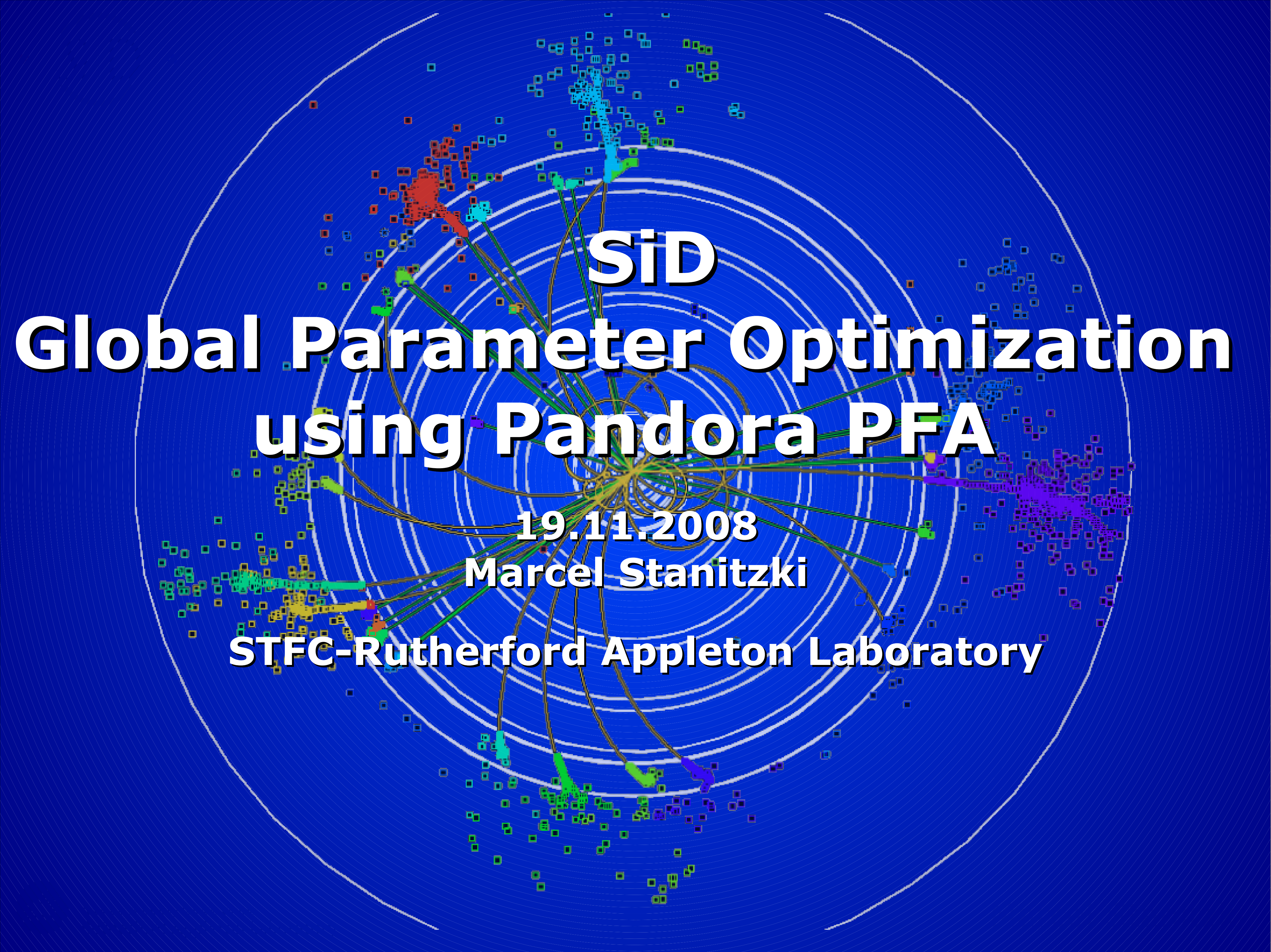
SiD
Global Parameter Optimization using Pandora PFA



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Detector Optimization

- Optimize the detector parameters
  - to maximize physics potential
  - only benchmarks will give you physics performance
- while keeping in mind
  - Engineering constraints
  - Costs
- In this talk
  - PFA is the driving force behind the detector design
  - So variable to optimize is **Jet Energy Resolution**
  - Use PFA algorithms to make choices

The study

- PFA of choice is PandoraPFA by Mark Thomson
  - Was the working algorithm at the begin of study
- Using an SID-lookalike , the SIDish
  - derived from LDC00Sc
- Results for 45 GeV & 100 GeV <u>uds</u> jets
- Numbers quoted are (if not mentioned otherwise)
  - $\cos(\theta_{Thrust}) < 0.7$: Barrel Events
  - using α in % $\frac{\sigma_E}{E} = \frac{\alpha}{\sqrt{E}}$

The caveats

- There are a set of caveats
  - ECAL/HCAL modelling
  - scintillator vs RPC
  - Using track cheaters and TPC instead of Silicon Tracker
  - different software frameworks
  - Different tunings ..
  - algorithm dependences
- That's why it is **SIDish** not **SID**

The detector setup

- Use PandoraPFA 2.01 & LCPHYS
- Use LDC00Sc Model
- Derive SIDish from that
- Detector Summary:

	LDC00Sc	SIDish
ECAL inner radius	1.7 m	1.25m
ECAL length	2.7 m	1.7 m
ECAL layers	30+10	20+10
ECAL material	SiW	SiW
HCAL layers	40	40
HCAL material	Fe-Scint	Fe-Scint
Field	4 T	5 T

