LIME: Correcting the Absorption Length

(using a simple MC simulation)

CYGNO Experiment

Rita Roque| CYGNO Reconstruction & Analysis Meeting | 22/09/2022

The speaker acknowledges the FCT PhD studentship (ref. SFRH/BD/143355/2019).

FCT Fundação para a Ciência e a Tecnologia
COMPETE 2020
PORTUGAL 2020
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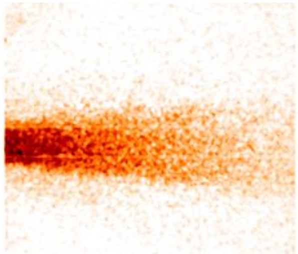
The Problem

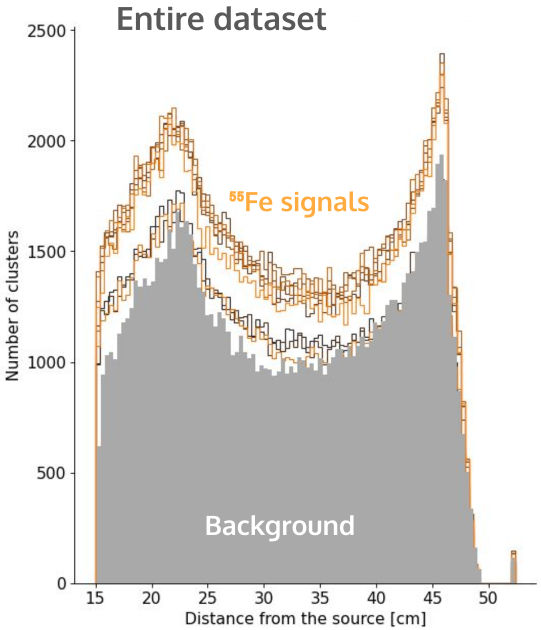


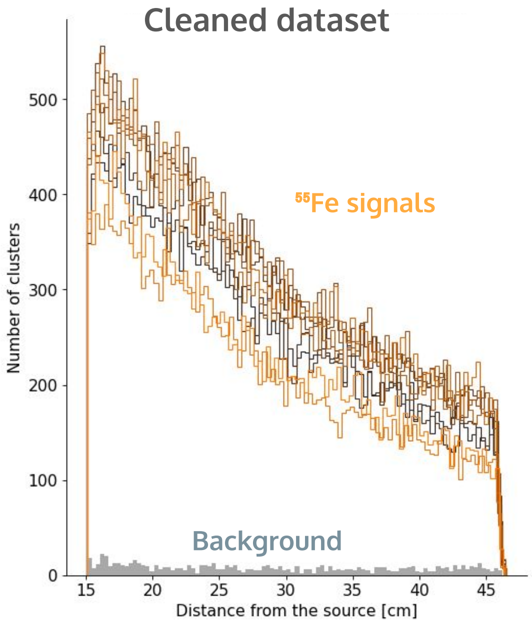
2D image

Distance was calculated using the Pythagoras' Theorem

$$d = \sqrt{(x_0 - x_c)^2 + (y_0 - y_c)^2}$$

- **Source position:** (x_0, y_0) = (-135, 178.6) mm
- **Cluster position:** (x_c, y_c) = (sc_xmean, sc_ymean)





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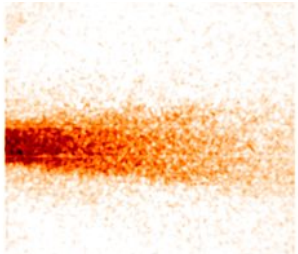

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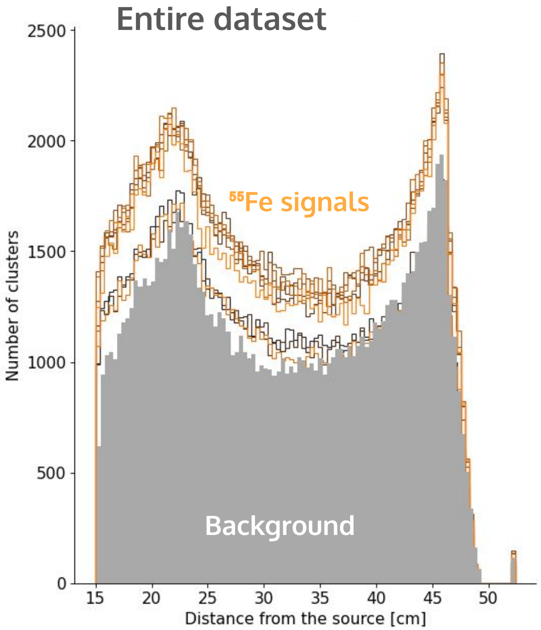

