Towards a Digital Hadron Calorimeter

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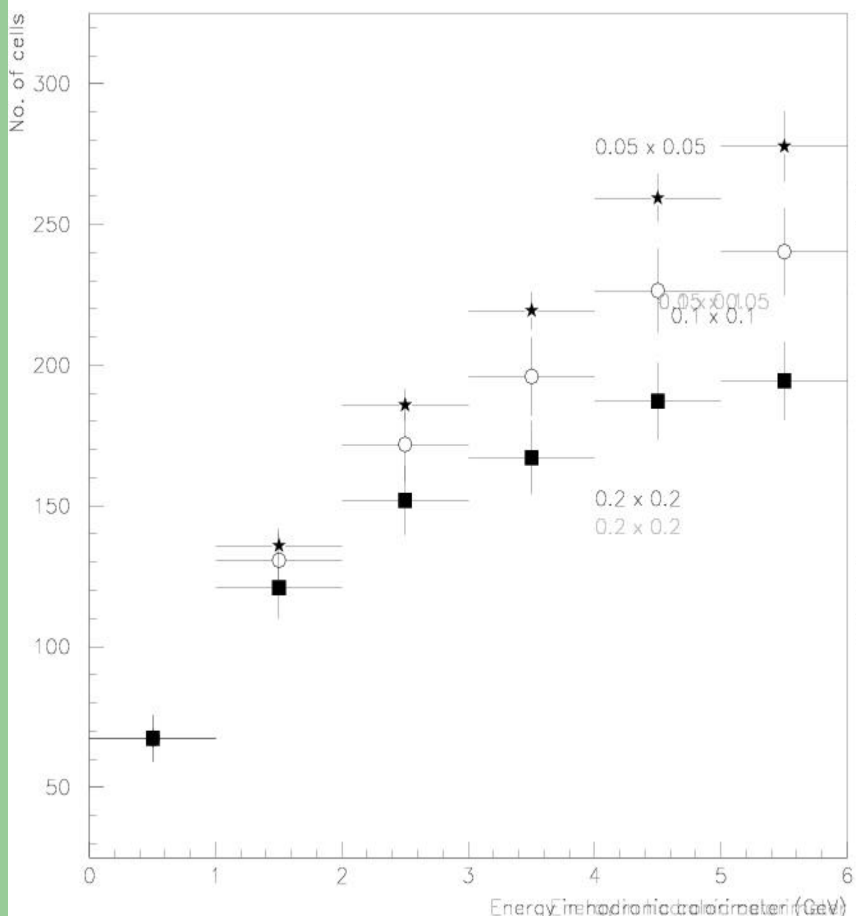
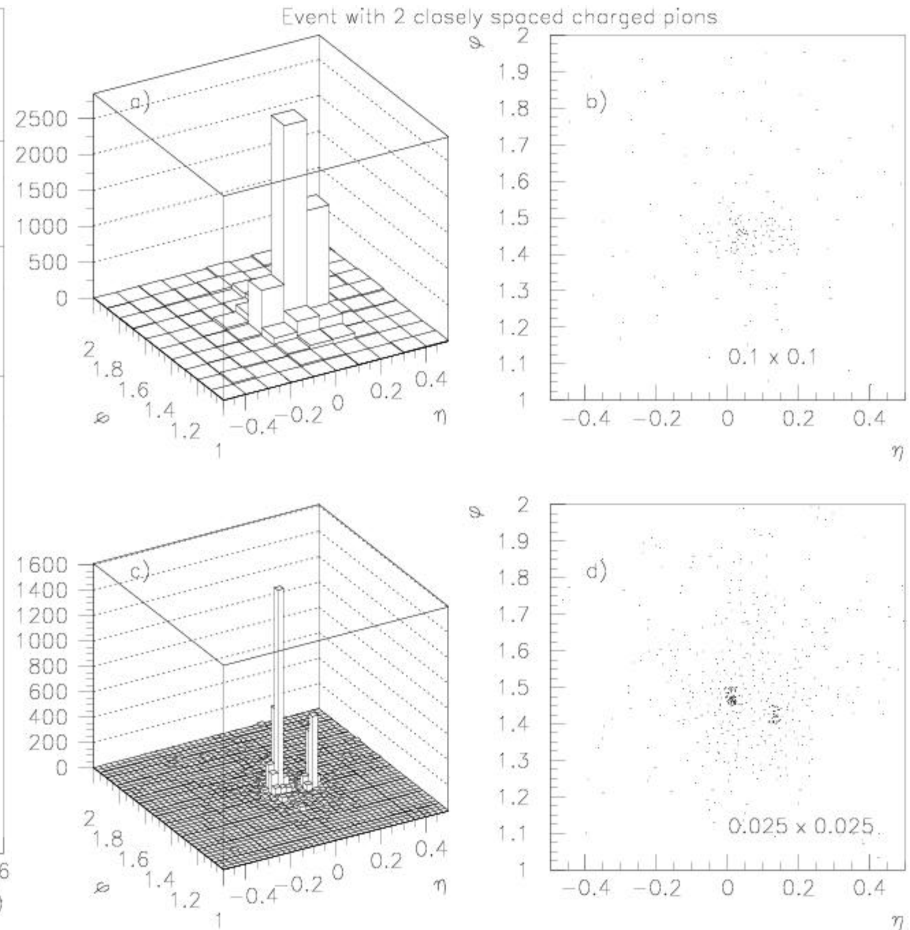
From analog to digital

