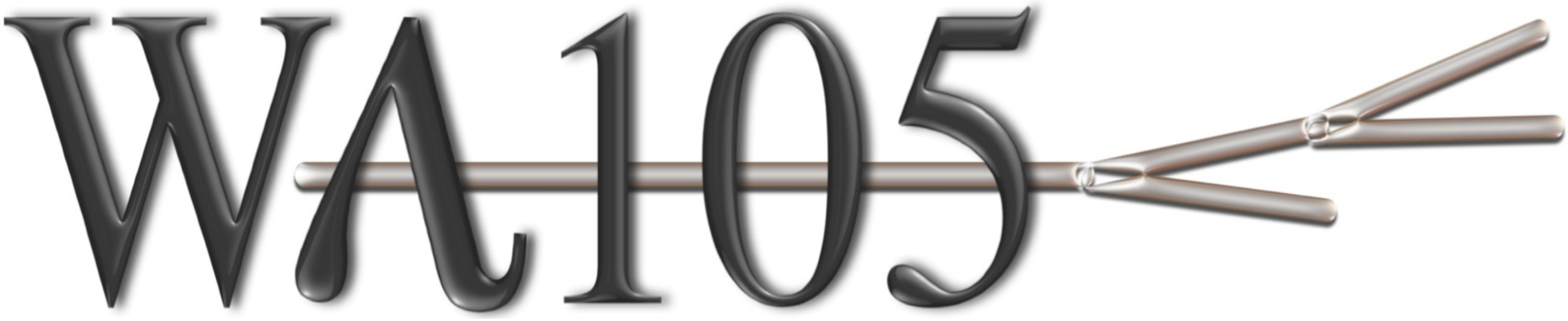
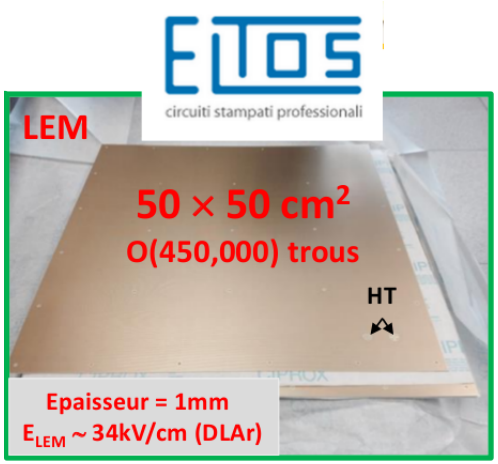


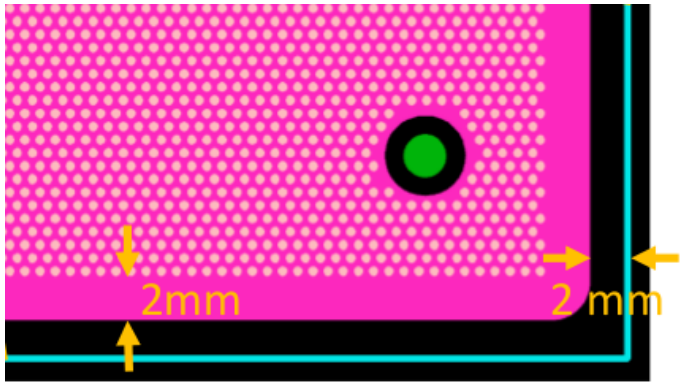

# Adding collection efficiency to anode pixels

Philippe COTTE

February 1, 2017

# Main question (reminder and update)




**4mm** without holes on LEM border + 0.5mm gap between anodes + screws and other imperfections

⇒ **Can influence the path of drifting electrons : some might be lost**

## Study

What is the impact on charge collection?

# Goal



## What had already been done

Qscan had been modified to ignore **borders**, i.e setting efficiency of **entire strips** at 0.

## Most recent work

Pixelization of the Anode to allow definition of efficiency on **pixels**

# Goal



## What had already been done

Qscan had been modified to ignore **borders**, i.e setting efficiency of **entire strips** at 0.

## Most recent work

Pixelization of the Anode to allow definition of efficiency on **pixels**

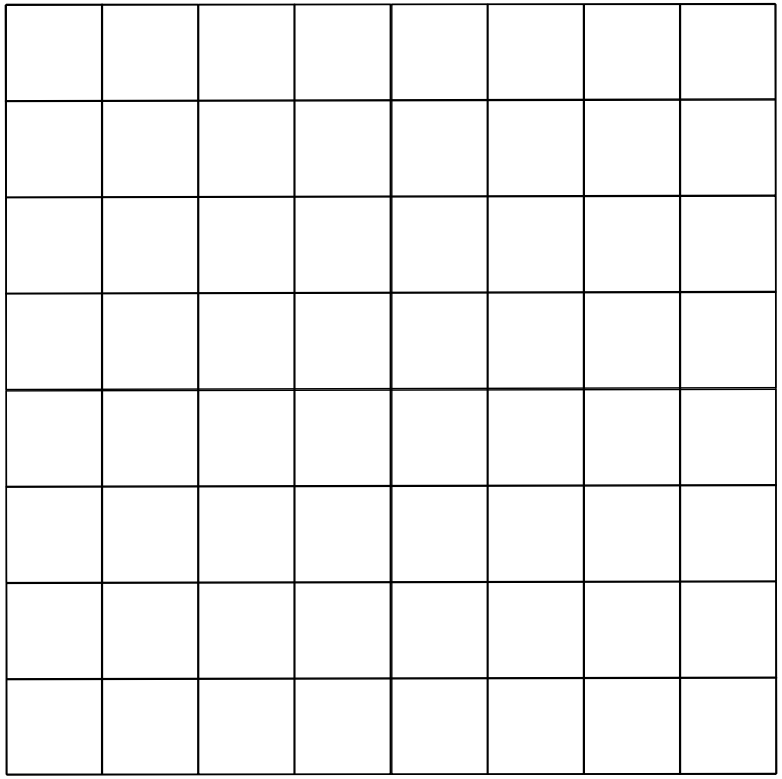
## Remark

Pixels are "virtual", no physical equivalence. $\Rightarrow$ not necessarily equivalent to two crossing strips. But **assumed to be** in this study.

