Ion Backdrift in an ILC TPC

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3. TPC Analysis Jamboree
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GEFÖRDERT VOM

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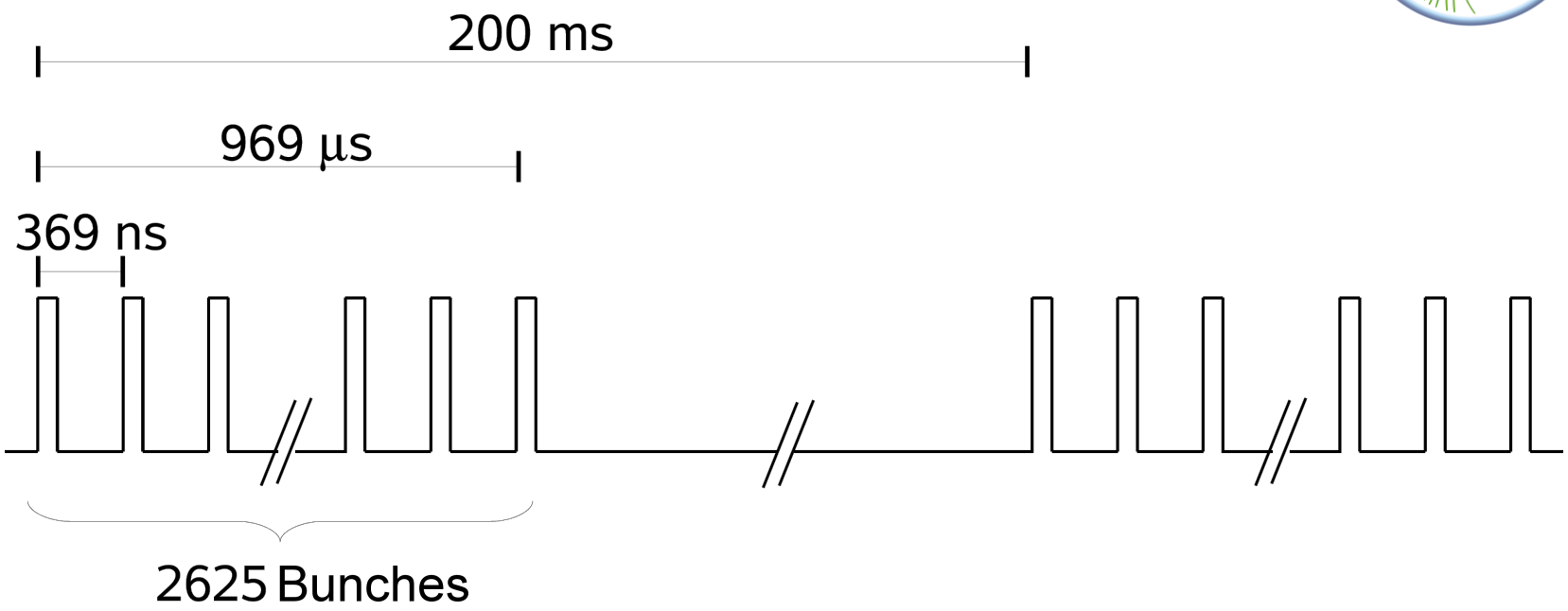
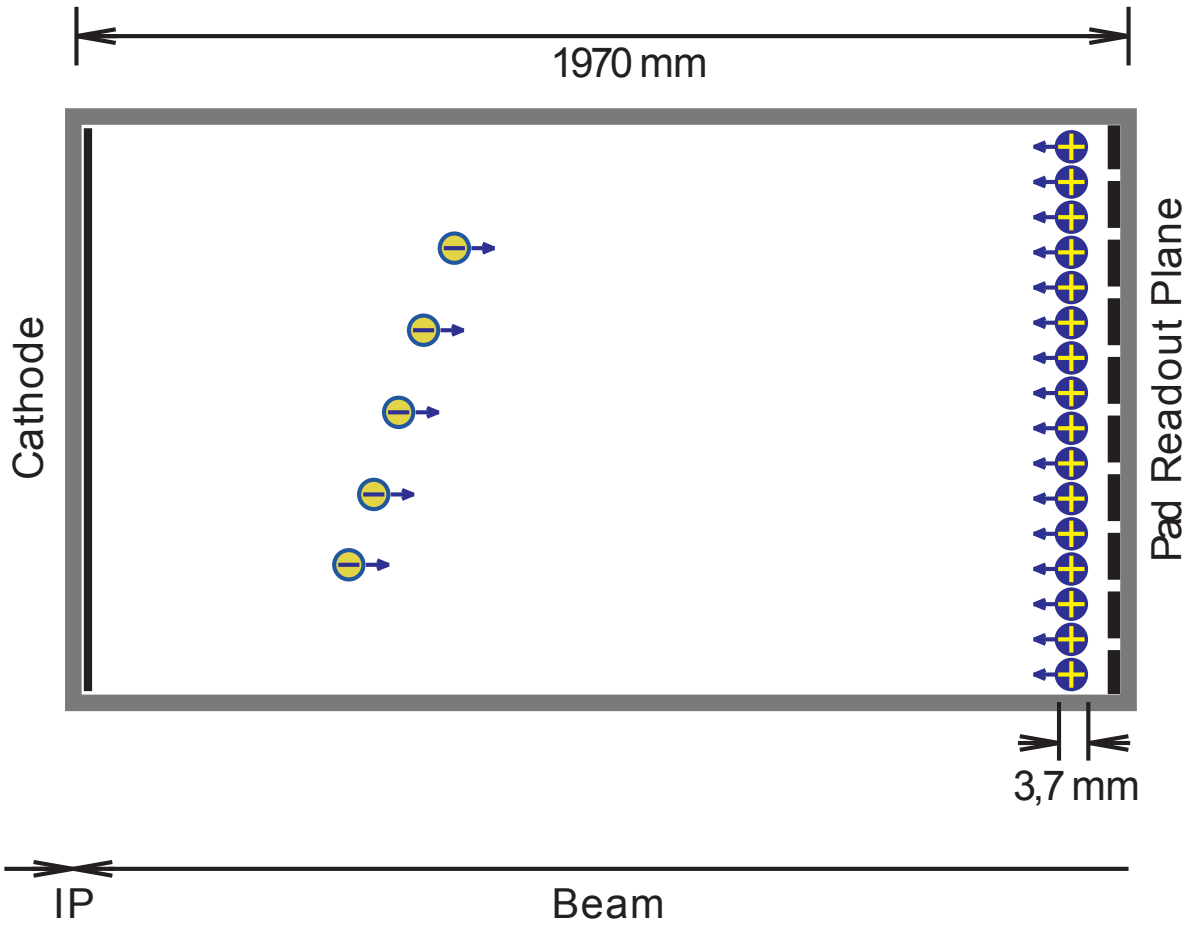
ILC Beam Structure



