Studies on ECAL sampling and shower reconstruction

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SPD Physics & MC meeting
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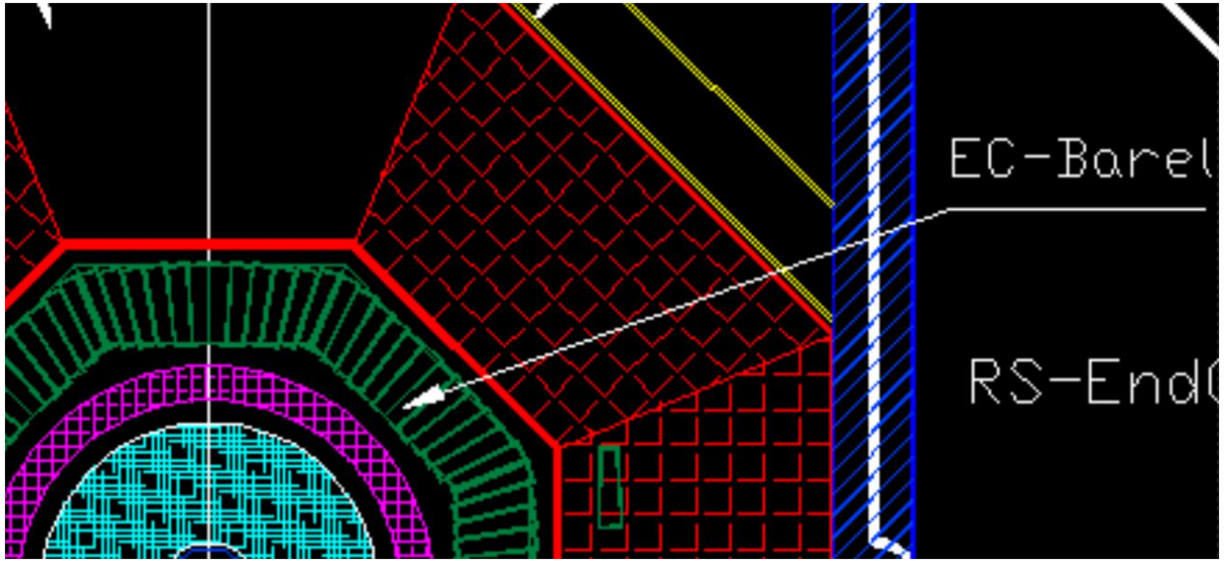
Sidenote: ECAL simulation in SPDROOT

- Endcaps (SpdEcalQEC): construction/simulation implemented, to be integrated into SPDROOT very soon
- Barrel: module placement algorithm to be finalized (this week)

(optimize cell size to avoid gaps)

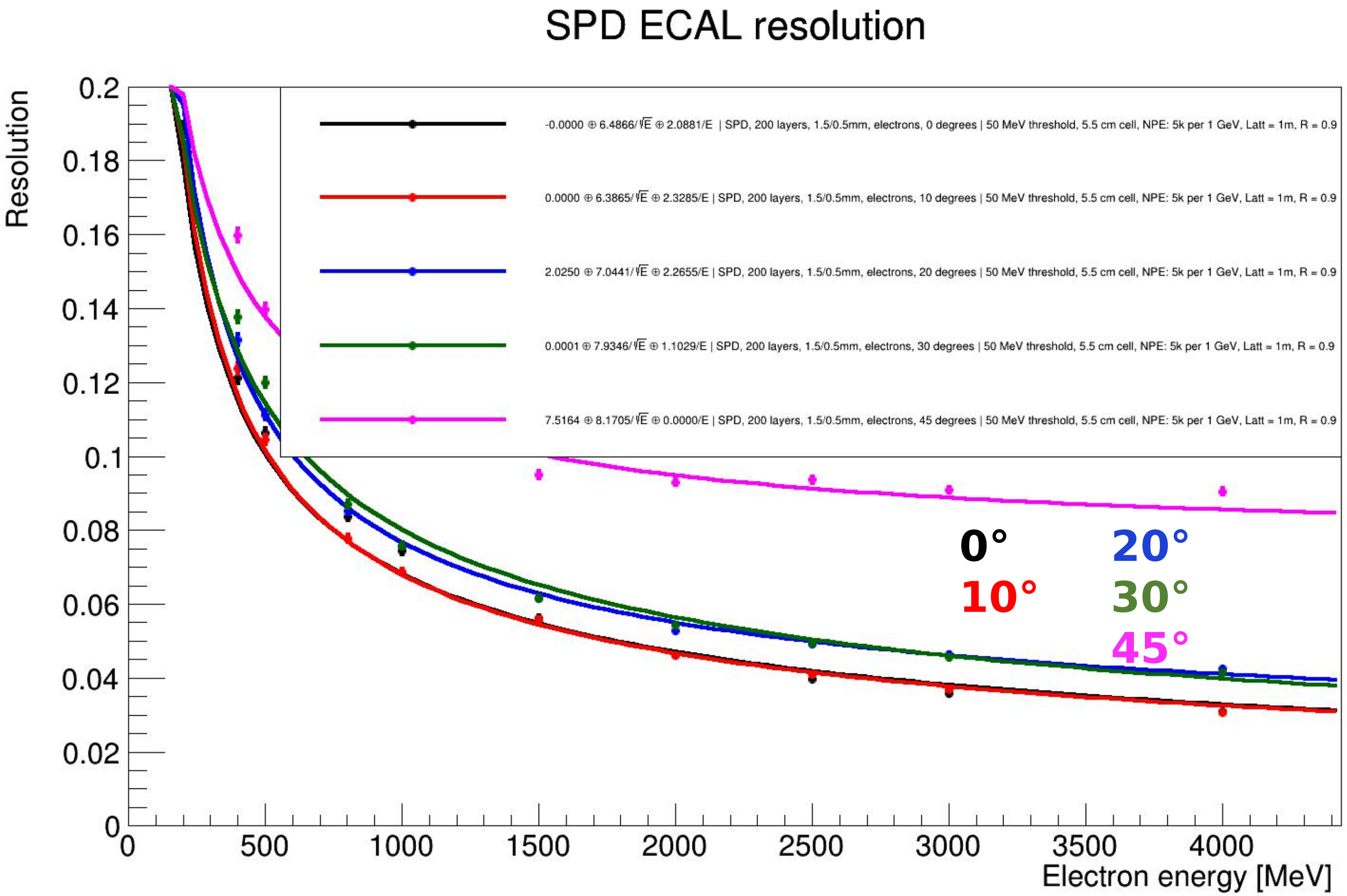


Picture of O.P.Gavrishchuk
Equal-sized modules:
not the most optimal setup?

also consider space for electronics?
(how large is ECAL-RS gap?)