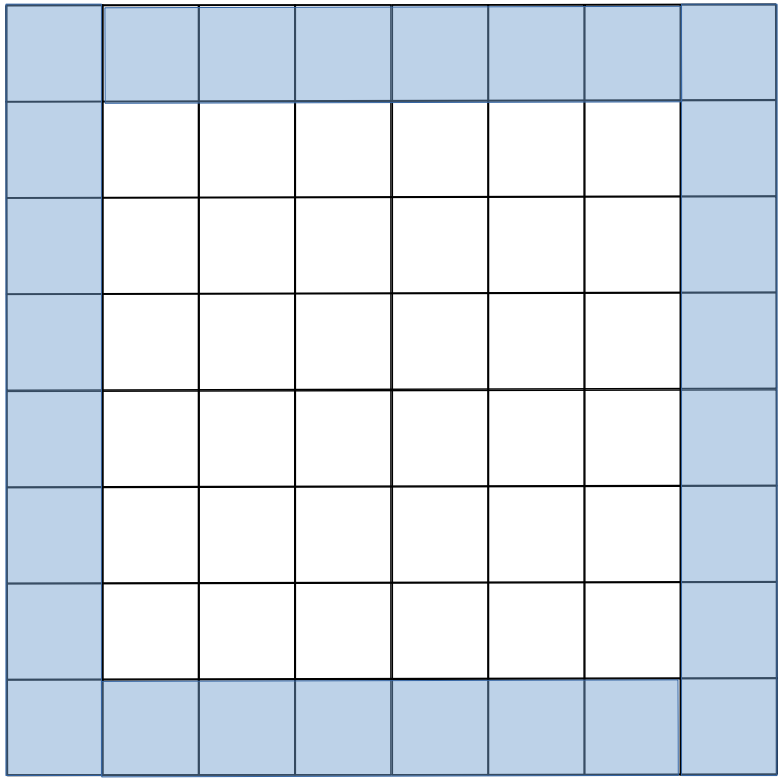
# Anode



960 $\times$ 960 strips anode



Anode with blind borders

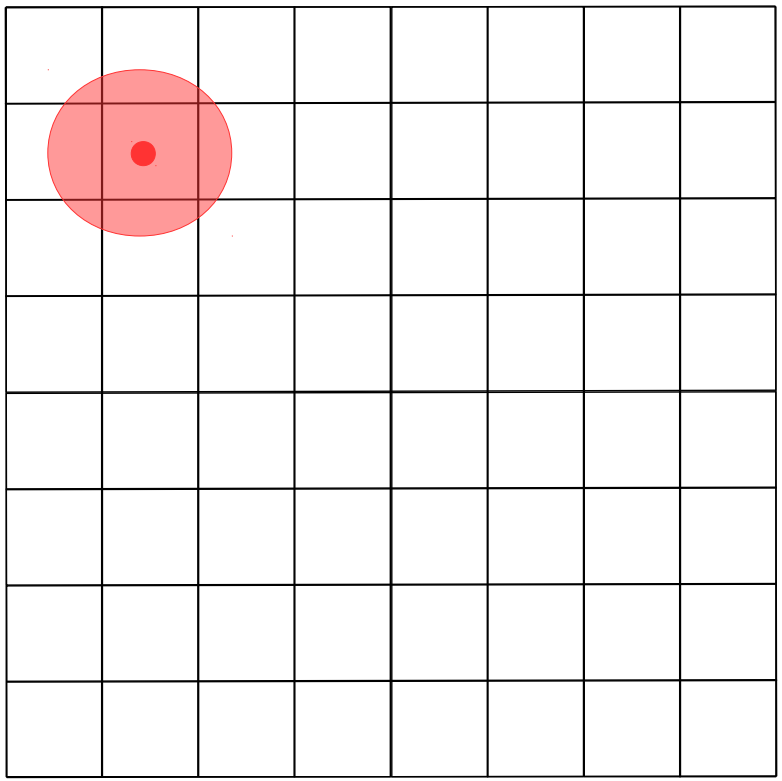


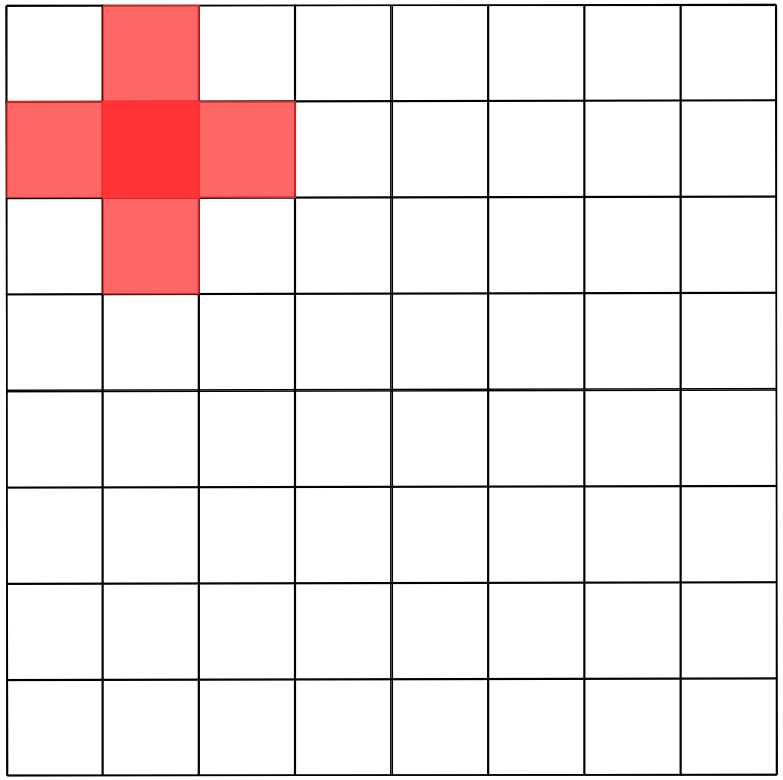
# Anode



*(blind borders not represented anymore for sake of readability)*

