SiD
Global Parameter Optimization using Pandora PFA

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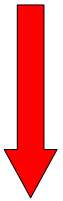
The Idea

- 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 within Marlin Framework
- No SiD detector model available in this framework
- Have to use a SiD look-alike, the SiDish

The setup

- Use PandoraPFA 2.0 & 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 ECAL 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

The different detectors

Detector TAG	B-field (T)	ECAL layers	ECAL cell size	HCAL layers	HCAL cell size	Tracker radius (mm)	Tracker length (mm)
LDC00Sc	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	3x3	1250	1700
SIDish_ecal_05x05	5	30	0.5x0.5	40	3x3	1250	1700
SIDish_45T	4.5	30	1x1	40	3x3	1250	1700
SIDish_55T	5.5	30	1x1	40	3x3	1250	1700

Current Status

- For each point
  - photons, hadrons, uds jets (45,100,250 GeV)
  - approx 45000 events per point
  - Check gear file is correct
  - for all points calibrate PandoraPFA
  - have photons, hadrons, uds jets for 45,100 (some at 250) GeV
- Simulation takes very long time
  - 1000 Z->uds (45 GeV) ~ 44 hours

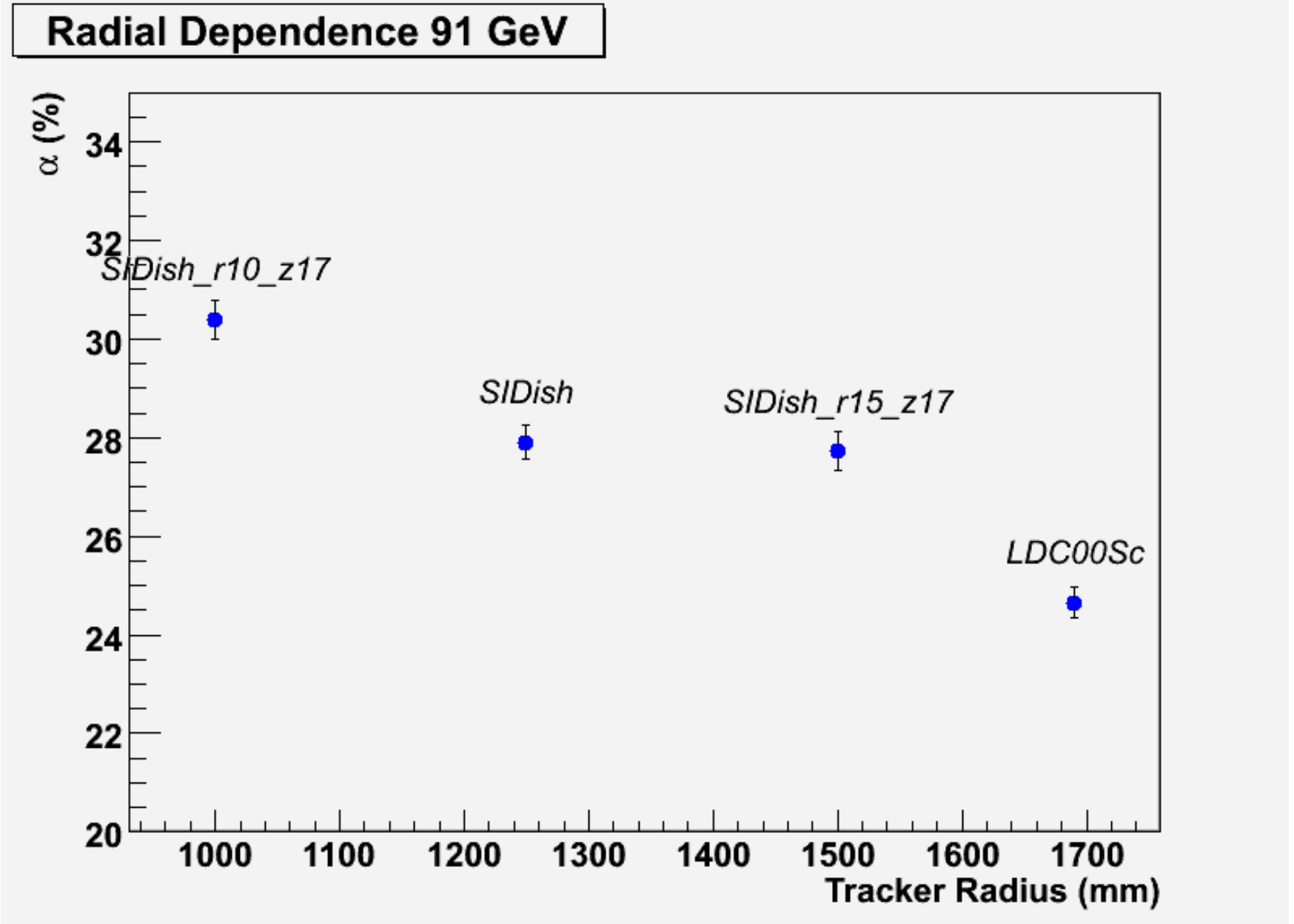
The results

- Results for 45 GeV & 100 GeV jets
- They are **PRELIMINARY**
- Numbers quoted are
  - cos(Thrust)< 0.7 : Barrel Events
- There are a set of caveats
  - Calibrate Response for different detector variations
  - Calibration can be retuned with existing samples
- Use latest Mokka Version with better HCAL driver ...
- So numbers could change slightly ...