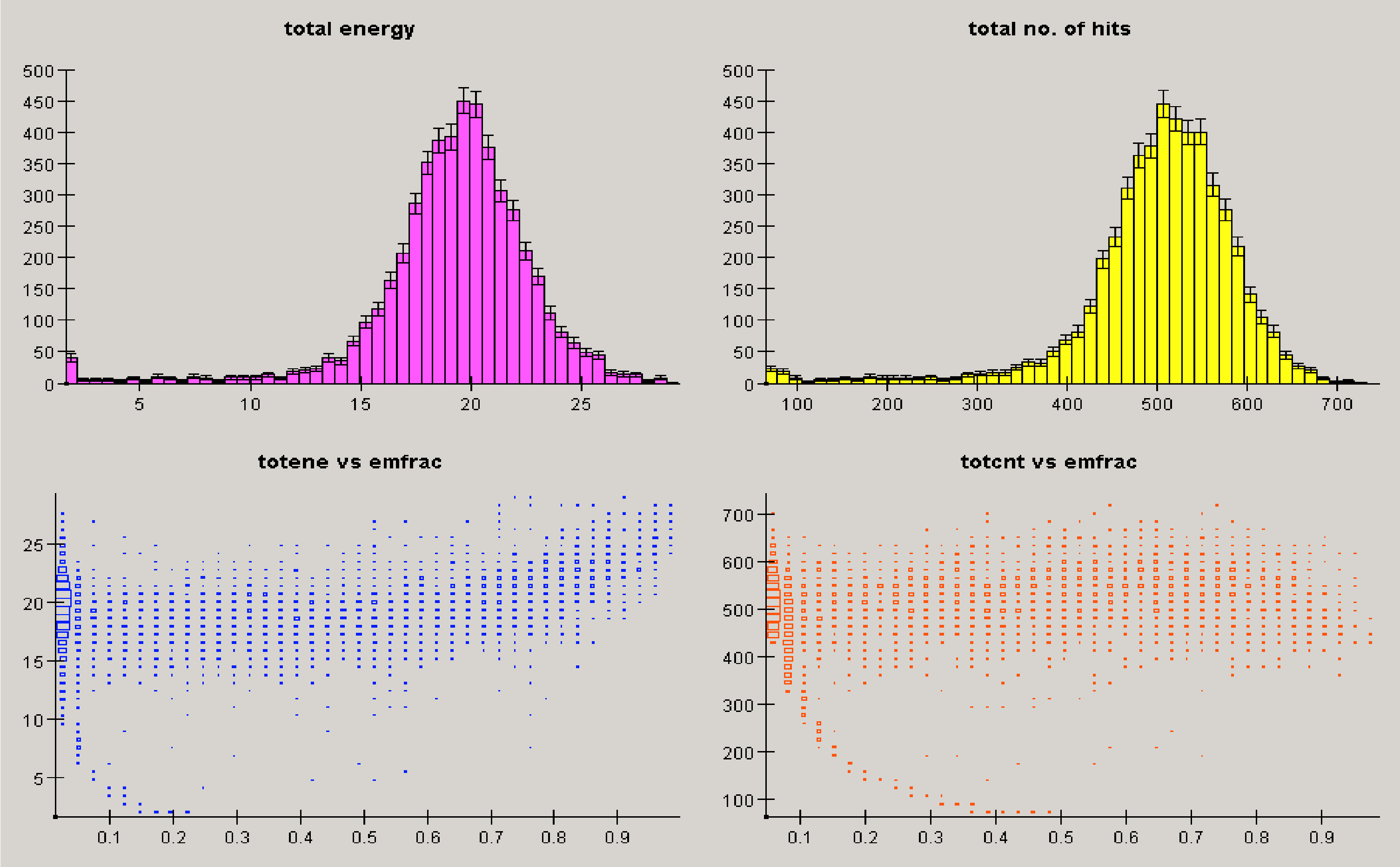
- Eflow seems to be a promising option for improving jet resolutions significantly
- ALEPH and CDF have successfully used it
- Requires a high granularity calorimeter
- Digital hadron calorimeters: high granularity at affordable price ?