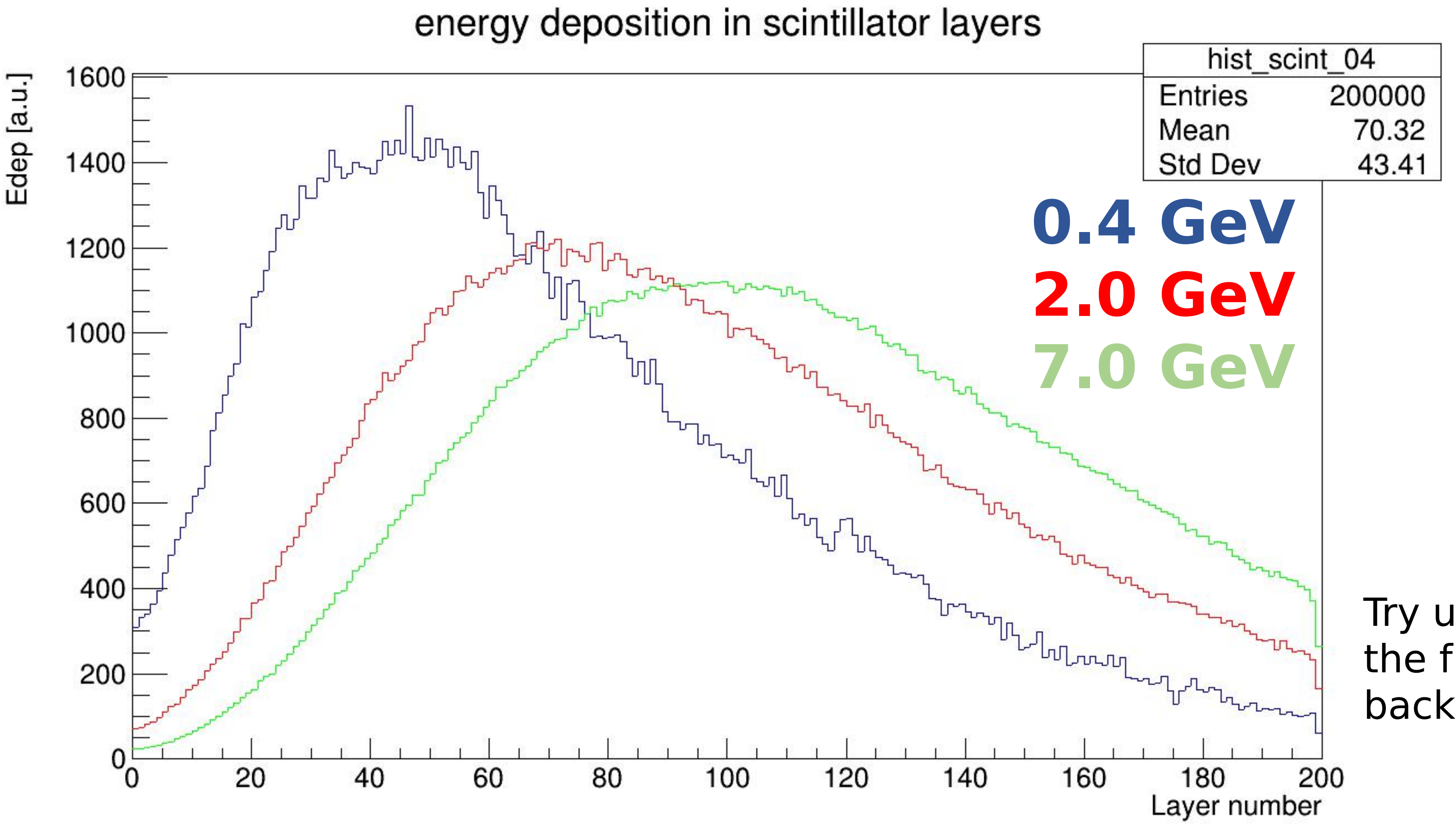
ECAL sampling studies

- Standard sampling: 0.5mm lead + 1.5mm scintillator x 200 layers



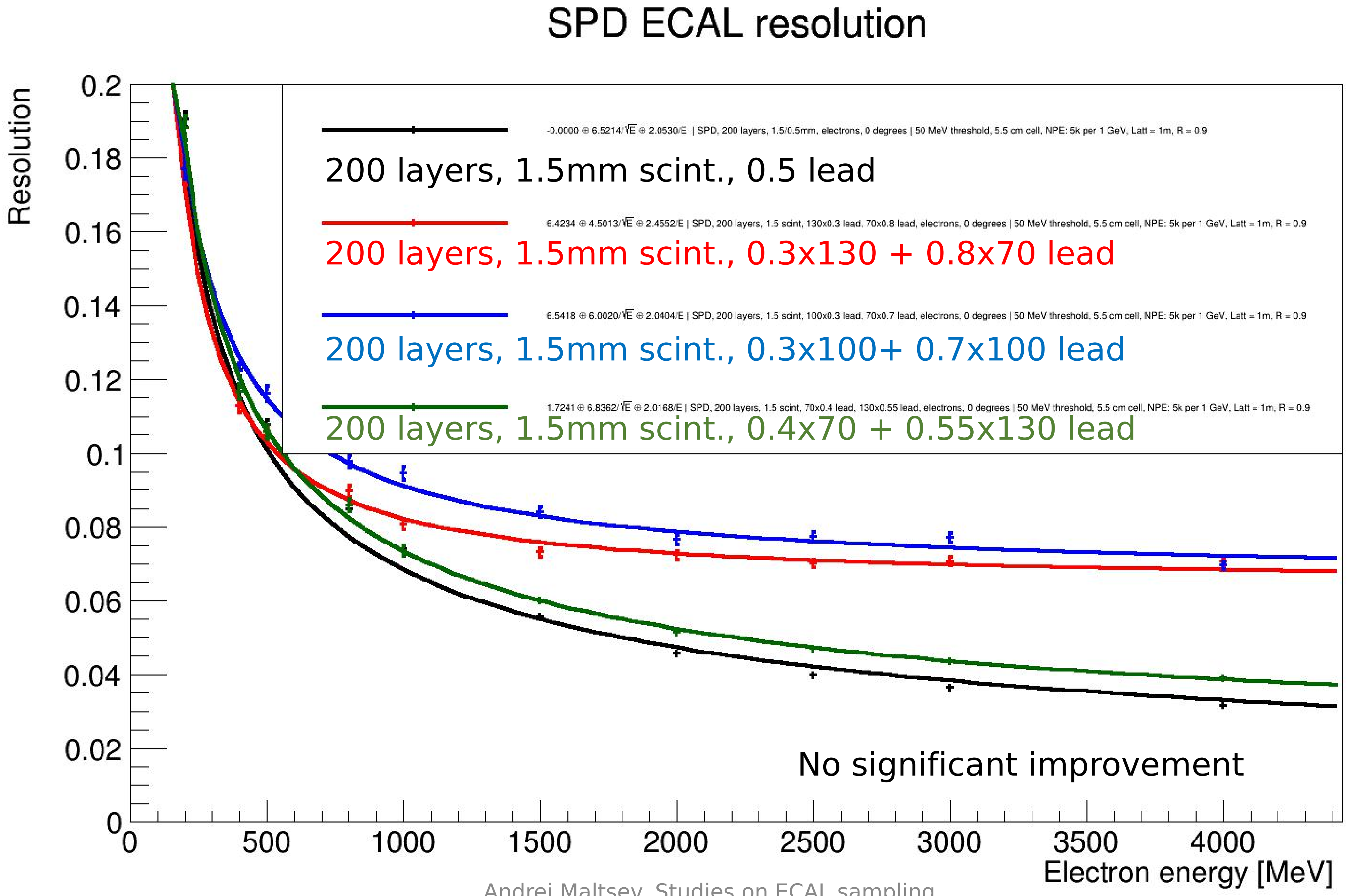
Energy resolution at 300-400 MeV: ~12%
too bad for χ_{c1}/χ_{c2} analysis

ECAL sampling studies



0.4 GeV
2.0 GeV
7.0 GeV

Try using finer sampling at the front and rougher at the back of a module



200 layers, 1.5mm scint., 0.5 lead

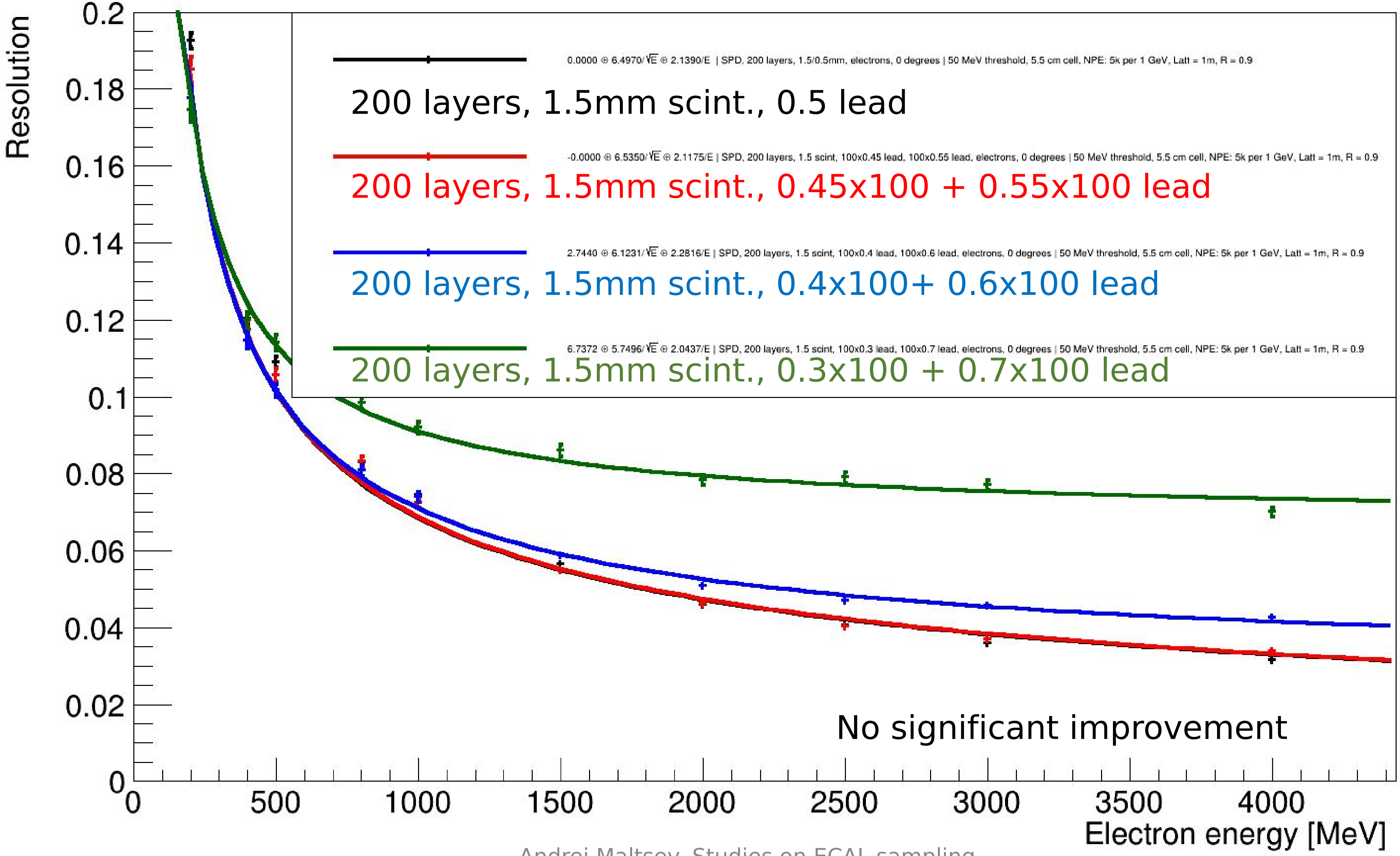
200 layers, 1.5mm scint., 0.3x130 + 0.8x70 lead

