Aggressive Vertexing Scenarios

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Possibilties for Further VTX Improvement

Improved Resolution

- Astronomy applications achieve $0.1\mu m$
- Issue is S/N; ideas include deeper depletion, low-noise readout, internal gain
- Try $5\mu m$ (standard), $2.5\mu m$, $1\mu m$.

Smaller Beampipe

- Less than 1cm seems difficult (sychrotron albedo)
- But try 0.5cm just to see

Greater Radial Extent

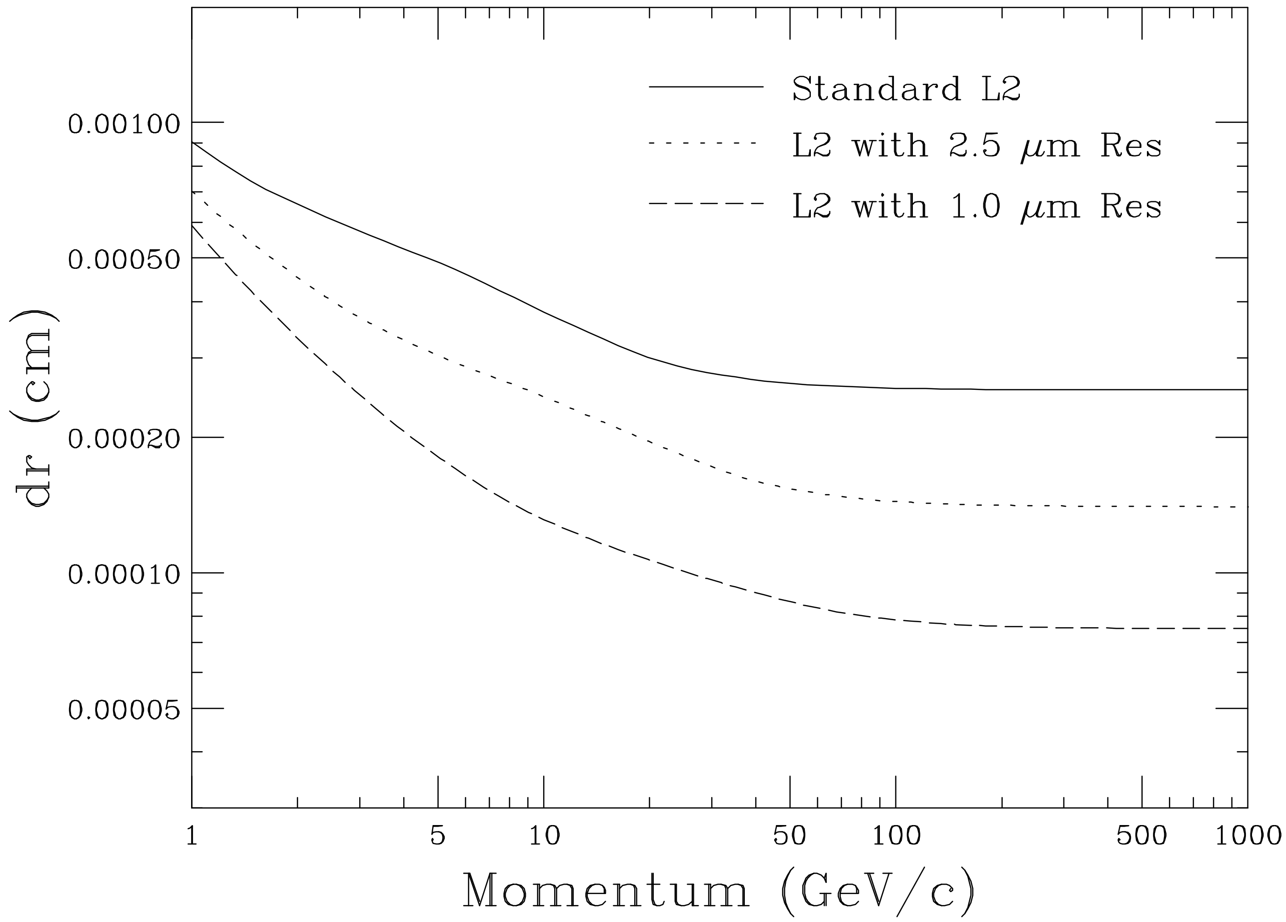
- Try doubling from $1 < r < 6$ cm to $1 < r < 11$ cm

