QED Background at low B Field

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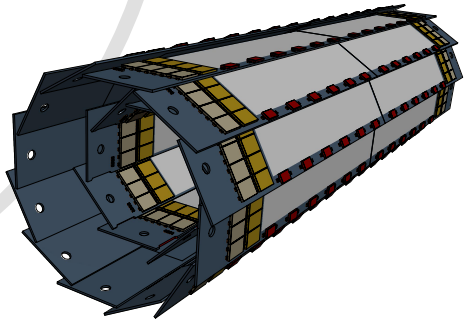
DEPFET
Active Pixel Detector

Overview
QED Background
Conclusions

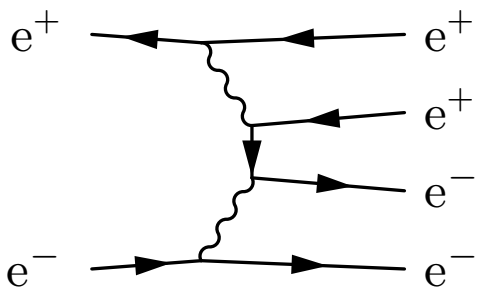


Overview

Background	Occupancy
Touscheck	0.02 %
Radiative Bhabha	0.13 %
Coulomb Scattering	0.01 %
Synchrotron Radiation	0.03 %
QED Background	0.80 %
Sum	$\approx$ 1 %

- Hardware limit is 3 % per ladder
- Synchrotron radiation is only for ideal alignment, up to 0.1 % in Andreas study
- QED background is dominating