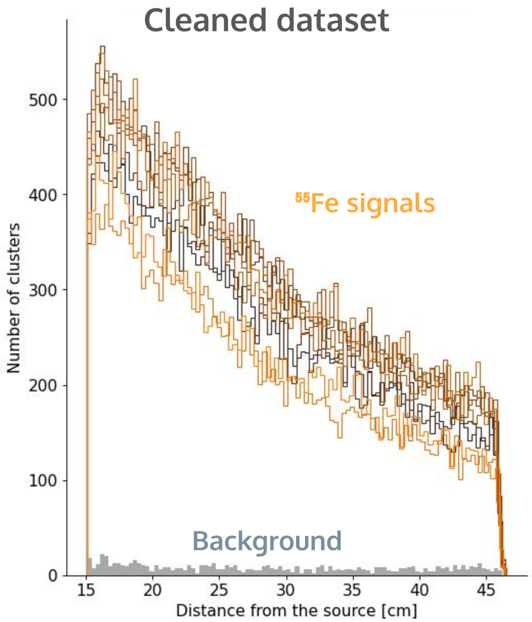

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Using only the (x,y) projection means that the distance of each cluster to the source is underestimated and so is the corresponding absorption length.

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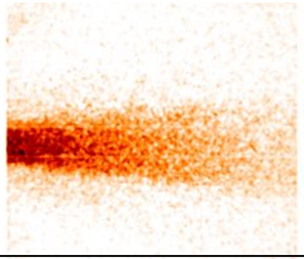

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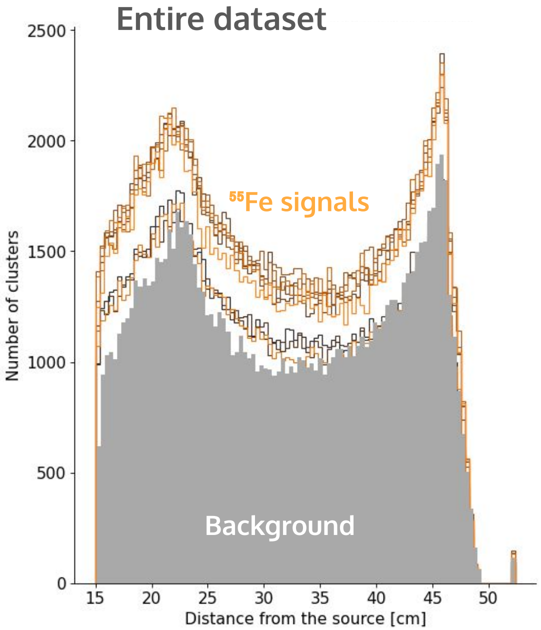

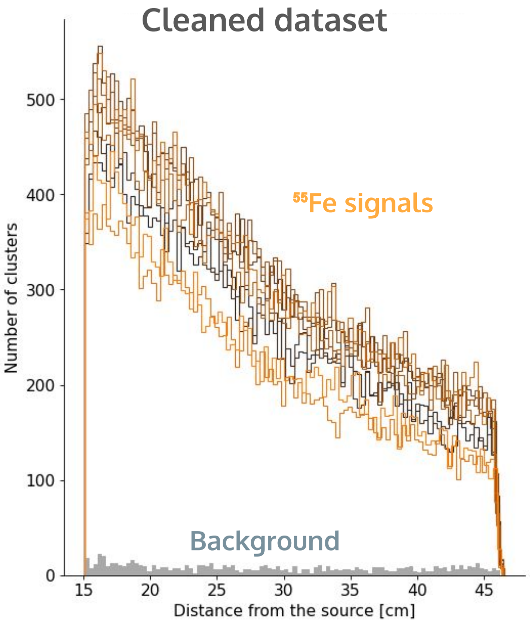

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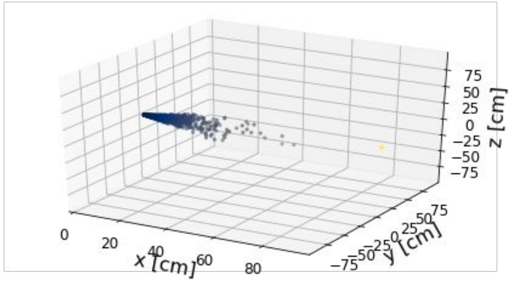
Can we understand and (maybe) correct this?

