

Gaisser–Hillas function

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The **Gaisser–Hillas function** is used in [astroparticle physics](#). It [parameterizes](#) the longitudinal [particle density](#) in a [cosmic ray air shower](#). The function was proposed in 1977 by [Thomas K. Gaisser](#) and [Anthony Michael Hillas](#).^[1]

The number of particles $N(X)$ as a function of traversed atmospheric depth X is expressed as

$$N(X) = N_{\max} \left(\frac{X - X_0}{X_{\max} - X_0} \right)^{\frac{X_{\max} - X_0}{\lambda}} \exp\left(\frac{X_{\max} - X}{\lambda} \right),$$

where N_{\max} is maximum number of particles observed at depth X_{\max} , and X_0 and λ are primary mass and energy dependent parameters.

Using substitutions

$$n = \frac{N}{N_{\max}}, \quad x = \frac{X - X_0}{\lambda} \quad \text{and} \quad m = \frac{X_{\max} - X_0}{\lambda}$$

the function can be written in an alternative one-parametric (m) form^[2] as

$$n(x) = \left(\frac{x}{m} \right)^m \exp(m - x) = \frac{x^m e^{-x}}{m^m e^{-m}} = \exp(m (\ln x - \ln m) - (x - m)).$$

References [[edit](#)]

- ↑ Hillas, A. M. (1972). *Cosmic rays* . New York: Pergamon Press. ISBN 978-0-08-016724-4.
- ↑ Darko Veberic (2012). "Lambert W Function for Applications in Physics". *Computer Physics Communications*. **183** (12): 2622–2628. [arXiv:1209.0735](#) .
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