



SiD

Global Parameter Optimization using Pandora PFA

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Outline

- Recap of talk given at SID Workshop 29th Jan 2008
- Only results at the Z pole so far
- 100 GeV/250 GeV Jets in the queue
- Results are **PRELIMINARY**

The Idea

- Use the current best Particle Flow Algorithm
 - PandoraPFA by Mark Thomson
 - Start optimizing SiD
 - $r, z, T,$
 - layers, segmentation
 - material, technology
-  More Difficult
- Caveat : Only works well within Mokka/Marlin Framework
 - No real SiD detector model available in this framework
 - Have to use a SiD look-alike, the *SiDish*



PandoraPFA

- Developed by Mark Thomson
- The world's best so far (V2.01 available)
- See Mark's Talk yesterday
- Well tailored towards LDC00Sc and (most recent) LDC01_05Sc



The setup

- Use PandoraPFA 2.01 & LCPHYS
- Start of with LDC00Sc (Reference Point)
- Then go to SIDish
- Use track cheating
 - tracking shouldn't matter ... to first order
- Vary parameters
 - radius
 - Z
 - field
 - layers
 - ...



LDC00Sc

- Tracker radius=1.69 m
- Tracker Z=2.73 m
- ECAL SiW 30+10 layers, 1x1 cm tiles
 - 1.4 mm/4.2 mm W + 2.5mm Gaps
- HCAL Fe-Scint 40 layers 3x3 cm tiles
 - 18 mm Iron + 7.5 mm Gap
- 4 T Field
- Basically the old Tesla Design
- A detector that will never be build ...





The "SiDish"

- Tracker radius=1.25m
- Tracker Z=1.7 m
- ECAL SiW 20+10 layers, 1x1 cm tiles
- HCAL Fe-Scint 40 layers 3x3 cm tiles
- Same Calorimeter layout as LDC00Sc (besides 30+10->20+10)
- 5 T Field



The different variations

- Vary Field
 - 4,5,6 T
- Vary R
 - 1.0, 1.25, 1.5 m
- Vary Z
 - 1.5, 1.7, 1.9 m
- Vary ECAL layers
 - 30,40
- Vary HCAL Material
 - Fe,Cu
- We have too much phase space !

Summarize ...

| Detector TAG | B-field | ECAL layers | ECAL cell size | HCAL layers | HCAL cell size | Tracker radius | Tracker length |
|-----------------|---------|-------------|----------------|-------------|----------------|----------------|----------------|
| LDC00 | 4 | 40 | 1x1 | 40 | 3x3 | 1690 | 2730 |
| SIDish | 5 | 30 | 1x1 | 40 | 3x3 | 1250 | 1700 |
| SIDish_r10_z17 | 5 | 30 | 1x1 | 40 | 3x3 | 1000 | 1700 |
| SIDish_r15_z17 | 5 | 30 | 1x1 | 40 | 3x3 | 1500 | 1700 |
| SIDish_r125_z15 | 5 | 30 | 1x1 | 40 | 3x3 | 1250 | 1500 |
| SIDish_r125_z19 | 5 | 30 | 1x1 | 40 | 3x3 | 1250 | 1900 |
| SIDish_4T | 4 | 30 | 1x1 | 40 | 3x3 | 1250 | 1700 |
| SIDish_6T | 6 | 30 | 1x1 | 40 | 3x3 | 1250 | 1700 |
| SIDish_ecal40 | 5 | 40 | 1x1 | 40 | 1x1 | 1250 | 1700 |



Current Status

- For each point
 - photons, hadrons, uds jets (45,100,250 GeV)
 - approx 45000 events per point
 - Check GEAR XML file is correct
 - for all points check PandoraPFA response
- Simulation takes forever
 - 1000 Z->uds (45 GeV) ~ 44 hours





The first result

- Results for 45 GeV jets ready
- They are **PRELIMINARY**
- Numbers quoted are
 - $\cos(\text{Thrust}) < 0.7$: Barrel Events
- There are a set of caveats
 - Had to calibrate response for each detector variation
 - Hadronic response is tricky ...
 - Can have an effect $< 1\%$ on $1/\sqrt{s}$ (e)
 - Calibration can be tuned with existing samples
 - Could use even more statistics
- So numbers could/will change slightly ...