Thinner Layers and Pipe

- Try halving, although defaults already assume R&D benefit

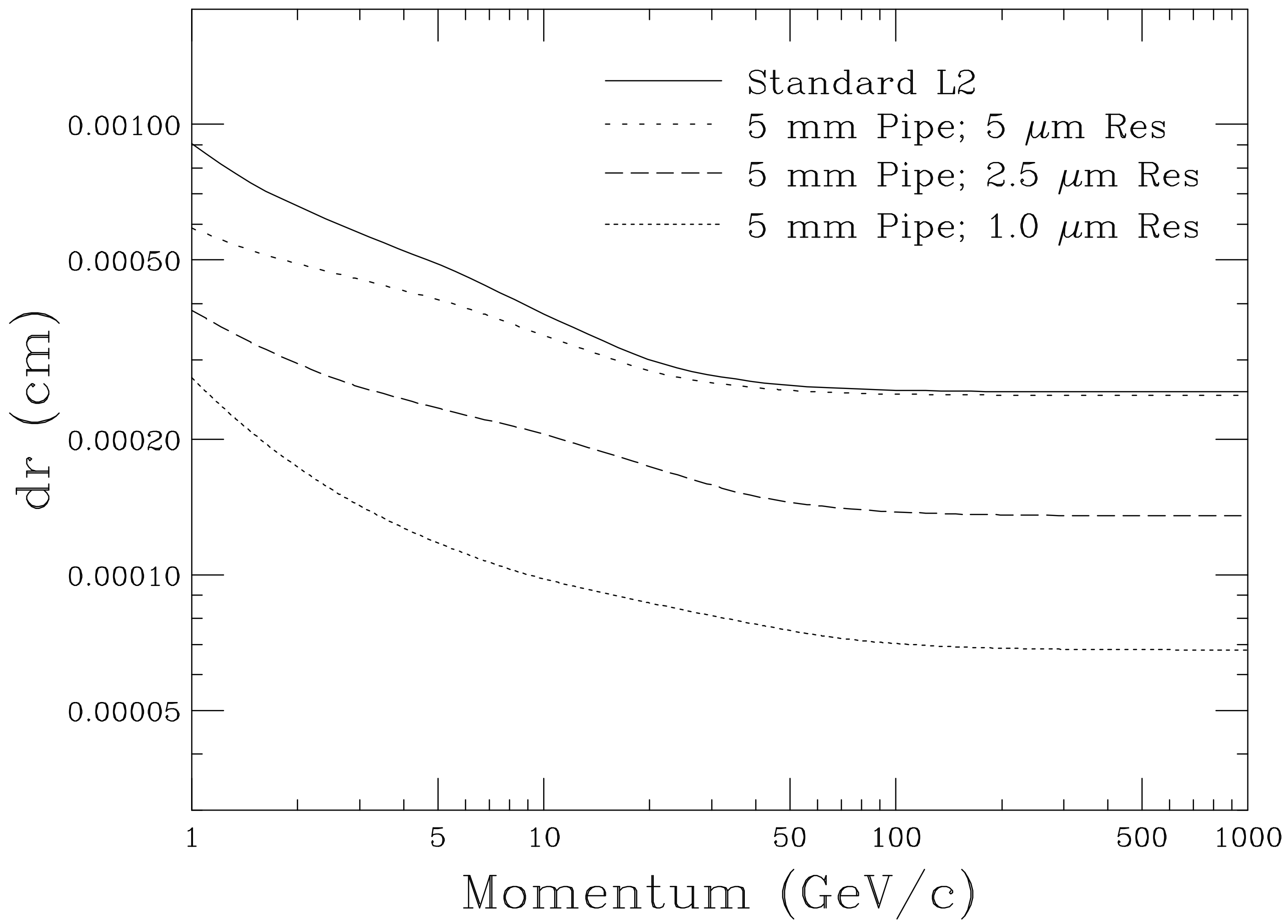
All improvements will be applied to existing L2 design (TPC central tracking option w/ intermediate Si layer at 48cm)

EFFECT OF IMPROVING RESOLUTION



- For 1μm, improvements from 50% to $\times 3.5$.