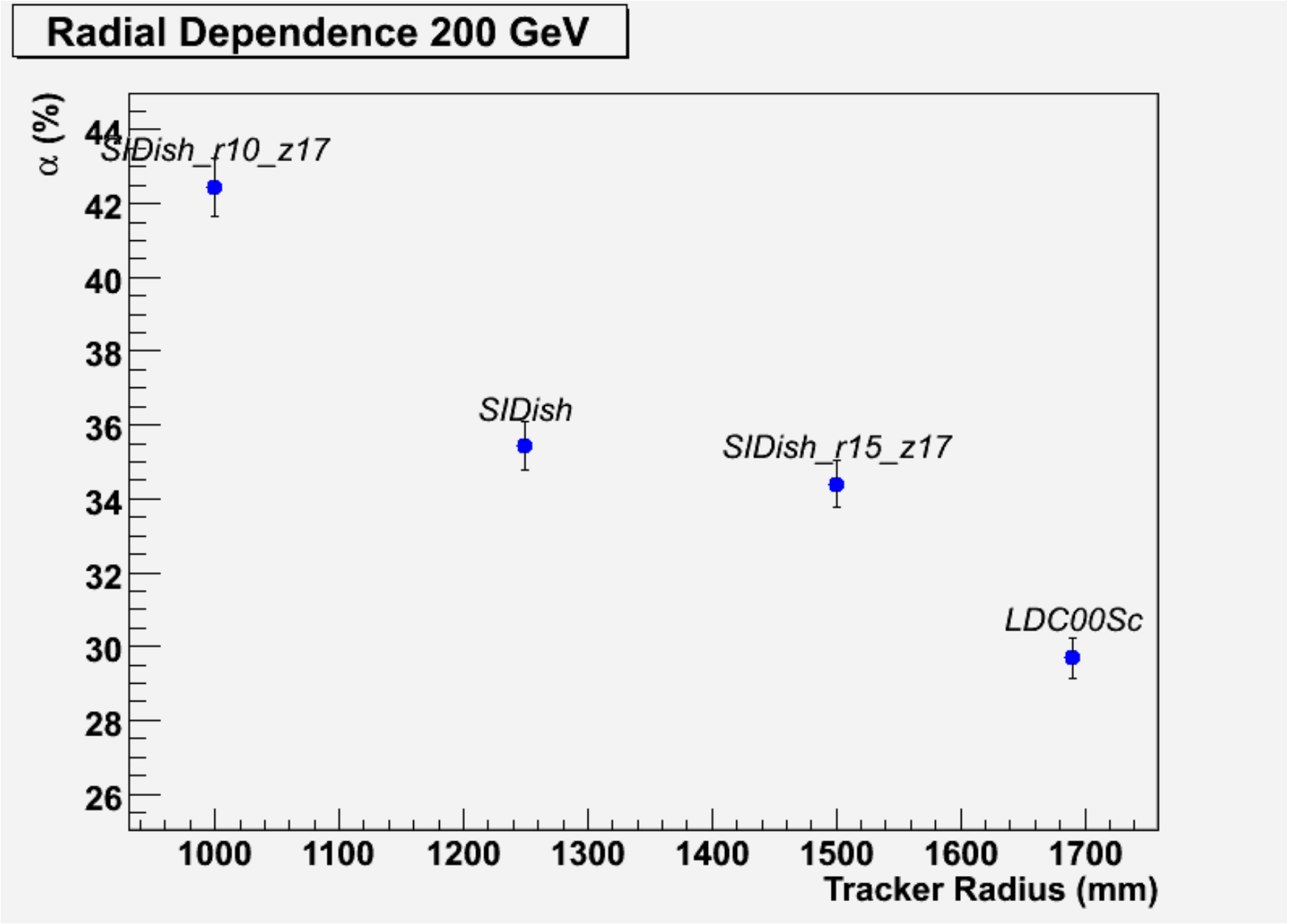
Grand Overview

Detector TAG	rms90 (91 GeV)	rms90 (200 GeV)
LDC00Sc	24.6 ± 0.3	29.7 ± 0.5
SIDish	27.9 ± 0.4	35.4 ± 0.7
SIDish_r10_z17	30.4 ± 0.4	42.5 ± 0.8
SIDish_r15_z17	27.7 ± 0.4	34.4 ± 0.6
SIDish_r125_z15	29.0 ± 0.4	34.4 ± 0.6
SIDish_r125_z19	28.5 ± 0.4	36.4 ± 0.7
SIDish_4T	28.9 ± 0.4	39.4 ± 0.7
SIDish_6T	28.6 ± 0.4	34.2 ± 0.6
SIDish_ecal40	27.1 ± 0.3	33.9 ± 0.6
SIDish_ecal_05x05	28.1 ± 0.4	35.7 ± 0.7

