III. C. 1. Gaussian plus Exponential Resolution Broadening

To understand how a resolution broadening may be described mathematically, we first consider the formula that describes how the neutron's energy is extracted from measured quantities:

$$E = \frac{1}{2} m v^2 = \frac{1}{2} m \left(\frac{L}{t} \right)^2 \quad , \tag{III C1.1}$$

where m is the neutron mass and v its velocity. The velocity is equal to the flight-path length L divided by travel time t. From this definition, it is clear that different types of resolution broadening are possible —due to distributions in time, distributions in length, and distributions in energy.

Several factors may contribute to each of the types of resolution broadening. In this version of SAMMY's resolution function, the following components of the resolution function are treated explicitly: (1) a square distribution in flight-path length (due, for example, to the neutron moderator and/or detector), (2) a square distribution in time (channel width), (3) a Gaussian distribution in time (burst width), and (4) a Gaussian distribution whose width is constant in energy. Each is expressed as an approximate Gaussian distribution in energy, using approximations if necessary (see Section III.C.1.a), and then convoluted to give the final Gaussian distribution in energy. An exponential distribution may also be included, as described in Section III.C.1.b.

Table III C 1.1 shows relationships between input parameters and the resolution width associated with various types of resolution distribution functions. This table is included here as an aid in determining appropriate values to use as input to SAMMY. Note that "equivalent," as used in the following pages, indicates only that the first and second moments of the distributions are identical, not that the distributions have the same shapes.

For a detailed discussion of resolution broadening with emphasis on flight path 1 at ORELA, see [DL84].

Table III C1.1. Resolution-broadening input parameters

SAMMY input variable	"Equivalent" quantity	Description
ΔL or DELTAL (Section III.C.1.a)		ΔL is the full width of a square distribution in flight-path length.
	$\sqrt{12}\ \sigma_L$	σ_L is the standard deviation of a Gaussian distribution in flight-path length.
	$F_L / \sqrt{(\ln 2) 2/3}$	F_L is the full width at half maximum of a Gaussian distribution in flight-path length.
	$S_L \sqrt{3}\ L / E$	S_L is the standard deviation of a Gaussian distribution in energy E, where L is the flight-path length.
	$\Delta_L \sqrt{3/2}\ L / E$	Δ_L is the full width at half maximum of a Gaussian distribution in energy E, where L is the flight-path

Table III C1.1 (continued)

SAMMY input variable	"Equivalent" quantity	Description
		length.
Δt_c or DELTAB × Cf$_i$ (see Section III.C.1.a)		Δt_c is the full width of a square distribution in time (channel width); this is the equivalent of the quantity *b* in [DL84], page 30.
	$\sqrt{12}\,\sigma_c$	σ_c is standard deviation of Gaussian in time.
	$\sqrt{3/2\ln 2}\;F_c$	F_c is full width at half max of Gaussian in time.
	$\dfrac{\sqrt{3}\,t}{E}\,S_c=\sqrt{\dfrac{3m}{2}}\,\dfrac{L\,S_c}{E^{3/2}}$	S_c is the standard deviation of a Gaussian distribution in energy.
Δt_G or DELTAG (Section III.C.1.a)		Δt_G is the full width at half max of a Gaussian distribution in neutron transit time.
	$\sqrt{8\ln 2}\,\sigma_G$	σ_G is the standard deviation of a Gaussian distribution in time.
	$\sqrt{2\ln 2/3}\;f$	f is the full width of square distribution in time.
Δt_E or DELTAE (Section III.C.1.b)		Δt_E is the exponential folding width in microseconds of an exponential distribution in time; note that this is an asymmetric function.
	$\dfrac{L\left(m/2\right)^{1/2}\Delta_E}{2E^{3/2}}$	Δ_E is the exponential folding width of the exponential distribution in energy.
Δ_C or DELTAC (Section III.C.1.a)		Δ_C is the width for a Gaussian in energy; Δ_C is constant in energy.
	$\sigma_C\sqrt{2}$	σ_C is the standard deviation for a Gaussian in energy.
	$\dfrac{f_C}{\sqrt{\ln 2}}$	f_C is the full width at half max of a Gaussian in energy.