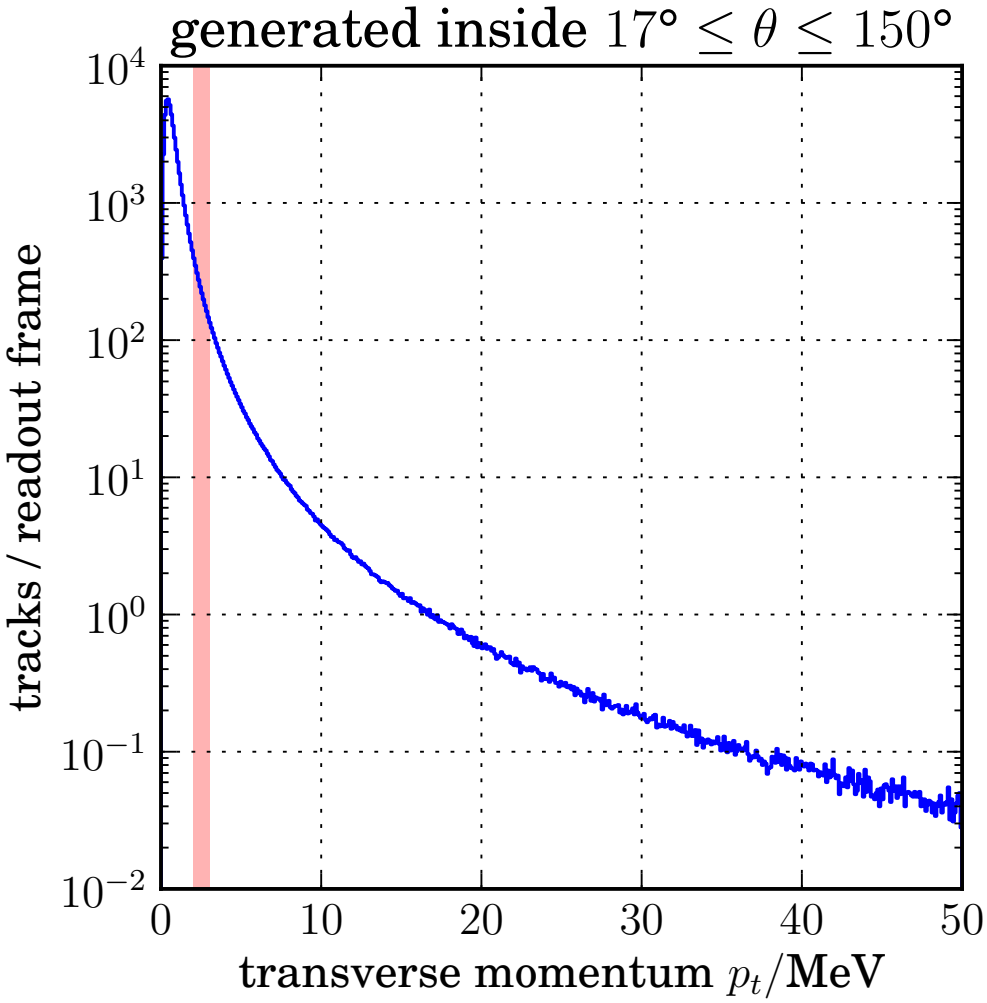
QED Background



QED Background = Events from two photon pair production

- most dominant PXD background
- irreducible
- very large cross section for soft electrons

➡ Reducing the magnetic field would drastically increase QED Background.



Generator Level Expectation

radius of helix:

$$p_t = 0.3 \cdot B \cdot r$$

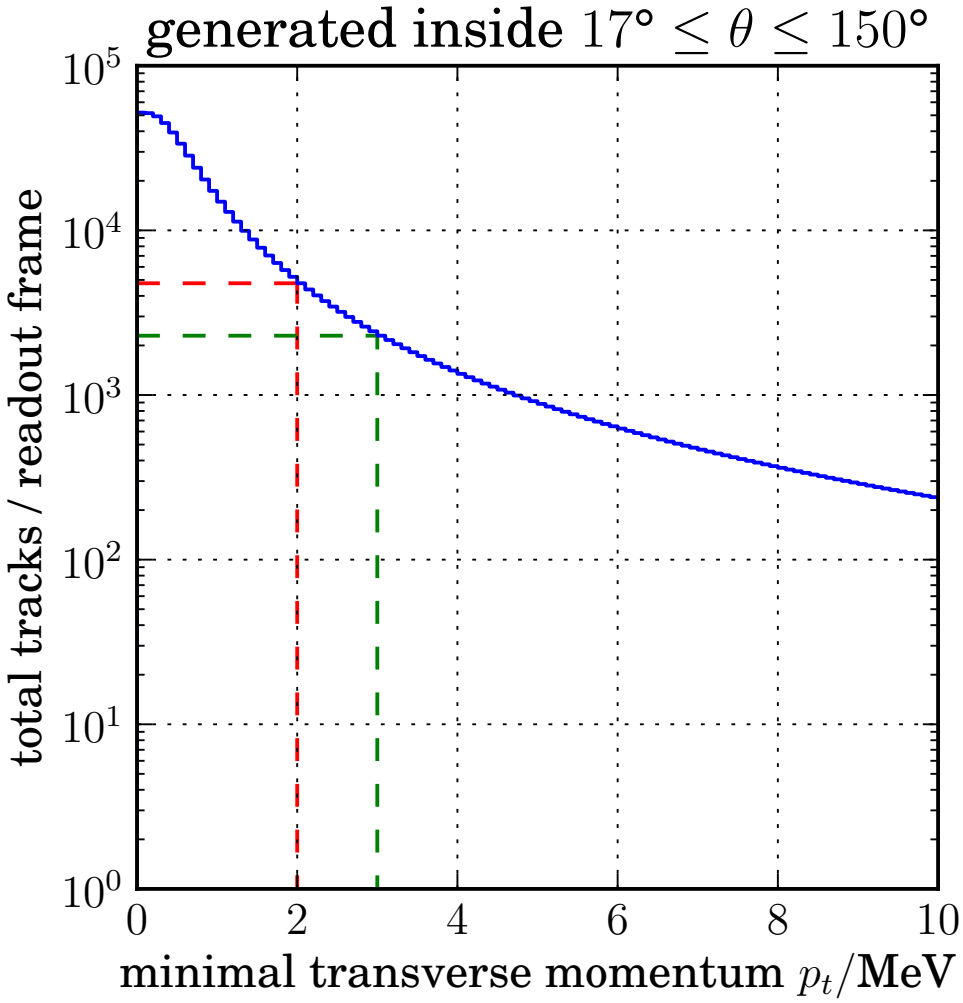
minimal p_t to hit PXD:

- 3 MeV for 1.5 T
- 2 MeV for 1.0 T

➡ factor 2 more background

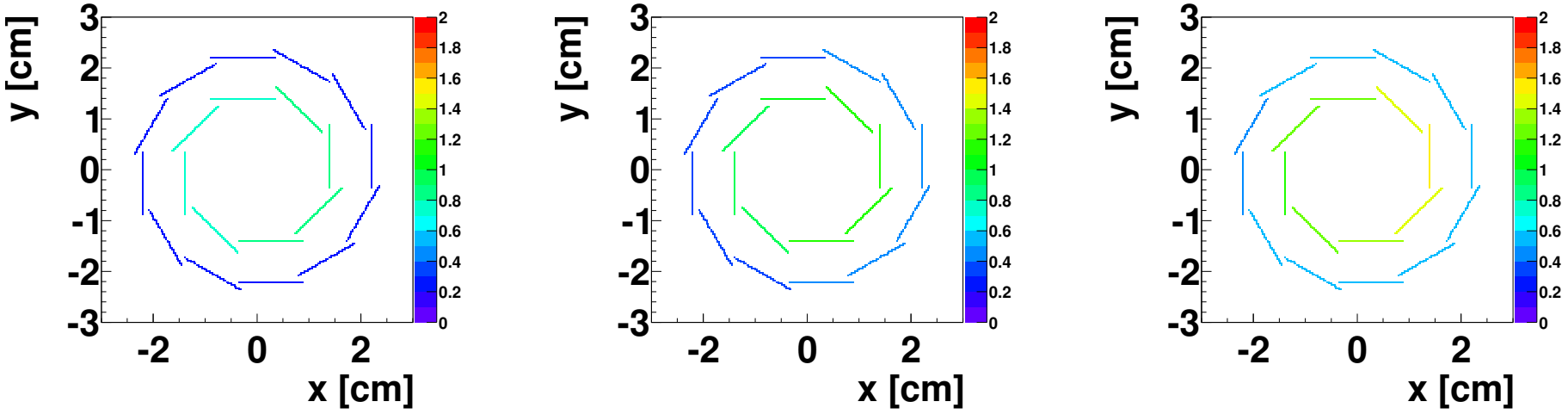
- additional tracks have very low momentum
- curl inside PXD

➡ even more than factor 2



Full Simulation Results

B-field	avg. occupancy	max. occupancy	increase
1.5 T	0.79 %	0.85 %	×1.00
1.2 T	1.07 %	1.19 %	×1.35
1.0 T	1.35 %	1.50 %	×1.71



- too close to hardware limit of 3 % occupancy
- less than factor 2 increase
- lower B field ➡ larger ϕ asymmetry