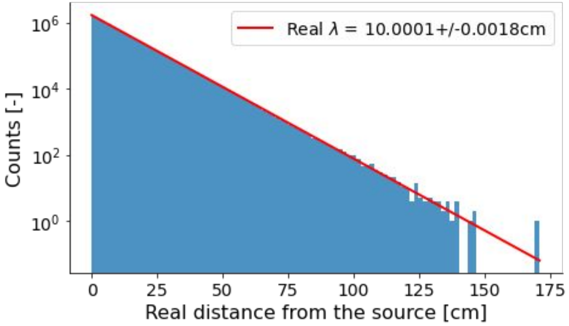
https://github.com/RitaROK/Analysis/blob/main/Absorption_length.ipynb

Simple MC Study

I generated random clusters in a spherical cap (θ,ϕ), distributed as: A = exp(-ρ/λ)

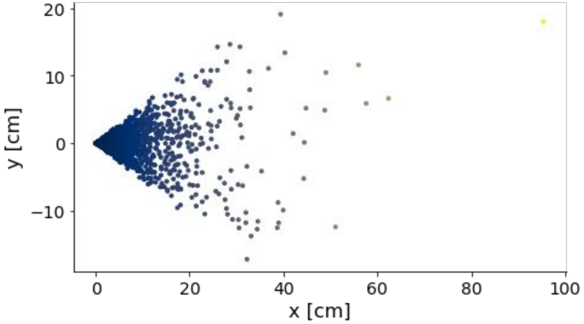
3D Real Case

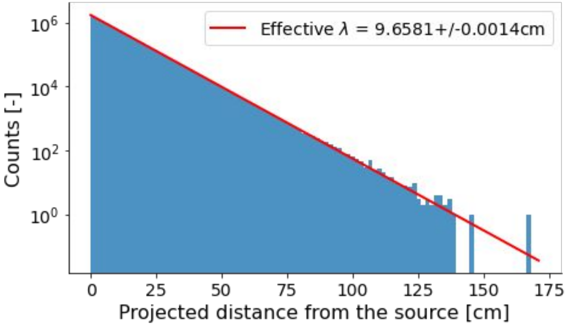




$$d = \sqrt{x^2 + y^2 + z^2}$$

2D Projection (what we are doing)





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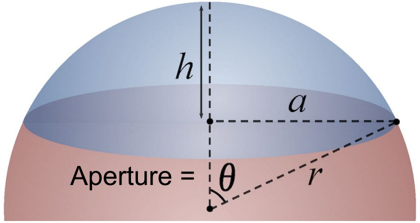

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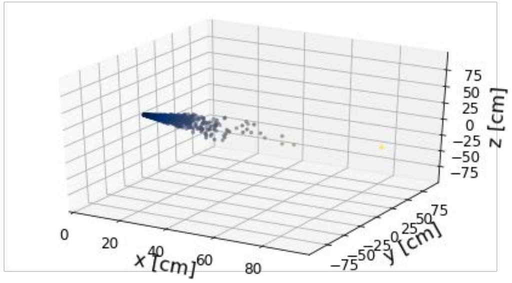

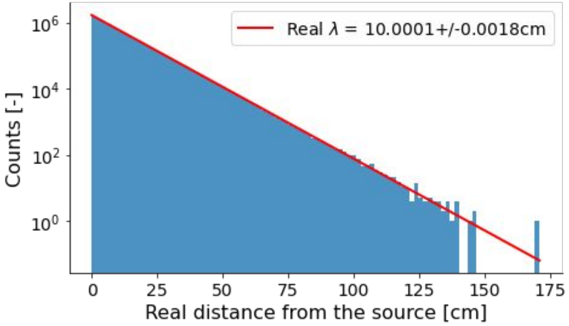

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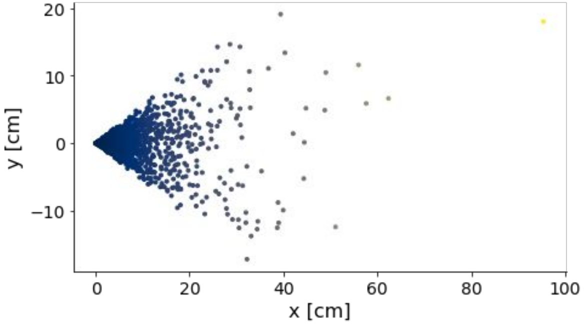