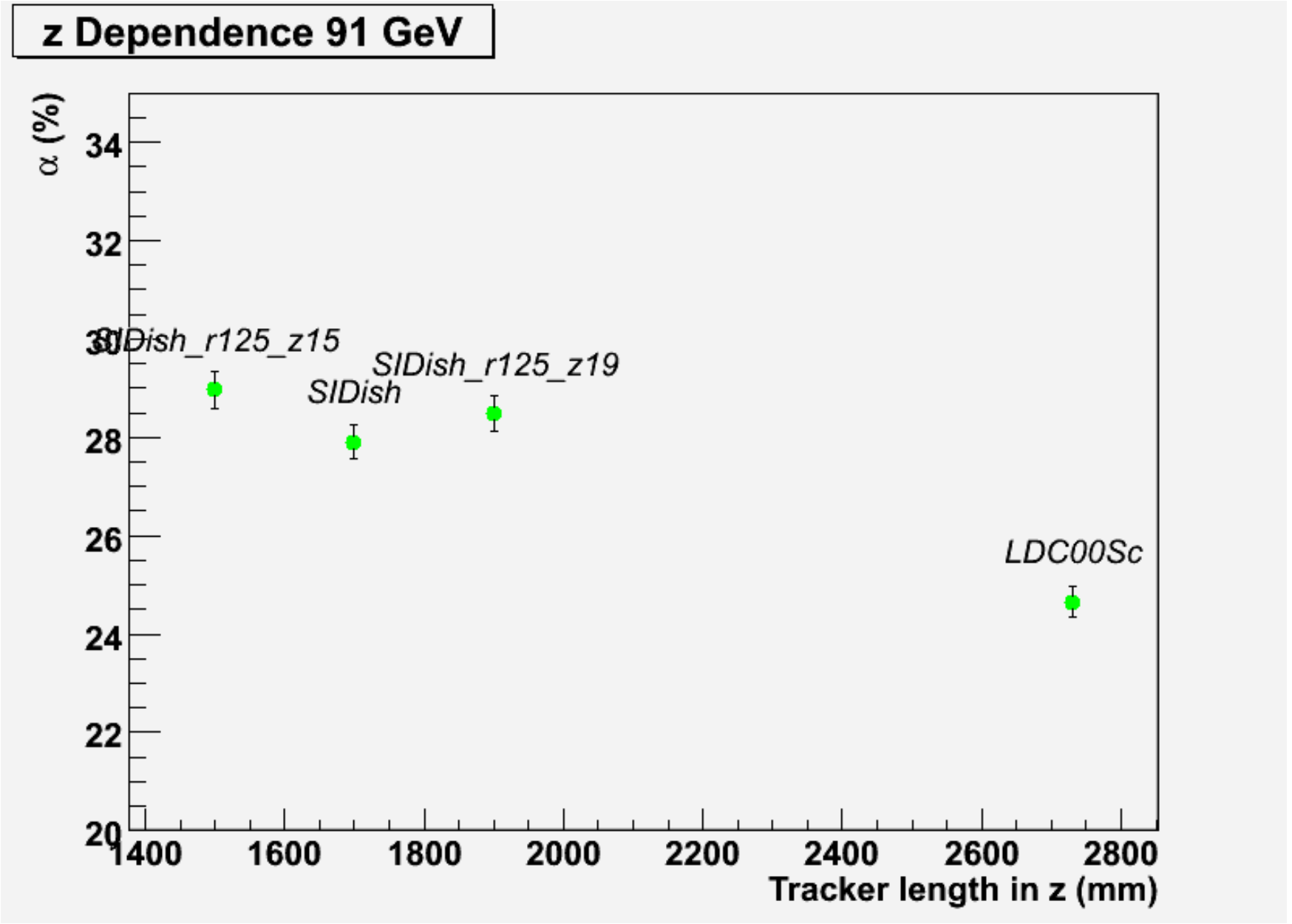
Radial Dependence



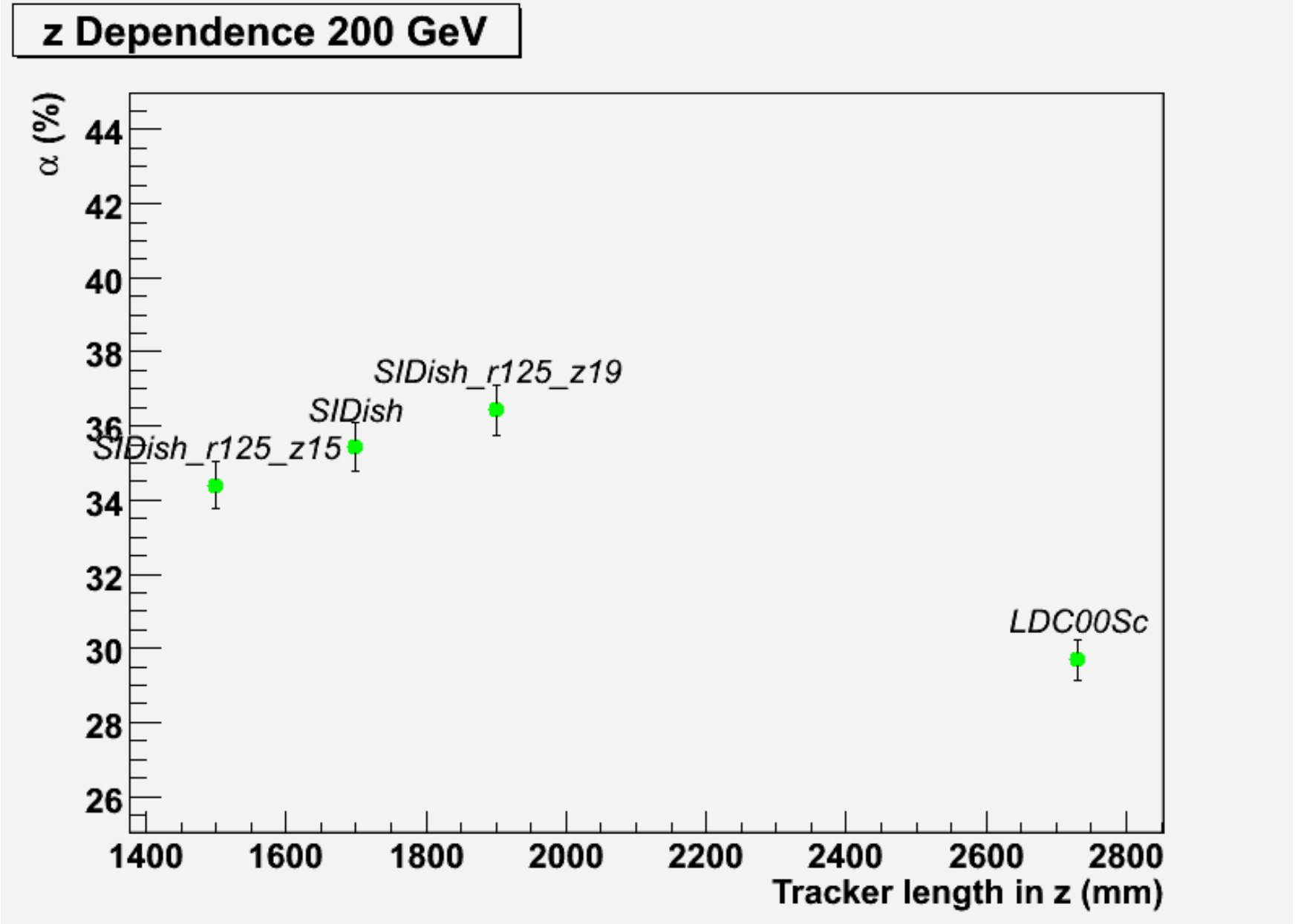
Radial Dependence (II)