Curling + Material Effects

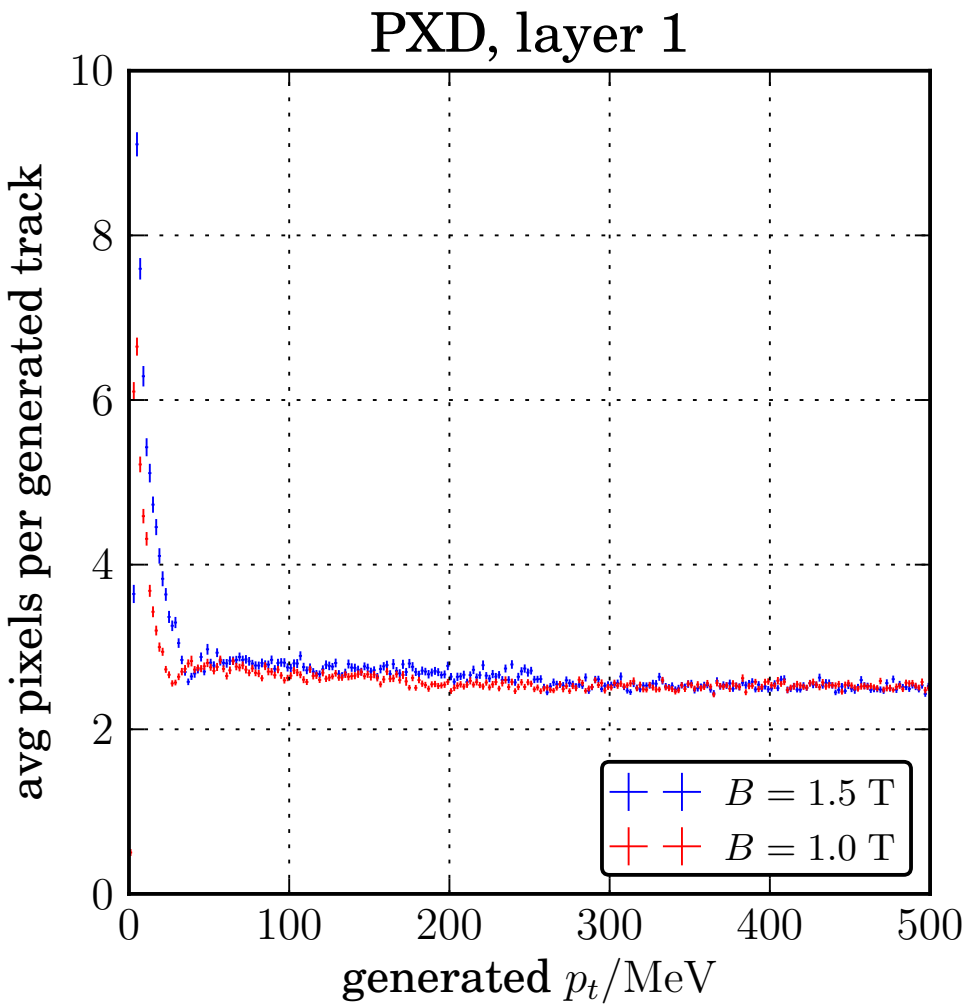
lower magnetic field = less curling

- pixels/track reduced

energy loss for few MeV

- energy loss ionization dominated
- most energy lost in beryllium
- restricts curling for very low energies

➡ increase in cross section partially compensated



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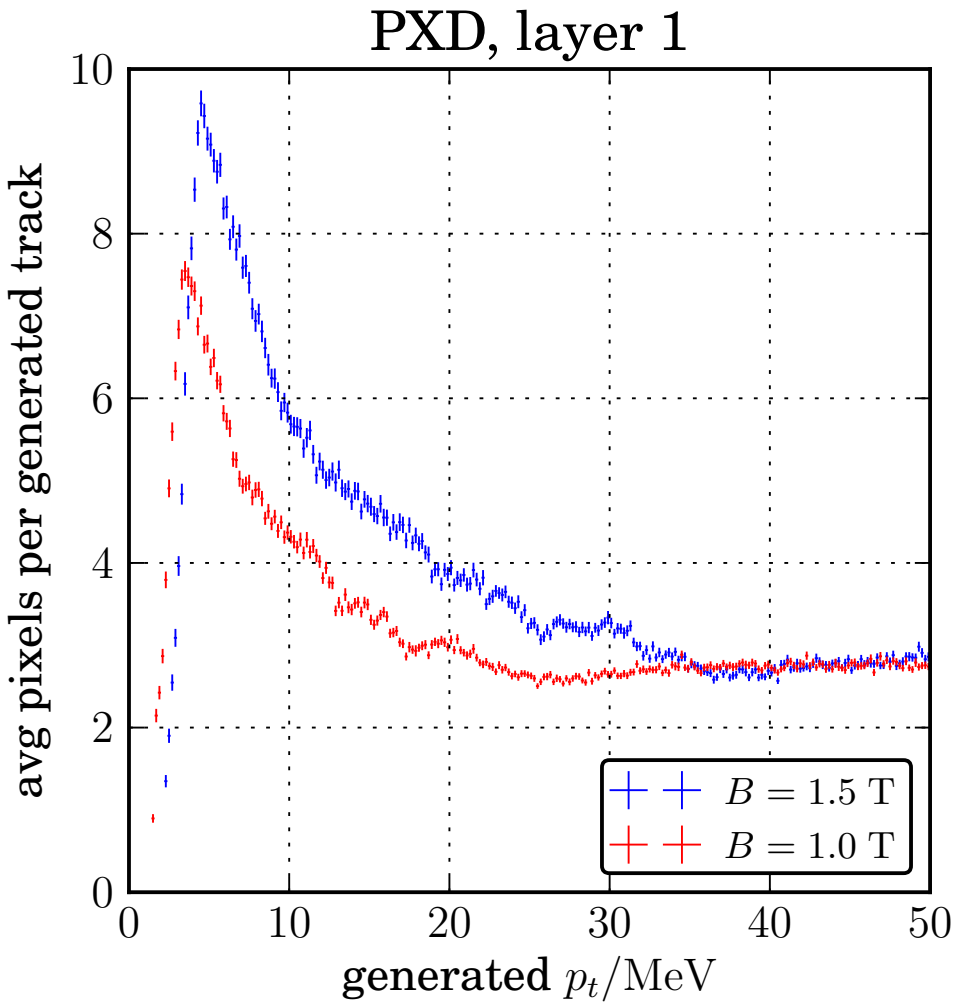


