

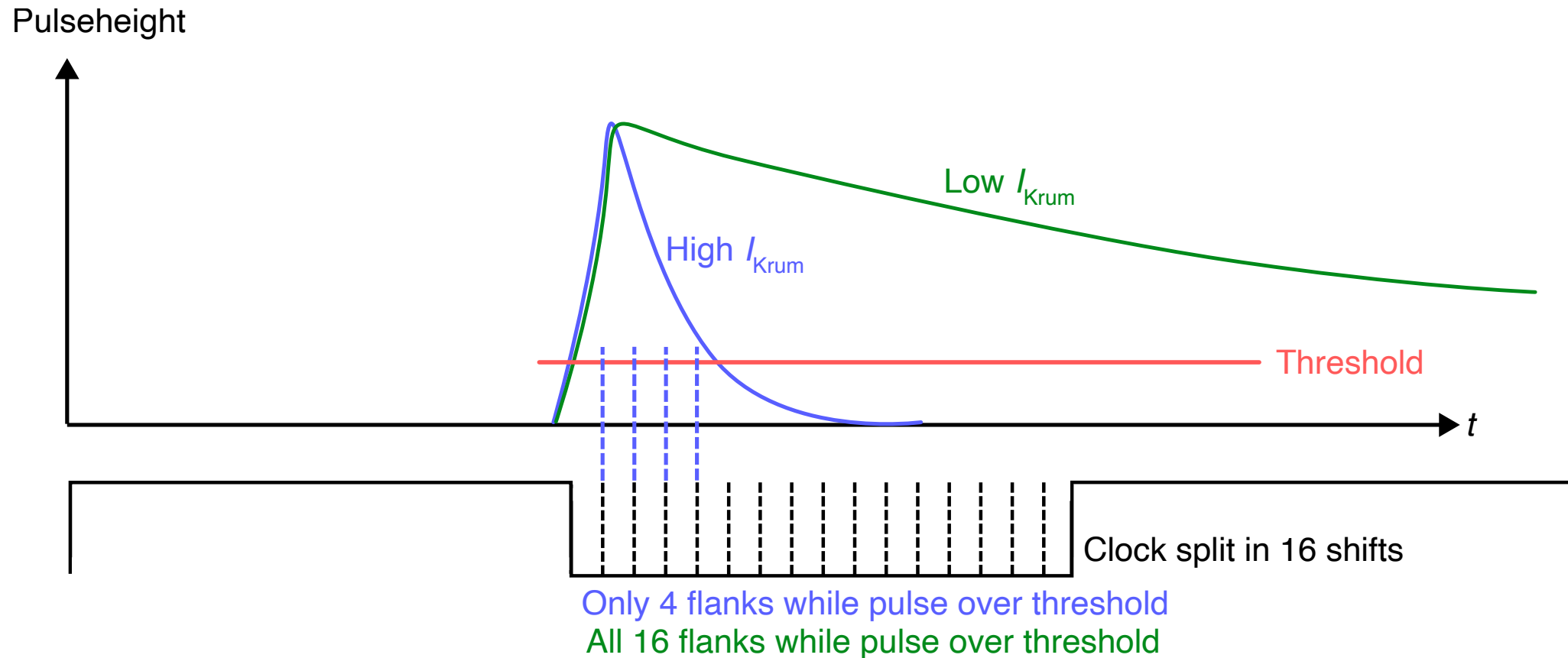
Chip calibration with low energy resolution

Lohengrin Meeting 17.04.2025

Cedric Breuning

The Problem we had

- Want a setup with low energy resolution $\longleftrightarrow$ High Krummenacher Current
- Leads to the following Problem:

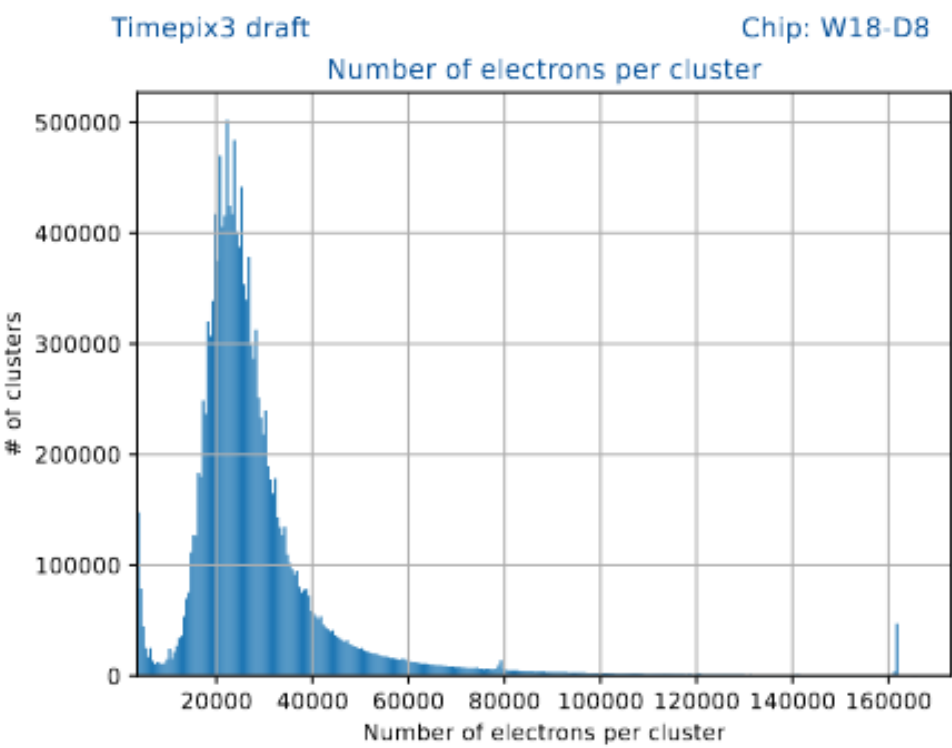


The solution

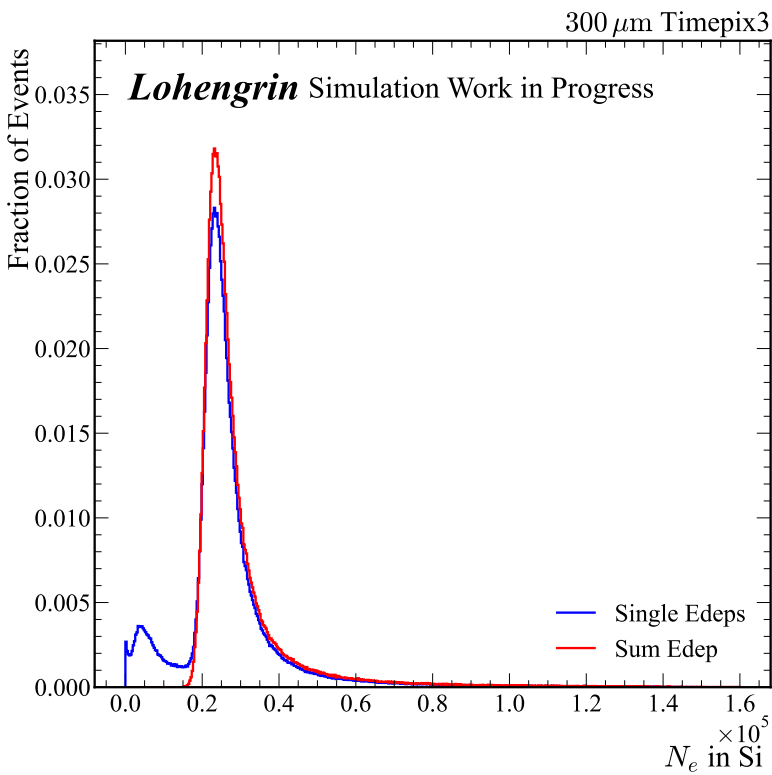
- The problem gets worse for lower pulses and better for higher pulses (longer ToT for higher energy deposit)
- Find the lowest energy deposit threshold where we still see the electron on at least 4 of 6 planes
- Calculate the resulting pulse height and do the calibration with this pulse height
 - Find the maximal Krummenacher current before the problem arises