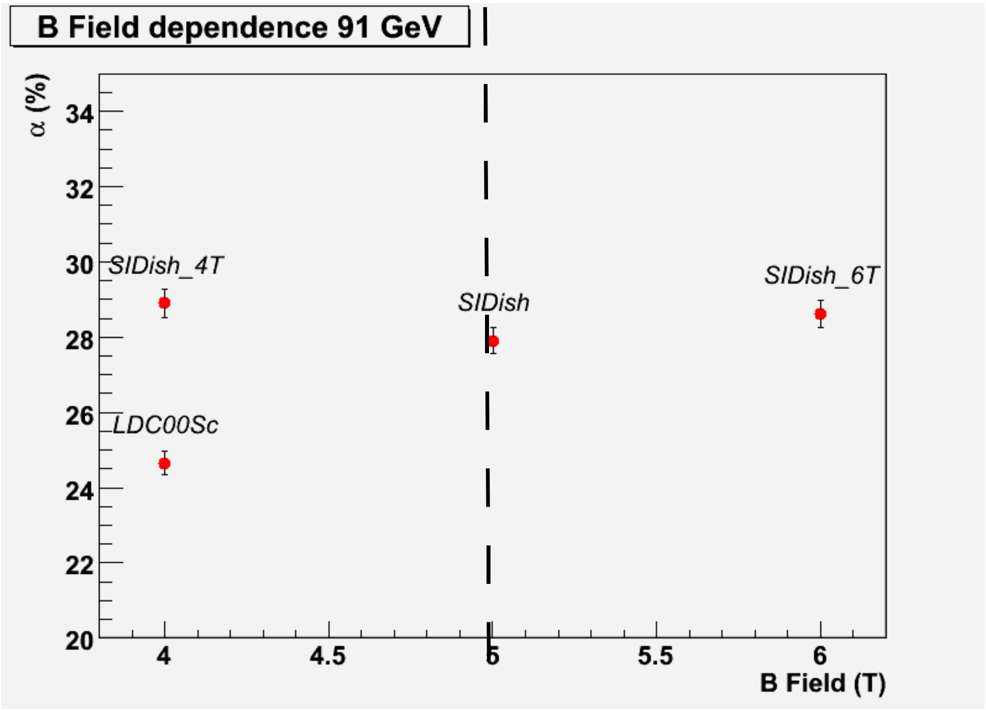
Global parameters for SiD

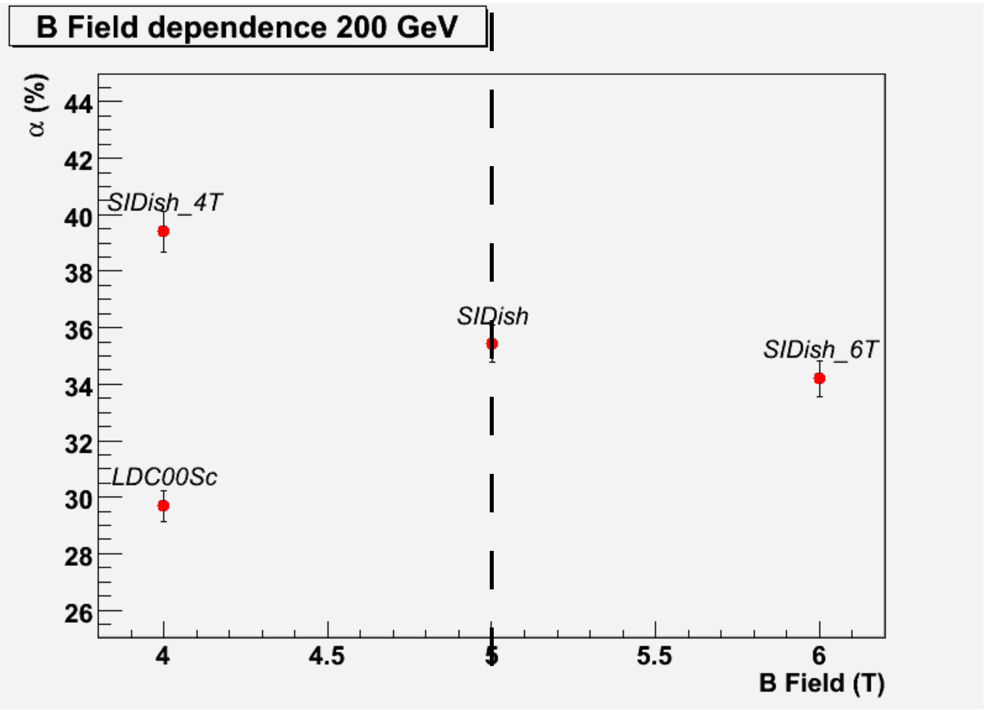
- B Field
- ECAL inner Radius
- ECAL inner z
- HCAL depth in λ_{iron}
- HCAL longitudinal segmentation

B field

- Choice for a compact detector with 5 T field
  - good for tracking, vertexing
  - important for beam background suppressions
  - PFA with sid01-style detectors require high B field
- Fixing the B field to 5 T severely constrains parameter phase space
- From *sid01* baseline we have <25 cm room to increase the radius
  - Driven by engineering