Preliminary Results

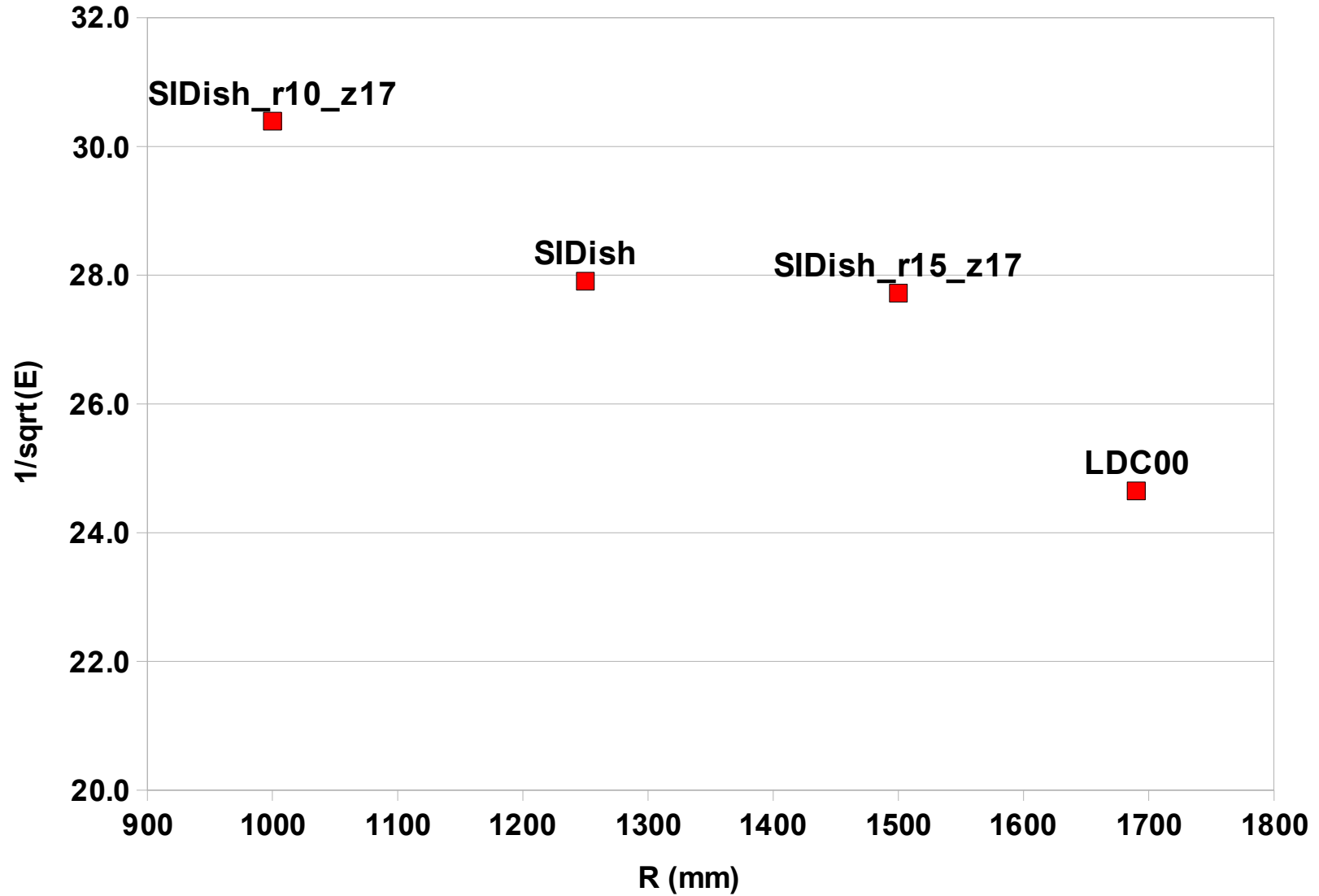
| Detector TAG | B-field | Tracker radius | Tracker length | rms90 (uds45) | Error |
|-----------------|---------|----------------|----------------|---------------|-------|
| LDC00 | 4 | 1690 | 2730 | 24.6 | 0.3 |
| SIDish | 5 | 1250 | 1700 | 27.9 | 0.4 |
| SIDish_r10_z17 | 5 | 1000 | 1700 | 30.4 | 0.4 |
| SIDish_r15_z17 | 5 | 1500 | 1700 | 27.7 | 0.4 |
| SIDish_r125_z15 | 5 | 1250 | 1500 | 29.0 | 0.4 |
| SIDish_r125_z19 | 5 | 1250 | 1900 | 28.5 | 0.4 |
| SIDish_4T | 4 | 1250 | 1700 | 28.9 | 0.4 |
| SIDish_6T | 6 | 1250 | 1700 | 28.6 | 0.4 |