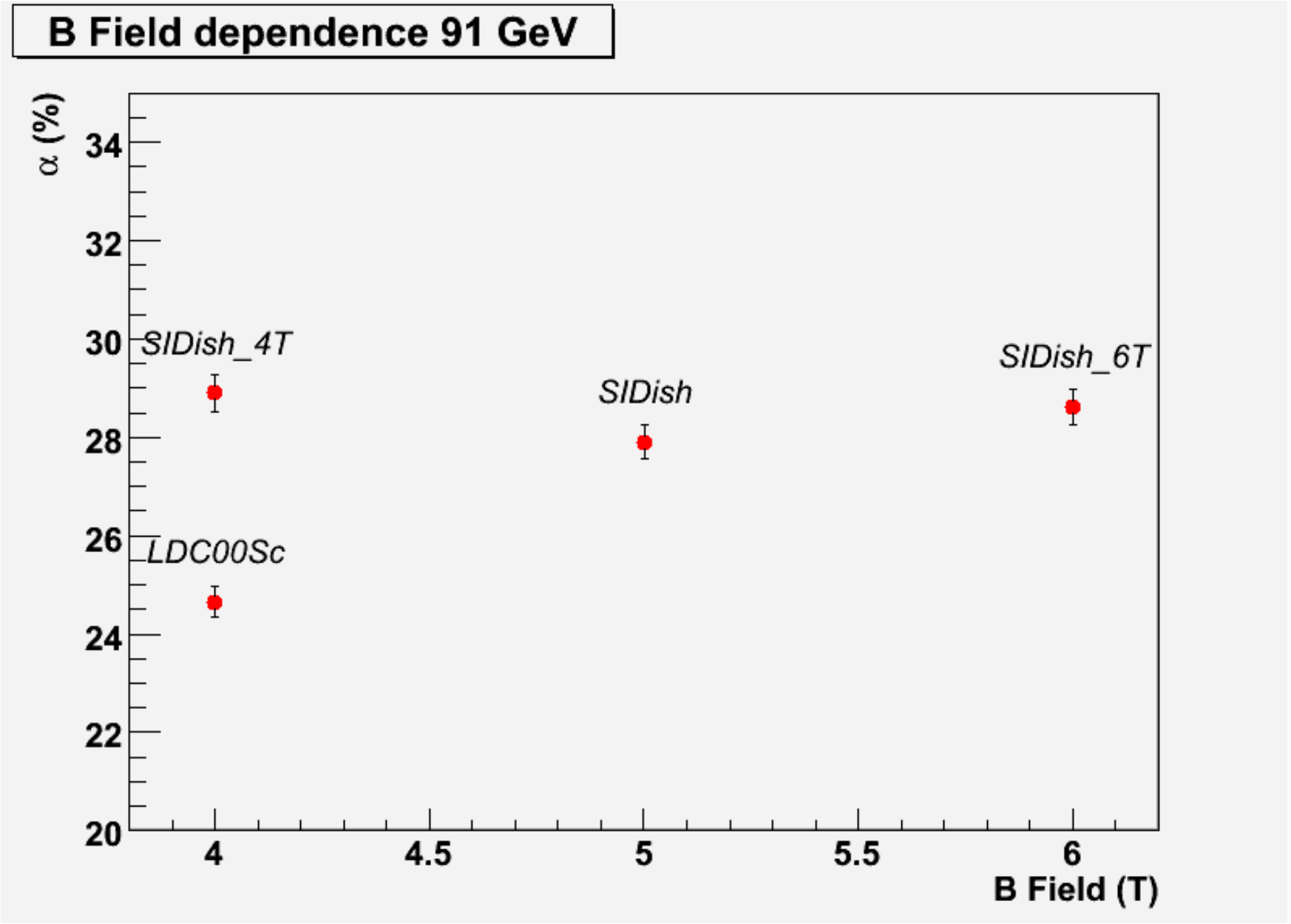
Z dependence



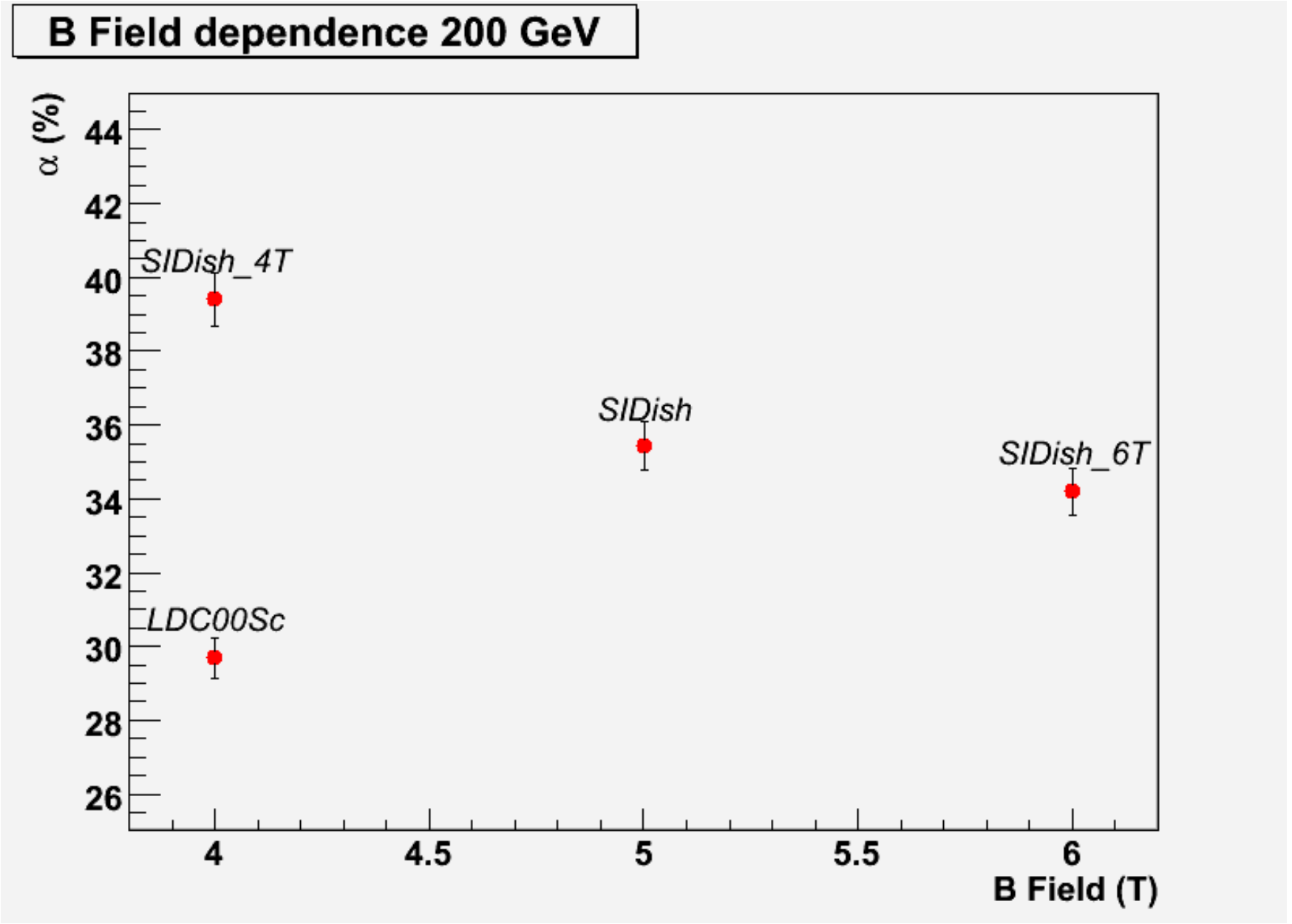
Z dependence (II)



