Assignment of gamma-intensity uncertainties based on authors' general statement

Jun Chen

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@ZOOM, BNL

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One common scenario for reported uncertainties in Ig

Very often encountered by evaluators, mostly seen in a footnote of a gamma-ray data table:

[a] The intensities are normalized to the 188.5 keV transition. The errors are 5% for the strongest peak and 40% for the weaker ones.

where uncertainties in intensities are not explicitly given and the evaluators must make educated guess for different Ig values based on the statement, like, using a step function of percentage uncertainties,

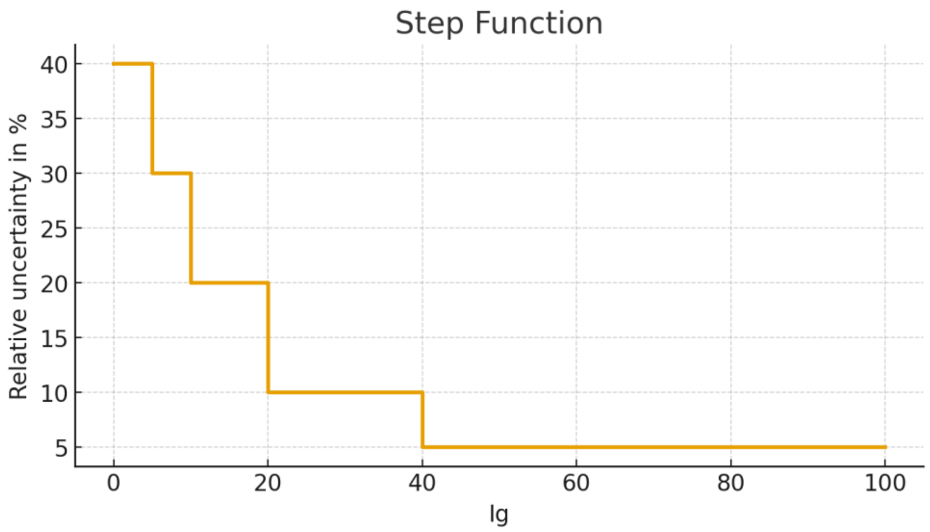
The evaluators have assumed the following uncertainties for Ig values: 40% for Ig<5, 30% for Ig<10, 20% for Ig<20, 10% for Ig<40, and 5% for Ig|>40.

FRIB
Facility for Rare Isotope Beams
U.S. Department of Energy Office of Science | Michigan State University
640 South Shaw Lane • East Lansing, MI 48824, USA
frib.msu.edu

