$$I = 2\sigma^4 = \int_0^\infty dx \ x^3 \exp\left(-\frac{1}{2} \frac{x^2}{\sigma^2}\right) = \int_0^\infty dx \ f(x) \operatorname{pdf}(x) \approx \sum_{i=1}^N f(x_i)$$
with: $f(x) = \sigma \sqrt{\frac{\pi}{2}} x^3$; $\operatorname{pdf}(x) = \begin{cases} \frac{1}{\sigma} \sqrt{\frac{2}{\pi}} \exp\left(-\frac{1}{2} \frac{x^2}{\sigma^2}\right) & \text{if } x \geq 0 \\ 0 & \text{if } x < 0 \end{cases}$

$$100.2\%$$

$$100.0\%$$

$$100.0\%$$

$$99.8\%$$

$$99.8\%$$

$$99.8\%$$

$$N = \text{number of extracted } x_i \text{ for a single Monte-Carlo integral}$$