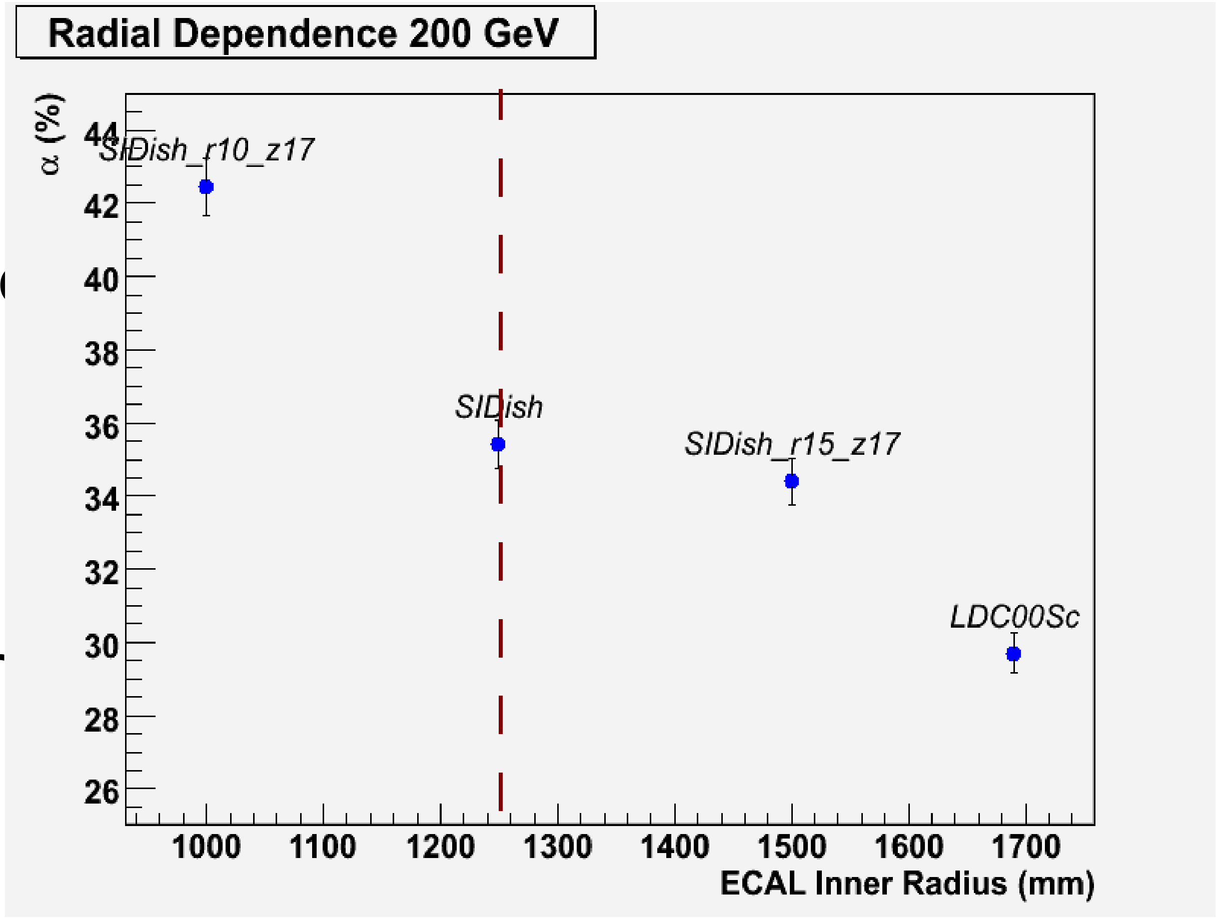
B field plots





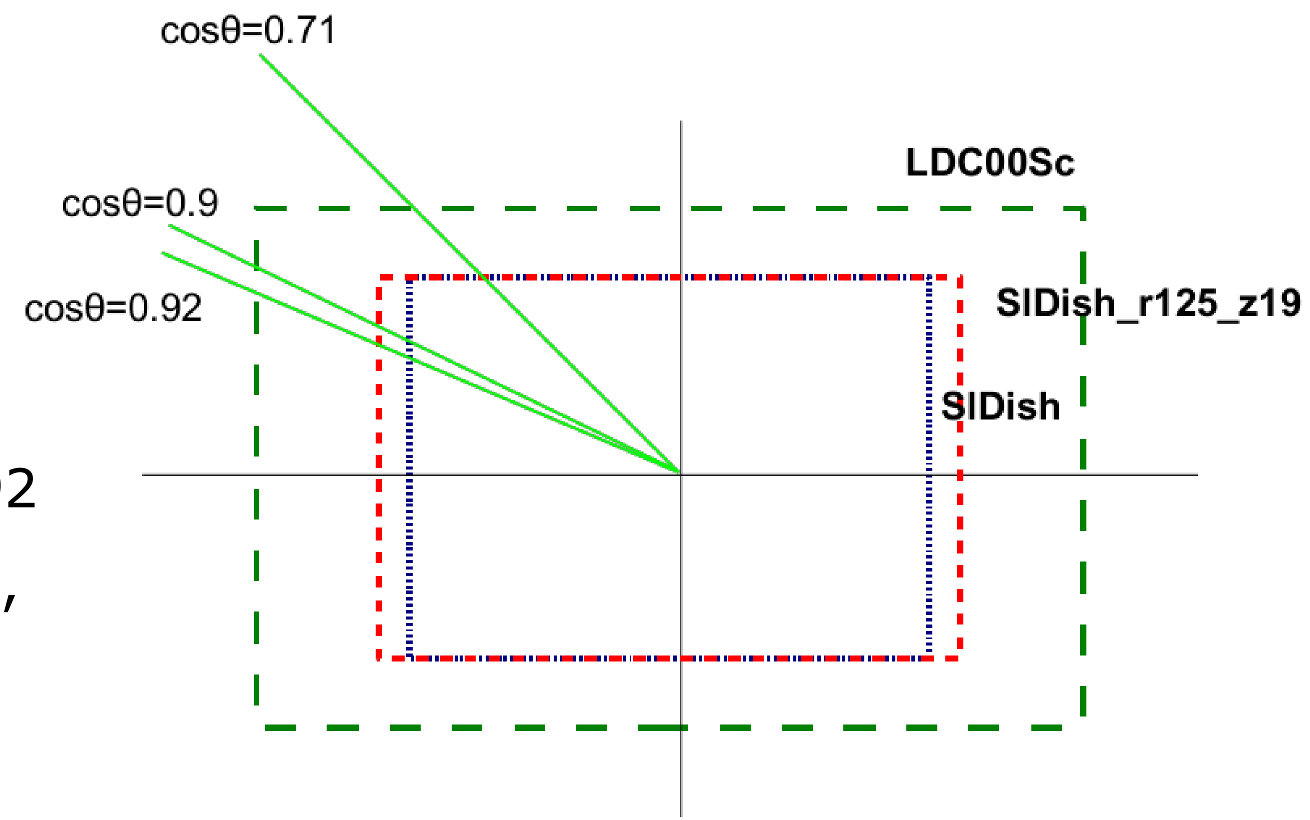
ECAL inner radius

- 1.25 m is alright for a SiD-style detector
- Decent performance f[...] PFA
- Larger Tracker brings small improvements