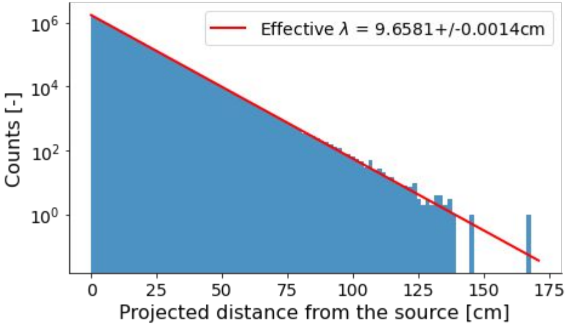

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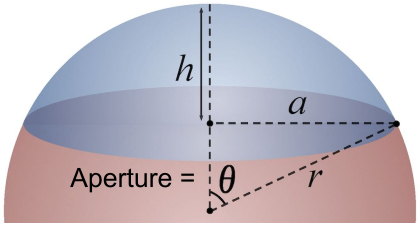
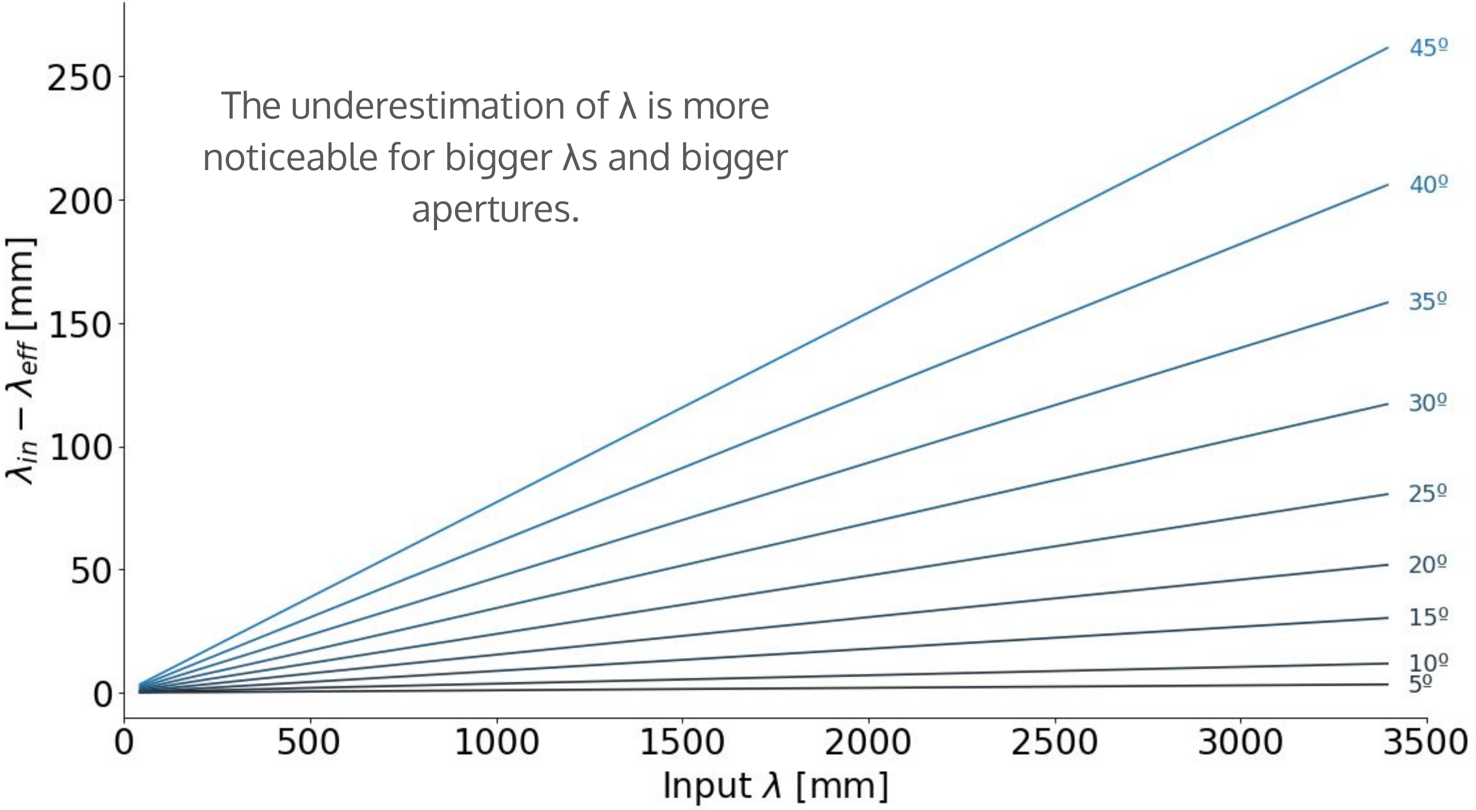
Using the projected distance underestimates λ

In this example, using an aperture of 30° and λ = 10 cm, gives an effective absorption length of 9.6581(14) cm.