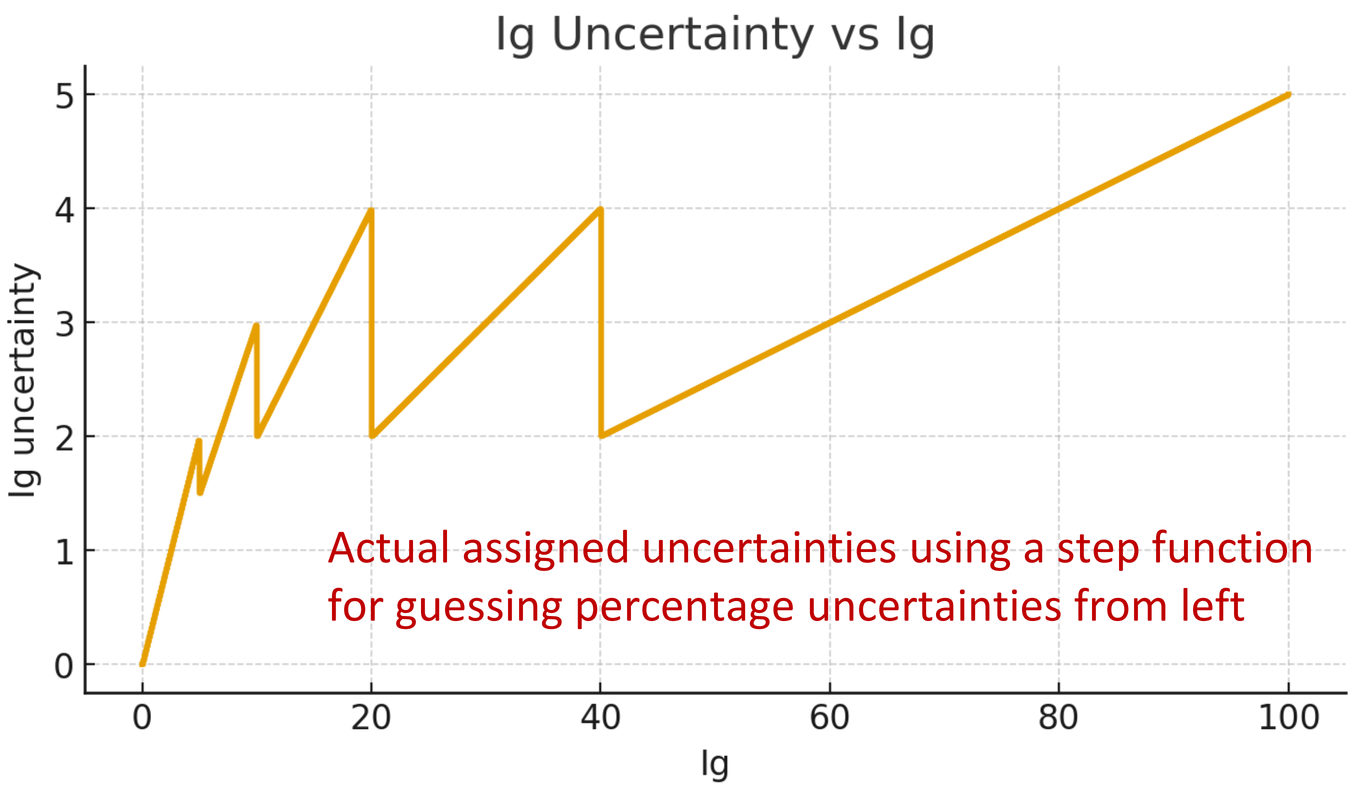
Problem with the educated guess using a step function

Evaluator's guess using step functions:

The evaluators have assumed the following uncertainties for Ig values: 40% for Ig<5, 30% for Ig<10, 20% for Ig<20, 10% for Ig<40, and 5% for Ig|>40.



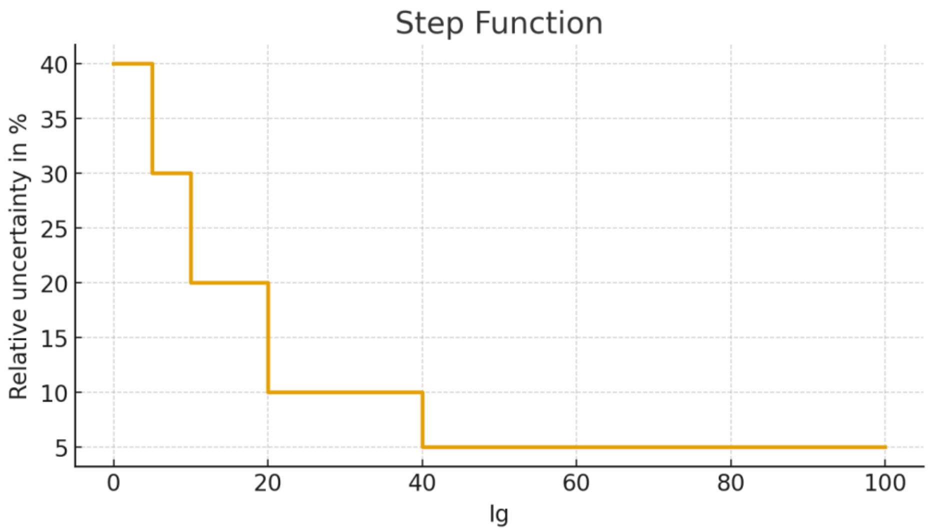
Percentage uncertainties for Ig values in different ranges from an educated guess using step function