- Smaller Tracker sever[...] affects performance



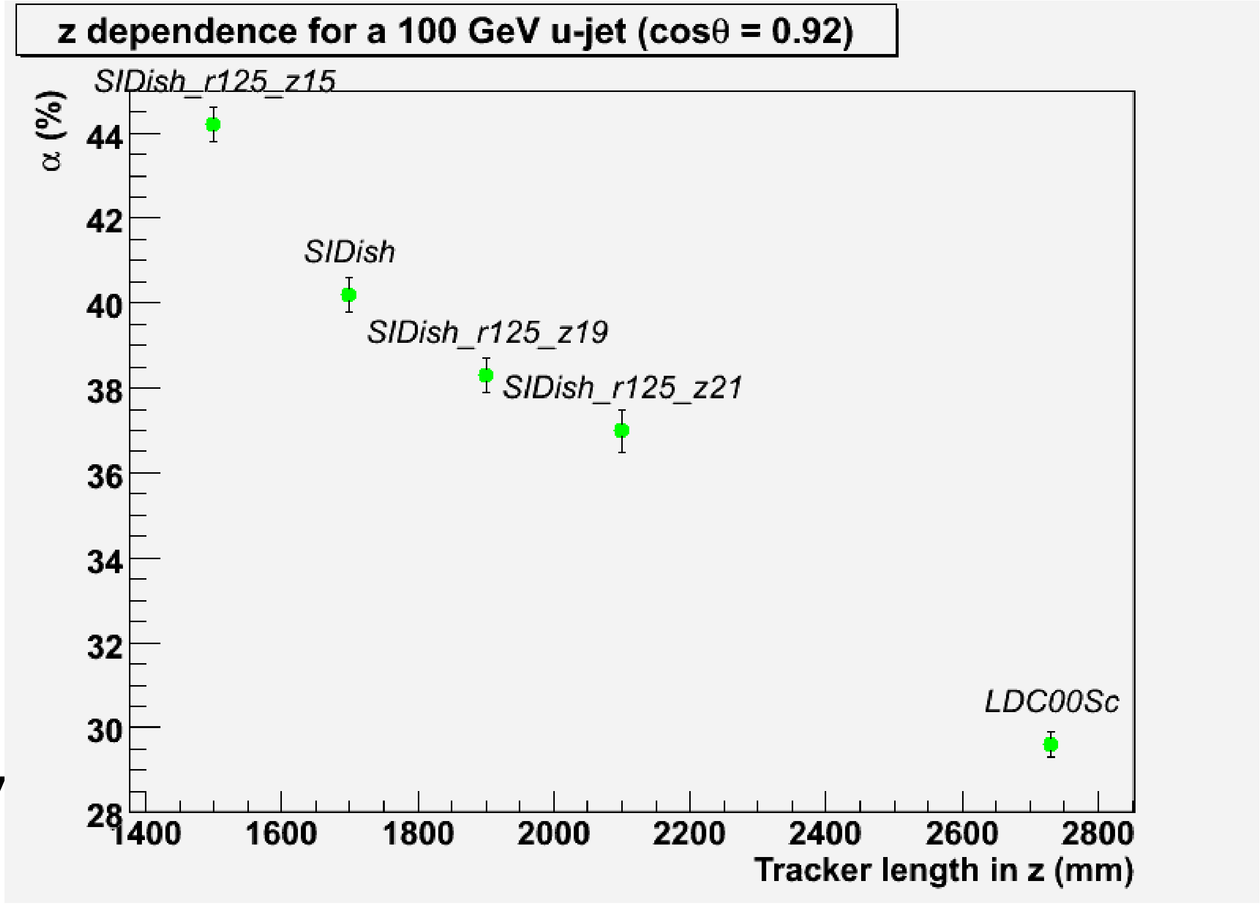
ECAL Inner z

- Study forward performance
- Special Samples
  - 1 u jet at cosθ=0.92
  - available at 50,100, 250 GeV
  - probing forward performance