Results

I determined the effective λ (λ_{eff}) for different apertures, α, and input absorption lengths (λ_{in}):

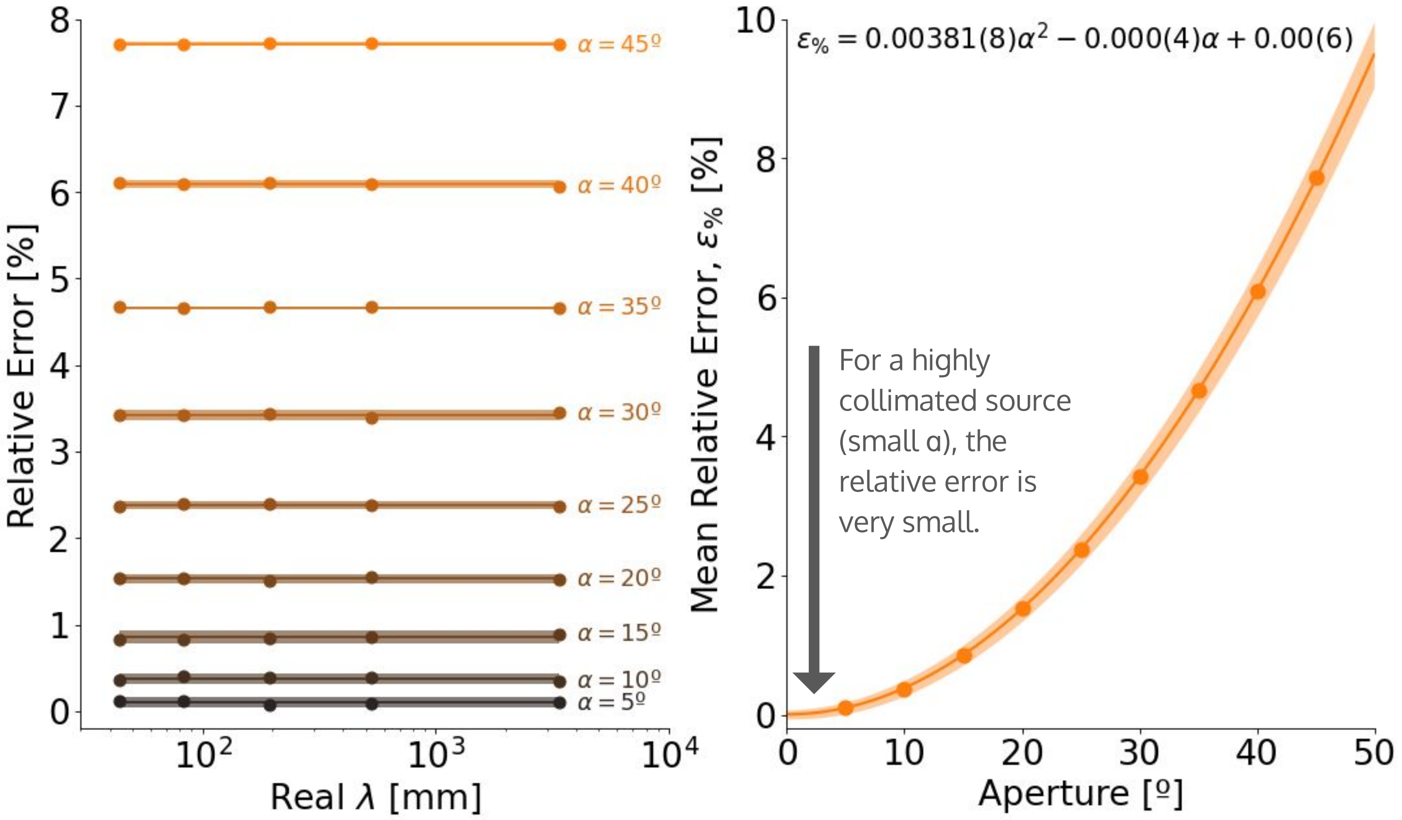


The underestimation of λ is more noticeable for bigger λs and bigger apertures.