Beam Structure

- Beam consists of bunch trains
- 2625 bunches per train
- 2×10^{10} particles per bunch
- Bunch spacings: 369 ns
- Time between trains: $\sim$199 ms
- Train length: $\sim$1 ms

Ion Backdrift at the ILC



Drift velocities:

$$v_{\text{ions}} = 3,7 \frac{\text{mm}}{\text{ms}}$$

$$v_{e^-} = 44,8 \frac{\text{mm}}{\mu\text{s}}$$

Drift times:

$$t_{\text{ions}} = 532,4 \text{ ms} \;\widehat{=}\; 2,7 \text{ BT}$$

$$t_{e^-} = 43,9 \text{ µs} \;\widehat{=}\; 119 \text{ BX}$$

Gas: TDR (Ar 93%, CH_4%, CO_2 2%)

Drift field: $|E| = 240 V/cm$

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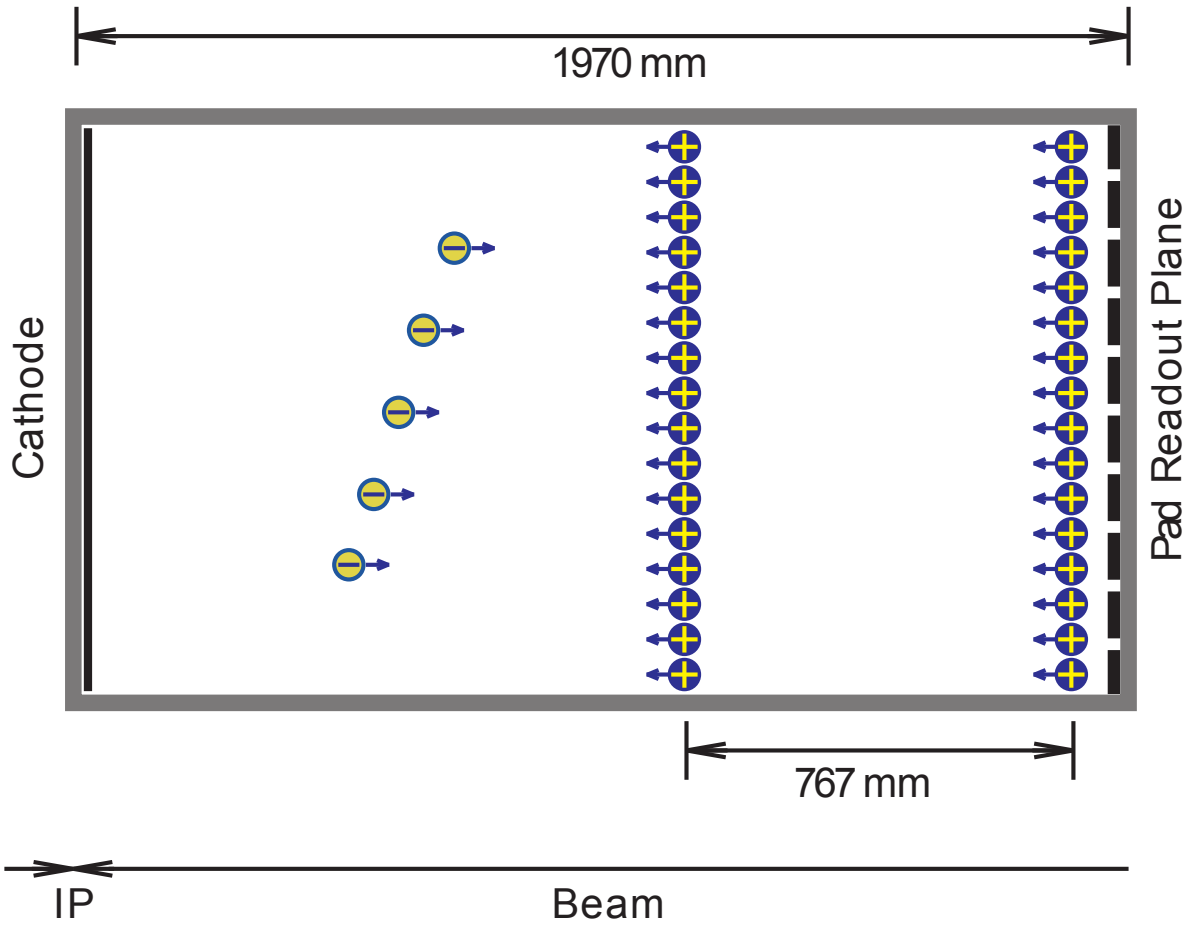