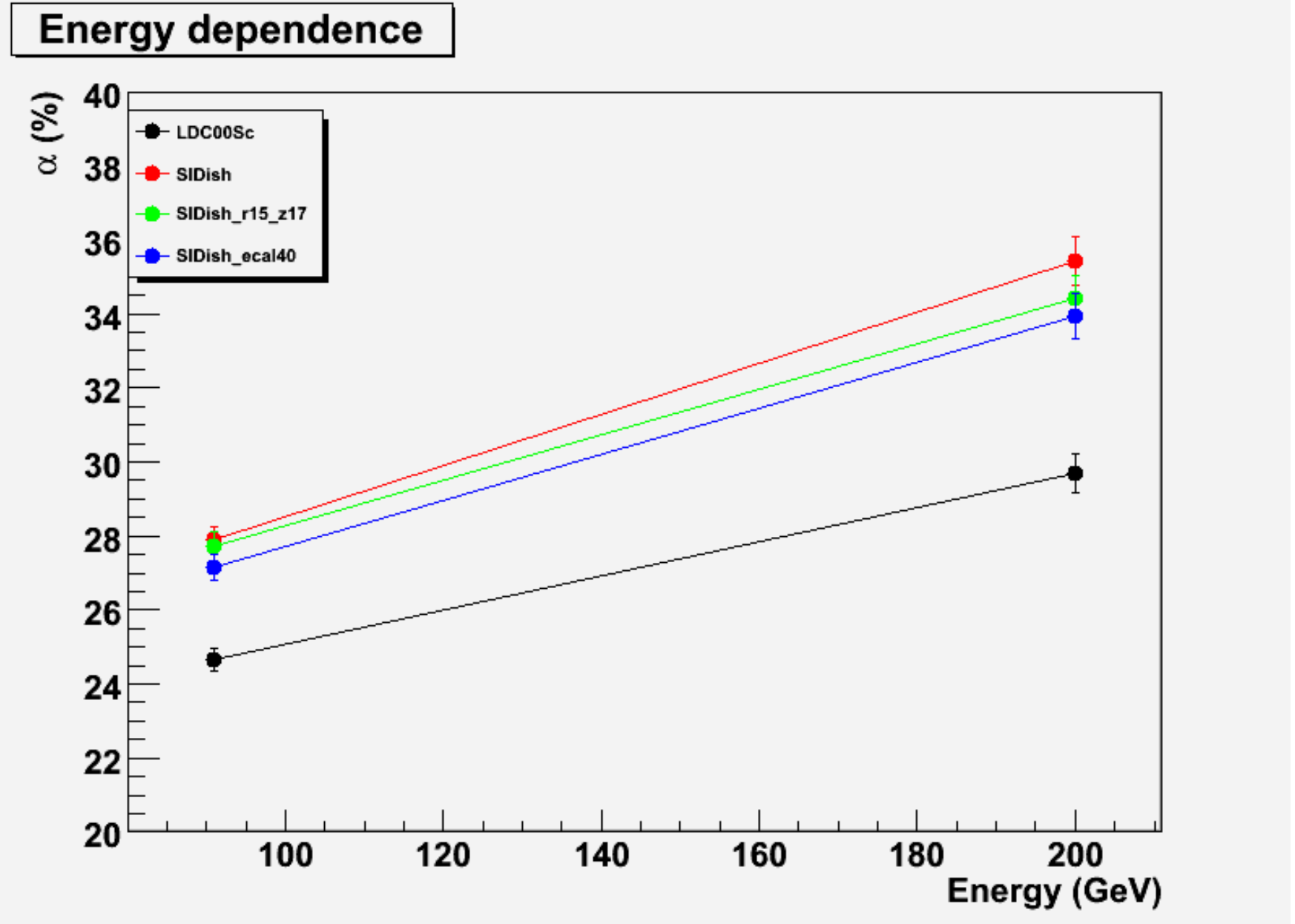
B Field


B Field dependence 91 GeV
α (%)
34
32
30
28
26
24
22
20
SIDish_4T