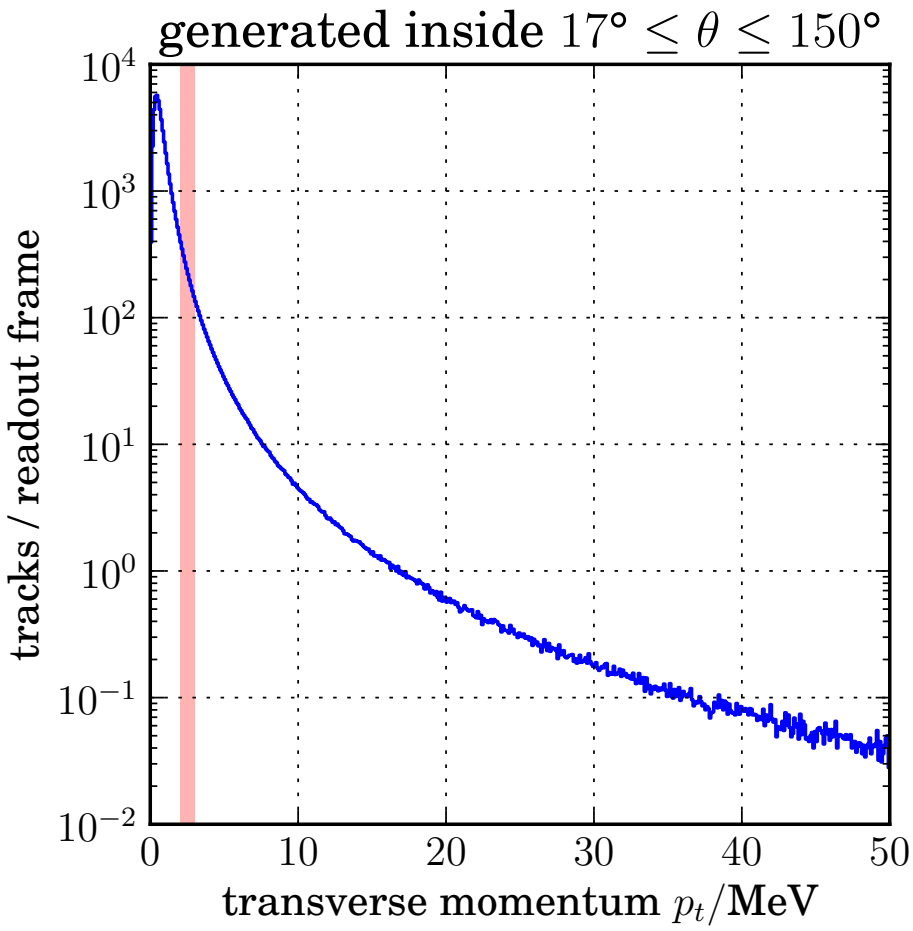
Conclusions

Synchrotron Radiation only for ideal alignment
➡ possible large occupancy from misalignment/halo

QED Background

- Lowering B field to 1 T
- ➡ almost double occupancy
- only verified for $p_t \geq 9$ MeV
- ➡ large uncertainty at 2 MeV

➡ $B = 1$ T very risky for PXD, might work but not enough tolerance



Thank you
for your attention