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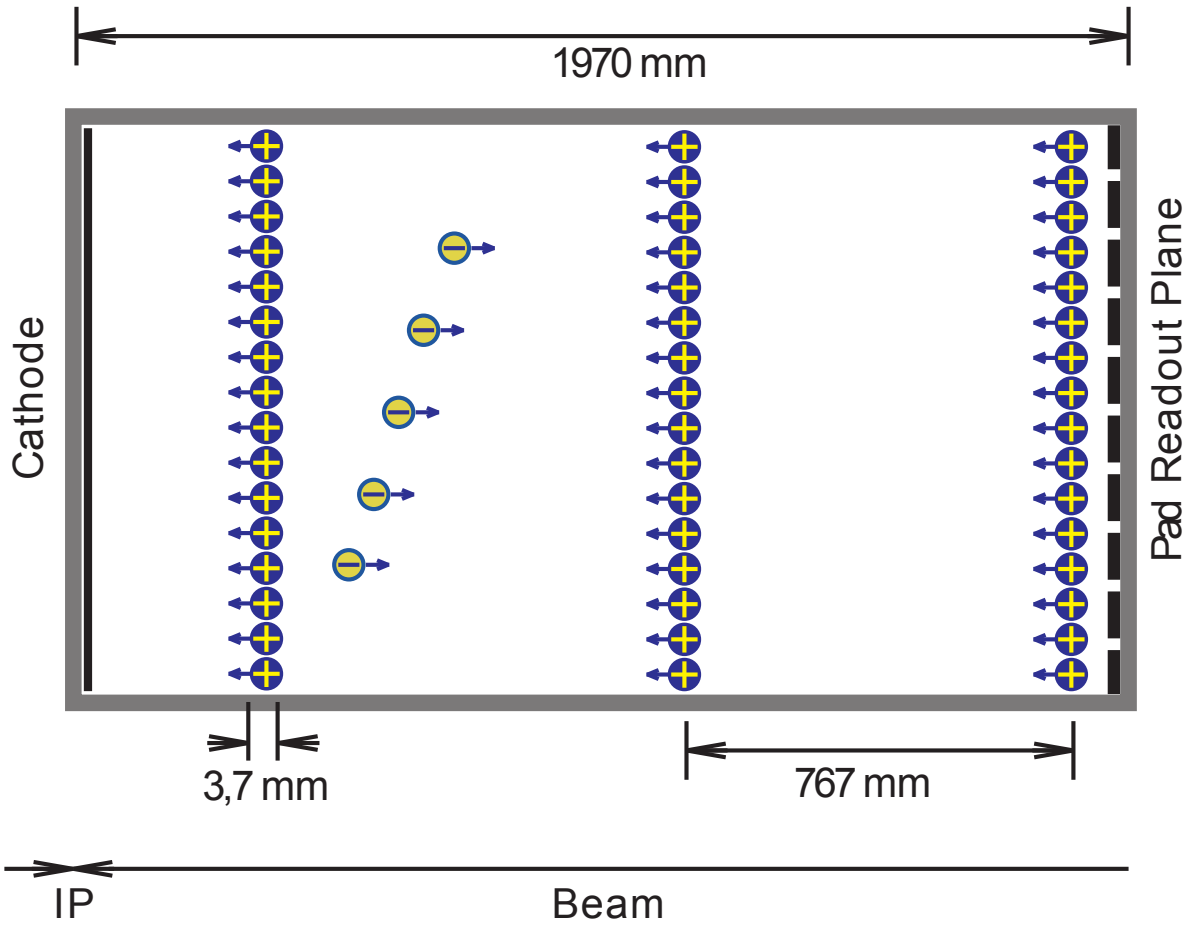

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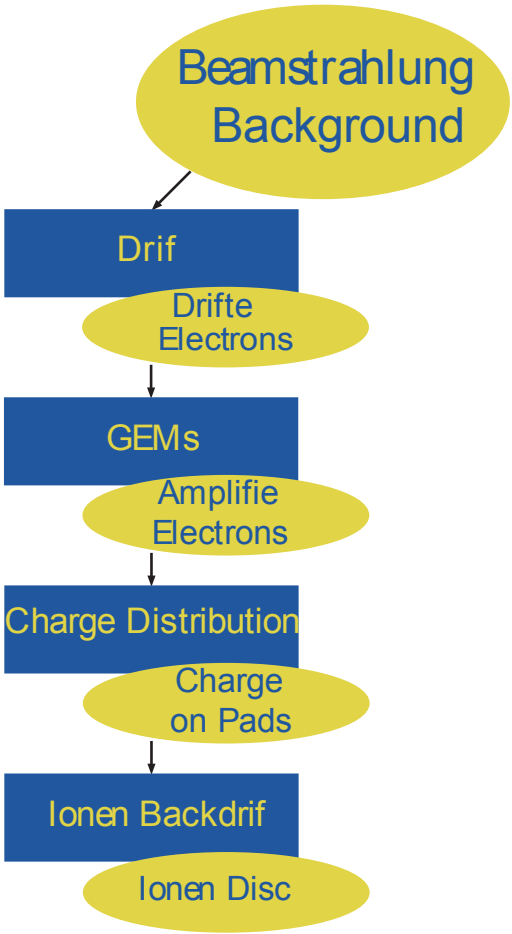