PRELIMINARY



R dependence (Barrel)

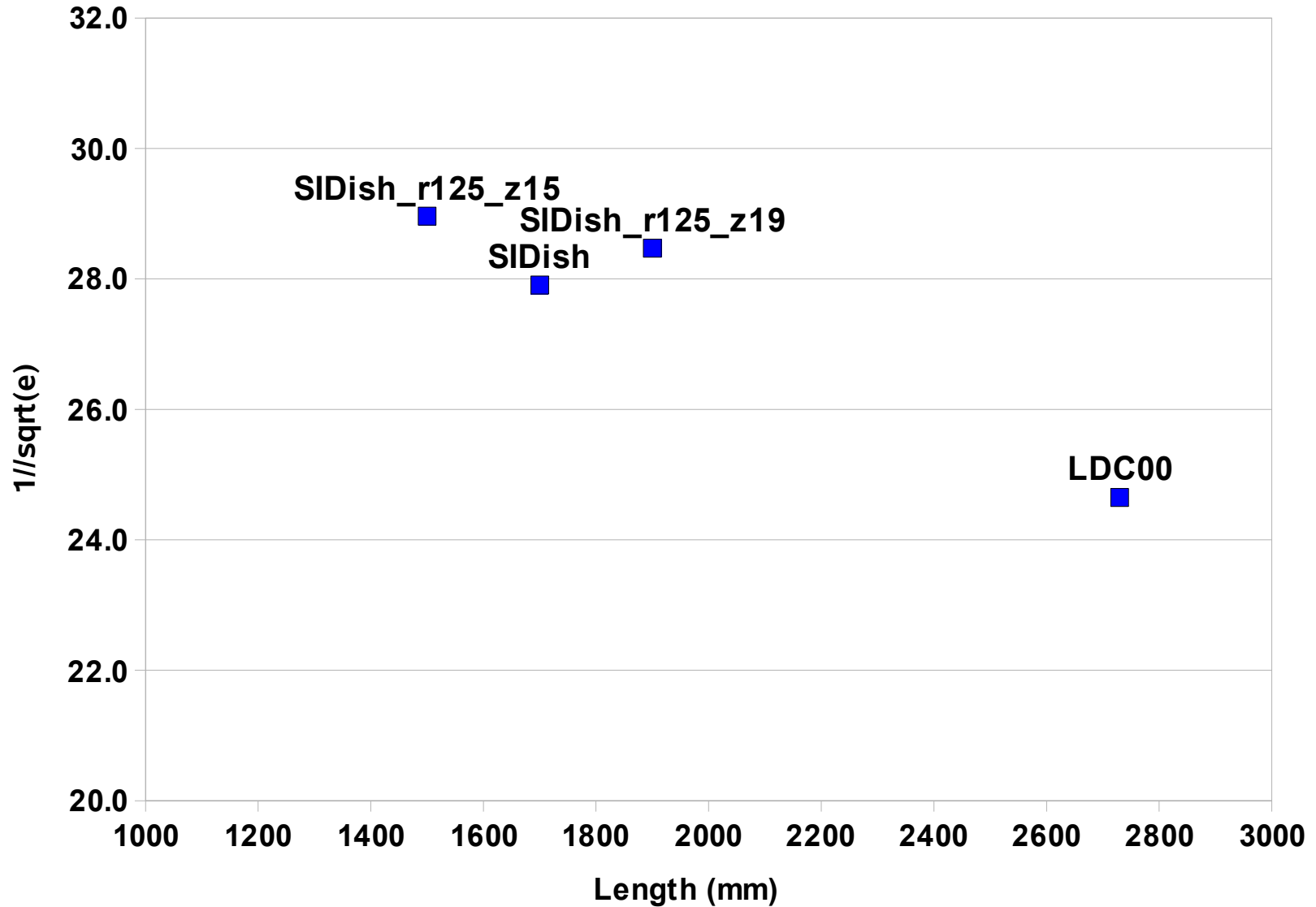
Dependence on Tracker Radius (R)





