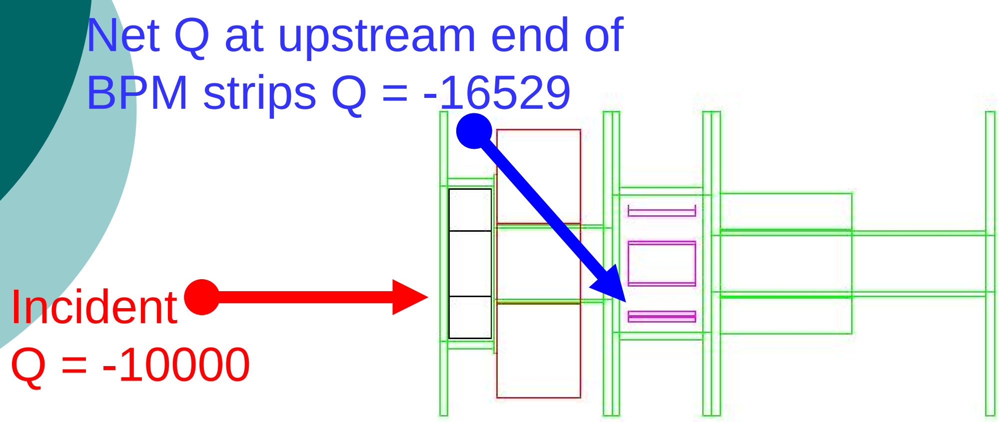
ILC: scheme 14, ~ 2×10^4 e+e- per strip

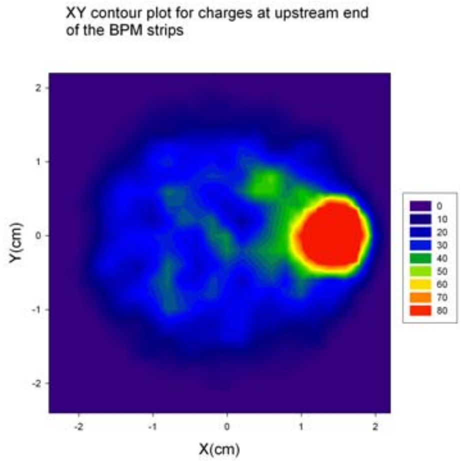
Raw voltage from BPM pickoffs

- main component is the usual bipolar doublet – 1ns between peaks reflects the 30cm round trip up and down the strip
- secondary “noise” feature apparent in BPM D – “noise” to “signal” ratio should be the greatest here for this configuration