Charge on anode with diffusion



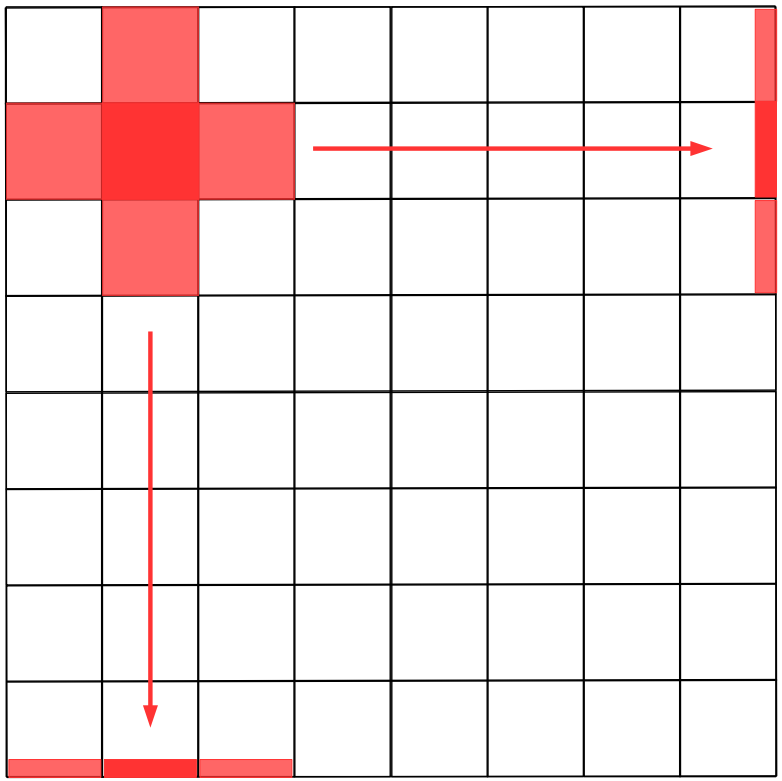


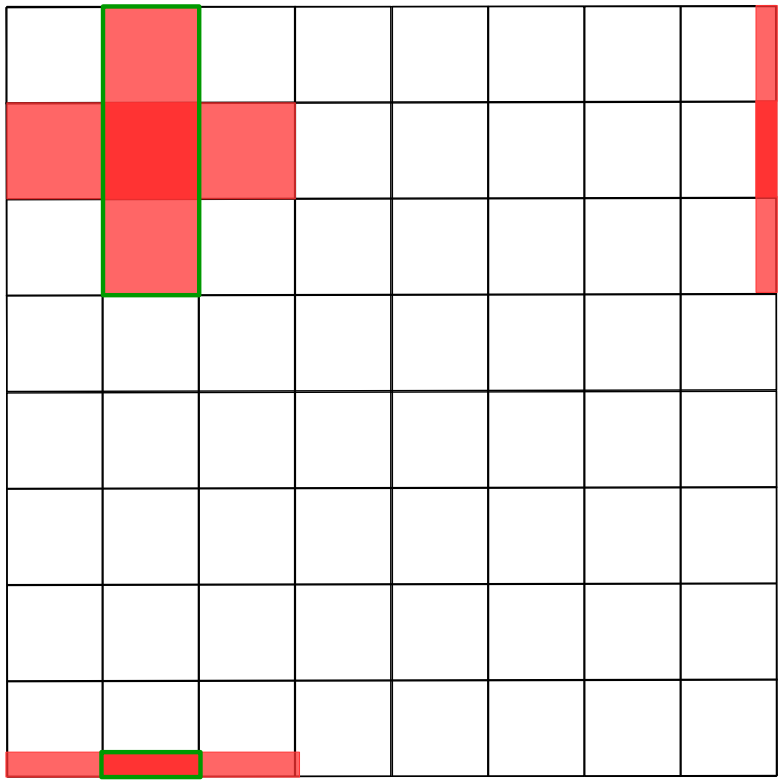
$\Rightarrow$ two pixels on borders

# Anode



Physically, we will only see charge in strips

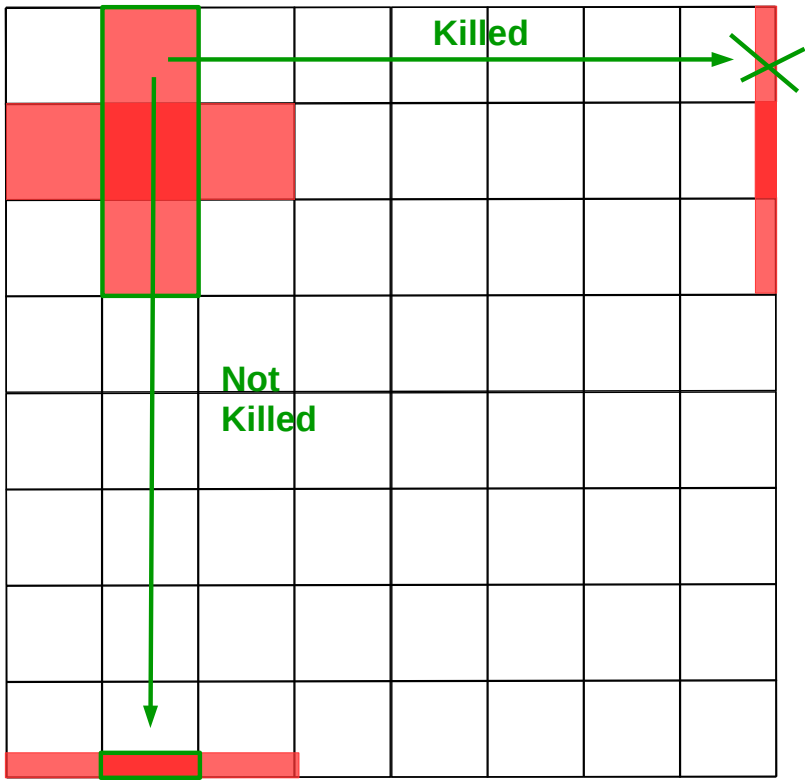