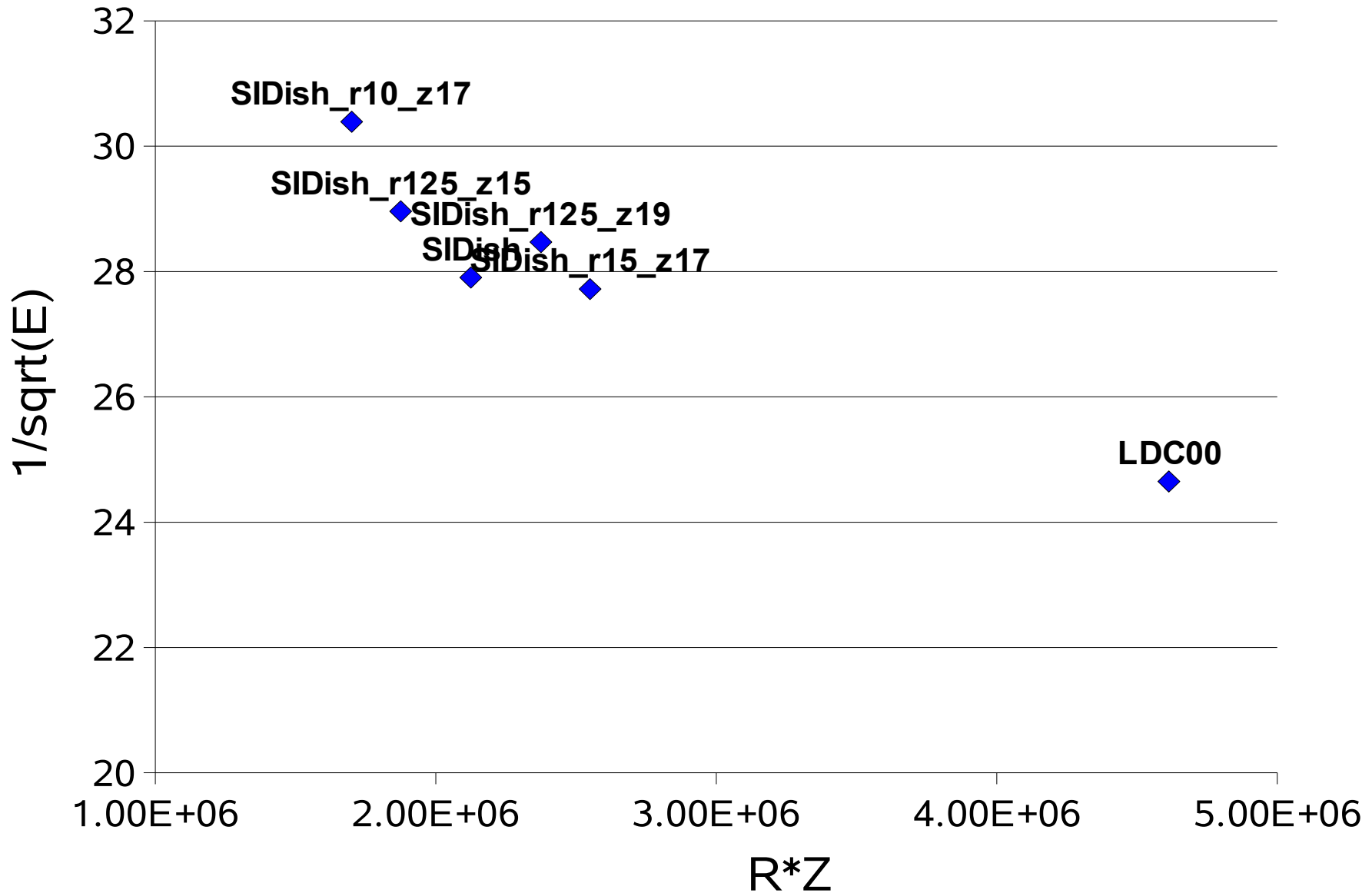
Z dependence (Barrel)

Dependence on Tracker Length (Z)