Energy and position



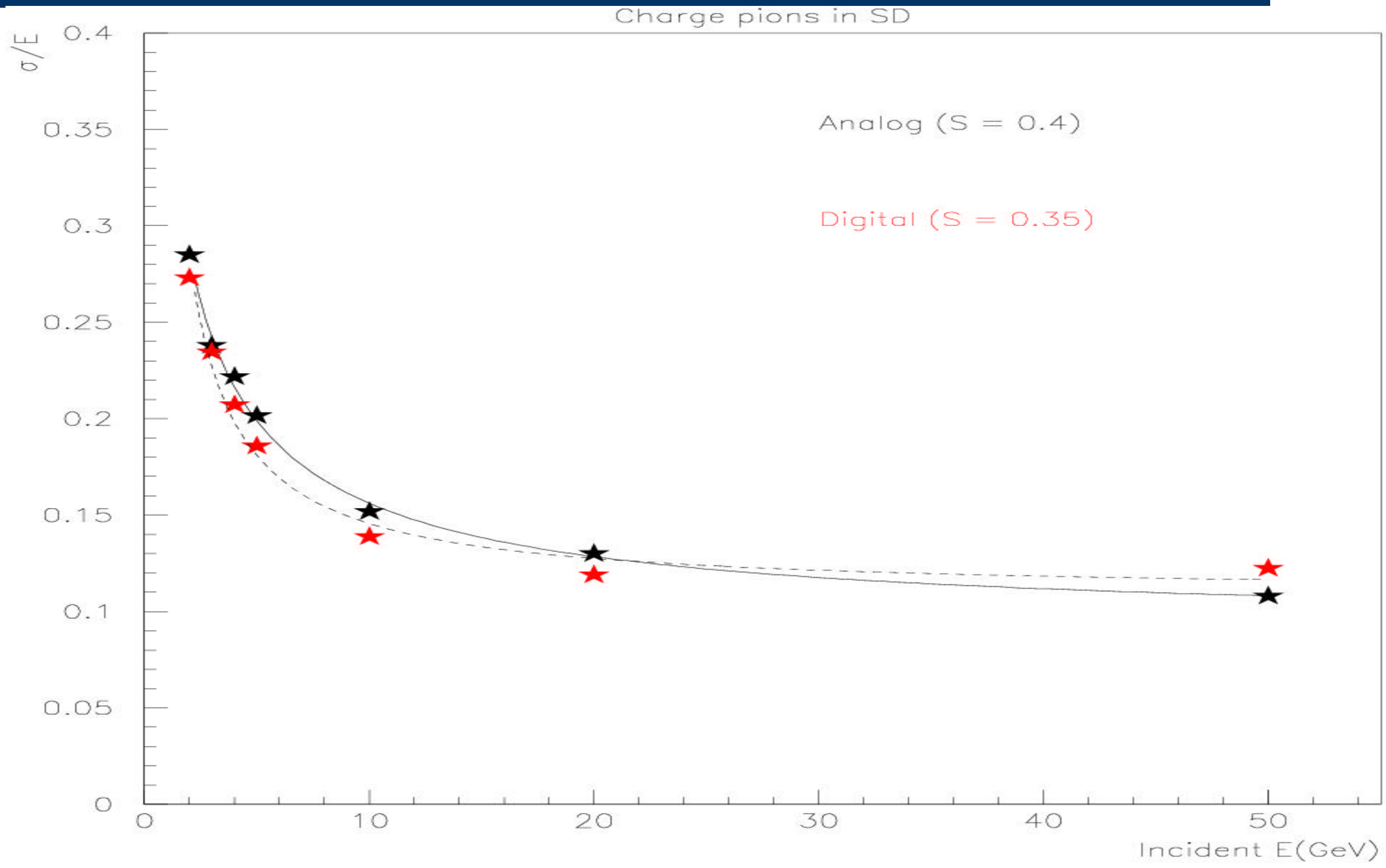


Analog and Digital



20 GeV pions in SD

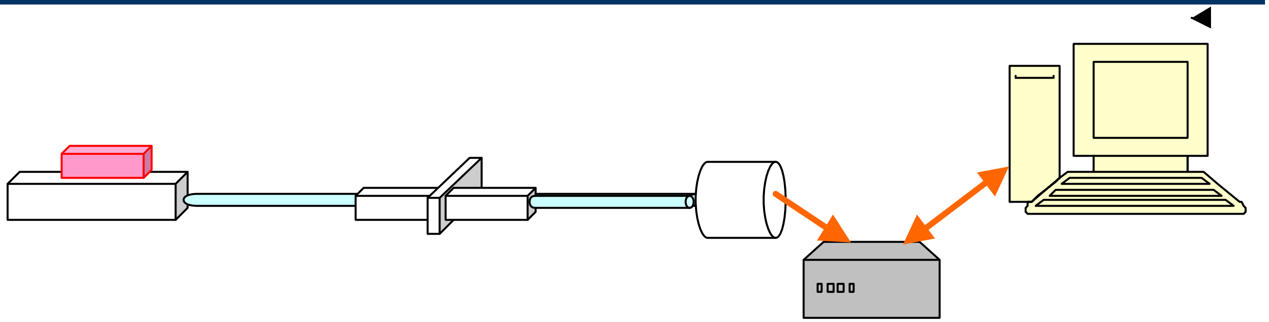
Single Particle Resolutions



Technology choice

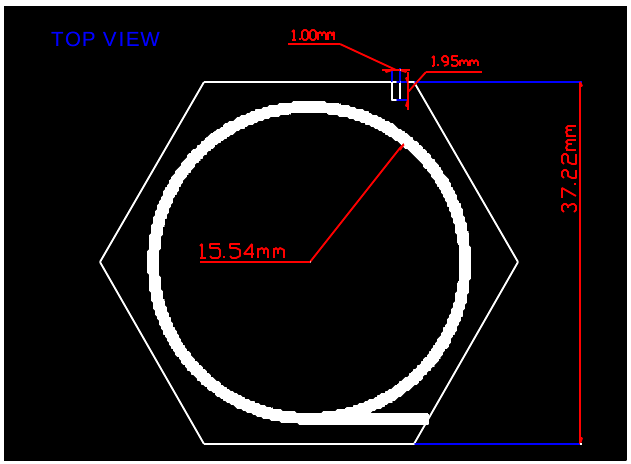
- Sampling calorimeter with scintillator as active medium
- Proven detection technique and well known readout devices
- Offers flexibility in terms of how ‘digital’ you want to make the output
- Challenges relate to no. of cells, light→ electrical conversion and associated costs

Test stand



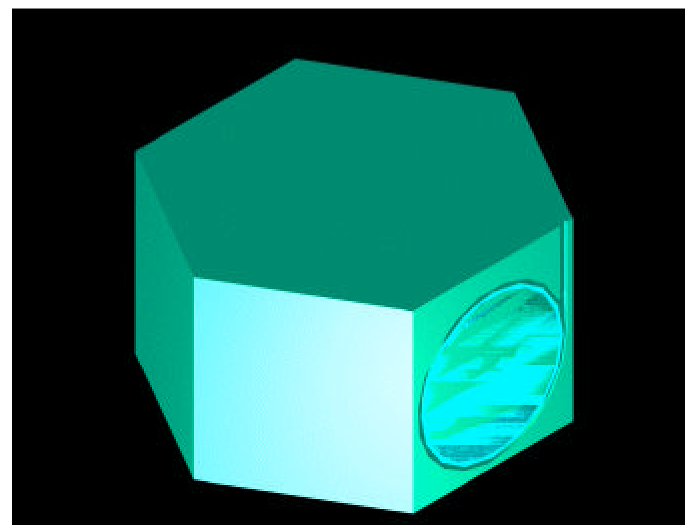
Cell with WLS fiber irradiated by a radioactive or LED
WLS fiber connected to clear fiber which is connected to a photo detector (PMT’s, VLPC’s etc.)
Output measured by a Pico ammeter

Test goals



Find minimum area/thickness of cell
Find optimum grooving
Find appropriate reflector

Measure signal losses at the WLSF to clear fiber transition



Early choices

- Cell geometry
  - hexagonal
- Scintillator material
  - BC408, extruded
- Absorber material
  - Brass
- Fiber material
  - WLS→BCF92, Y11
- Fiber geometry
  - ∅ 0.9mm (mirrored end)
  - 0.9mm (mirrored end)
- Groove geometry
  - Straight vertical/horizon.
  - Center rib, sigma
- Reflector material
  - Tyvek, paint, sputtering(Al)

Test matrix

	Scintillator BC-408					
	Sputtered		Tyvek		Paint	
	Ø	_	Ø	_	Ø	_
Straight Vertical	X	X	X	X	X	X
Straight Horizontal	X	X	X	X	X	X
Center Rib	X	X	X	X	X	X

BC408 cells ($9cm^2$ area with 5mm thickness)

Preliminary test results

Wrapping	Relative Light Output
Tyvek	1.0 (4.5 PE with PMT)
Paint (vinyl)	~0.5
Paint (enamel)	~0.5
Mylar (aluminized)	~0.5

Sr-90 source used

Plans

- Continue with cell-fiber-groove-reflector treatment testing
- Make absolute light yield measurements with PMT's and VLPC's
- Test out MRS devices
- Investigate the use of extruded scintillator
- Build prototype (7cells x 10 layers) for cosmics