# Anode



What the original program does:

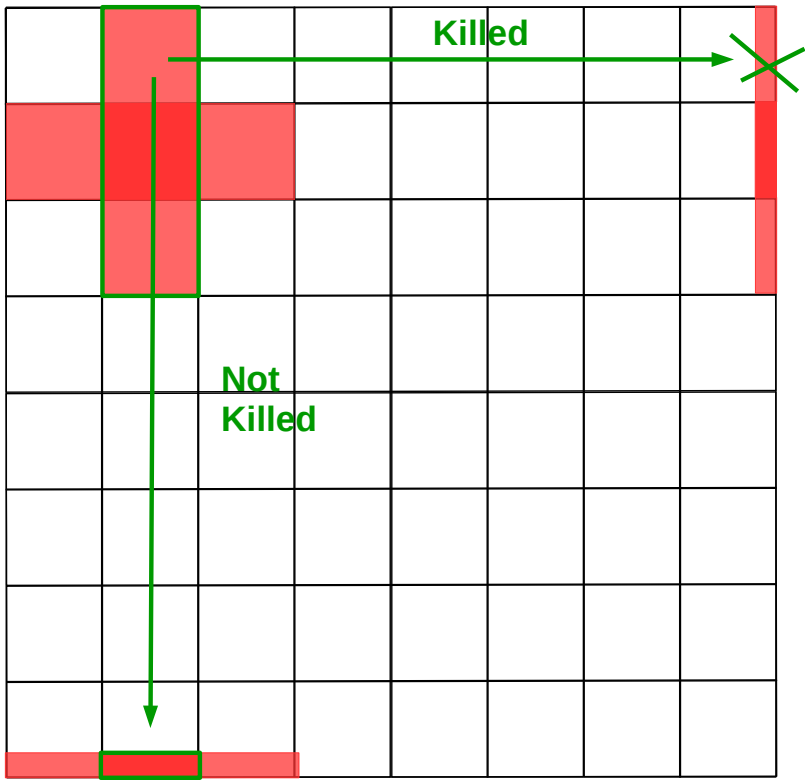



$\Rightarrow$ can not kill all the charge!

# Anode

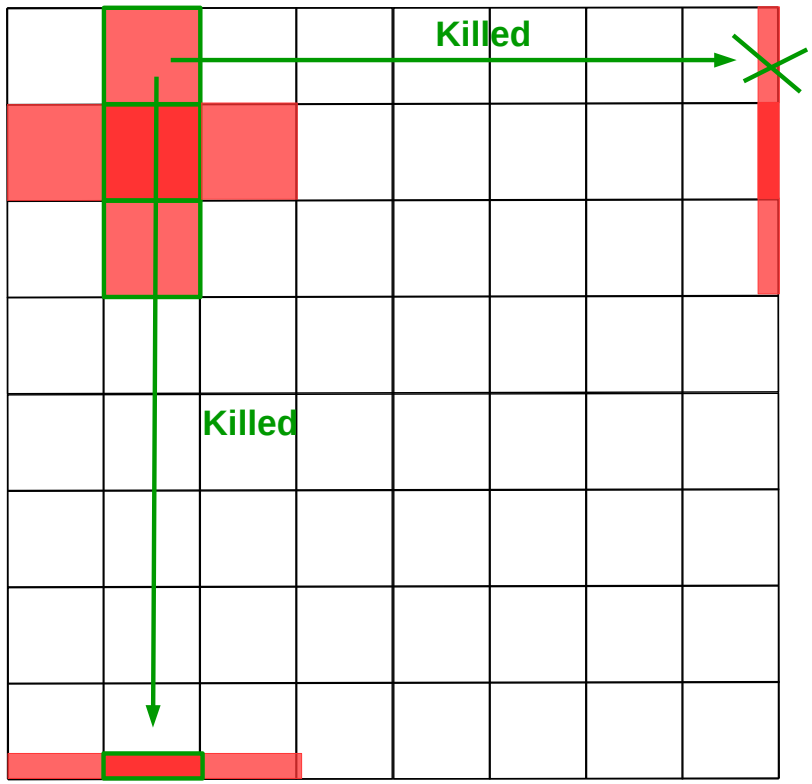


What the original program does:




⇒ can not kill all the charge!

