# Study of saturation parameters (update)

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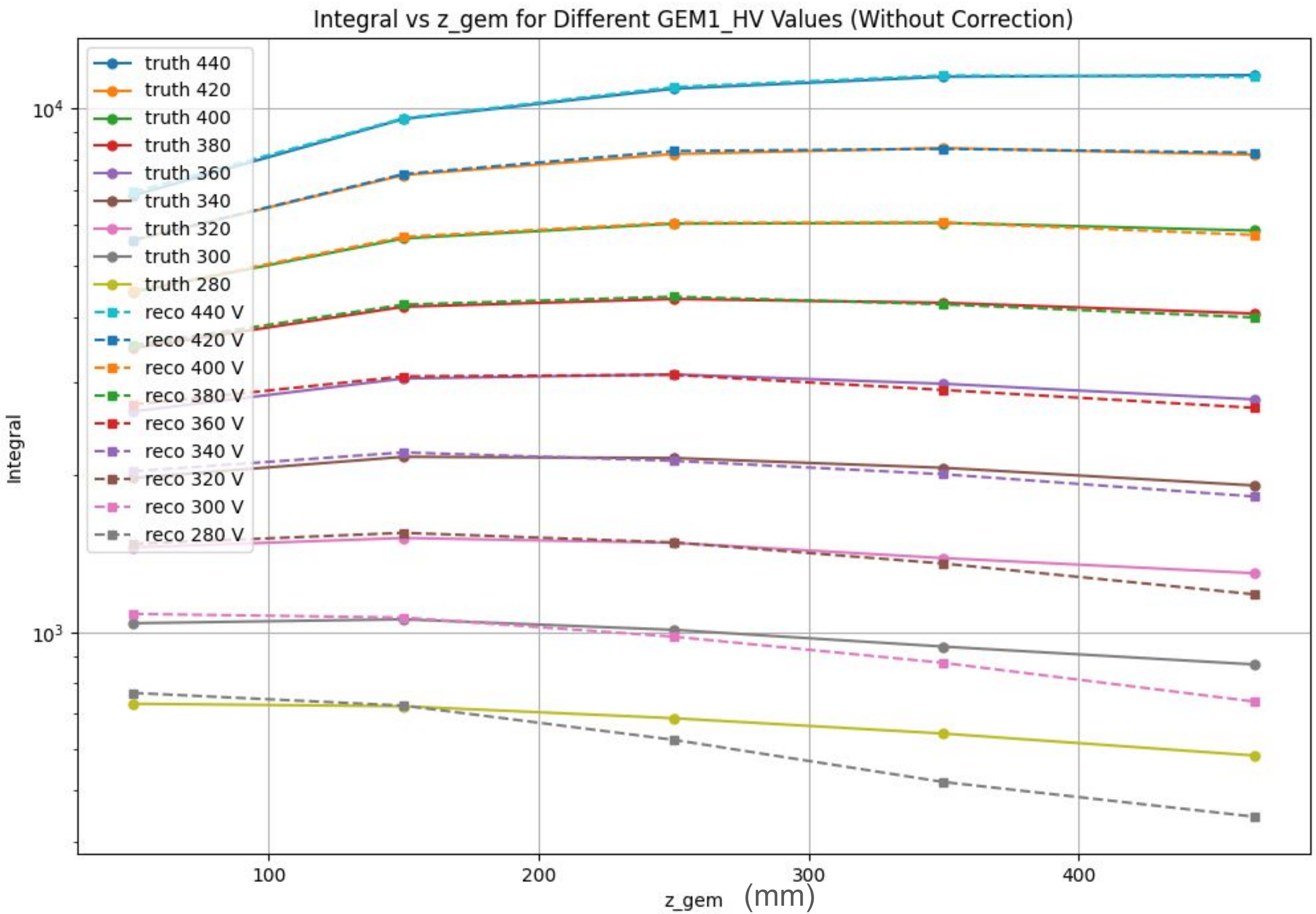
# Overview

- by using the **correct pedestals** we computed the efficiency of reconstructing sc_integral as a function of density (sc_integral / sc_nhits) on simulated data where we know the real integral

- then we apply the integral correction to real data (runs 42985-43040), and we estimate **lambda**, **alpha** with the 2D exp fit ( $I = I_0 \cdot e^{\alpha \cdot V} \cdot e^{-\frac{z}{\lambda}}$ )