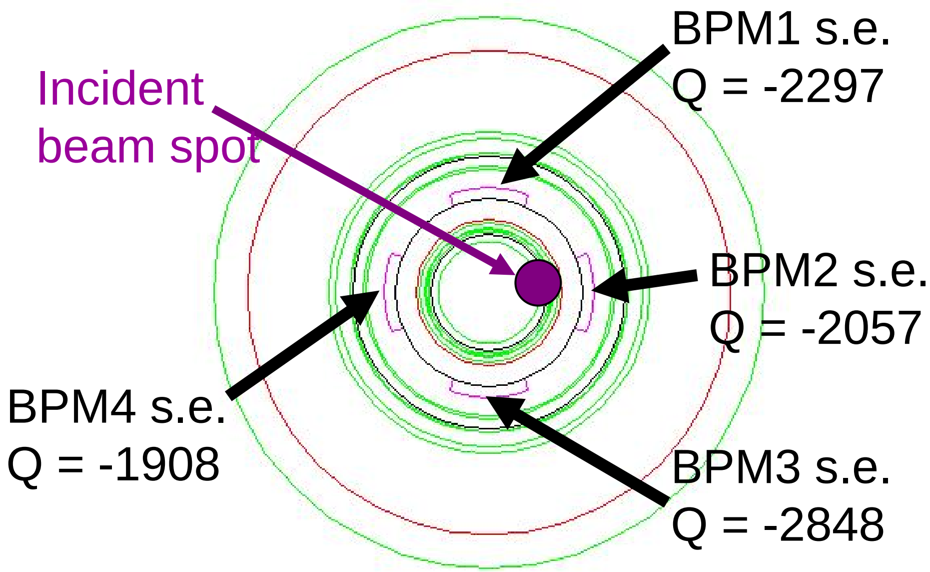


Geant Data

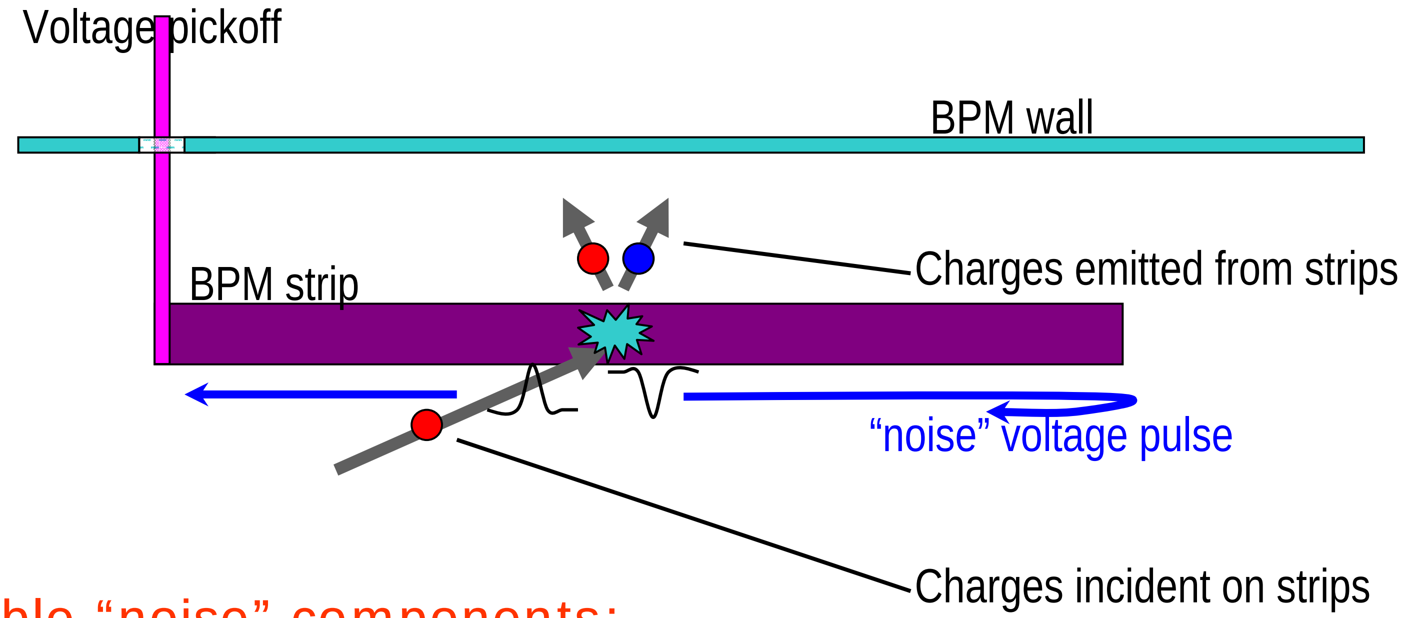




- 1mm spot size incident on low Z at (x,y)=(1.4,0)
- "Signal" obtained by counting net charge passing by strips
- "Noise" obtained by counting net charge in the secondary emission from the striplines
- Time response obtained from GEANT T.O.F. parameter



How to model the noise?



Possible "noise" components:

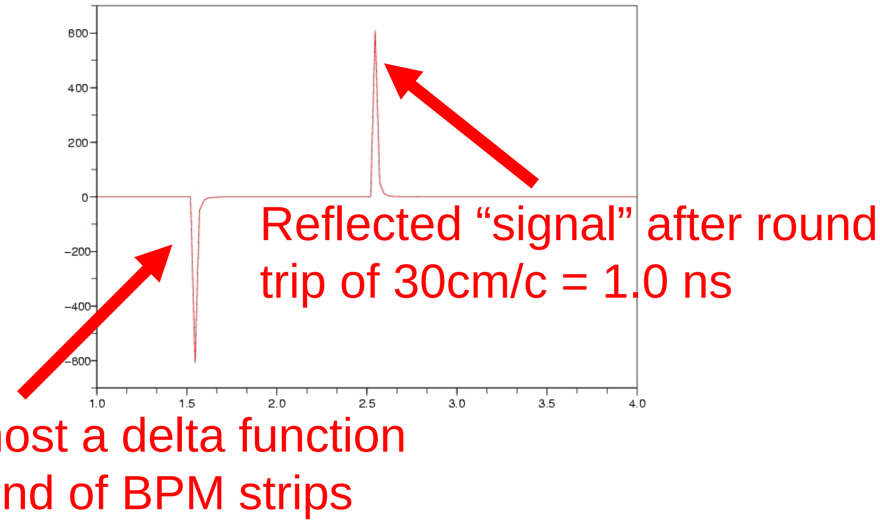
- Incident hits – partly make up the "signal" as main charge bunch passes voltage pickoff – these are generally tangential – must take into account the change in image charge. Charges moving toward a strip roughly balanced by those moving away from it, so no net effect from incident hits