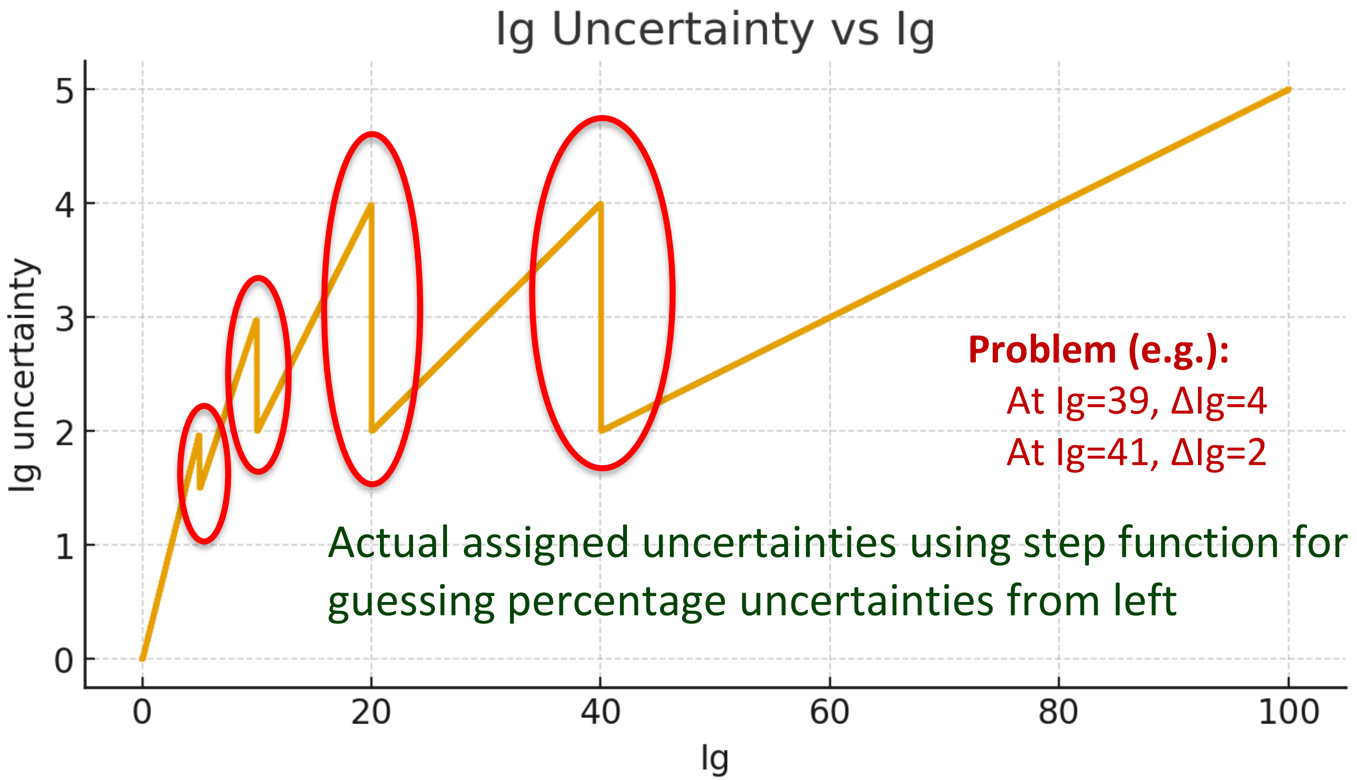
Problem with the educated guess using a step function

Evaluator's guess using a step function (often used):

The evaluators have assumed the following uncertainties for Ig values: 40% for Ig<5, 30% for Ig<10, 20% for Ig<20, 10% for Ig<40, and 5% for Ig|>40.



