III.C.3. RPI (and GELINA and nTOF) Resolution Broadening

Researchers at Rensselaer Polytechnic Institute (RPI) have carefully measured the resolution function associated with the "bounce target" and the transmission detector (lithium glass) for the LINAC at RPI [BM96]. This resolution function may be described by the sum of a chi-squared function (with six degrees of freedom) plus two exponential terms. The total resolution function appropriate for data measured on that machine is then the convolution of the target-detector resolution function, with a Gaussian function representing the electron burst and a square function representing the channel width.

An extension to the RPI resolution function has been shown by Gunsing [FG05] to provide a reasonable description for the resolution functions for two other time-of-flight facilities: the Geel Electron Linear Accelerator (GELINA) at IRMM in Belgium and the neutron time of flight (nTOF) facility at CERN in Switzerland. This extension (discussed in the next section) has been implemented in SAMMY.

Within SAMMY, the RPI resolution function is formed in much the same manner as described for the realistic resolution function of Section III.C.2, that is, the resolution-broadened cross section $\bar{\sigma}(t)$ may be expressed as

$$\bar{\sigma}(t) = \int I_1(t-t_1)\,dt_1 \int I_2(t_1-t_2)\,dt_2 \int I_3(t_2-t_3)\,dt_3\;\sigma(t_3) \quad , \qquad \text{(III C3.1)}$$

where I_i is our mathematical model for the ith component. This expression may then be rearranged into the form

$$\bar{\sigma}(t) = \int I(t-t')\,\sigma(t')\,dt' \quad , \qquad \text{(III C3.2)}$$

where the resolution function $I(t-t')$ is defined as

$$I(t-t') = \int I_1(t-t_1)\,dt_1 \int I_2(t_1-t_2)\,dt_2\; I_3(t_2-t'). \qquad \text{(III C3.3)}$$

Because SAMMY deals with cross sections as functions of energy, rather than time, the relationship

$$E = \frac{1}{2} m v^2 = \frac{1}{2} m \frac{L^2}{t^2} \qquad \text{(III C3.4)}$$

is used to convert from energy to time and vice versa in Eq. (IIIC3.2), yielding

$$\bar{\sigma}(E) = \int I'\big(t(E)-t'\big)\;\sigma\big(E'(t')\big)\,dt' \quad . \qquad \text{(III C3.5)}$$

In the following section (Section III.C.3.a), the component functions I_i are described, along with the parameters for those components.

Test cases tr053, tr054, tr094, and tr095 show several examples using the RPI resolution function, with parameter values suitable for RPI data and candidate parameters for use with GELINA data. More recently, the RPI resolution function has been extended to give a more suitable energy-dependent form for use with both GELINA and nTOF data; this form was suggested by Gunsing [FG05], who also provided preliminary parameter values. Testing for the extension is given in test cases tr104 and tr107; Gunsing's parameter values are used in tr108.

To make plots of this resolution function and the individual components, see Section X.K. Also see test case tr107 for examples of another method of plotting the RPI resolution function, using the Dirac delta function option for pseudo cross section with uniform energy grid (Section V.E).

Section III.C.3.b discusses the various input options for the RPI/GELINA/nTOF resolution function.