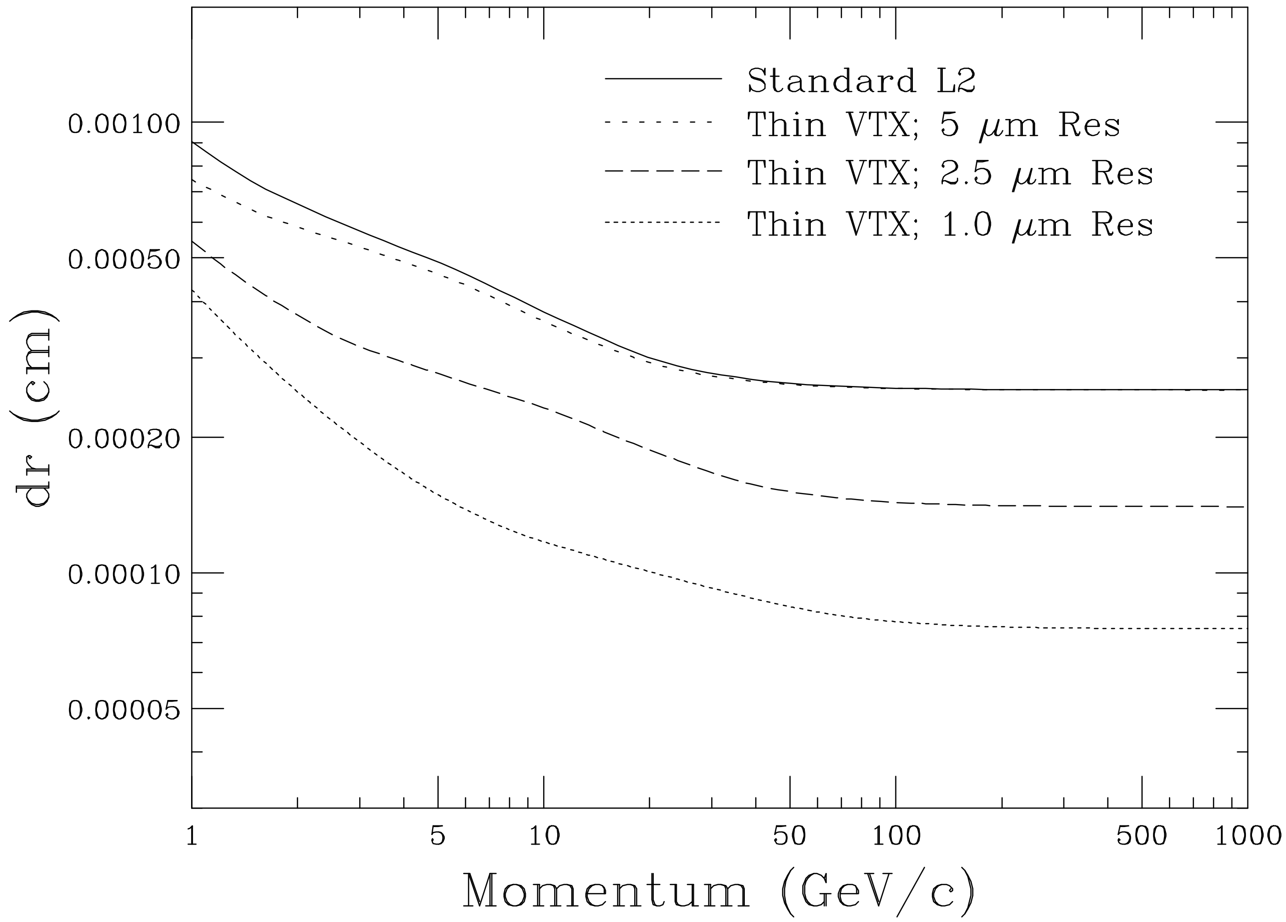
EFFECT OF SQUEEZING BEAMPIPE



Improvements at low momentum:

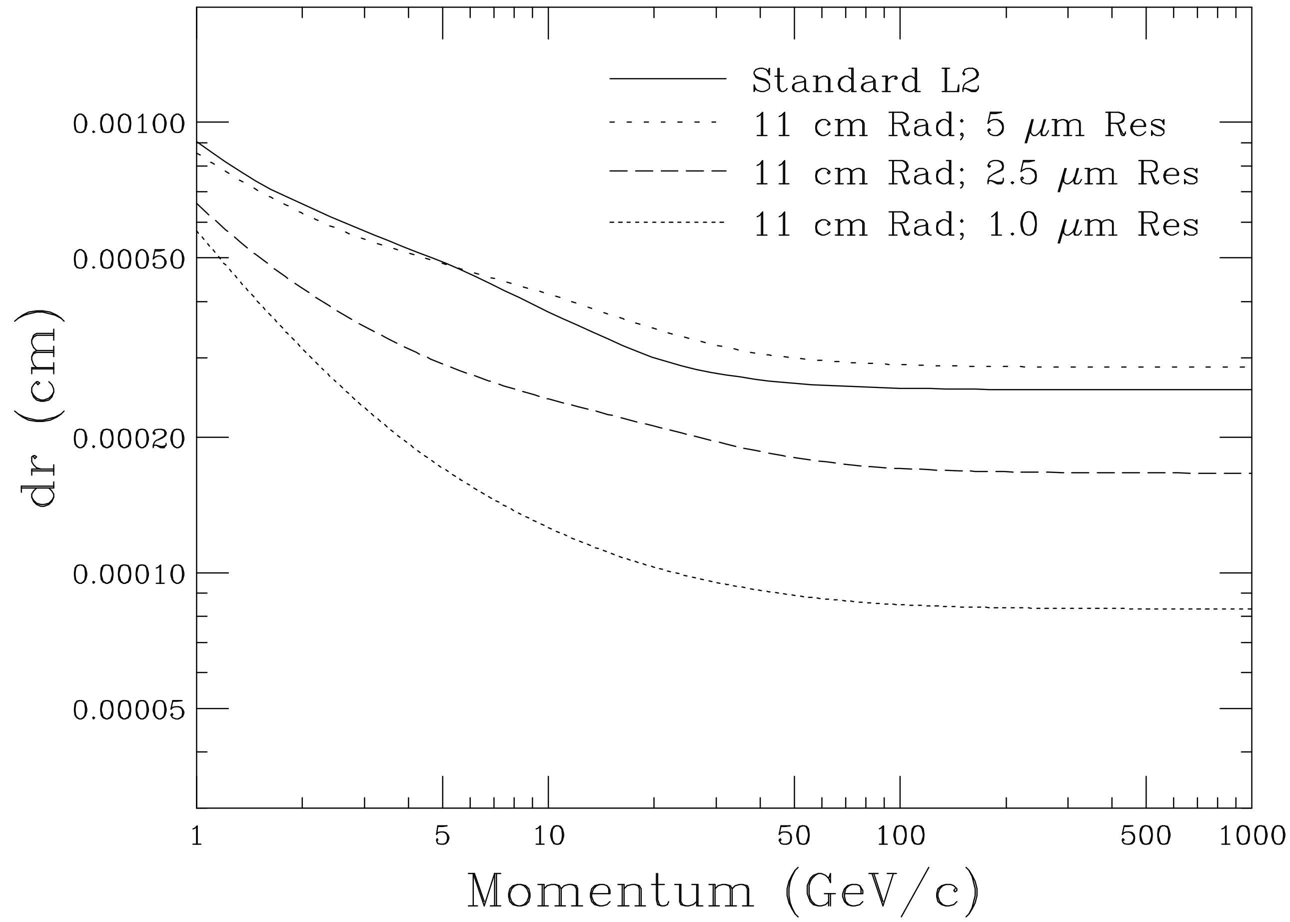
- 50% with 5μm resolution
- Get full $\times 2$ with 1μm resolution

EFFECT OF THINNING MATERIAL



- Approximately 20% improvement at low momentum

EFFECT OF INCREASING VTX OUTER RADIUS



- Slight improvement at low momentum (rely more on curvature/angle from VTX)
- Somewhat *less* efficient use of information for high momentum