Another parametrization

R*Z dependence



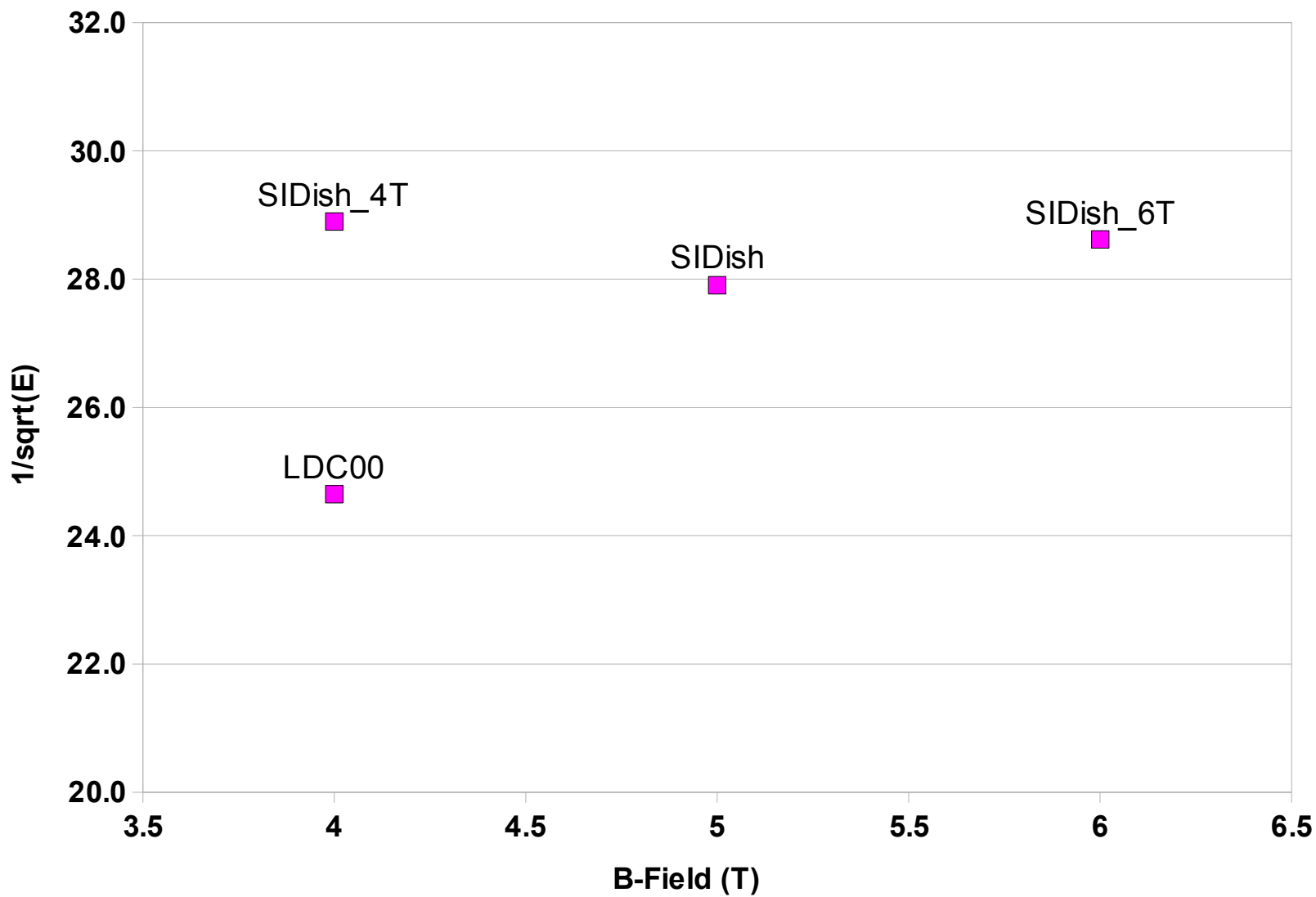
Some comments

- It is clear, that making R bigger does help
- Z is less obvious
- Are we asking the right question ?
- Probably we should scale Z and R at the same time
- We'll learn much more with higher energy jets



B field dependence (Barrel)

Dependence on B-Field



- 5T seem to be a sweet spot ...
 - Could be coincidence
 - We need more points 4.25, 4.5, 4.75, 5.25, 5.5 ...
 - Just a few 10 GB more
- Also higher energy jets will help us a lot to understand the dependence

Segmentation ?

- For the HCAL need to hack Mokka, it seems
 - need to look into this again
- For the ECAL it is a simple study
- Jobs are running
- Changing segmentation has an impact on Pandora
 - MIP finding, Clustering ...
- Digital vs. Analog ...
 - That is a completely different question...
 - Also requires algorithm changes/Optimization
 - Works at some level already with RPC's



RPC/GEM/Scintillator HCAL

- This is hard
- No model for GEM's afaik
- RPC model is existing ... at some level
- This will need real work
- Running Digital HCALs is possible
 - Mark showed that yesterday

- Machinery in place
- We have about 450 GB of simulation right now
- Thanks to
 - Steve Worm submitting jobs
 - Ray Cowan for setting things up at SLAC and taking on the 250 GeV samples
- We are becoming CPU limited ...
- Book-keeping is becoming challenging ...
- Stay tuned



The Setup

- CLHEP 2.0.2.2
- LCIO v01-09
- ROOT v5.16.00
- GEAR v00-08
- GEANT 4.9.0.p01
- Mokka 06-04-p03
- Marlin v00-09-10
- MarlinUtil v00-05
- MarlinReco v00-05
- PandoraPFA v02-00