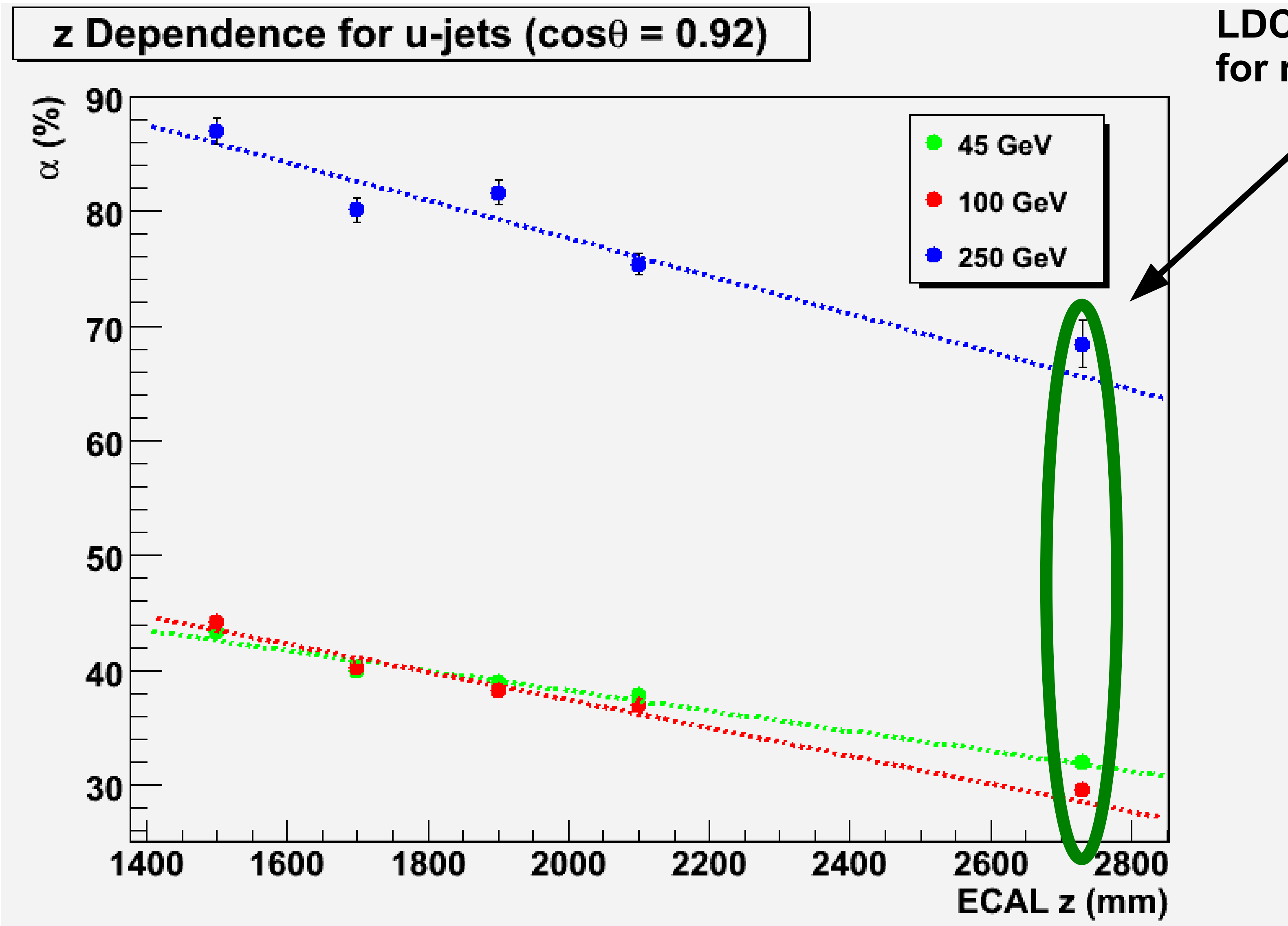


Results

- Clear trend
- larger z is better
- Many reasons
  - done at fixed angle
  - better separation
  - less losses down the beampipe
- Also need to quantify forward physics gain