Recap of Findings

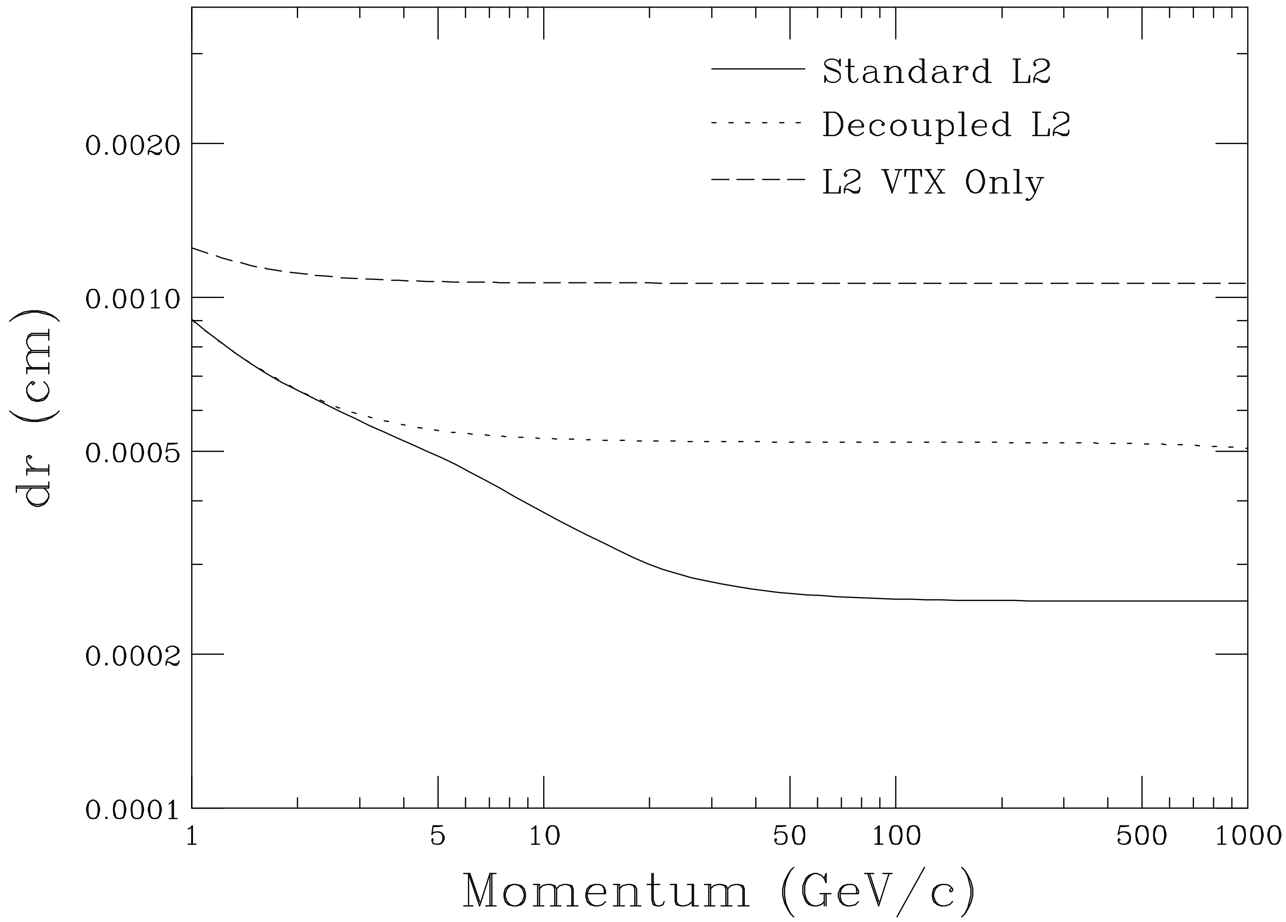
- Spatial resolution and beampipe radius lead to substantial improvement in complementary regimes
- Small beampipe may not be feasible however
- Further reduction in MCS thickness may not be worth effort
- With good central tracking, increased VTX radius not a benefit to impact parameter resolution

Interplay of Vertex and Central Trackers

'DECOUPLED' – ∞ thick dead layer between VTX and TPC; TPC provides curvature only