SIDish
SIDish_6T
LDC00Sc
4
4.5
5
5.5
6
B Field (T)

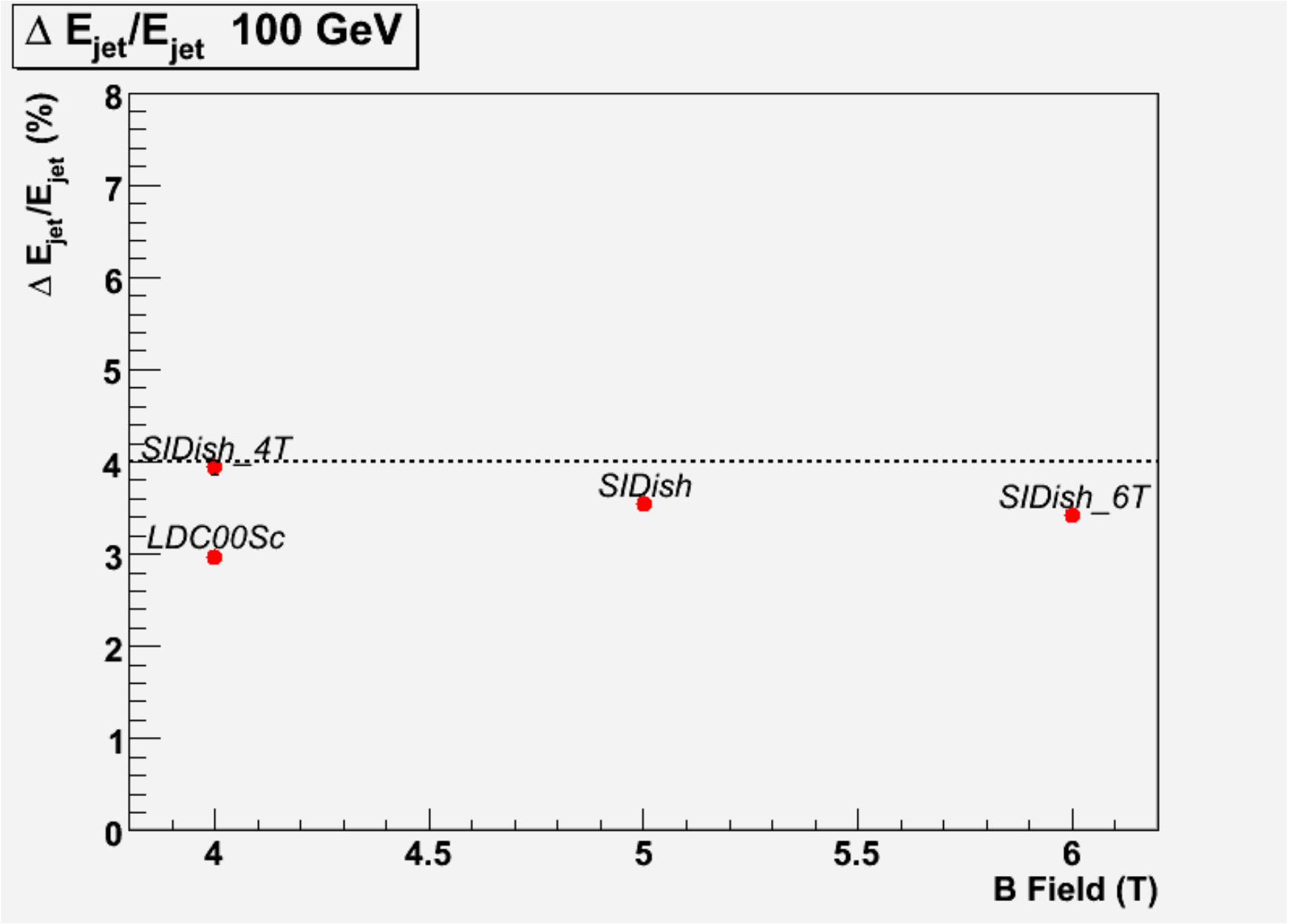
B Field (II)