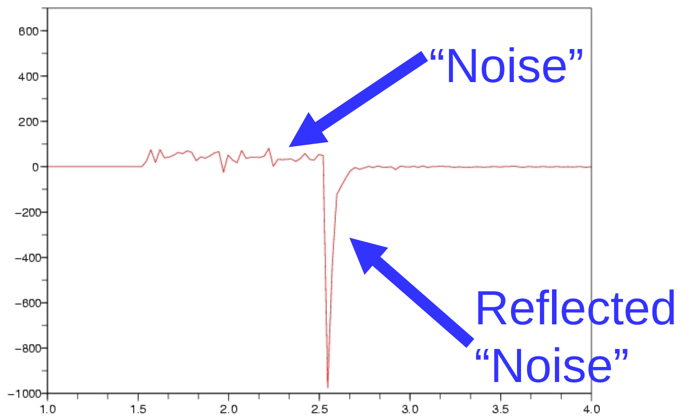
- Emitted hits – electrons yield positive (+ reflected negative) voltage pulse, positrons the opposite. Reflected voltage pulse "piles up"

TOF histogram “raw” charges

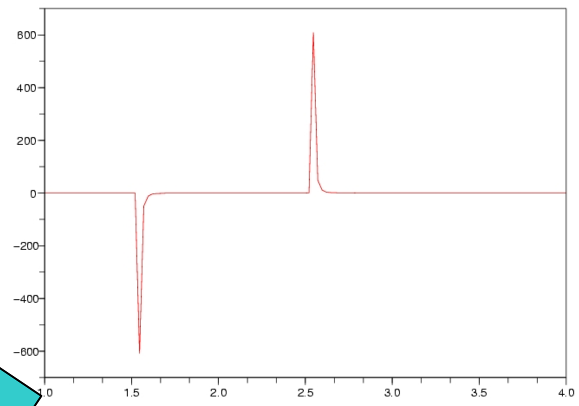
This is “raw” because…

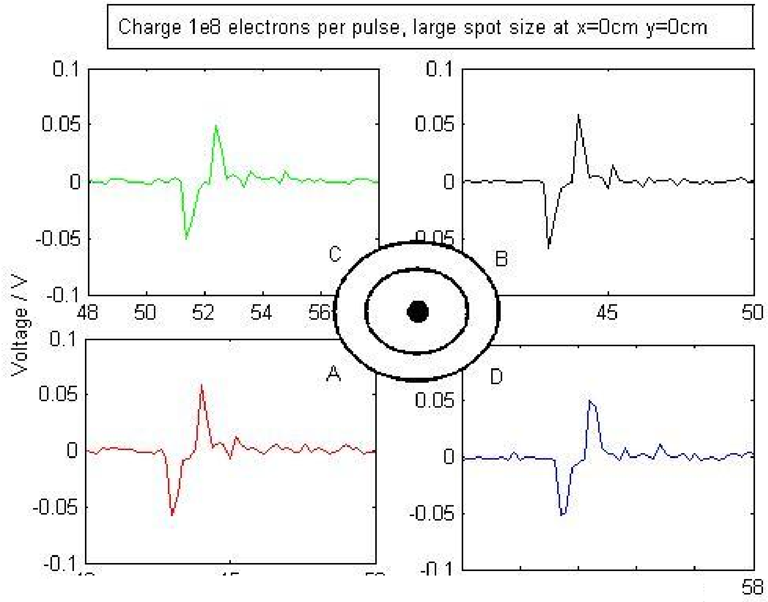
- we have to balance signal against noise by taking into account the fraction of the image charge on each strip
- we want to compare with real voltage measurements, take into account residual impedance and capacitance in the measuring circuit