200 layers, 1.5mm scint., 0.3x100+ 0.7x100 lead

200 layers, 1.5mm scint., 0.4x70 + 0.55x130 lead

No significant improvement

SPD ECAL resolution



200 layers, 1.5mm scint., 0.5 lead

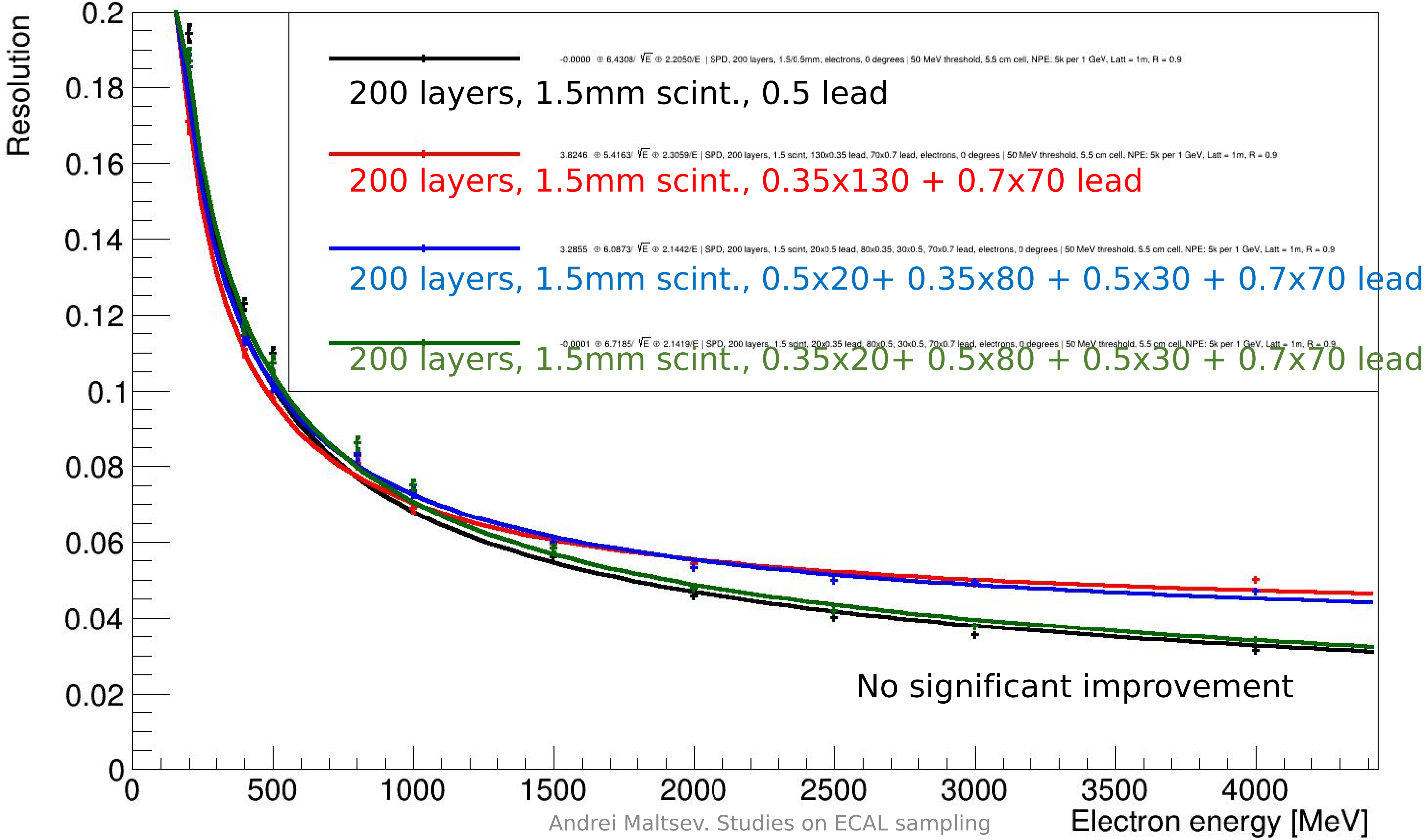
200 layers, 1.5mm scint., 0.45x100 + 0.55x100 lead