What the modified program does:

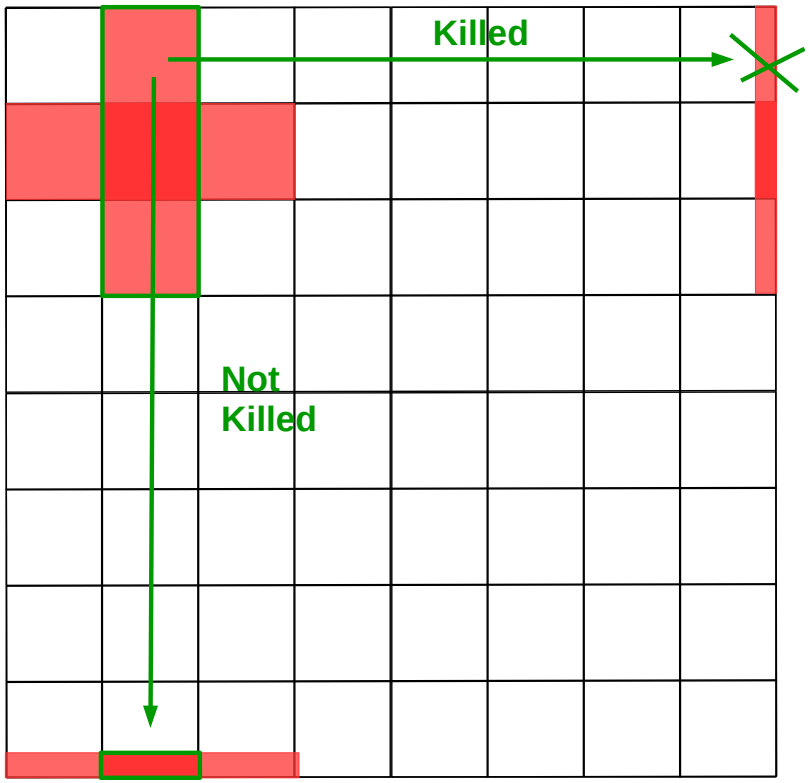



Can kill the charge!

# Anode

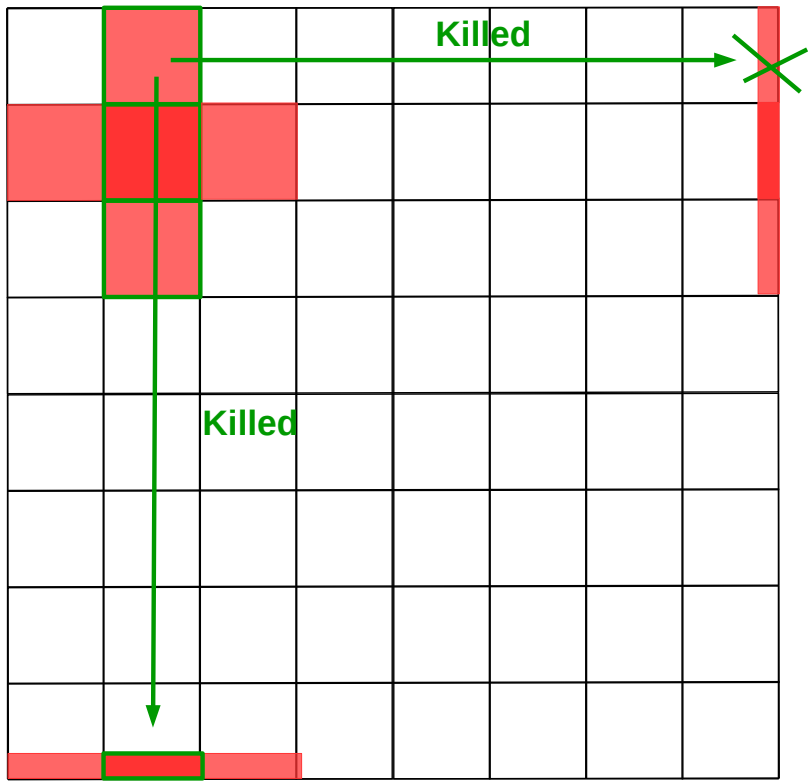


What the original program does:




⇒ can not kill all the charge!

What the modified program does:




Can kill the charge!

Use blind borders to test pixelized method.

# Software



$\Rightarrow$ Original Qscan computes charge Strip by Strip (**SbS**), does not consider pixels.

$\Rightarrow$ Original method should see more charge than **pixelized** method when diffusion is taken into account.

# Checking consistency of pixelized method



**Compare pixelized and SbS method.**

## Reminder

2 plots per method. *Border included* (no inefficiencies, black) and *border excluded* (inefficiencies on border strips, red)

# Checking consistency of pixelized method



**Compare pixelized and SbS method.**

## Reminder

2 plots per method. *Border included* (no inefficiencies, black) and *border excluded* (inefficiencies on border strips, red)