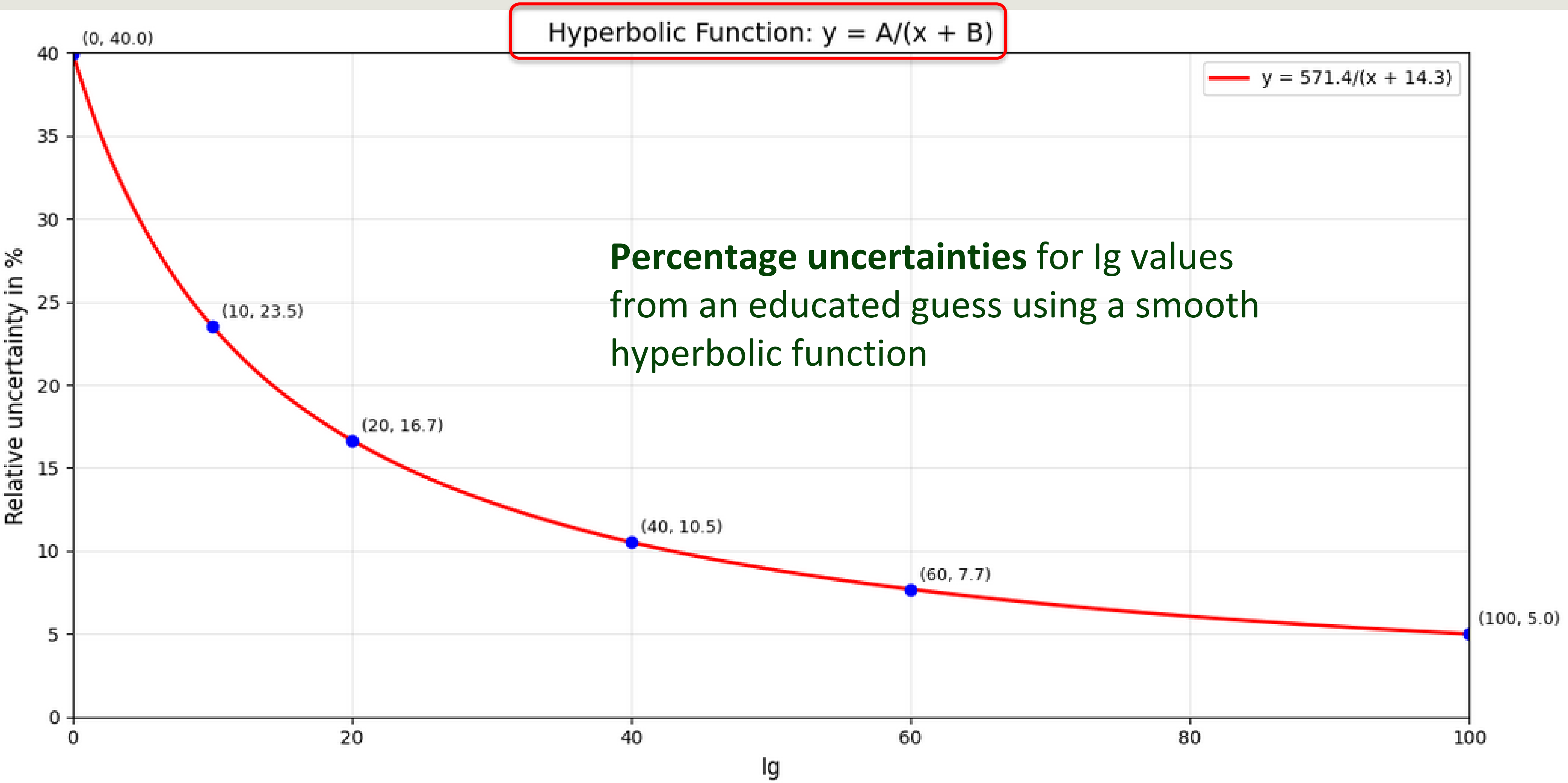
Percentage uncertainties for Ig values in different ranges from an educated guess using step function



Problem: close Ig values at different sides of jump points have very different uncertainties, which makes no sense (circled area)