200 layers, 1.5mm scint., 0.4x100+ 0.6x100 lead

200 layers, 1.5mm scint., 0.3x100 + 0.7x100 lead

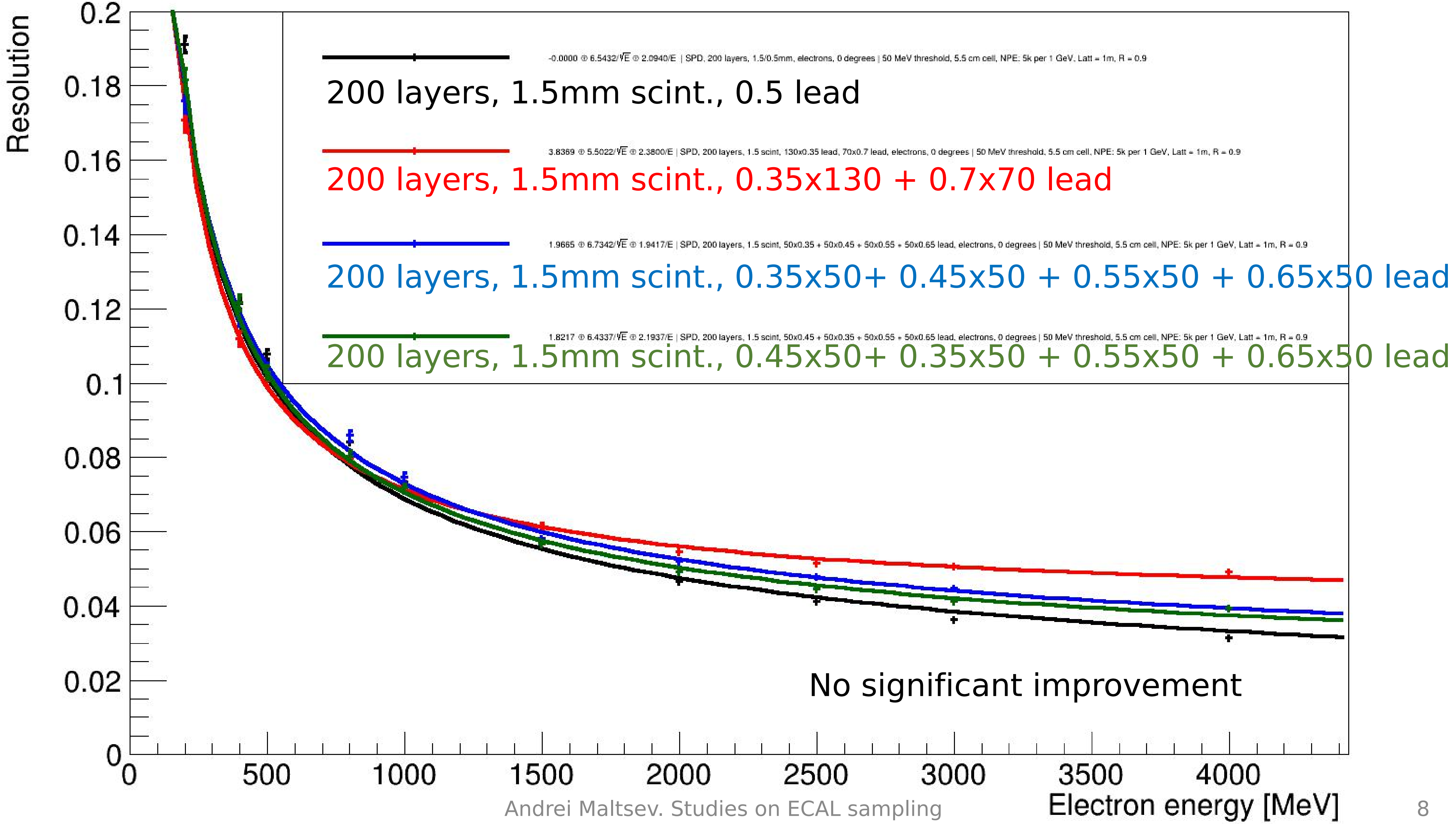
No significant improvement

SPD ECAL resolution



No significant improvement

SPD ECAL resolution



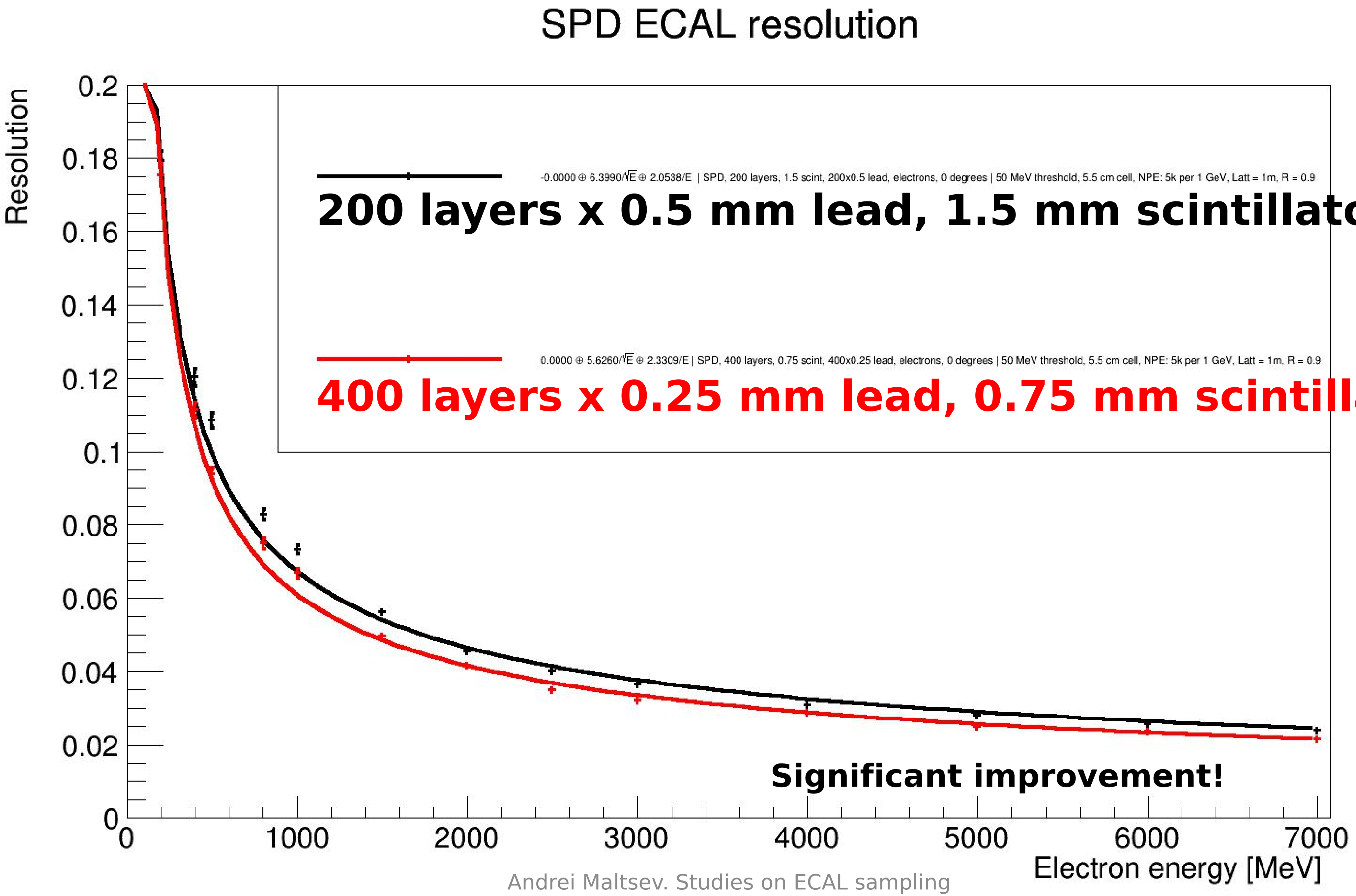
200 layers, 1.5mm scint., 0.5 lead

200 layers, 1.5mm scint., 0.35x130 + 0.7x70 lead

200 layers, 1.5mm scint., 0.35x50+ 0.45x50 + 0.55x50 + 0.65x50 lead

200 layers, 1.5mm scint., 0.45x50+ 0.35x50 + 0.55x50 + 0.65x50 lead

No significant improvement

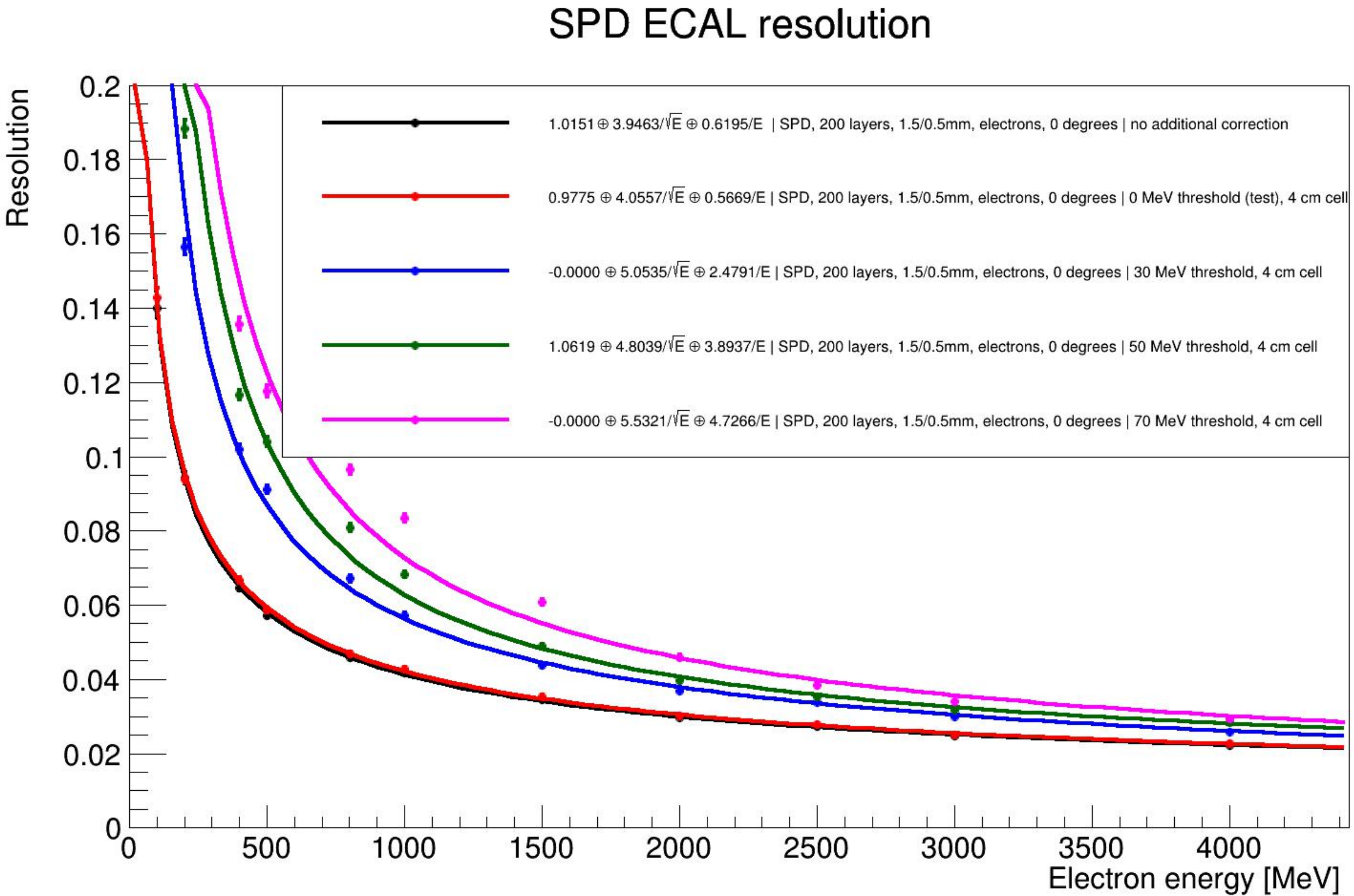


200 layers x 0.5 mm lead, 1.5 mm scintillator

400 layers x 0.25 mm lead, 0.75 mm scintillator

Significant improvement!

Effect of cell threshold on resolution



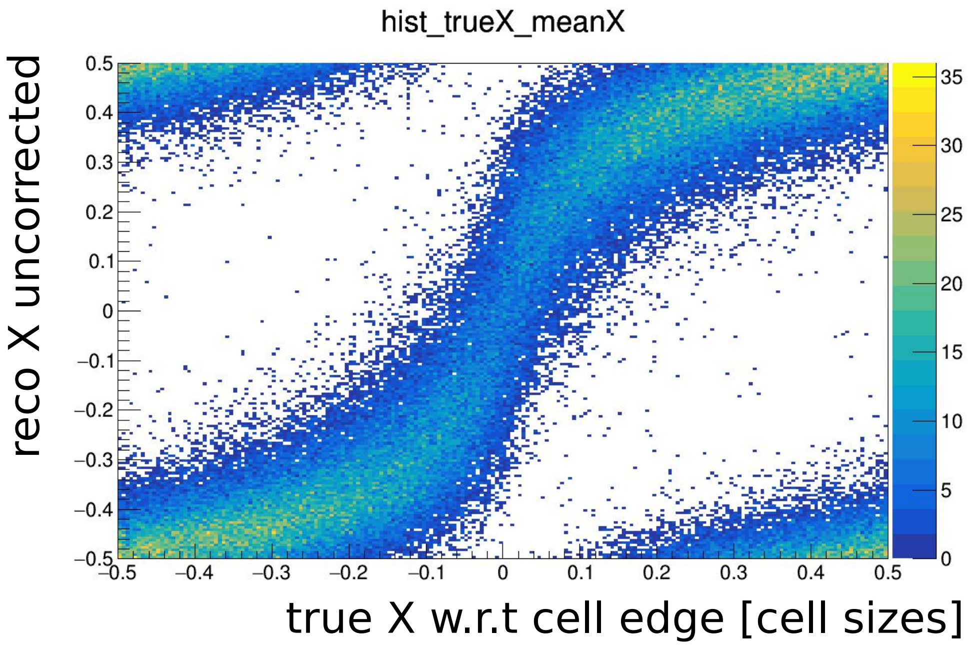
NO CORRECTION
30 MeV THRESHOLD
50 MeV THRESHOLD
70 MeV THRESHOLD