## Events

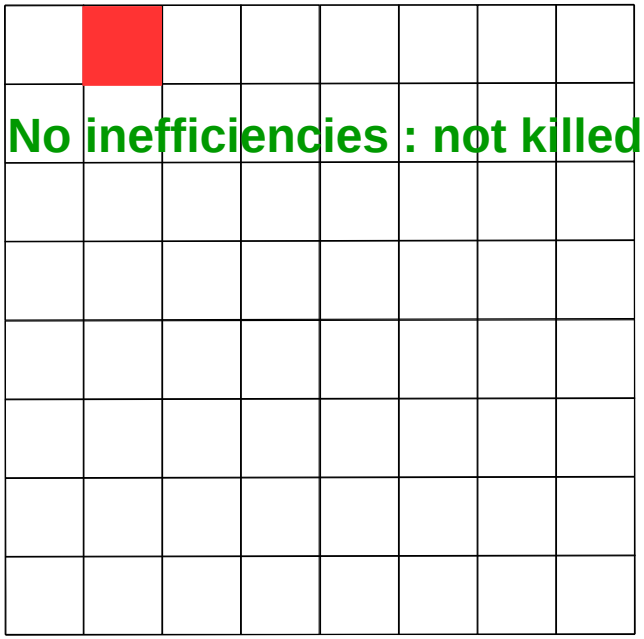
4GeV/c electrons, generated in the middle of fiducial volume, direction random on $4\pi$.
$\Rightarrow$ Each electron crosses several anode borders

# Checking consistency of pixelized method



We expect :

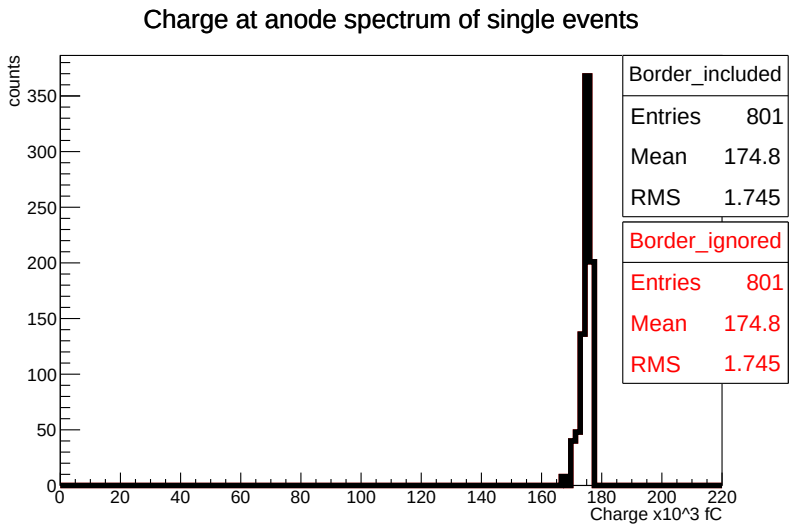
- **With no diffusion and no inefficiencies:** all 4 plots identical

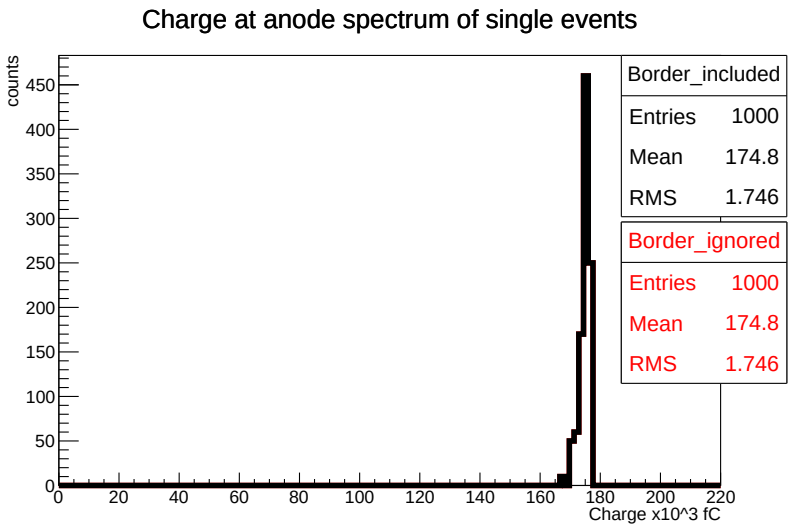


# Checking consistency of pixelized method



Simulation of 1000 electrons at 4GeV/c, no diffusion, no inefficiencies.
**Left:** SbS **Right:** pixelized.



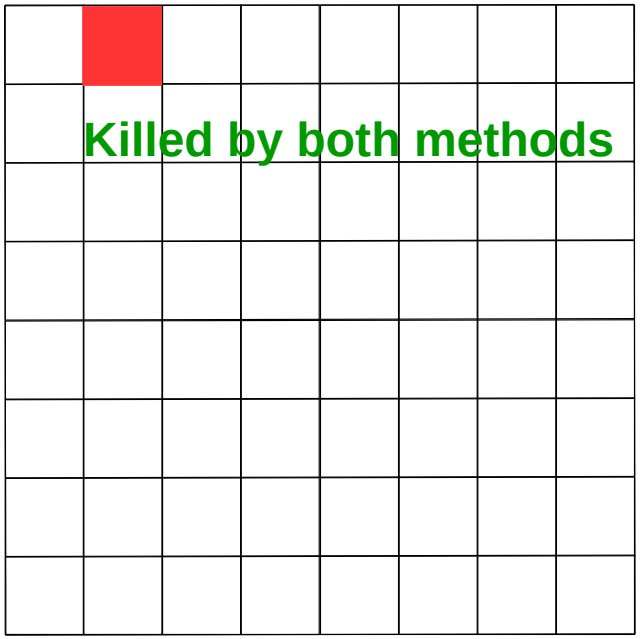

corresponds to expectations.