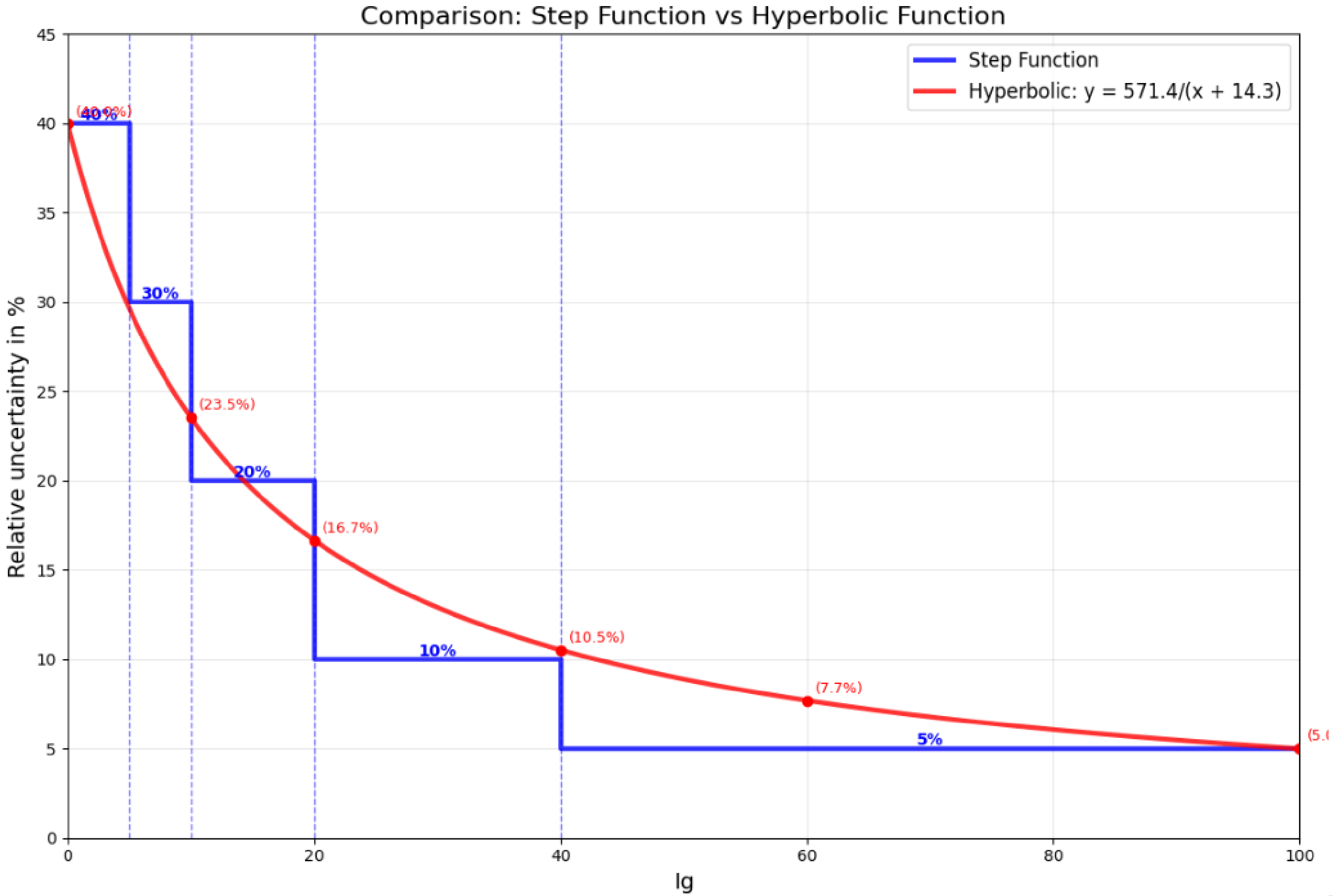
Expected: smoothly-varied uncertainty

Using a smooth function for educated guess



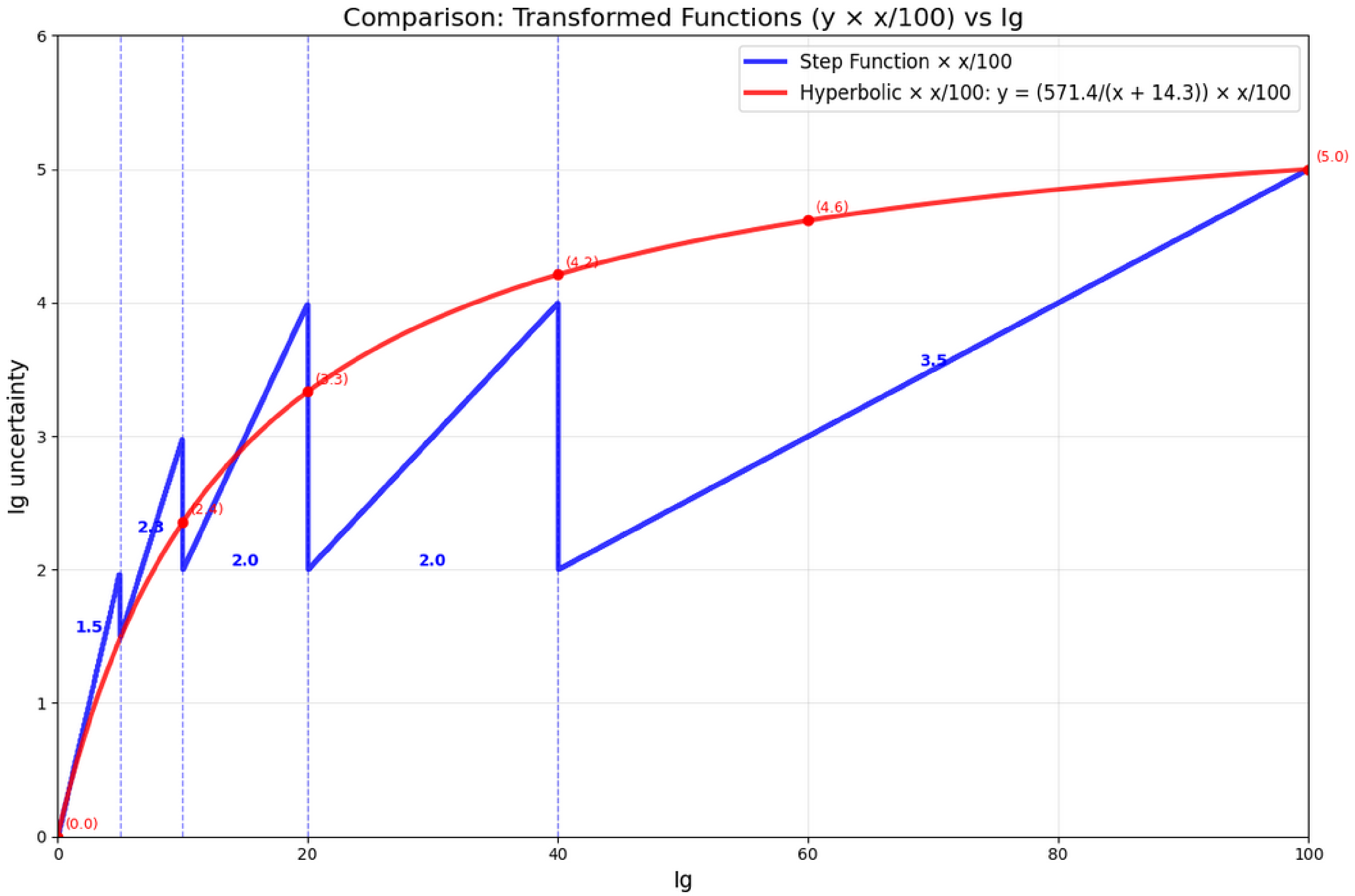
Percentage uncertainties for Ig values from an educated guess using a smooth hyperbolic function

Using a smooth function for educated guess



Percentage uncertainties for Ig values: comparison of a smooth hyperbolic function with a step function

Using a smooth function for educated guess



Ig uncertainties for different Ig values: comparison of a smooth hyperbolic function with a step function

With a hyperbolic function for guessing percentage uncertainty, the Ig uncertainty varies smoothly as expected. The only "downside" might be that it tends to assign a constant uncertainty for strong Ig values (Ig>60 in this case) --- more conservative than using a step function

A simple hyperbolic function

For authors' general statement on percentage Ig uncertainties:

[a] The intensities are normalized to the 188.5 keV transition. The errors are 5% for the strongest peak and 40% for the weaker ones.