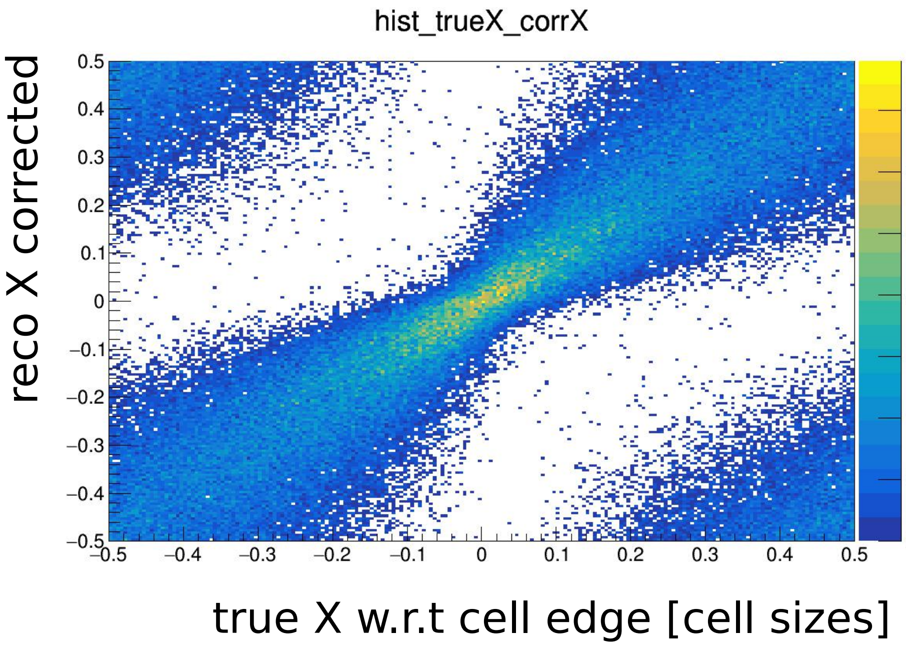
for low energies, low threshold is very important

Shower reconstruction

- Lednev's method: NIM A 366 (1995) 292-297
- Determine transverse shower shape using data:

  1) correct transverse position of shower

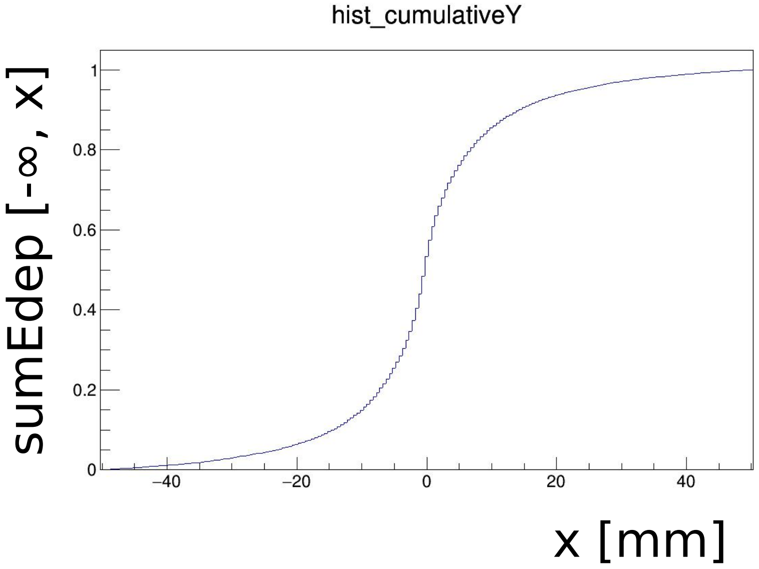




Shower reconstruction

- Lednev's method: NIM A 366 (1995) 292-297
- Determine transverse shower shape using data:

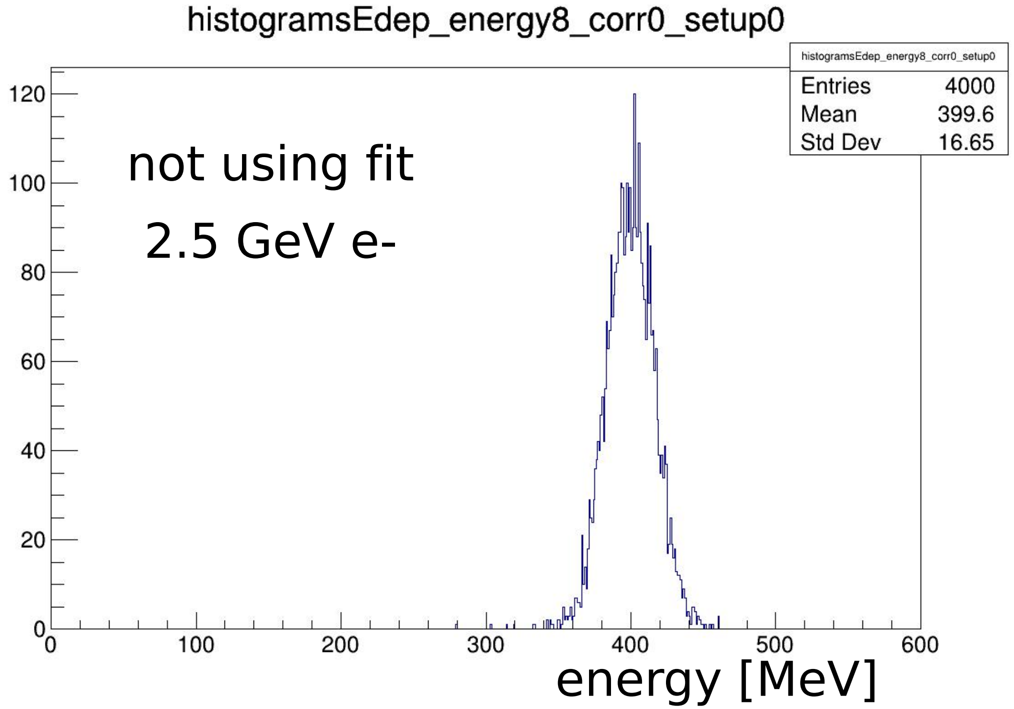
2) determine cumulative energy distribution across transverse variable

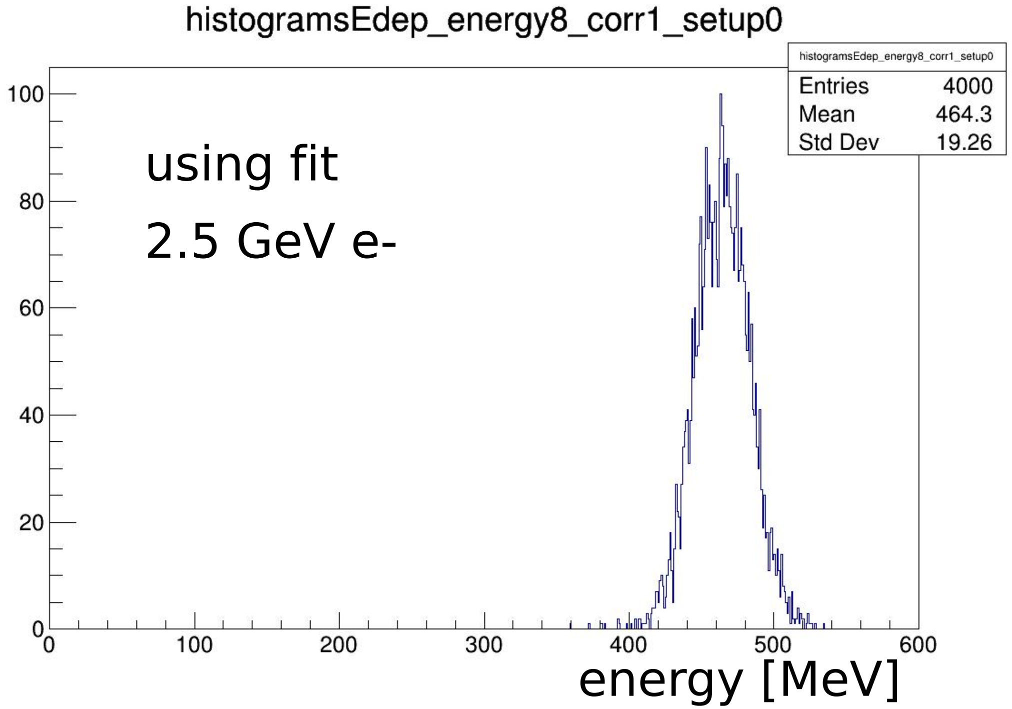


3) use the cumulative distribution to fit showers in data

Shower reconstruction

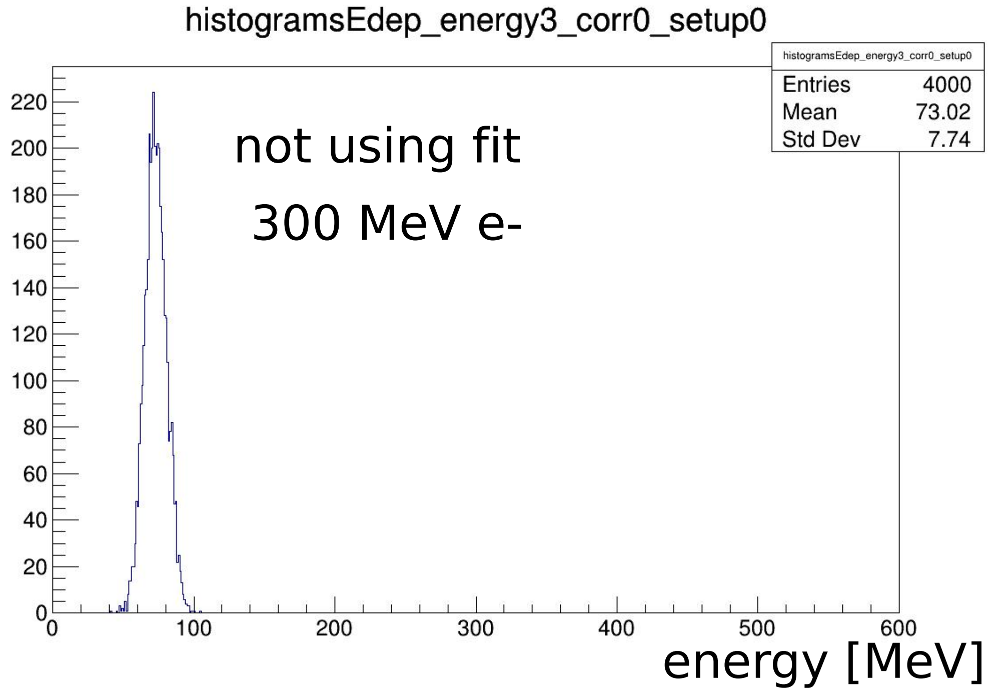
- Lednev's method: NIM A 366 (1995) 292-297
- Determine transverse shower shape using data:





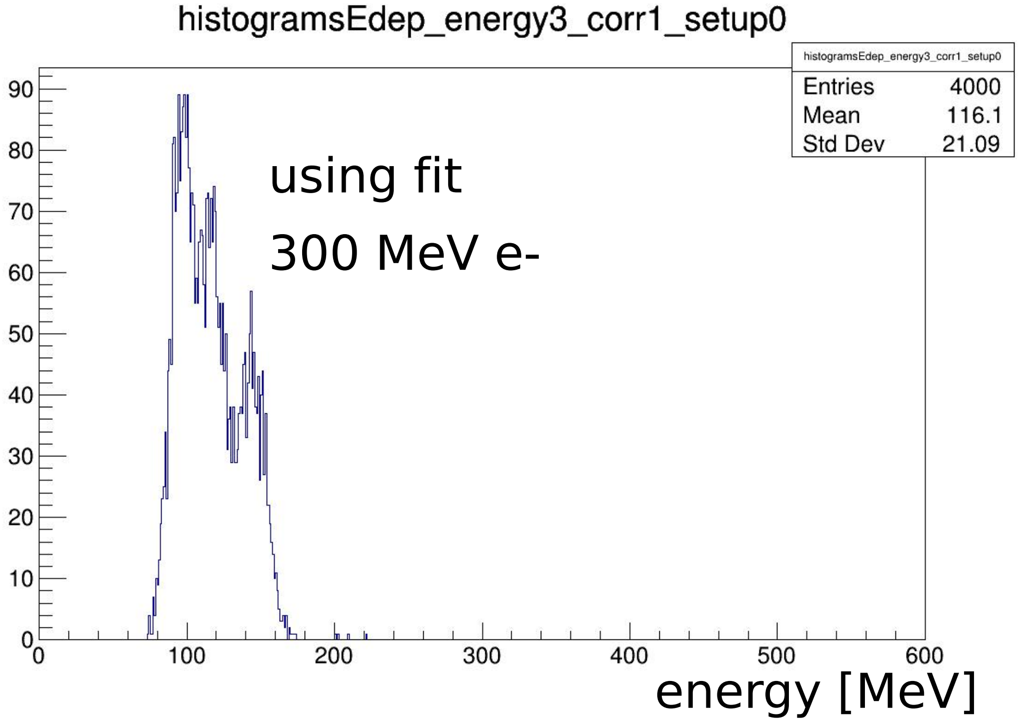
Shower reconstruction

- Lednev's method: NIM A 366 (1995) 292-297
- Determine transverse shower shape using data:


histogramsEdep_energy3_corr0_setup0

not using fit

300 MeV e-


histogramsEdep_energy3_corr1_setup0

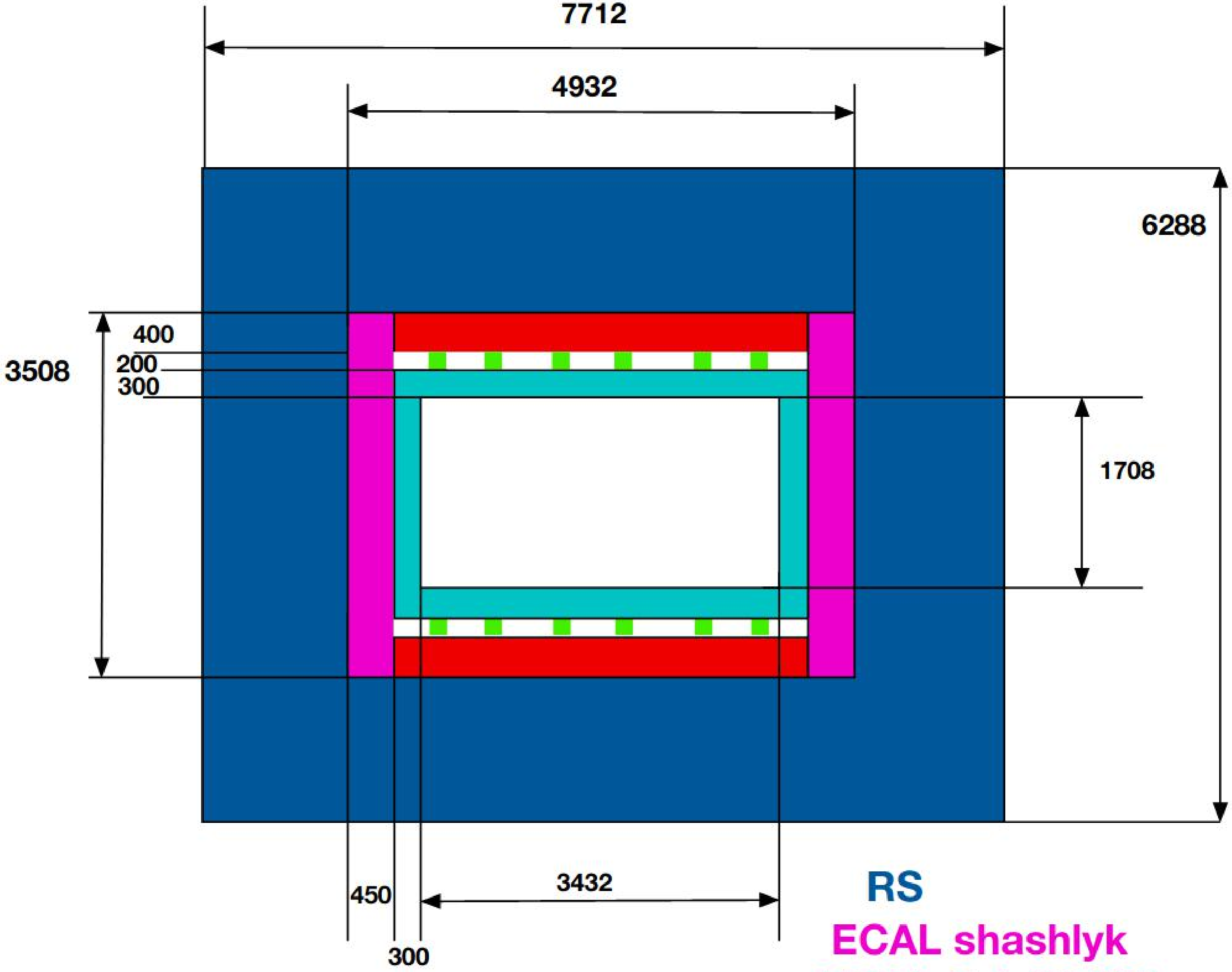
using fit

300 MeV e-

Conclusions

- ECAL simulation in SPDROOT will be ready soon (worst case - next week)
- Lower cell energy threshold would significantly improve energy resolution at low energies
- Finer sampling with increasing number of layers (same module length) would be favourable for low energy resolution
- Fitting algorithm requires further work