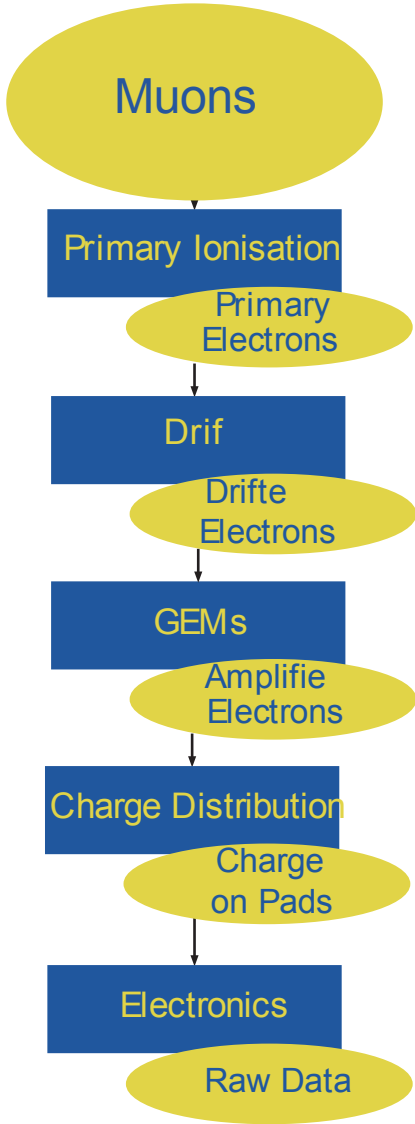

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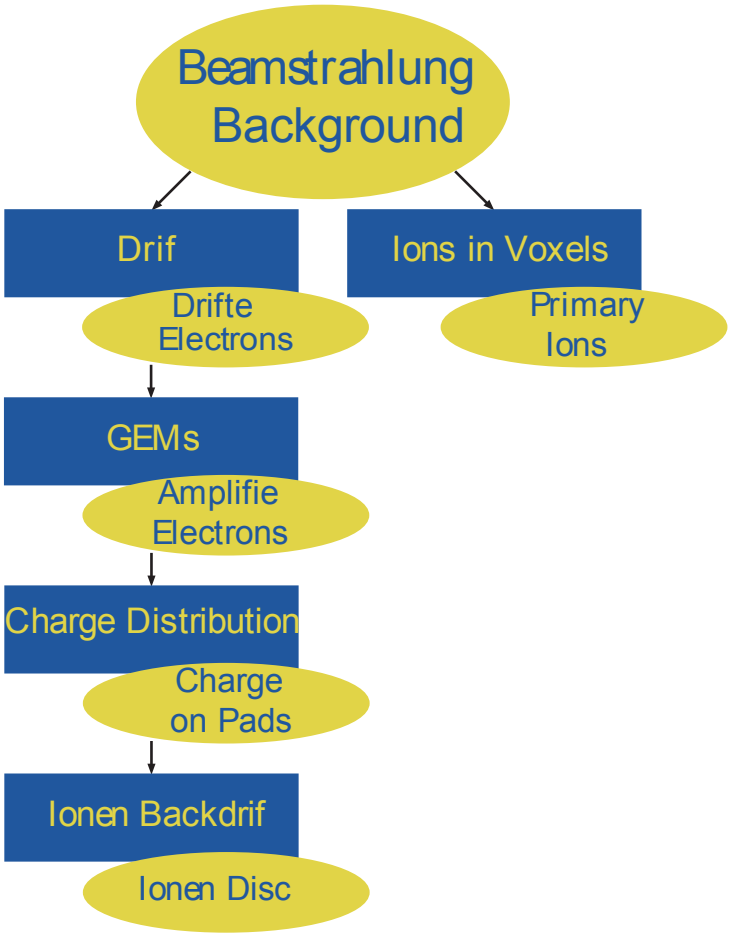