# Checking consistency of pixelized method



We expect :

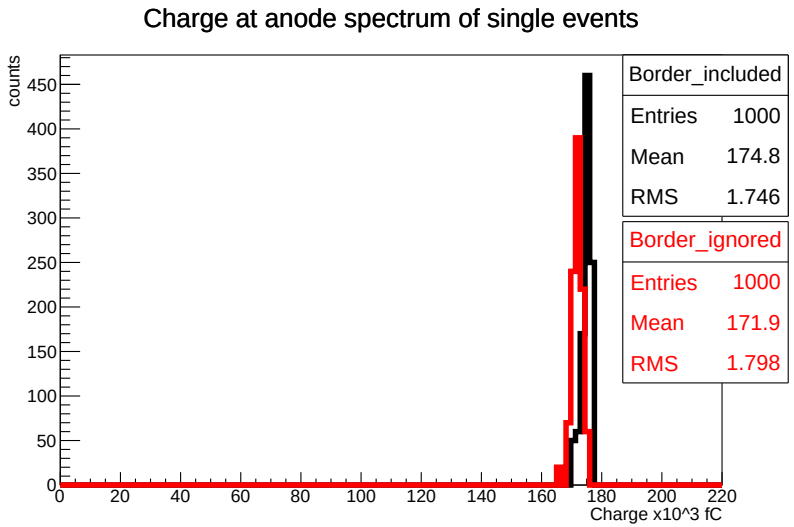
- **With no diffusion and no inefficiencies:** ✓
- **With no diffusion, but with inefficiencies:** Both methods equivalent. Red and black histo different.

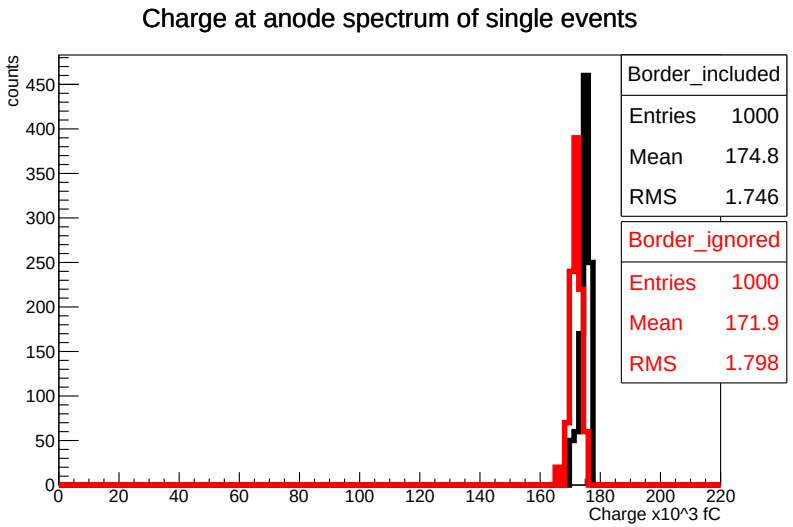


# Checking consistency



Simulation of 1000 electrons at 4GeV/c, no diffusion, with inefficiencies
**Left:** SbS **Right:** pixelized.




corresponds to expectations.

# Checking consistency of pixelized method



We expect :

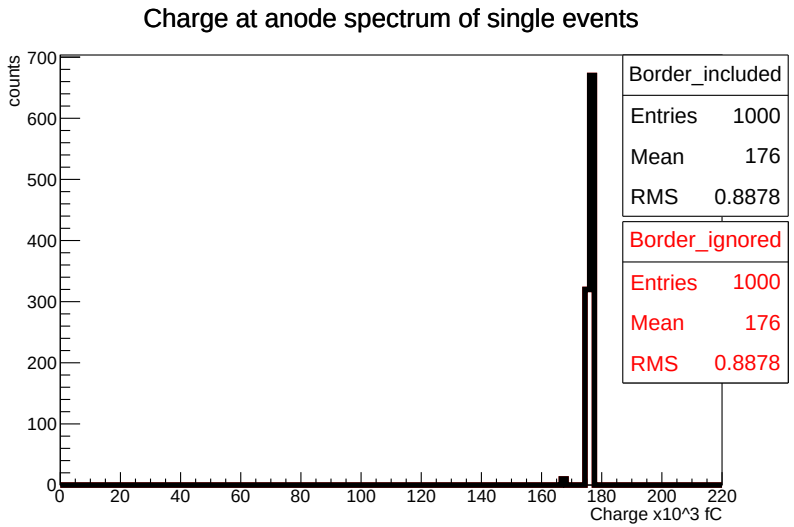
- **With no diffusion and no inefficiencies:** ✓
- **With no diffusion, but with inefficiencies:** ✓
- **with diffusion but no inefficiencies:** Both methods still equivalent, red and black histo identical.

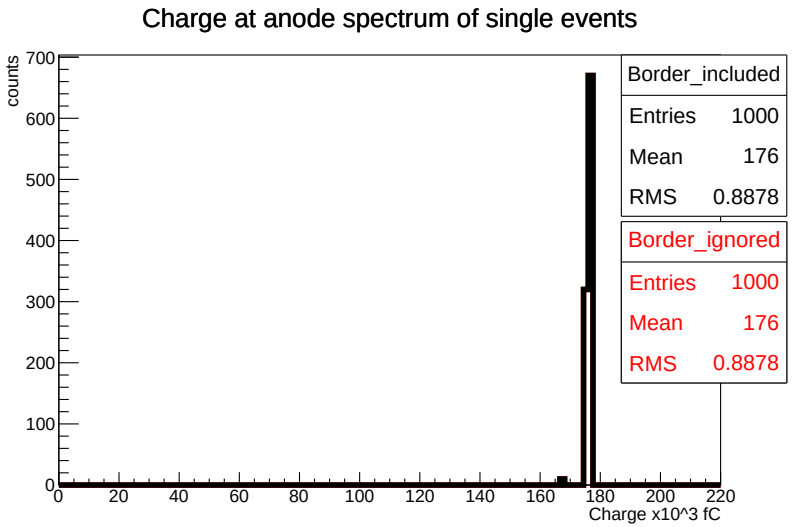
# Checking consistency



Simulation of 1000 electrons at 4GeV/c, with diffusion, no inefficiencies

**Left:** SbS **Right:** pixelized.




corresponds to expectations.