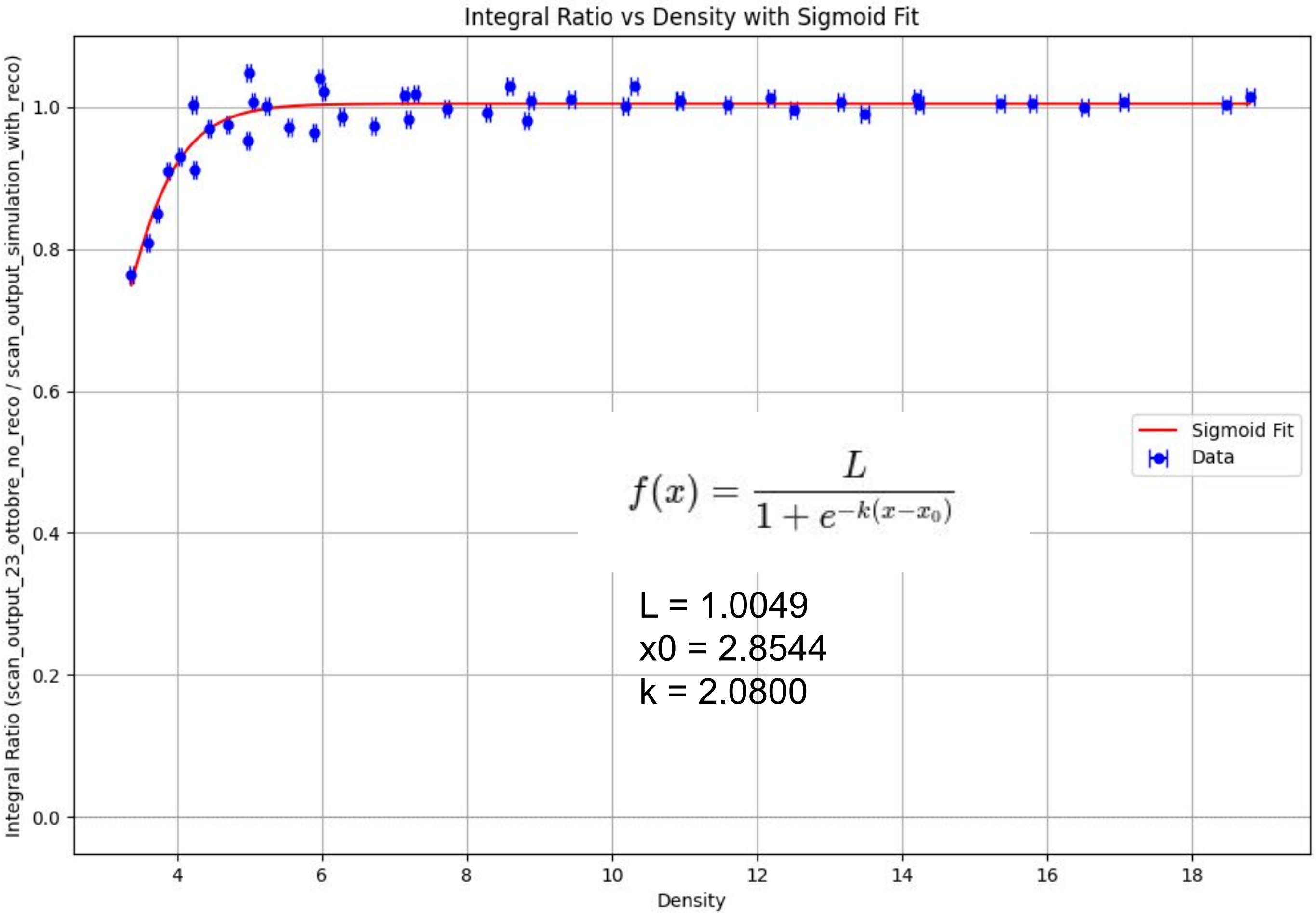
- we finally **estimate the goodness of the fitted parameters** with simulated data in which we know the real lambda and alpha




(mm)

In the low saturation region, we are not reconstructing properly (**note the dependency on the z, that is the density**)

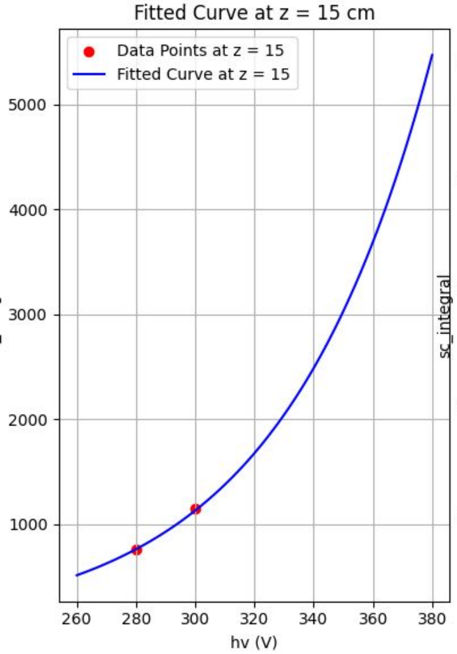
# Efficiency with **correct pedestals** (42985-43040)