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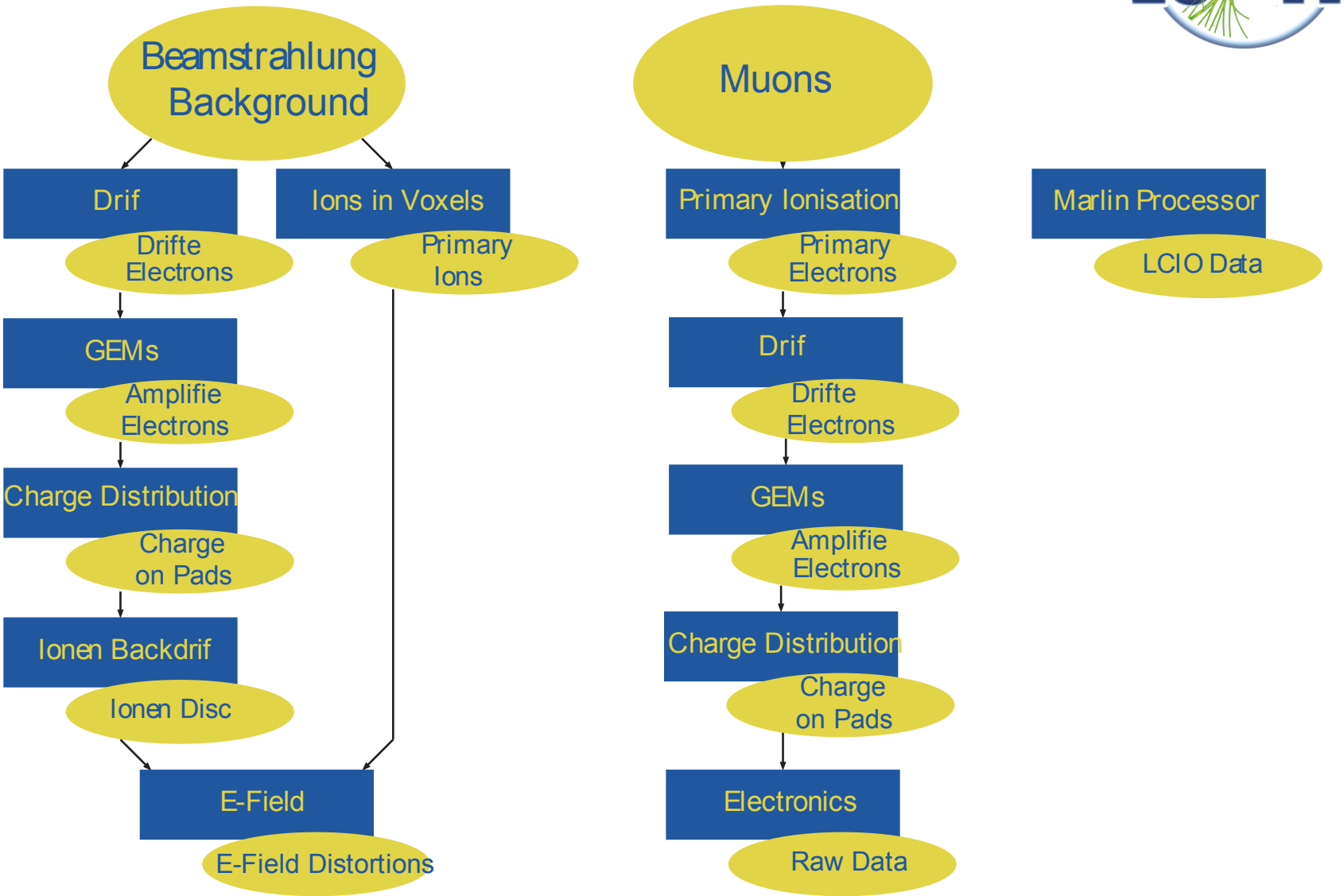