Energy deposits 1 plane

Master Thesis Leonie Test Beam Result



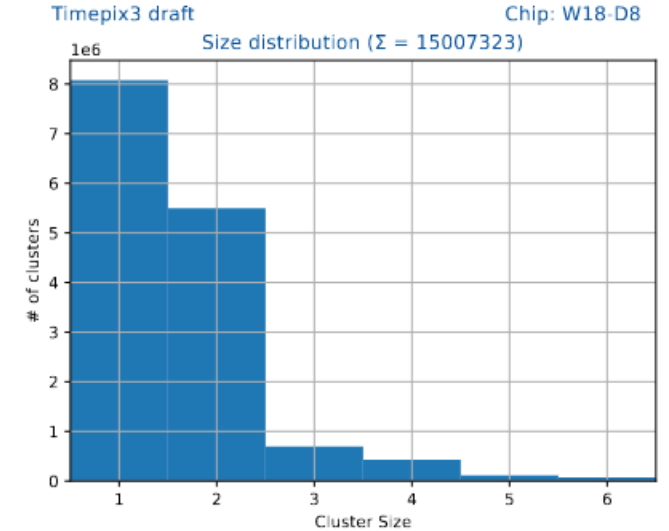
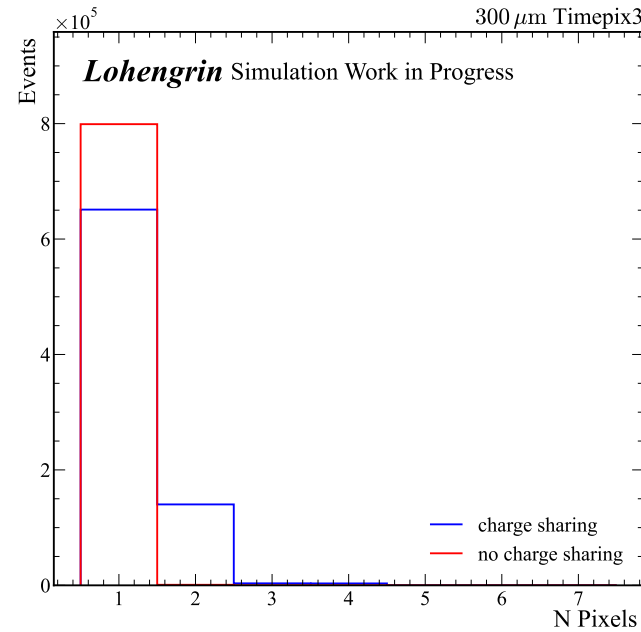
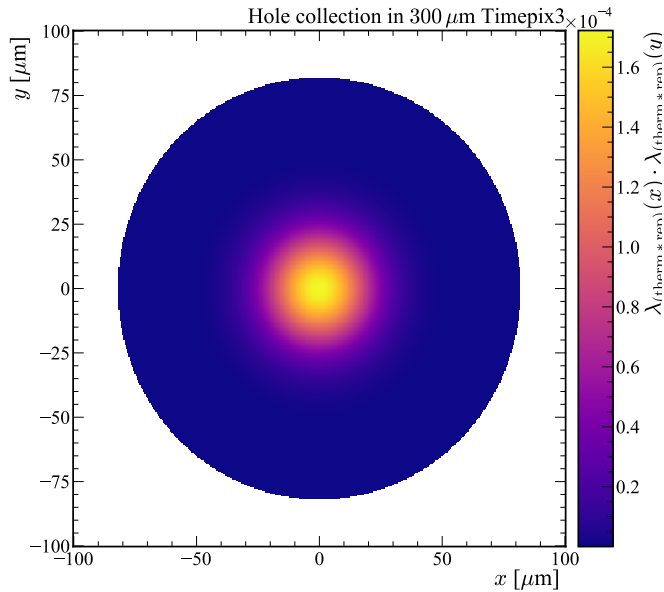
Geant4 Simulation 300 μm of silicon