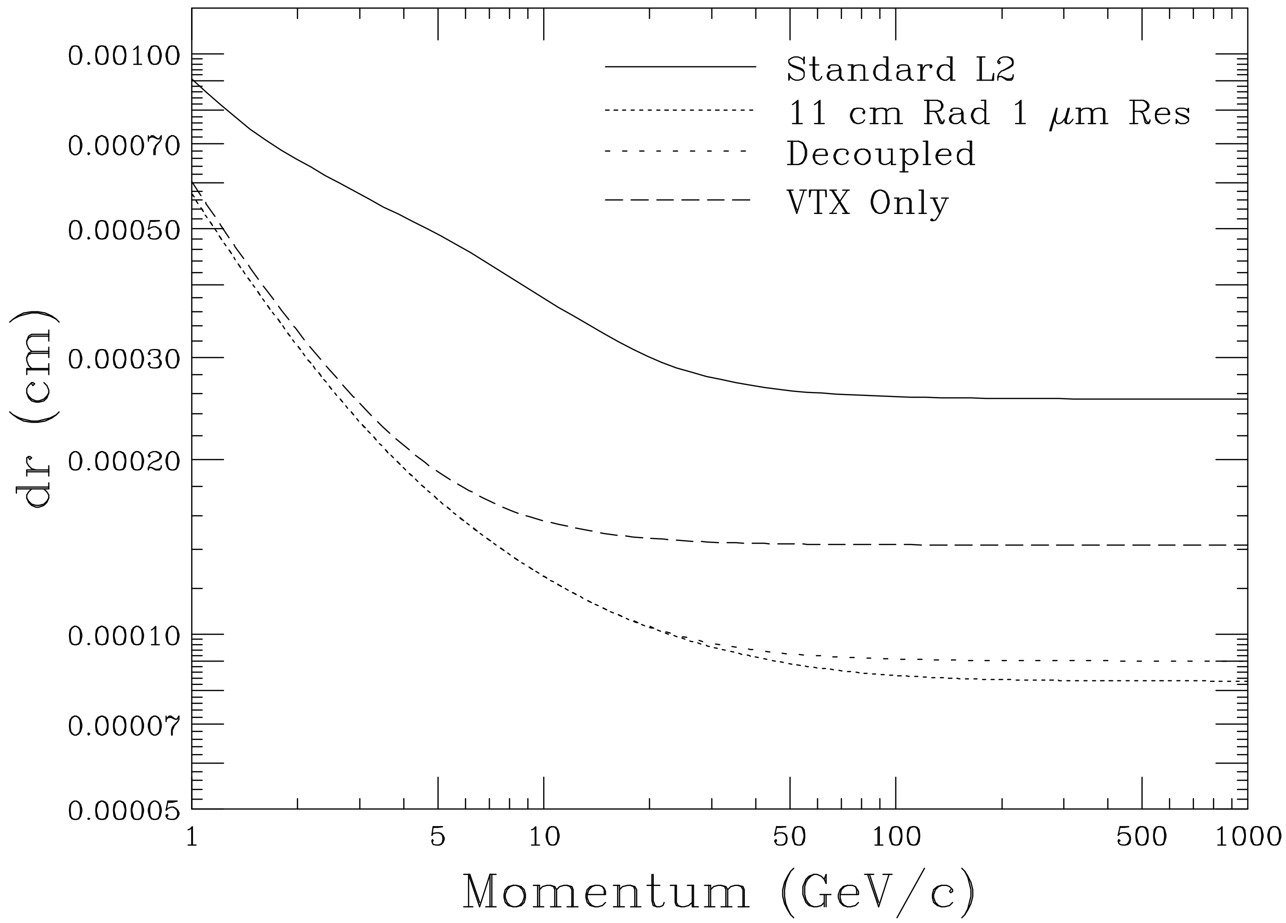
'VTX ONLY' – e.g., TPC is knocked out by LC backgrounds

DECOUPLED AND VTX-ONLY L2



- Curvature constraint from TPC always important
- TPC/intermediate trackers also add angular information above 5 GeV/c