BACKUP


7712
4932
6288
3508
400
200
300
1708
450
3432
300

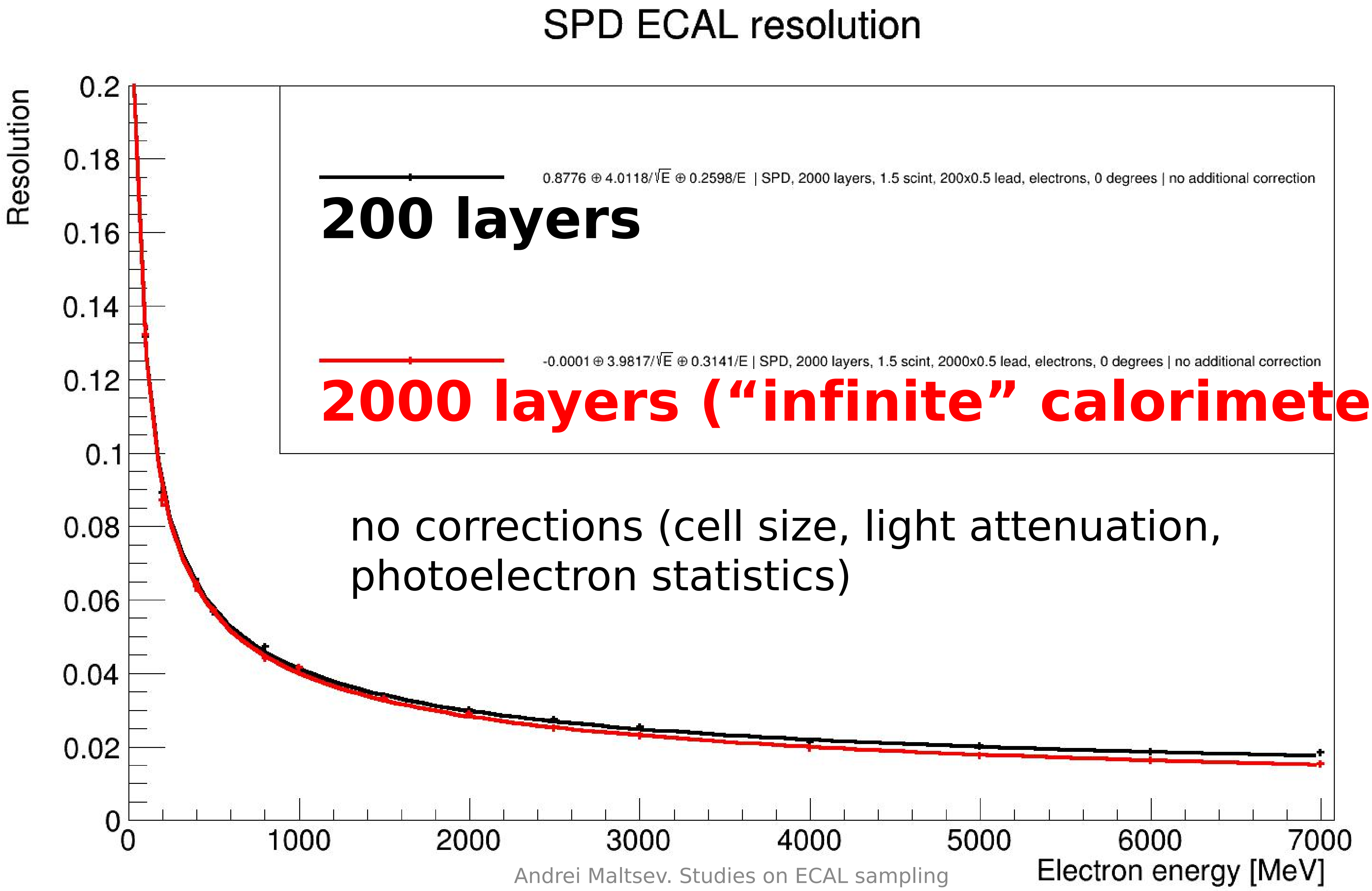
RS

ECAL shashlyk

ECAL CsI (20 X0)

Magnetic Coils

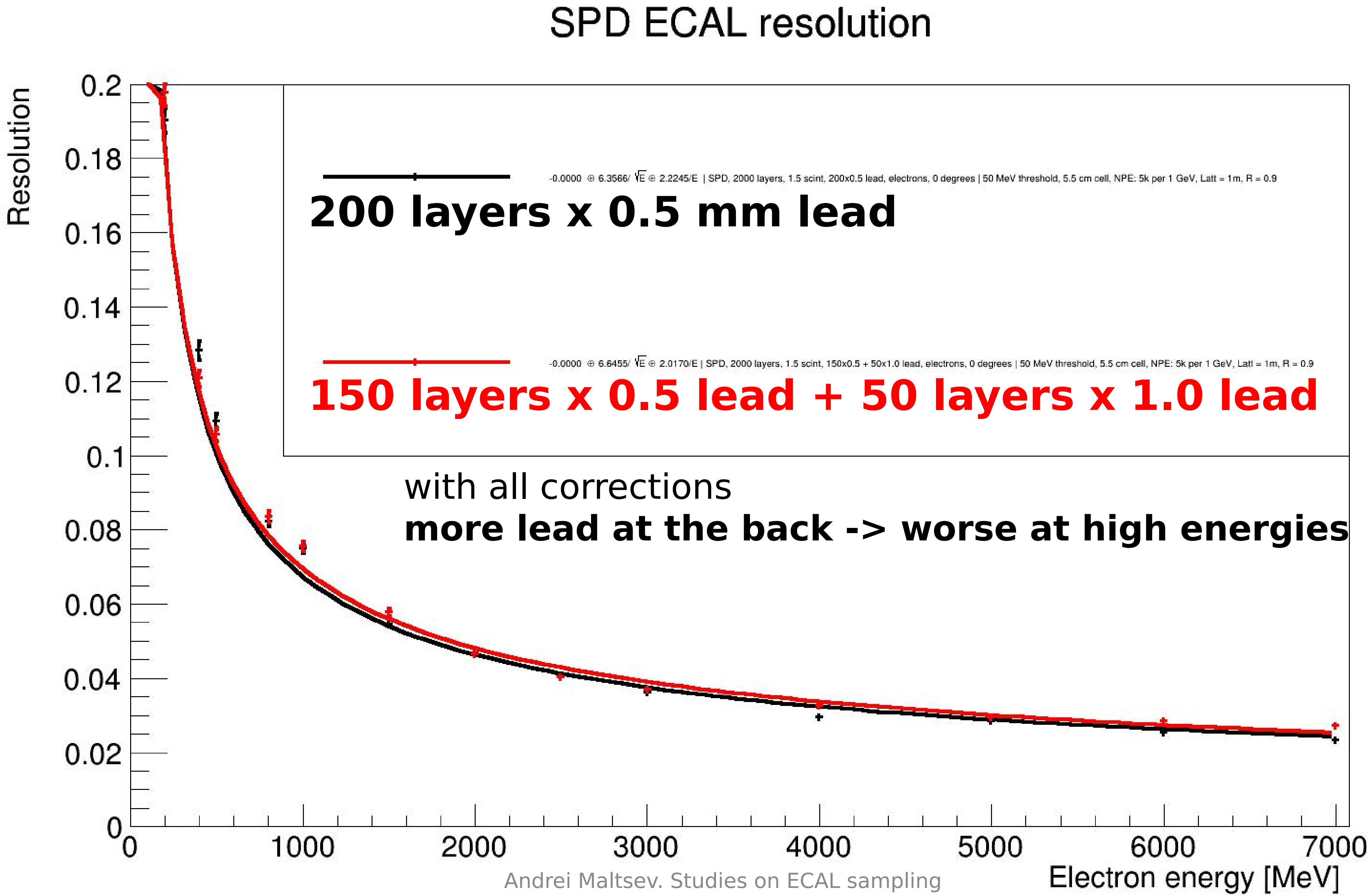
TOF



200 layers

2000 layers (“infinite” calorimeter)

no corrections (cell size, light attenuation, photoelectron statistics)