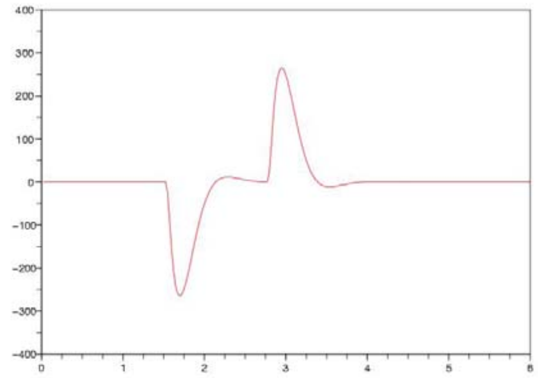


Simulate measured voltages

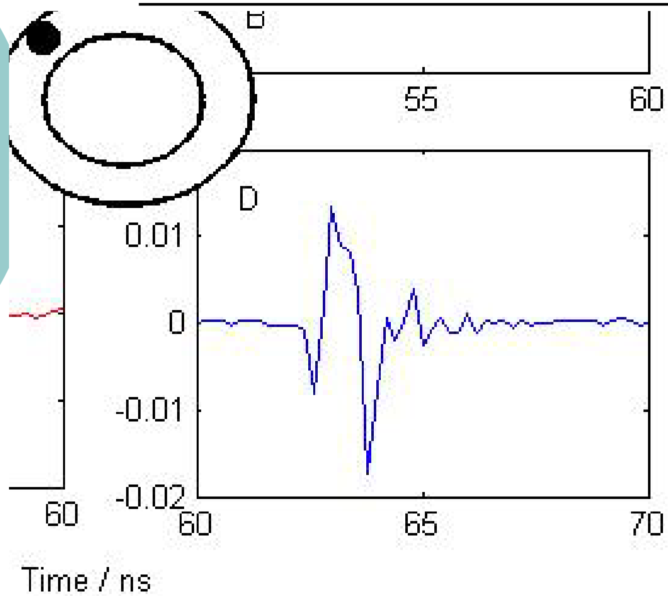


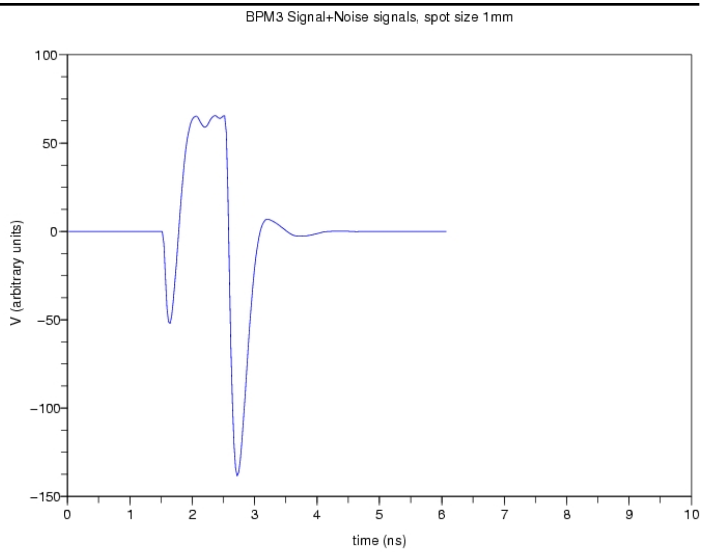


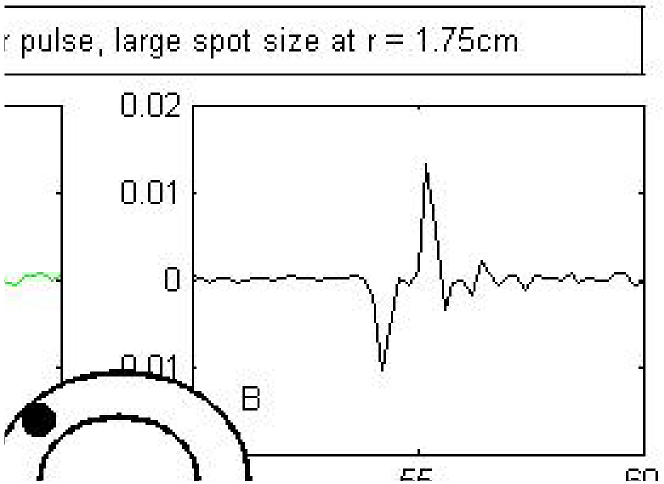
Broaden analytic signal pulse by passing through a 2nd order 1.2 GHz Butterworth Low pass filter