For different energies

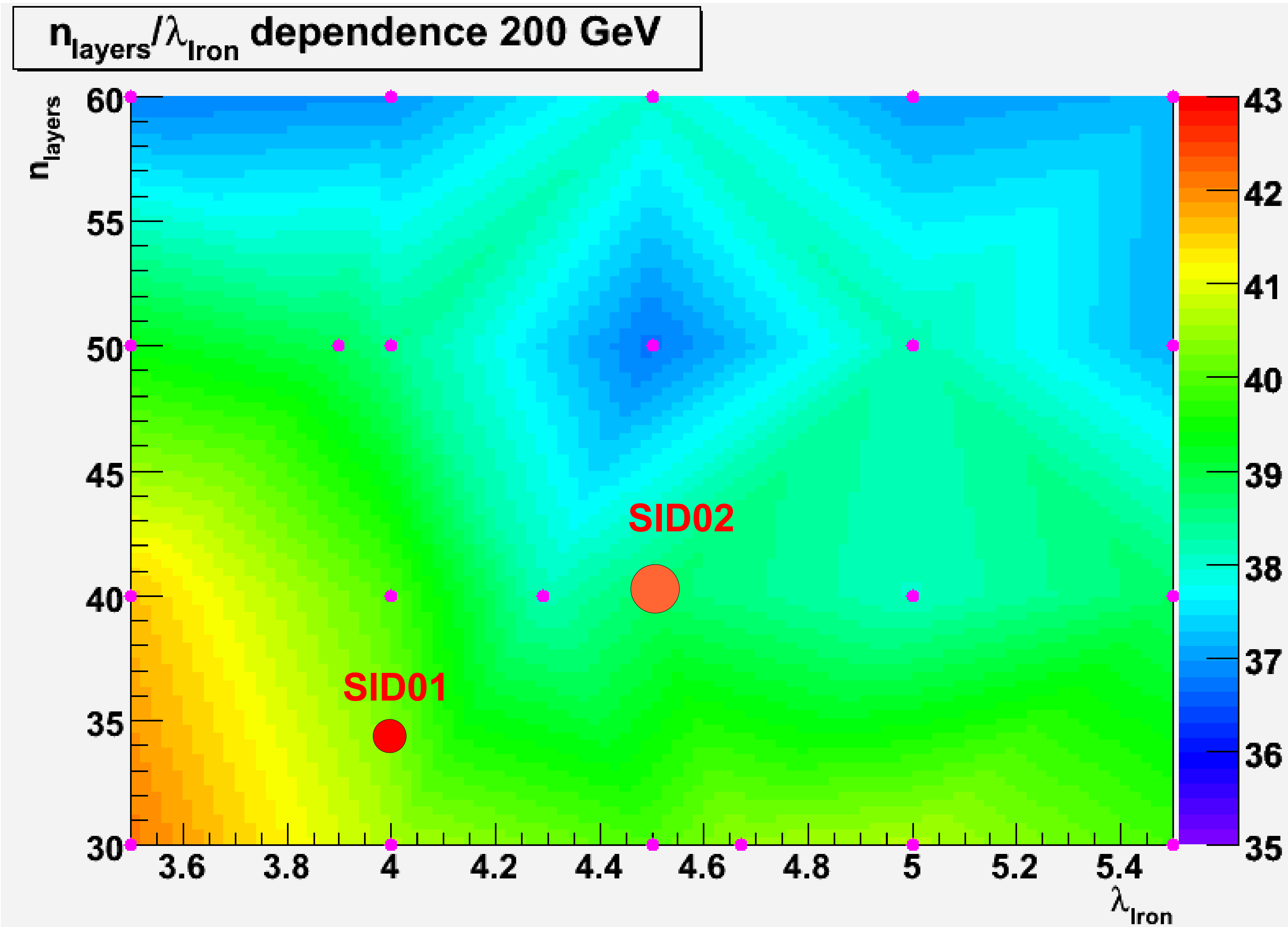


Points for LDC00Sc for reference

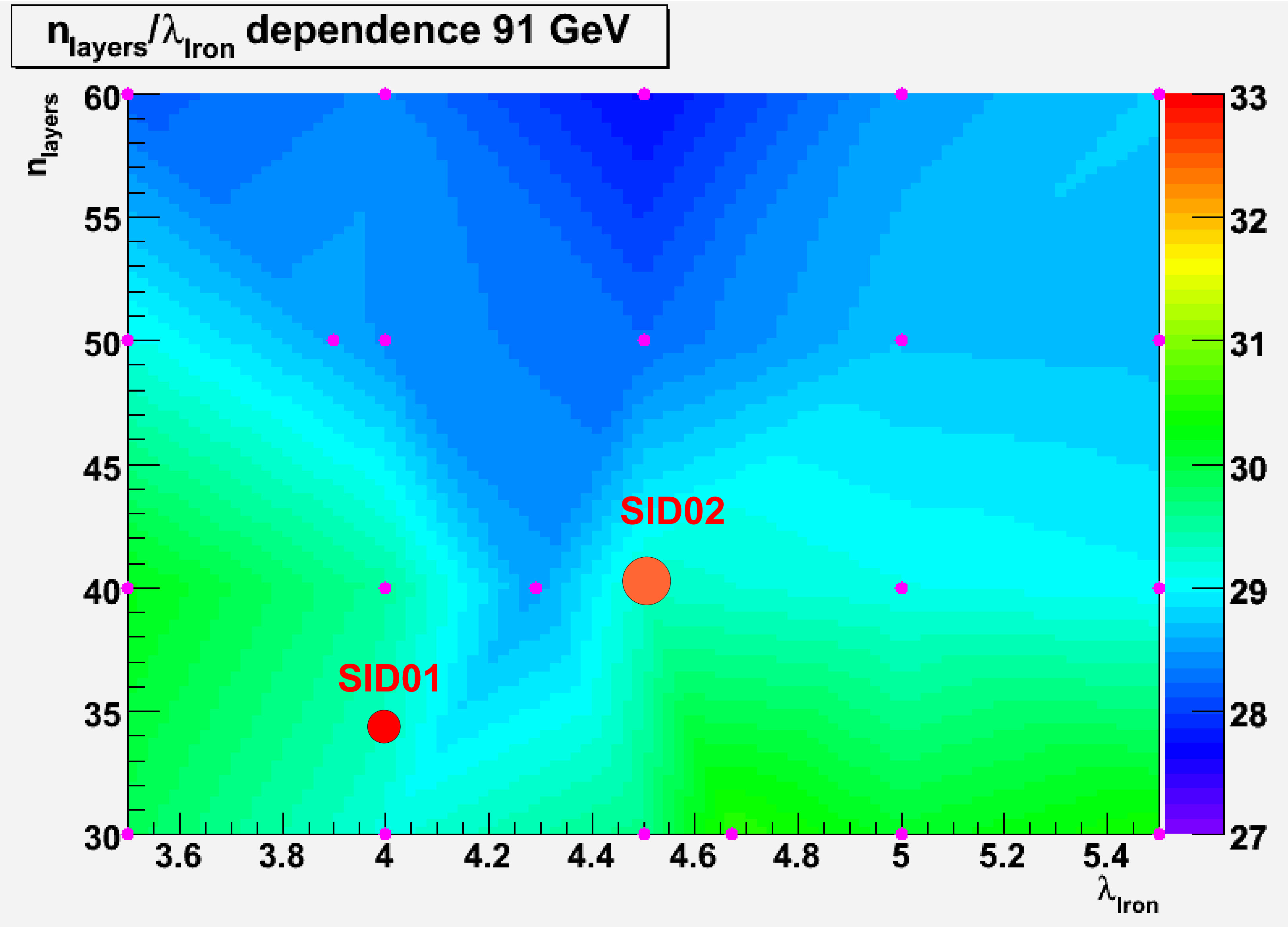
HCAL

- sid01 HCAL was only 4.0 λ_{iron} and 34 layers
- Agreement already before
  - Probably too shallow
- But how much more do we need ?
- Make scan over n_{Layers} and λ_{iron}
  - 30- 60 layers
  - 3.5-5.5 λ_{iron}
  - 20 detector configurations in total