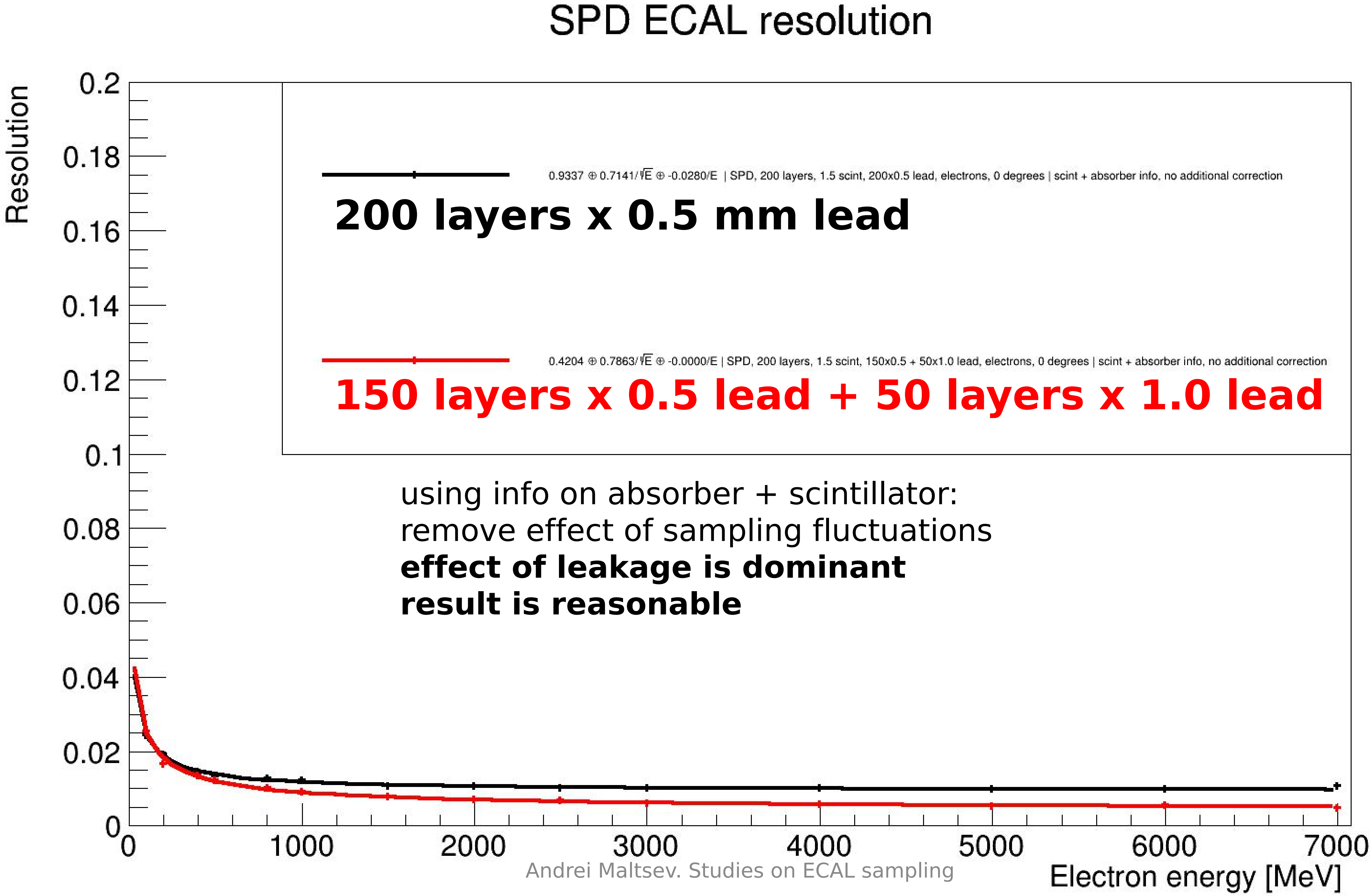


200 layers x 0.5 mm lead

150 layers x 0.5 lead + 50 layers x 1.0 lead

with all corrections

more lead at the back -> worse at high energies

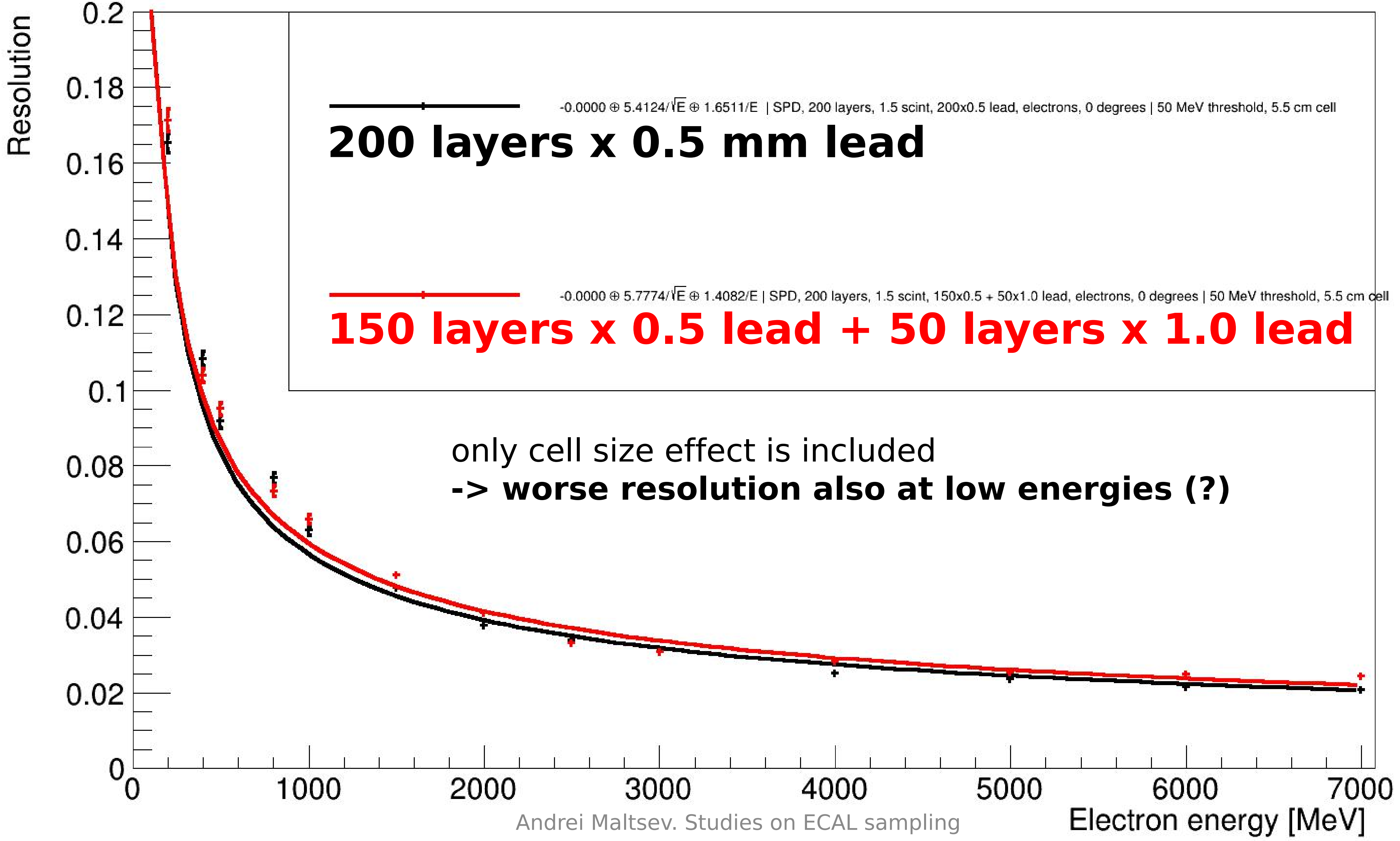


200 layers x 0.5 mm lead

150 layers x 0.5 lead + 50 layers x 1.0 lead

using info on absorber + scintillator:
remove effect of sampling fluctuations
effect of leakage is dominant
result is reasonable

SPD ECAL resolution



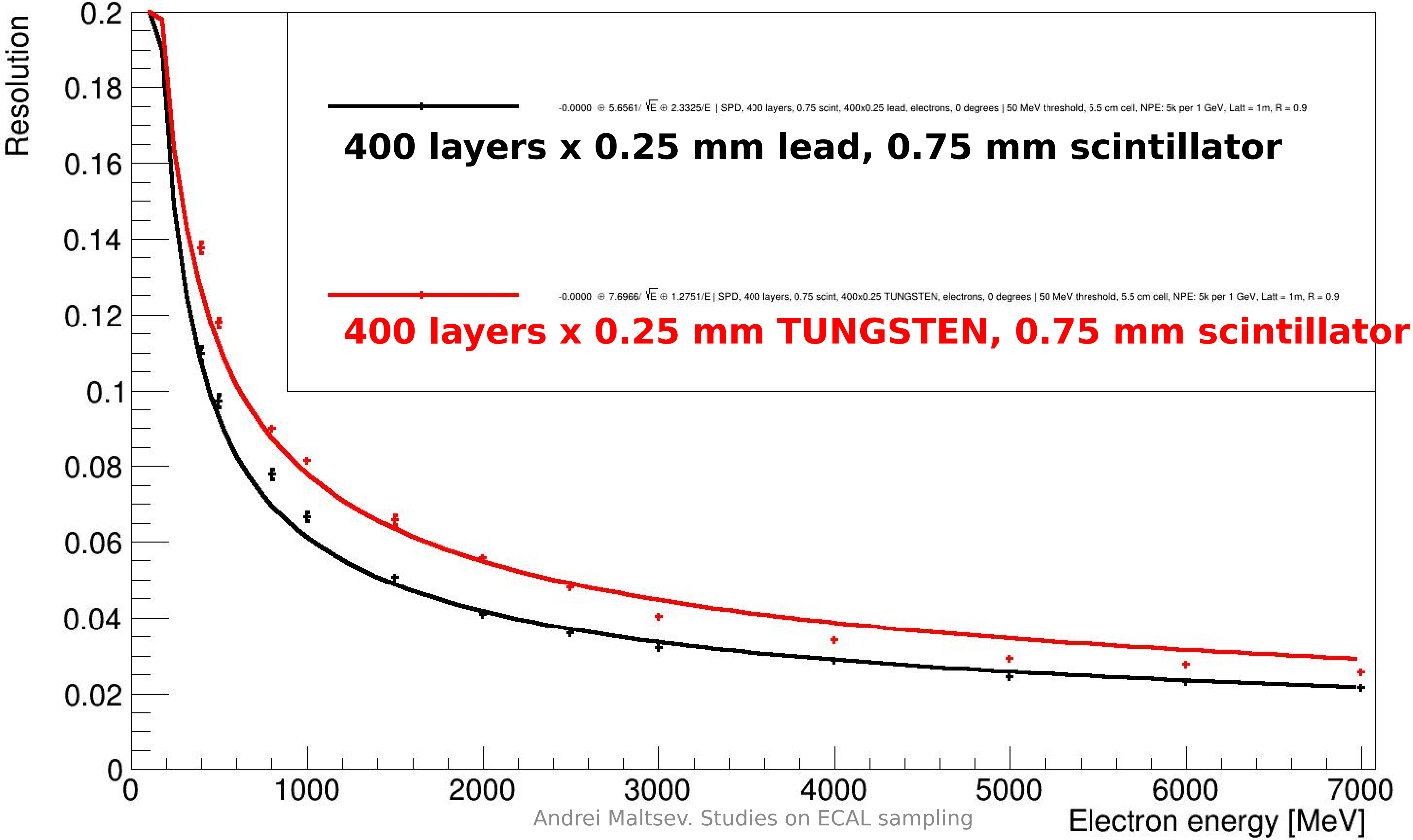
200 layers x 0.5 mm lead

150 layers x 0.5 lead + 50 layers x 1.0 lead

only cell size effect is included

-> worse resolution also at low energies (?)

SPD ECAL resolution



400 layers x 0.25 mm lead, 0.75 mm scintillator

400 layers x 0.25 mm TUNGSTEN, 0.75 mm scintillator