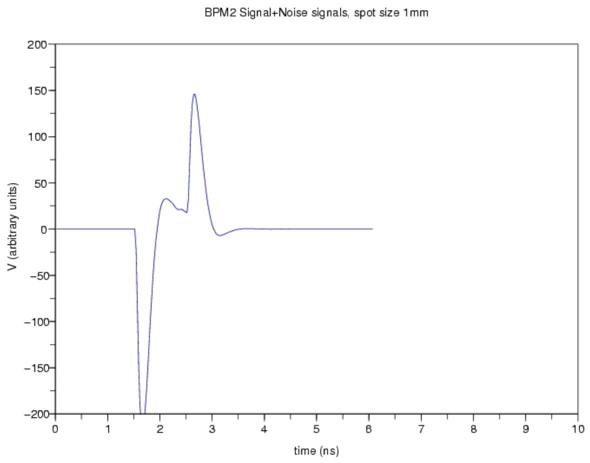


Simulated Signal+Noise results

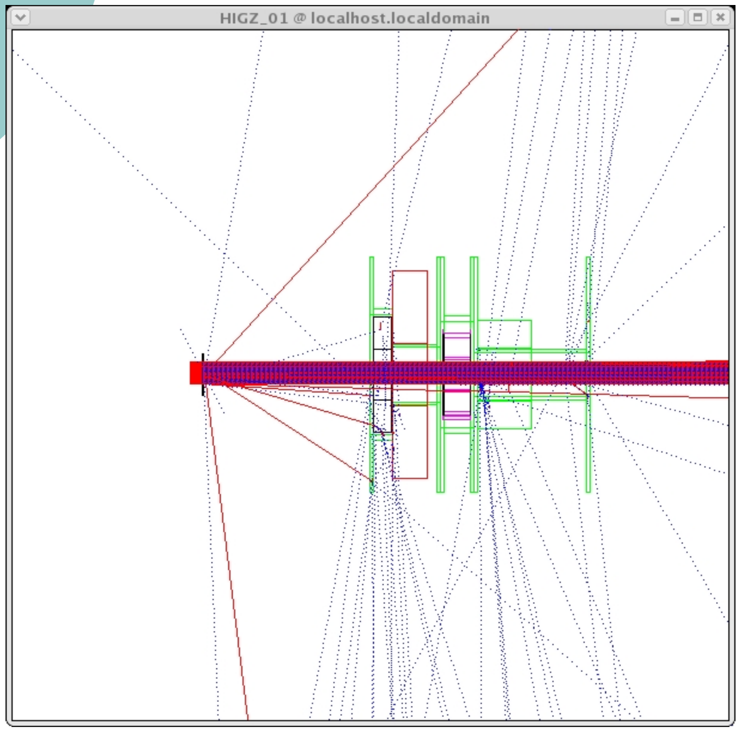








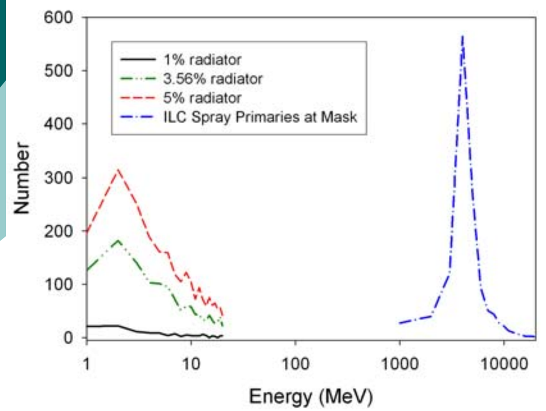
New ESA run 2007



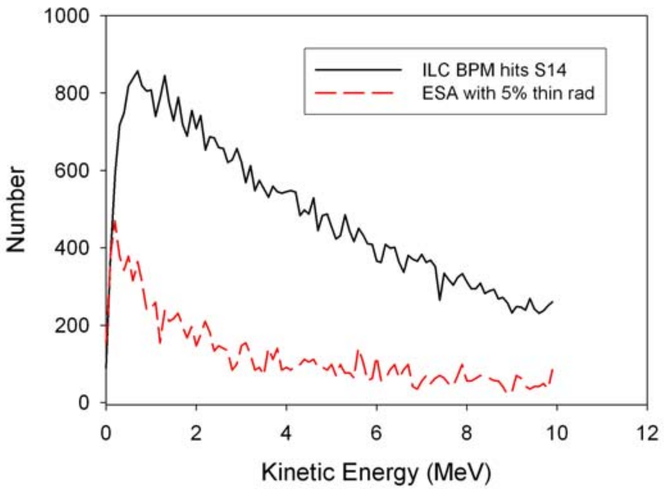
- 2006 run aimed the primary beam at LowZ mask directly – noise to signal higher than we can expect at ILC
- Modify the module to include thin radiator
- Match spray to expected ILC spray

Geant studies to compare ILC and ESA

Energy spectrum of emitted electrons from an Aluminium thin radiator - Comparison with ILC Spray Primaries at z=3.12m



Energy spectrum of BPM hits



- Energy spectra at LowZ mask different between ILC/ESA, but...
- At BPM strips the spectra is similar
- 5% Al radiator ~ 1m upstream of lowZ mask delivers noise:signal ratio twice that of ILC-can adjust down

Further work

- Further data run at ESA in 2007
  - Insert thin radiator upstream of LowZ mask
  - Attach FONT processer to gauge effect of noise on processed signal

- Firm up simulations by
  - Theoretical considerations of noise
  - Full electromagnetic simulation