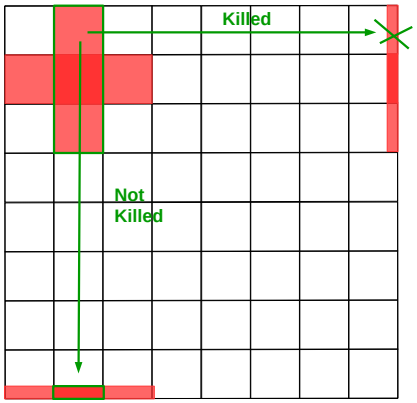
# Checking consistency of pixelized method



We expect :

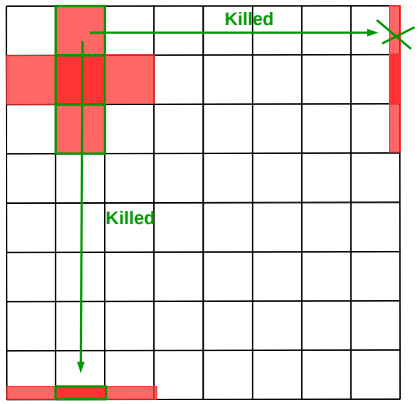
- **With no diffusion and no inefficiencies:** ✓
- **With no diffusion, but with inefficiencies:** ✓
- **with diffusion but no inefficiencies:** ✓
- **with diffusion and inefficiencies: SbS** – *Border excluded* should see more charge than **Pixelized** – *Border excluded*. Red and black histo different.

What the original program does:




$\Rightarrow$ can not kill all the charge!

What the modified program does:

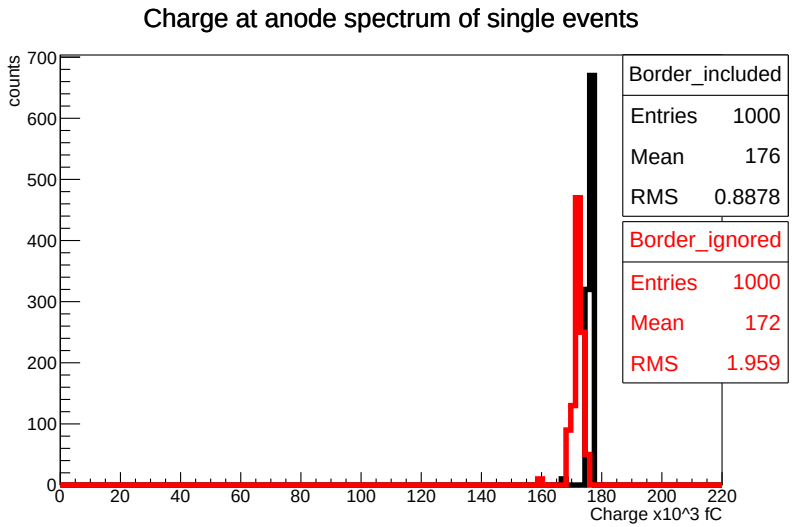


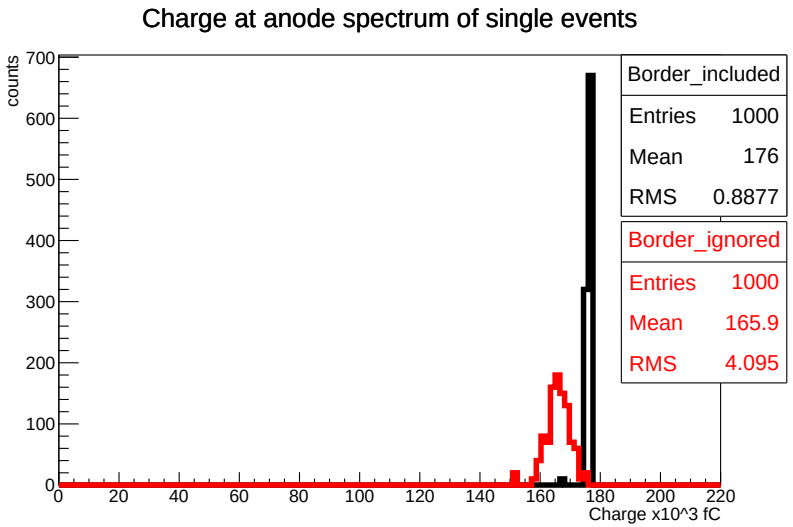

Can kill the charge!

# Checking consistency



Simulation of 1000 electrons at 4GeV/c, with diffusion, with inefficiencies
**Left:** SbS **Right:** pixelized.




corresponds to expectations.

# Checking consistency of pixelized method



We expect :

- **With no diffusion and no inefficiencies:** ✓
- **With no diffusion, but with inefficiencies:** ✓
- **with diffusion but no inefficiencies:** ✓
- **with diffusion and inefficiencies:** ✓

Pixelized $\Rightarrow$ method works!

# Computation time?


**Pixelized** method adds $\sim$ 15% of computation time ($\sim$ 30 minutes for $10 \times 100$ 4GeV/c electron events)
We can work with that!

# Conclusion and next work



We can now assign a complete efficiency map to the anode.

- Compute the efficiency map by simulating electric field (Garfield+ANSYS) 
- Modify Qscan to take different sizes of efficiency pixels (independent on strip size)

# The End



Thank you!