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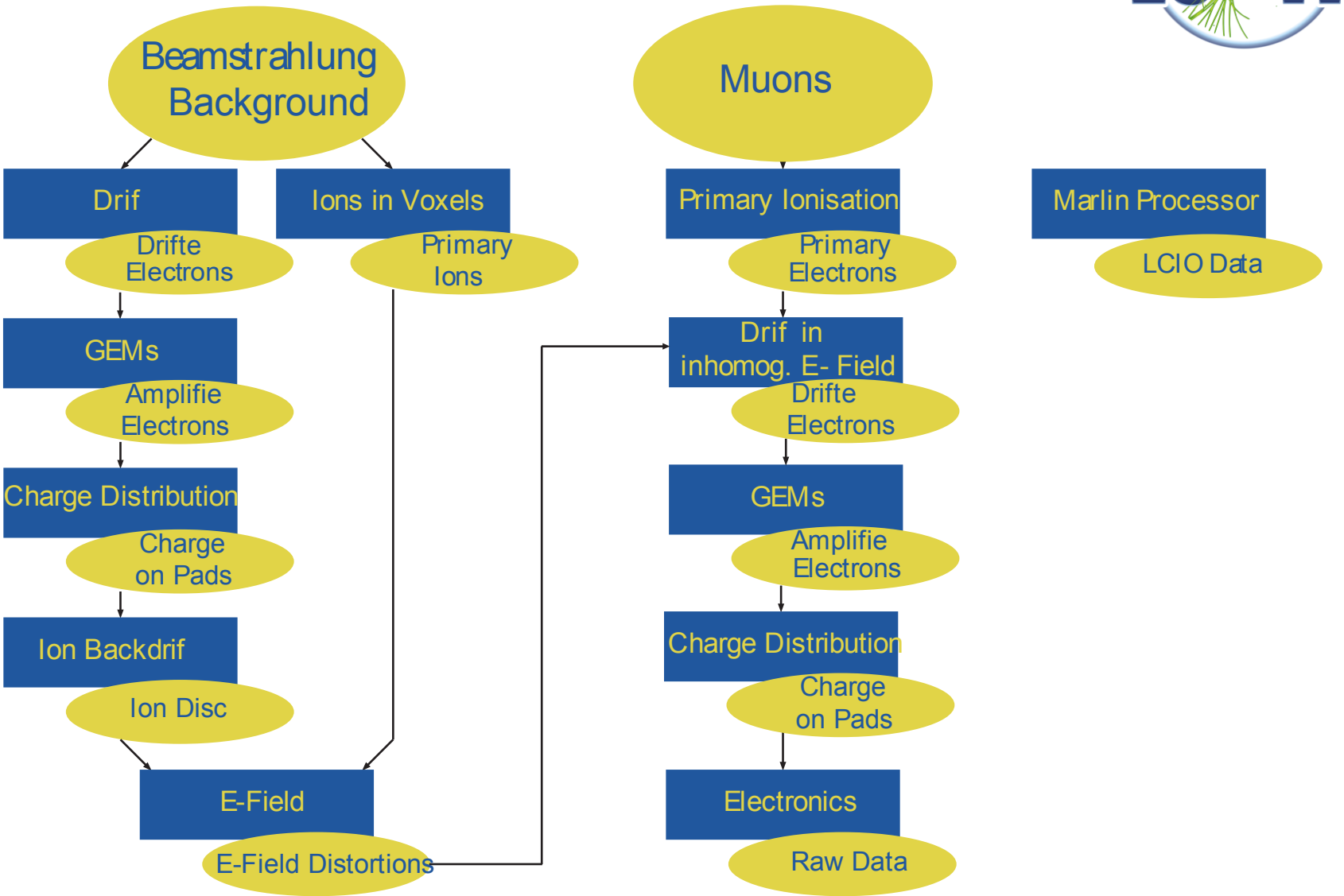
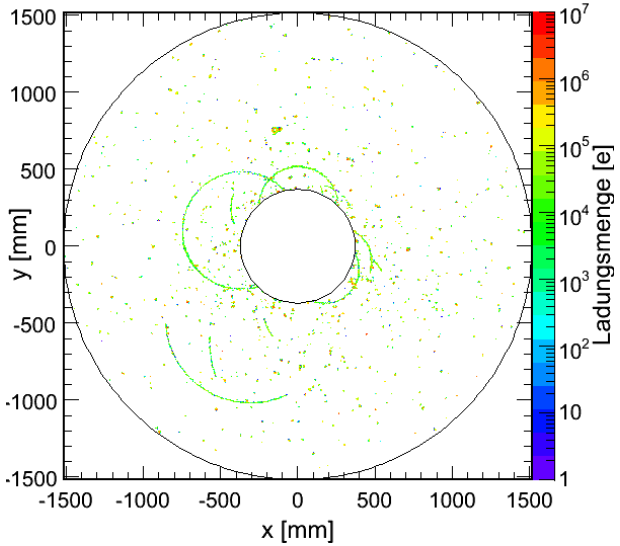
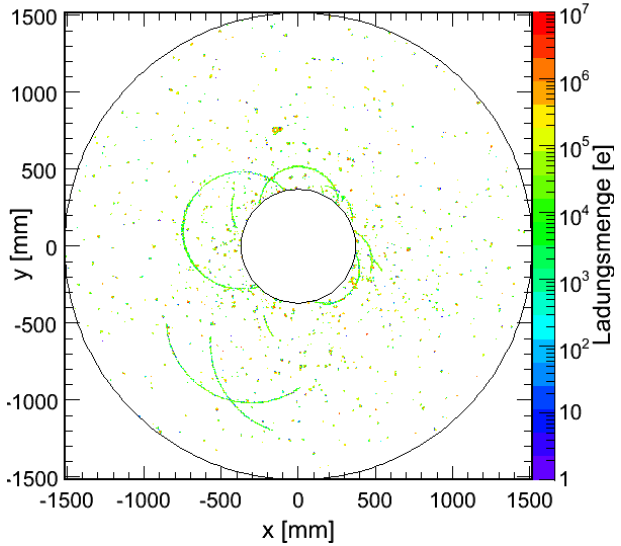