DECOUPLED LARGE LEVER-ARM 1 μm VTX

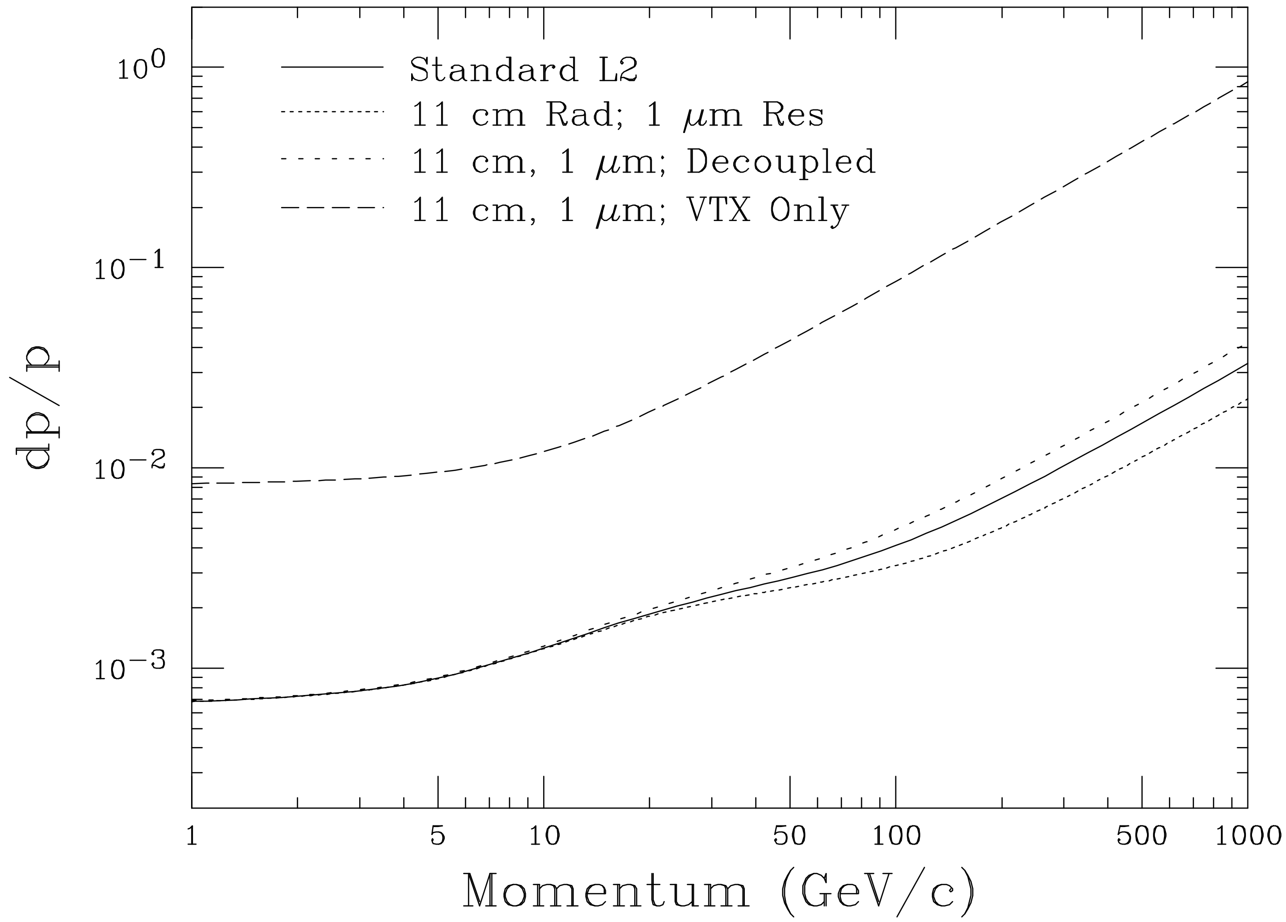


- Impact information from VTX alone out to $\sim$ 10 GeV/c.

- TPC/intermediate angular information never helpful.

Do we really even need a TPC?

MOMENUTM RESOLUTION AND DECOUPLING



- Yes, we do want a TPC for the 500 GeV machine

- May be less important for PRECISE detector, but probably do still want it