B Field dependence 200 GeV
α (%)
44
42
40
38
36
34
32
30
28
26
SIDish_4T
SIDish
SIDish_6T
LDC00Sc
4
4.5
5
5.5
6
B Field (T)

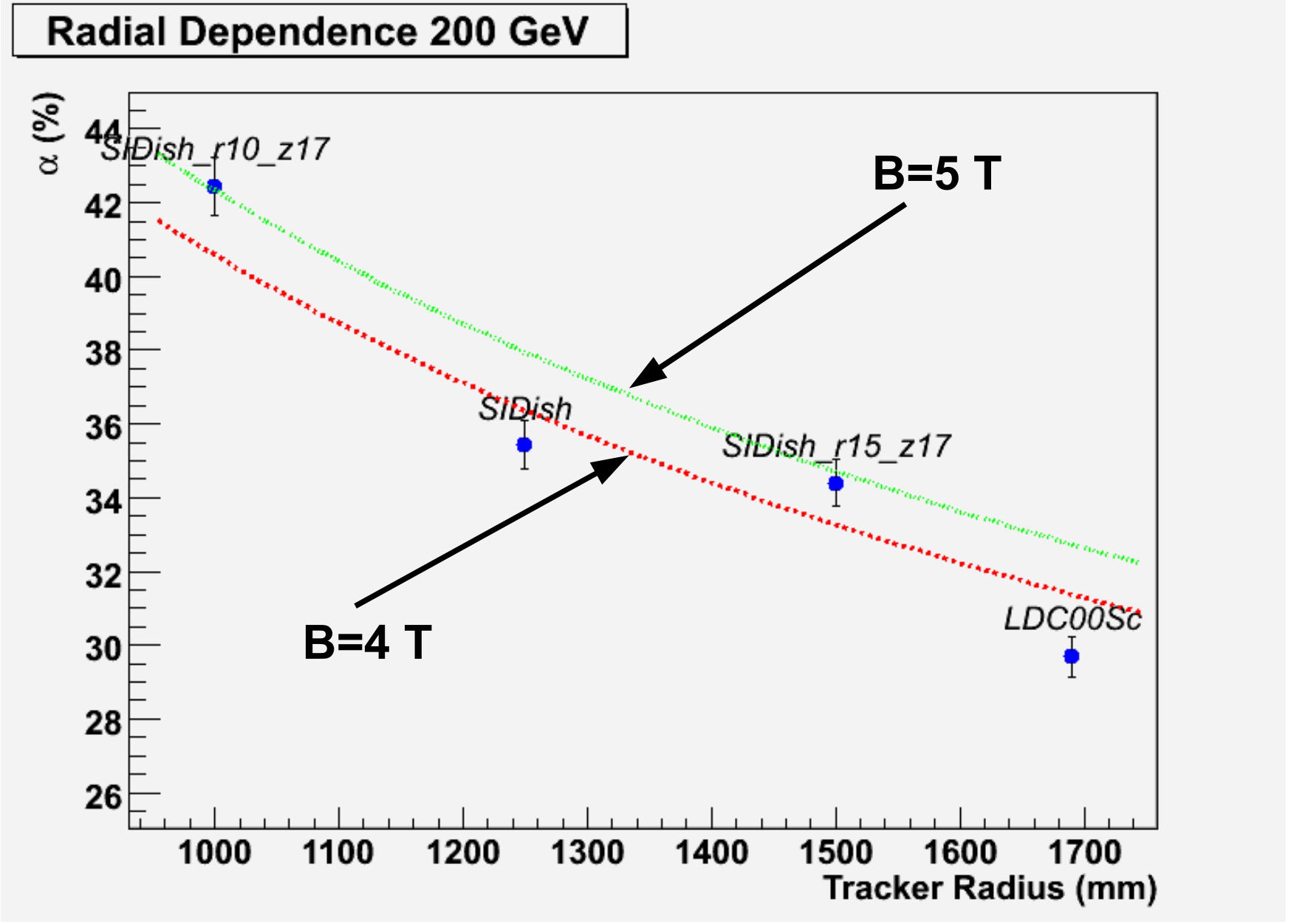
Energy Dependence



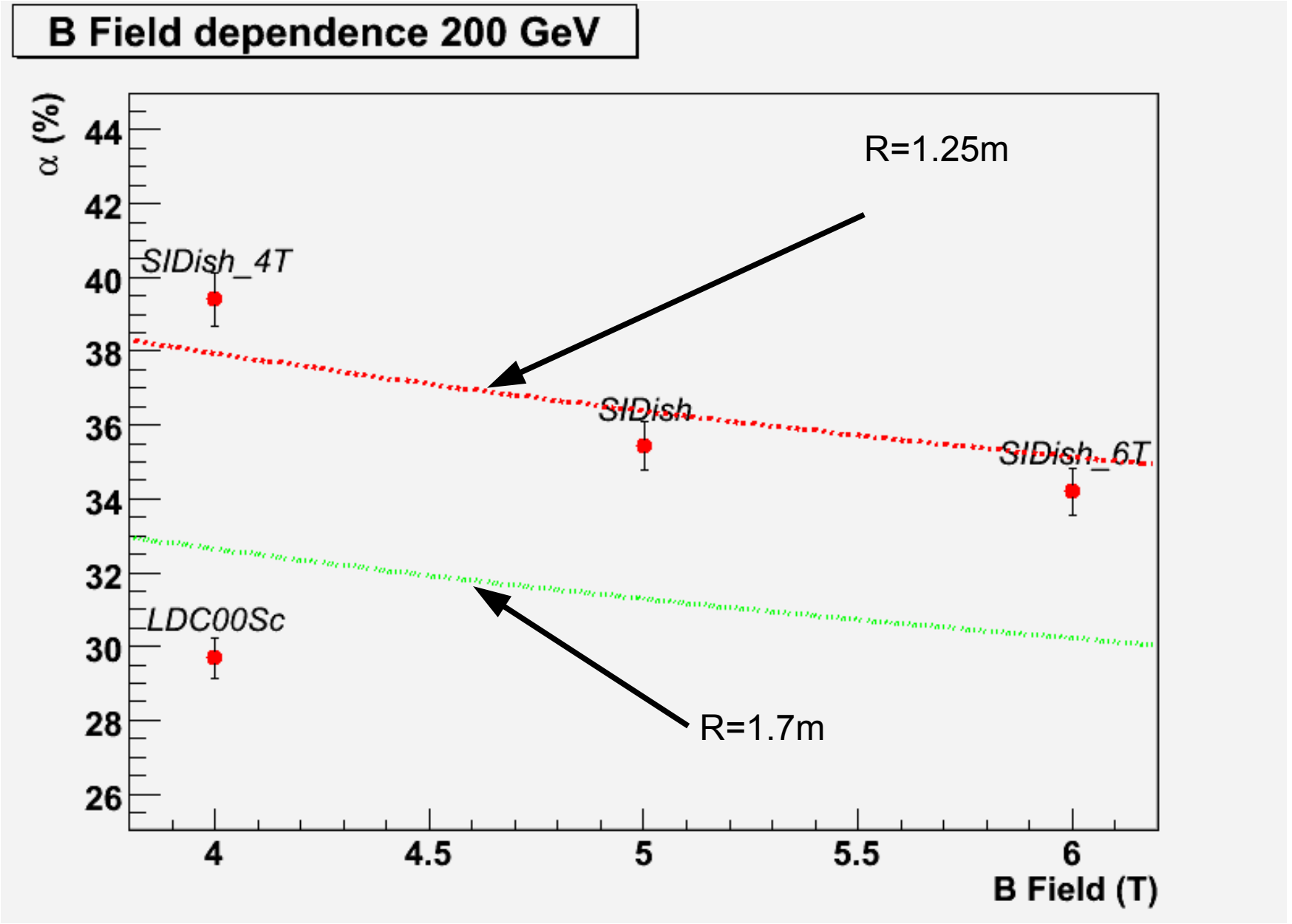
Jet Energy Resolution



Using Mark's scaling Law



Mark's scaling Law (II)



Some comments

- It is clear, that making R bigger does help
- Z is less obvious
- Probably we should scale Z and R at the same time
- B field only has an impact at higher energies
- What should we focus on for discussion:
  - Make the calorimeter deeper
  - move out the ECAL (1.25 to 1.5 meters ...)
  - Is 4 or 4.5 T sufficient ?
- **PLEASE COMMENT !**

Plans

- Use 500 GeV qq samples (being generated at MIT)
- Run with Digital HCAL samples
- Use latest Mokka for HCAL studies
  - Depth
  - Layers
  - Segmentation ...
- More longterm
  - use org.lcsim Reconstruction via LCIO

Summary

- First results at 200 GeV available
  - The ILC jet physics region ...
- What do want to learn?
  - What is the best PFA detector
    - performance
    - affordable
    - passes the laugh test
  - Stay tuned for Marty's talk
- Will continue working on this, with 500 GeV samples as well
- Thanks to Ray Cowan & Steve Worm for the help in running jobs

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