Ion Discs

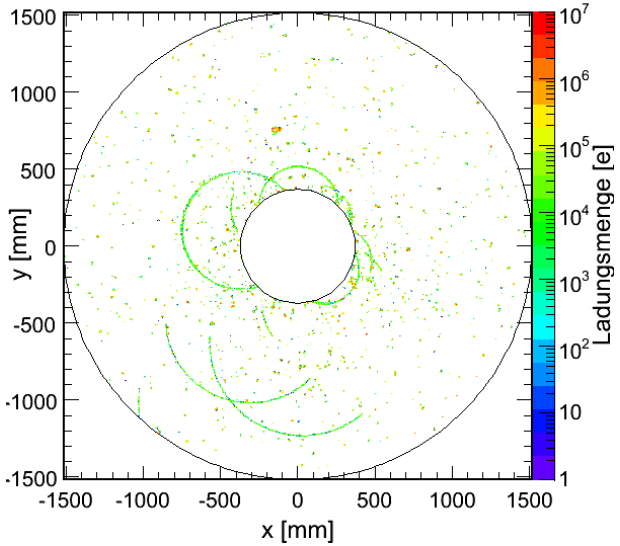
110 Bunch Crossings



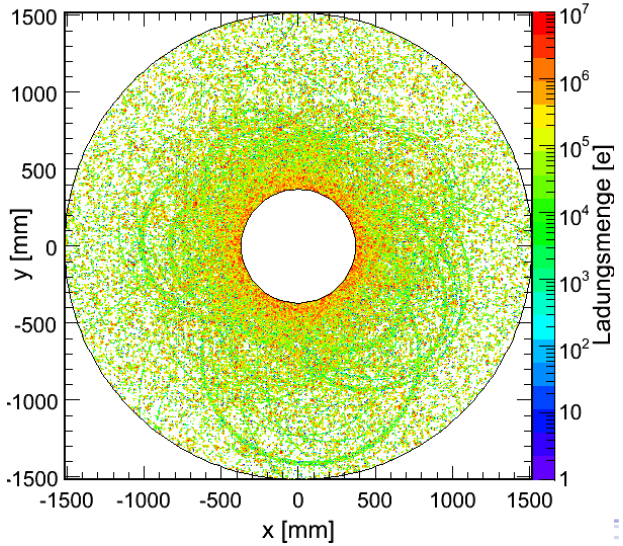
115 Bunch Crossings



120 Bunch Crossings

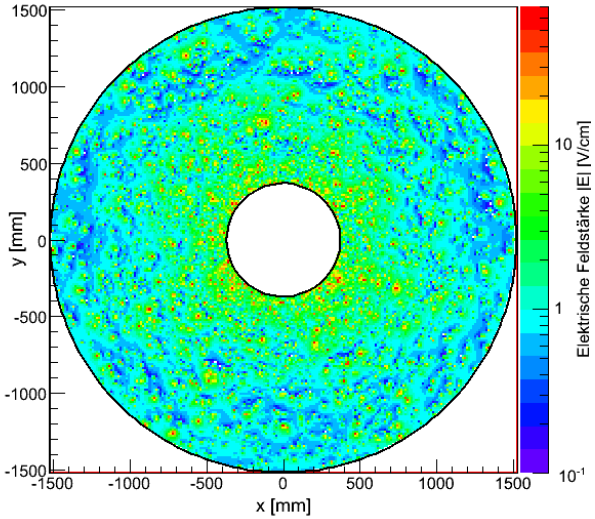


2750 Bunch Crossings

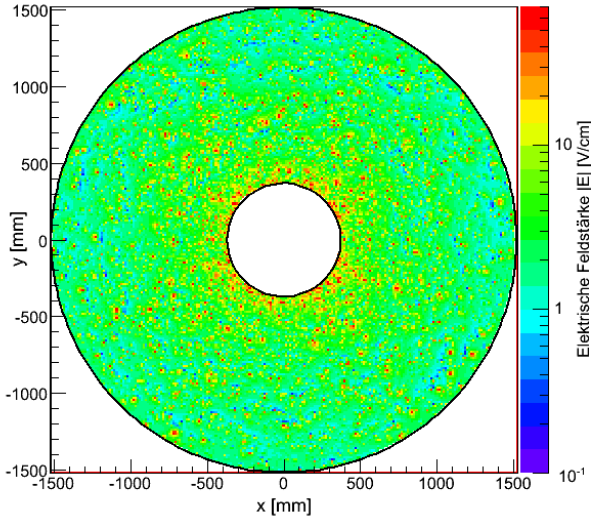


Field Distortions

500 Bunch Crossings



1000 Bunch Crossings



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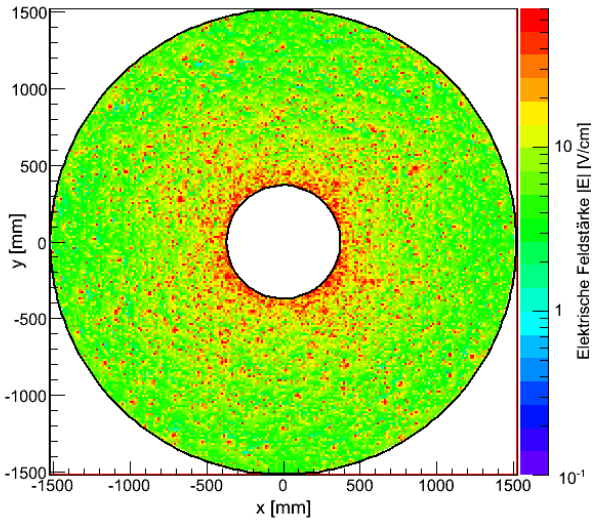

- Drift field:
  $|E| = 240\ V/cm$
- Field distortions:
  $\Delta\ E \leq 20\ \%$
- Change on drift velocity
  $\Delta\ v_{e^-} \leq\ 1 \frac{mm}{\mu s}$