Results

$$\text{Relative error} = \frac{\lambda_{in} - \lambda_{eff}}{\lambda_{in}} \times 100\%$$

Looking to the relative error of λ is even more enlightening:



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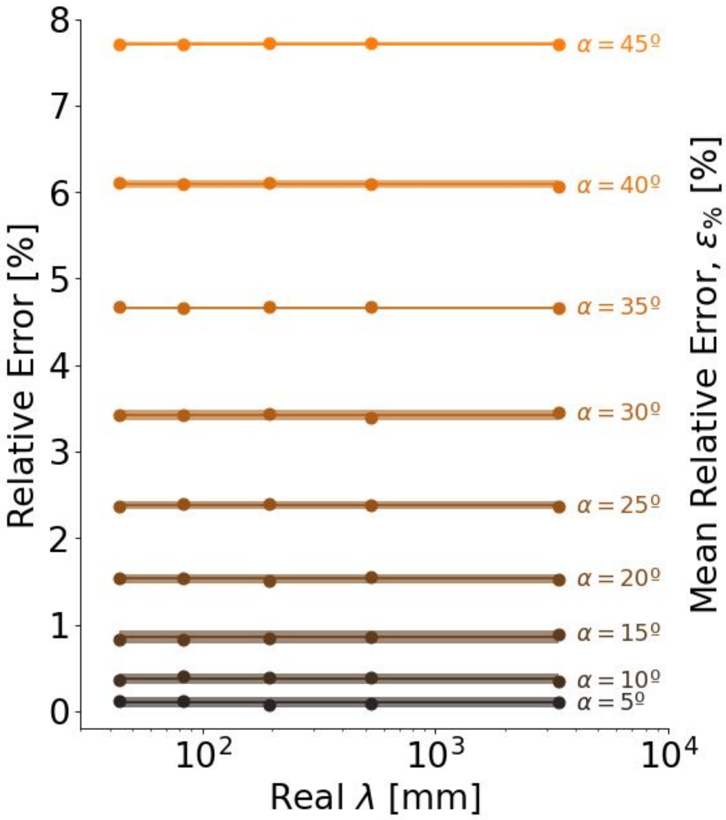

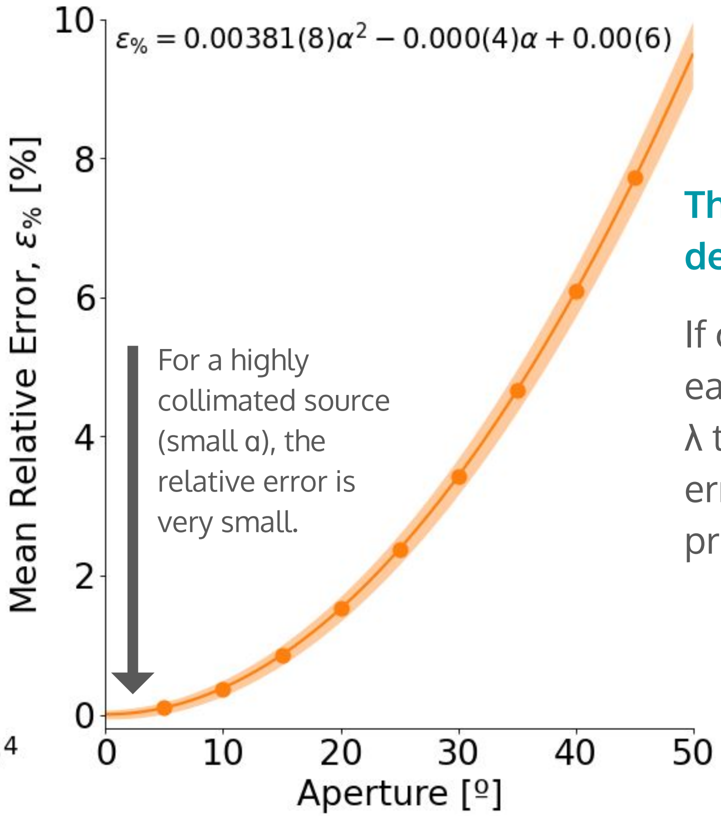

The relative error of λ depends only on α

If α is known, we can easily correct the effective λ to compensate for the error introduced by the projection.