## III.C.1.b. Resolution broadening: exponential

An exponential form for the resolution broadening is also provided in SAMMY (and MULTI). Physically this may correspond to an asymmetry in the burst width or moderator or detector resolution function. When only the exponential function is to be used, the broadened cross section (or transmission) is given by the integral

$$f_{\exp}\left(E\right)=\frac{1}{\Delta t_E}\int_t^{\infty}\exp\left\{-\frac{\left(t-t'\right)}{\Delta t_E}\right\} f(E')\,d\,t' \quad , \tag{III C1 b.1}$$

where $f\left(E'\right)$ represents the unbroadened cross section. This expression may be rewritten in terms of $E'$ rather than $t'$ using the relationship in Eq. (III C1.1), and assuming $\sqrt{E'}\cong\sqrt{E}$ as needed. Eq. (III C1 b.1) becomes

$$f_{\exp}\left(E\right)=\frac{1}{\Delta_E}\int_E^{\infty}\exp\left\{-\frac{\left(E-E'\right)}{\Delta_E}\right\} f(E')\,d\,E' \quad , \tag{III C1 b.2}$$

in which the width is given by

$$\Delta_E=\frac{2E^{3/2}}{L\left(m/2\right)^{1/2}}\Delta t_E \quad . \tag{III C1 b.3}$$

Setting $m/2 = (72.3)^2$ as in the previous section gives the result used in SAMMY,

$$\Delta_E = cE^{3/2} \quad , \tag{III C1 b.4}$$

in which $c$ is defined as

$$c \;=\; 2\sqrt{m/2}\,\Delta t_E\,/\,L \;\cong\; 0.02766\,\Delta t_E\,/\,L \quad ; \tag{III C1 b.5}$$

exact values used for the constants are discussed in Section IX.A.

The width $\Delta t_E$ is the "exponential folding width in microseconds" and is the required input quantity DELTAE (see Table VI A.1, card set 5, or Table VI B.2, card set 4). Two options are available for energy-dependent width: The first assumes the form

$$\Delta t_E=\frac{\Delta t_x}{\sqrt{E/E_x}} \quad . \tag{III C1 b.6}$$

In this case the input quantity is $\Delta t_x$ and $E_x$ is fixed at 100 eV. The line "EXPONENTIAL FOLDING width is energy dependent" must be included in the INPut file; see Table VI A1.2. The second option assumes energy dependence of the form

$$\Delta t_E = D_1 E + D_0 + D_2 \ln\left(E\right) \quad ; \tag{III C1 b.7}$$

parameters $D_i$ are specified in card set 11, line 10, of the PARameter file.

## Partial derivatives

The partial derivative of $f_{\exp}$ with respect to $\Delta t_E$ is given by

$$\frac{\partial f_{\exp}}{\partial \Delta t_E} = \frac{\partial \Delta_E}{\partial \Delta t_E} \frac{\partial f_{\exp}}{\partial \Delta_E} \quad , \qquad \text{(III C1 b.8)}$$

where the first partial derivative is found from Eq. (IIIC1b.3) to be

$$\frac{\partial \Delta_E}{\partial \Delta t_E} = \frac{\Delta_E}{\Delta t_E} \quad . \qquad \text{(III C1 b.9)}$$

The second partial derivative in Eq. (III C1 b.8) is evaluated numerically via

$$\frac{\partial f_{\exp}}{\partial \Delta_E} = \frac{f_{\exp}\left(\Delta_E + d\right) - f_{\exp}\left(\Delta_E - d\right)}{2d} \quad , \qquad \text{(III C1 b.10)}$$

where $d$ is set to $q\Delta_E$ with $q$ = 0.02.