Intermezzo: Charge sharing

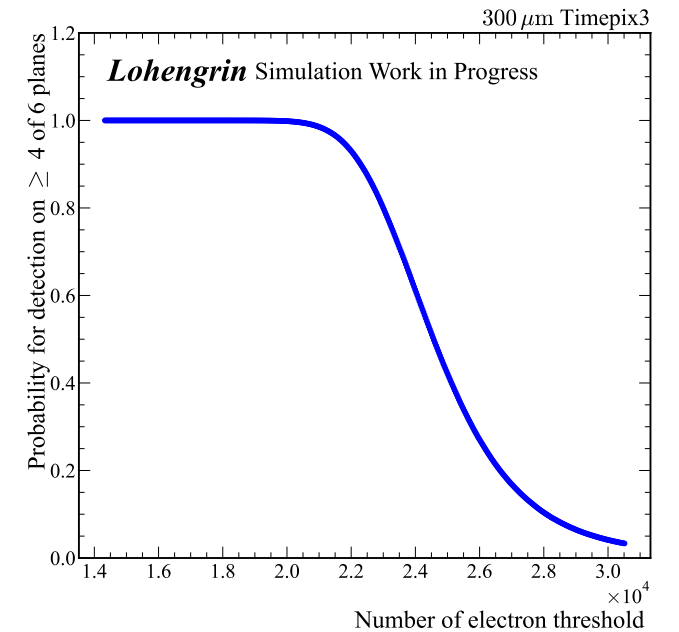
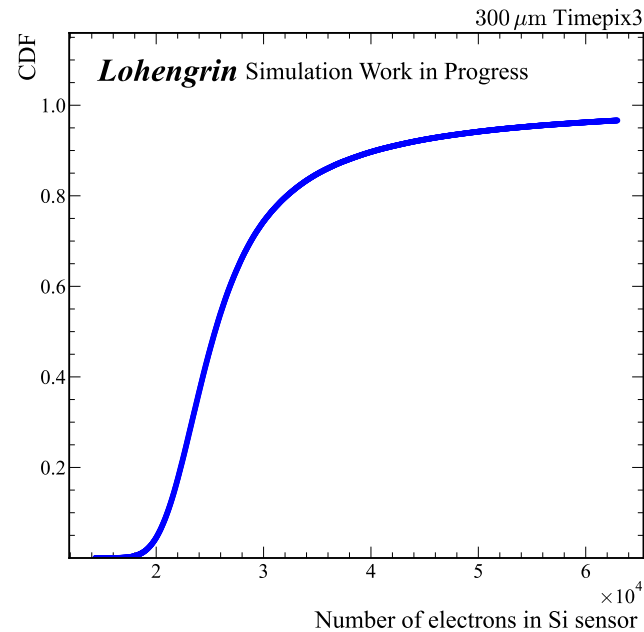
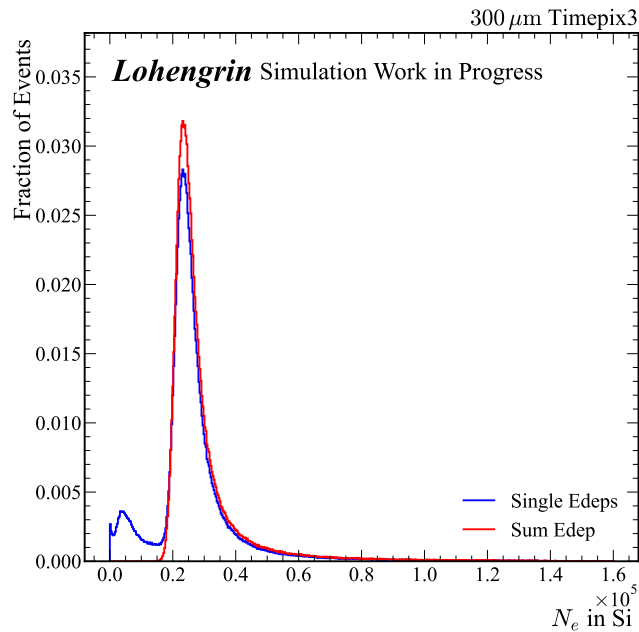
- Charge sharing approximated as convolution of thermal drift and electrostatic repulsion: $\lambda_{(\text{therm*rep})}(x, N, t)$:

$$\lambda(x, N, t)_{(\text{therm*rep})} = \frac{3N}{8\eta^3} (\eta^2 - x^2 - \sigma^2) \left[\text{erf} \left(\frac{b}{\sqrt{2}\sigma} \right) - \text{erf} \left(\frac{a}{\sqrt{2}\sigma} \right) \right] + \frac{3N}{4\eta^3} \frac{\sigma}{\sqrt{2\pi}} \left[(2x - a)e^{-\frac{a^2}{2\sigma^2}} - (2x - b)e^{-\frac{b^2}{2\sigma^2}} \right]$$



Optimal pulse

- Find pulse height, so that electrons are detected on 4/6 planes:
 - $N_e \rightarrow f_N \text{ PDF} \Rightarrow \text{CDF } F_N$
 - $P(X \geq 4; N_t) = \sum_{n=4}^6 \binom{6}{n} \cdot (1 - F_N(N_t))^n \cdot F_N(N_t)^{6-n}$



Choosing around 10000 electrons which corresponds to $\gtrsim 534 \text{ mV}$ with $C = 3 \text{ fF}$ seems to be ok