Guess percentage uncertainty using a simple hyperbolic function:

$$percentage\ uncertainty\ \ P = \frac{A}{B + Ig}$$

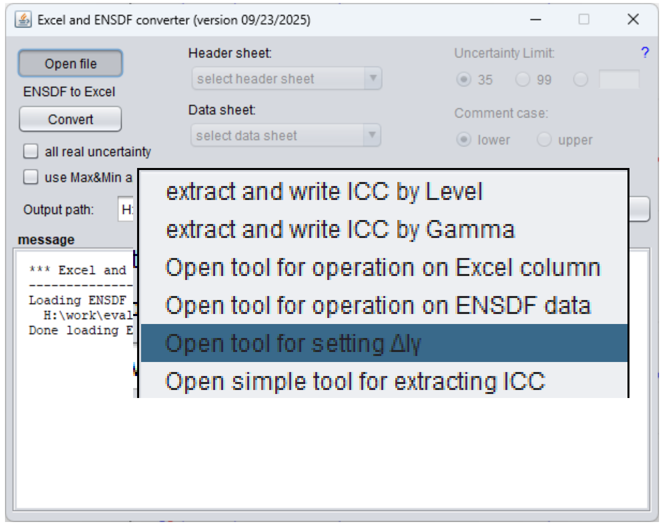
Constants **A** and **B** are determined by:
P=5 at Ig=100 for the strongest
P=40 at Ig=0 for the weakest
(the weakest point can also be set at a different Ig, like Ig=5)

Applied to this case:

$$\%\left(\frac{\Delta I_\gamma}{I_\gamma}\right) = \frac{571.4}{14.3 + I_\gamma}$$

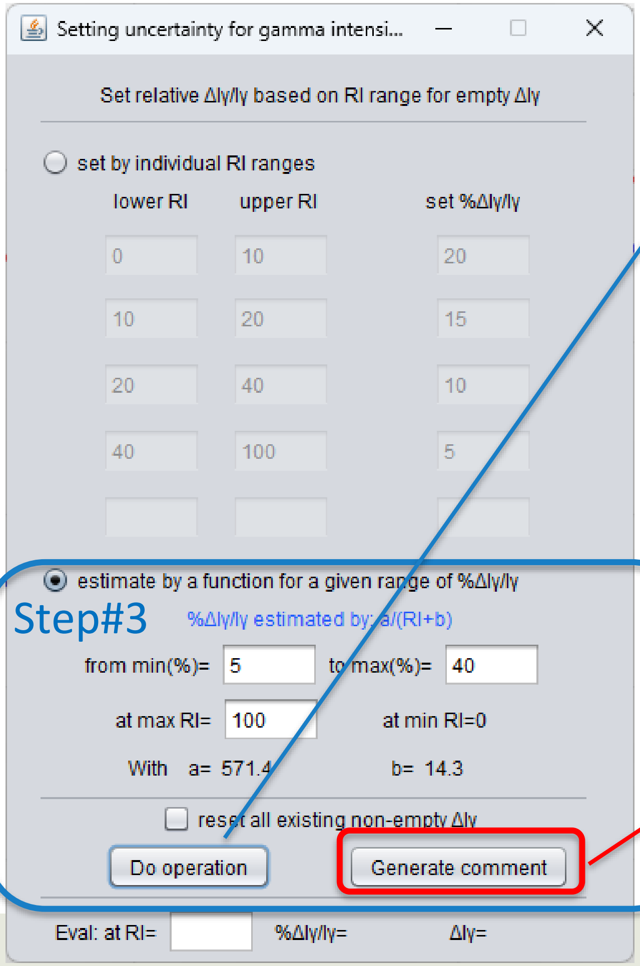
A tool for setting $\%\left(\frac{\Delta I_\gamma}{I_\gamma}\right)$ in a dataset

For setting Ig uncertainties to Ig values in a dataset, based on authors' general statement on percentage Ig uncertainties using a hyperbolic function as an educated guess:



Step#1: In Excel2ENSDF code
Load the ENSDF dataset

Step#2: right click on a blank area,
select "open tool for setting ΔI_γ"



New output: *"dataset_after_setting_DRI.out"*

Generated generic comment:

```
223RA  cG RI$Based on the general statement that the uncertainty ranges from 5%
223RA2cG for strong lines to 40% for weak lines, the evaluators have estimated
223RA3cG and assigned uncertainties using a smoothly-varying function of I|g
223RA4cG values, that is, %(|DI|g/I|g)=A/(I|g+B), with A=571 and B=14 determined
223RA5cG from 5% at I|g=100 and 40% at I|g close to 0
```