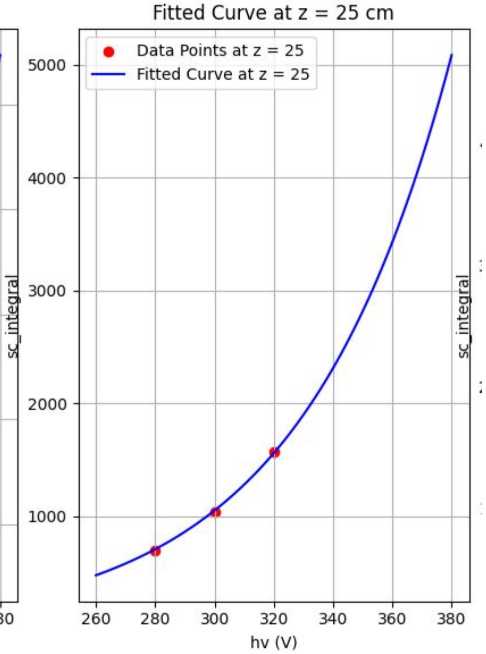


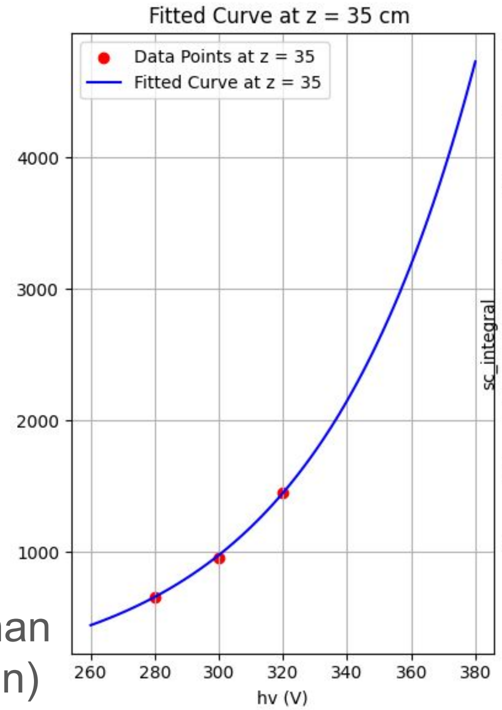

$$f(x) = \frac{L}{1 + e^{-k(x - x_0)}}$$

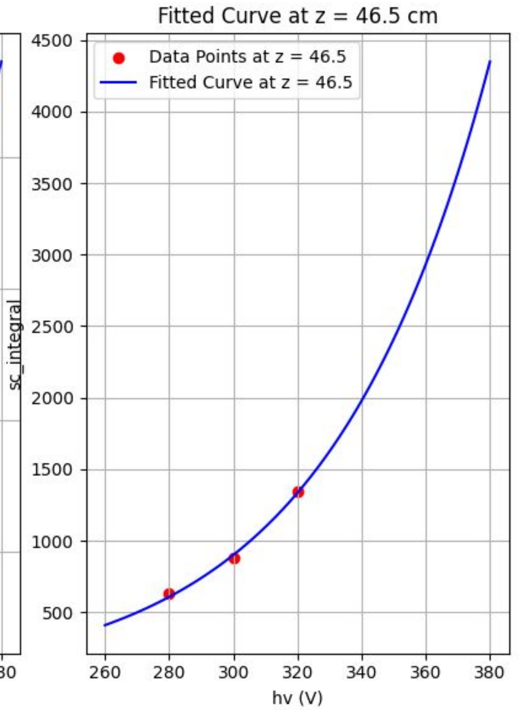
L = 1.0049
x0 = 2.8544
k = 2.0800

# After applying the correction to data, we fit only “low saturation data”




g0: 0.011

alpha: 0.0237 V^-1

lambda: 1375 mm

(slightly larger lambda than without integral correction)

# How well is the 2D fit estimating lambda and alpha?

The next step would to use the estimated parameters in the digitization. But how good is our fit? Remember, we are fitting sc_integral at different z and HV, only on a subset of data points where we expected the integral not to be saturated:

(150 mm, 280 V), (150 mm, 300 V), (250 mm, 280 V), (250 mm, 300 V), (250 mm, 320 V), (350 mm, 280 V), (350 mm, 300 V), (350 mm, 320 V), (465 mm, 280 V), (465 mm, 300 V), (465 mm, 320 V)

# How well is the 2D fit estimating lambda and alpha?

To have an idea of how well is the 2D fit estimating the parameters, we can fit simulated data that were generated with known parameters:

alpha = 0.022 V^-1
g0 = 0.024
lambda = **1250 mm**
beta = 4.00e-06

→ (set in digitization)

After applying the integral correction and fitting the simulated data we get:

alpha: 0.023 V^-1
g0: 0.015
lambda: **1277 mm**

→ (fitted parameters)

**The estimated lambda with the fit is compatible with the one set in the digitization! The fit really is estimating lambda correctly.**

# Conclusions

- **It seems the exponential fit on low saturation data is estimating correctly lambda**
- Now with the estimated parameters, we can run a final simulation for comparison that hopefully will get an error less than 15% **(already running on the cloud)**

$$I = I_0 \cdot e^{\alpha \cdot V} \cdot e^{-\frac{z}{\lambda}}$$

$$I_0 = \frac{E}{W} \cdot 0.07 \cdot 4 \cdot \Omega \cdot \mathrm{extr\_eff}^2 \cdot g_0^3 \cdot e^{2\alpha \cdot 440\,\mathrm{V}}$$