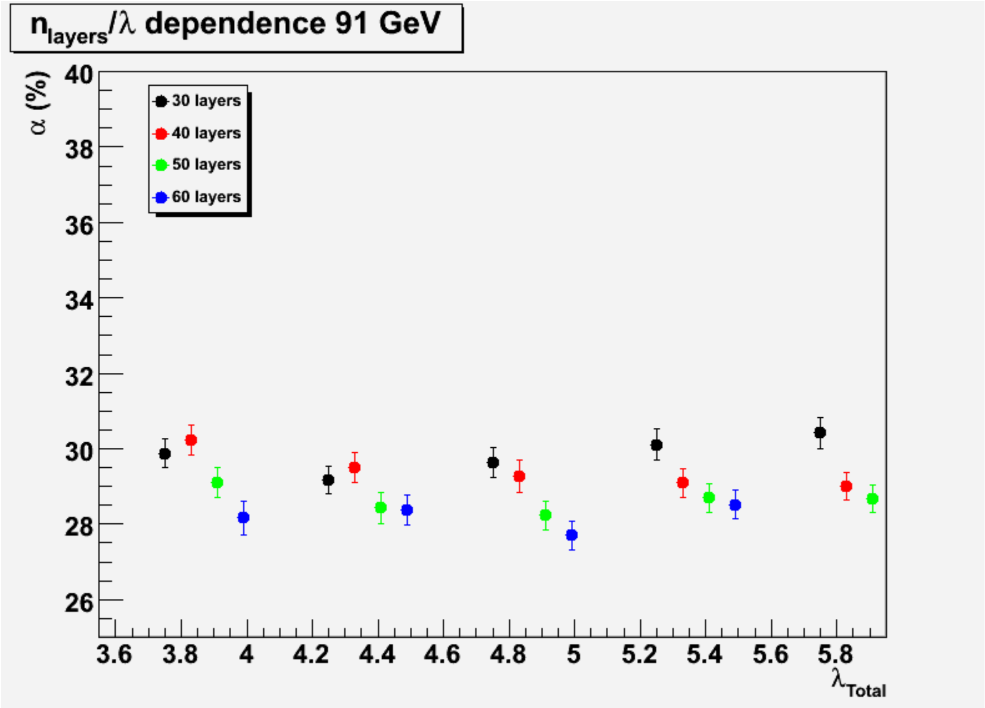
Results at 200 GeV

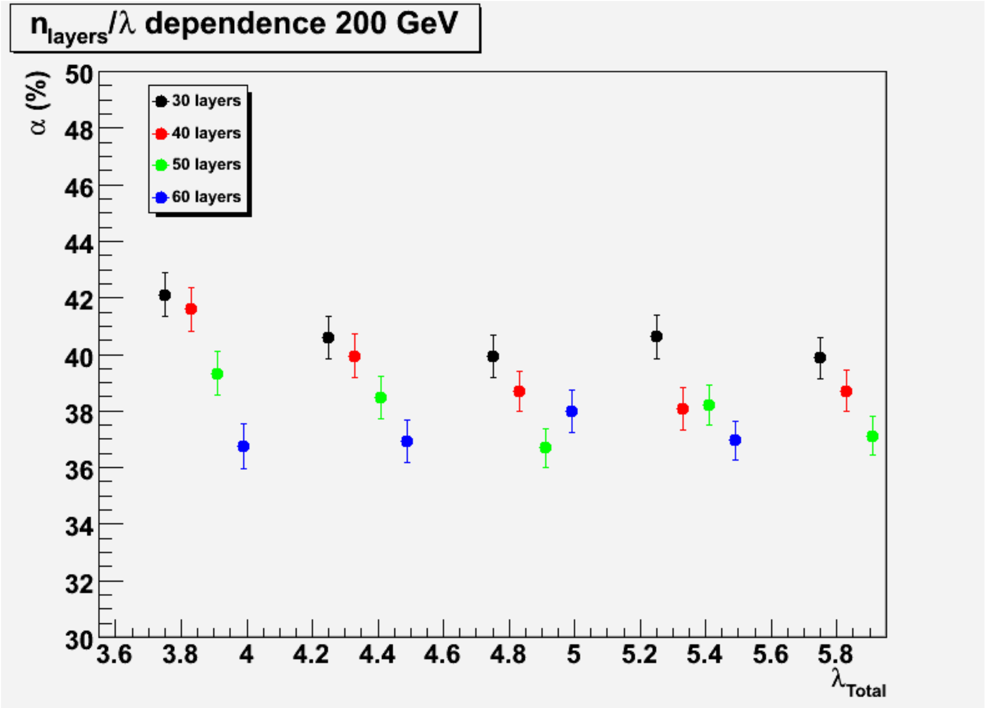


Results at 91 GeV



A closer look





Making SiD02

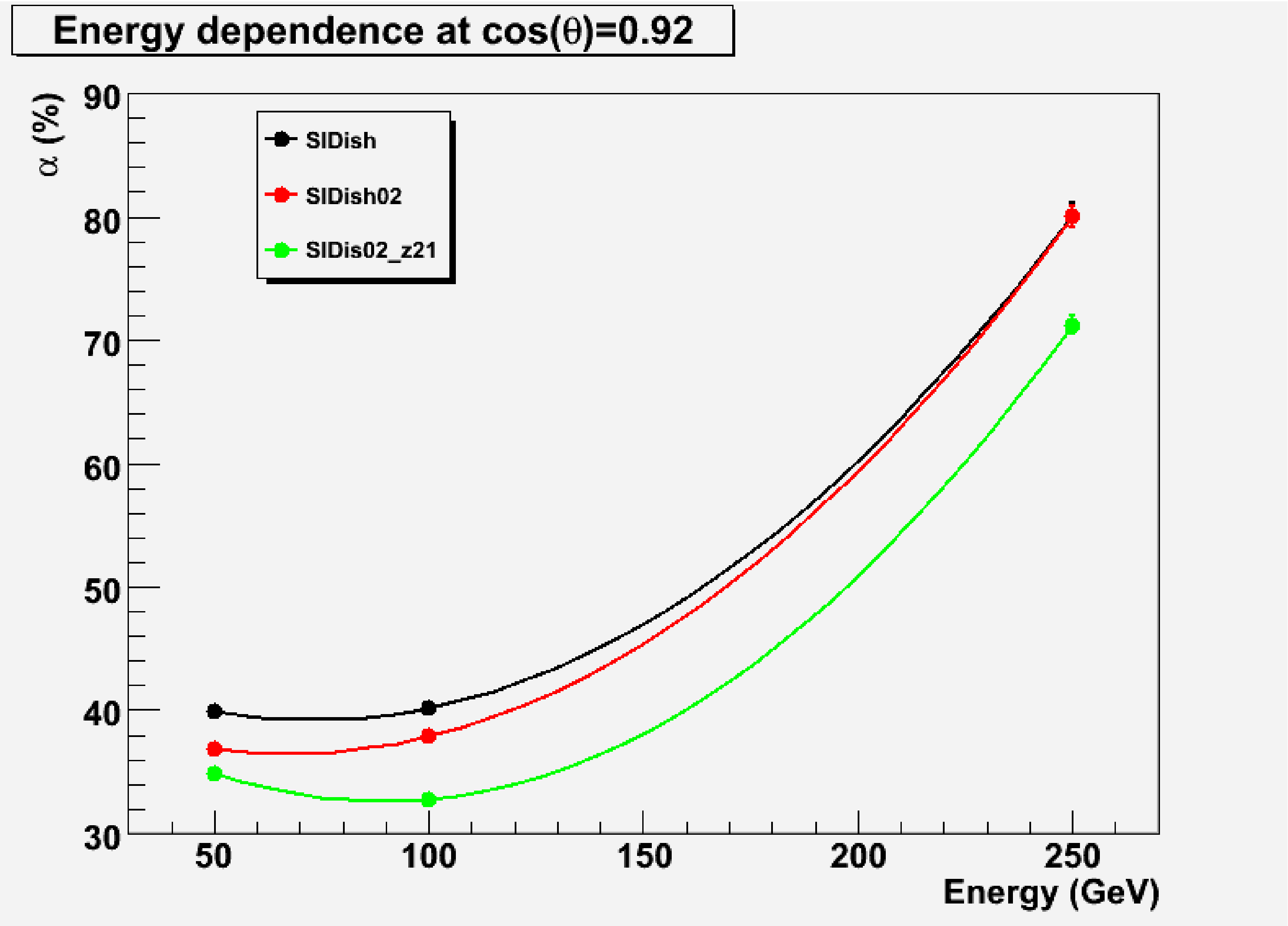
	sid01	sid02-stretch	sid02
ECAL inner radius (m)	1.25	1.25	1.25
ECAL inner Z (m)	1.7	**2.1**	1.7
HCAL depth (λ_{iron})	4	**4.5**	**4.5**
HCAL layers	34	**40**	**40**
B Field	5	5	5

- Two versions proposed for sid02
  - standard
  - stretched
- Standard sid02 was chosen for LoI

Testing SiD02

- Updating SIDish to SIDish02
  - HCAL with 4.5 λ_{iron} and 40 layers
  - ECAL in SiD Config (20 x 2.5mm +10 x 5 mm)
- Evaluated both versions
  - sid02
  - sid02 stretched

Z dependence



Forward performance at cos (θ)=0.92 using a single u jet at 50,100,250 GeV

Plans after LoI

- SIDish was a useful model
  - but has reached its end-of-life
  - learned a lot from it
- Move to real SiD
  - use Matt's PFA
  - real tracking
- Plenty of studies still to do
  - Will continue after the LoI
- The LoI
  - is a snapshot of our knowledge not the final answer
  - lays out plans for our future work

Summary

- Have converged on sid02
  - Long process with lots of input from subgroups
- sid02 a good choice
  - physics performance
  - engineering constraints
  - cost
- Will be with us for the LoI
  - The detector we benchmark ...
- Redo the optimization exercise after the LoI
  - we have learned a lot already