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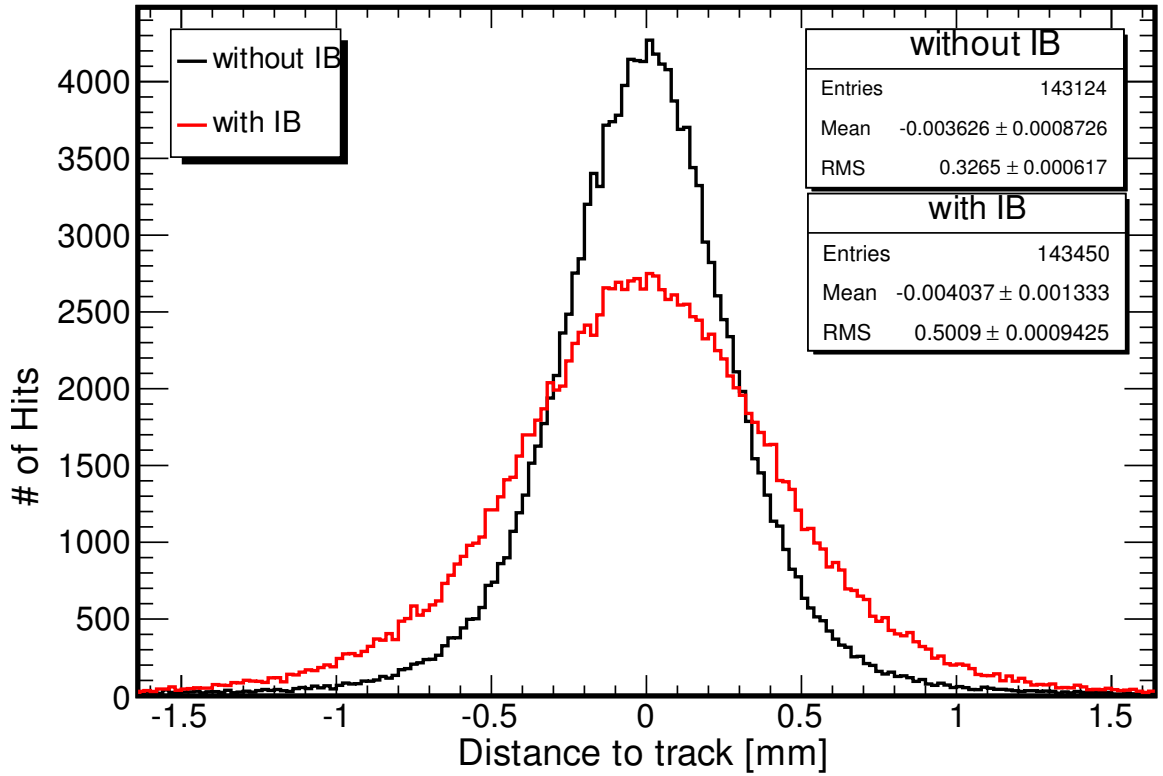
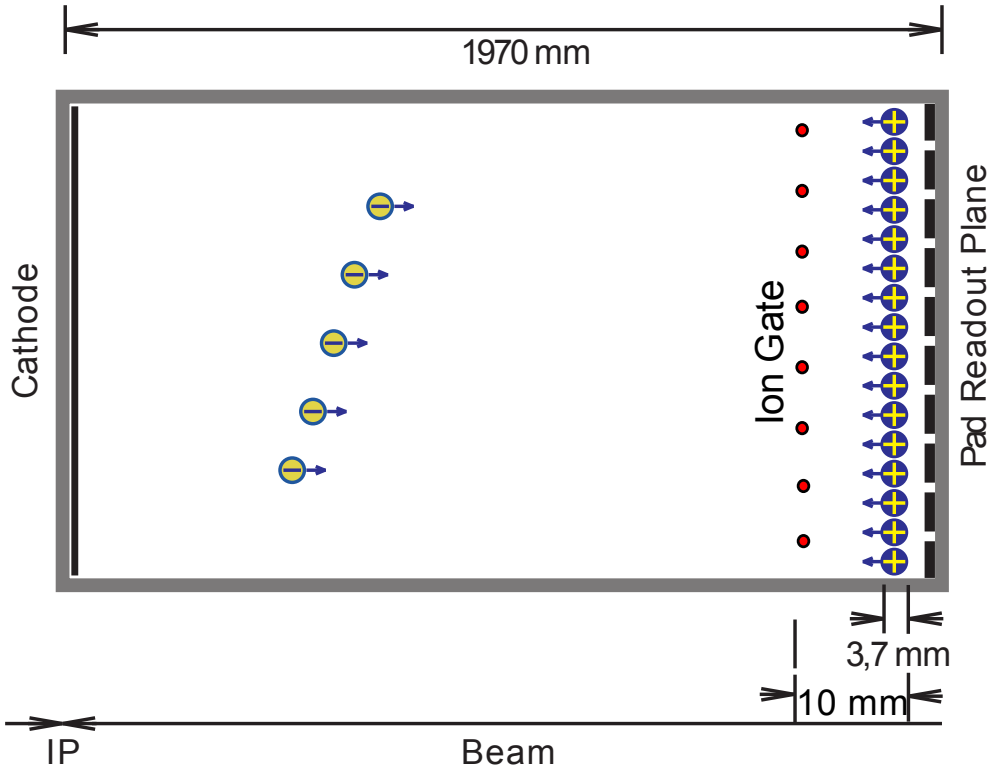
Influence on Spatial Resolution



Spatial Resolution

Significantly reduced spatial resolution for high gas gain (∼20.000)

An Ion Gate for LC-TPC?



- Gating only between bunch trains
- Additional ion discs in the volume can be suppressed
- $>$ 98 % optical transparency

- Field distorstions only near the wires ($\approx$ 3 radii)
- Terminates the dirft field
- Shields the electric charges near the readout

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Summary & Outlook

Summary

- Influence of ion backdrift on spatial resolution can be simulated in detail
  - Locally high charge depositions
  - Significant field distortions
  - Spatial resolution degrades

Outlook

- Detailed Studies:
  - Different GEM settings
  - Impact on momentum resolution
- Simulation of several ion discs
- Influence of ion gate

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