Computer Code Abstract

GAMLEG - A FORTRAN Code to Produce Multigroup Cross Sections for Photon Transport Calculations*

1. Name of Program: GAMLEG
   Programming System: FORTRAN-IV
2. Computer for Which Program Designed: IBM-7030
3. Nature of Code: Code prepares group averages of Legendre moments of the Klein-Nishina differential scattering cross section for scattering transfers from energy E' to energy E. The code also prepares group averages of absorption, coherent scattering, source and flux data specified as input. Punched-card output of cross-section tables is suitable for input to Los Alamos transport theory codes[1,2] DDF and DTF.
4. Method of Group Averaging: The average of the scattering transfer cross section is defined as

$$\sigma_{sn}^{g\leftarrow h} = \frac{\int_{E' \text{ in } h} f(E')dE' \int_{E \text{ in } g} \sigma_{sn}(E' \rightarrow E)dE}{\int_{E' \text{in } h} f(E')dE'}, \quad (1)$$

where σ_{sn} is the n'th Legendre component of the Klein-Nishina differential cross section and $f(E)$ is a weighting distribution. The E integral is evaluated from an analytic integration of $\sigma_{sn}(E' \rightarrow E)$ for values of E in group g, and the E' integrations are evaluated by trapezoidal integration with uniform mesh spacing for E' values in group h. If $f(E')$ is not available at E' mesh points, values of $f(E')$ are obtained from available values by linear interpolation. At the option of the user, $f(E')$ can be a constant or a supplied input distribution.

The group-average absorption cross section (for the isotropic cross-section table), and, analogously, the group-average coherent scattering cross section are defined by

$$\sigma_a^g = \int_{E \text{ in } g} f(E)\sigma_a(E)dE \Big/ \int_{E \text{ in } g} f(E)dE. \quad (2)$$

Trapezoidal integration and linear interpolation of f and σ_a are used to evaluate the integrals. A group total (isotropic) cross section is defined by

$$\sigma_t^g = \sigma_a^g + \sigma_{\text{coh}}^g + \sum_h \sigma_{so}^{h\leftarrow g}. \quad (3)$$

The analytic form of the Klein-Nishina total scattering cross section is also group averaged and the value of

$$\sigma_s^g - \sum_h \sigma_{so}^{h\leftarrow g} \quad (4)$$

is printed. Equation (4) serves as a check of the accuracy of integrations in Eq. (1), $n = 0$.

5. Restrictions on the Use of the Code:
   a) Storage restrictions (IBM-7030)
      1) Number of groups ≤ 100
      2) Trapezoidal intervals per group ≤ 100
      3) Absorption, coherent scattering, source, and flux data specified at ≤ 1000 energies
      4) No restriction on the number of elements.
   b) Coding restriction: As written, the code provides averages of up to six Legendre transfer moments.
   c) Accuracy restriction: Certain arithmetic operations require double precision execution on 36-bit machines. See Ref. 3 for details.
6. Typical Running Time: 3 to 4 min (IBM-7030) for 6 Legendre moments for 5 elements with 100 integration points per group for 13 groups.
7. Present Status: In use.
8. *References:*

[1]B. G. Carlson, W. J. Worlton, W. Guber, and M. Shapiro, "DTF Users Manual," United Nuclear Corp. Report UNC Phys/Math-332 (1963).

[2]K. D. Lathrop, "DTF-IV, a FORTRAN-IV Program for Solving the Multigroup Transport Equation with Anisotropic Scattering," Los Alamos Scientific Laboratory Report LA-3373 (1965).

[3]K. D. Lathrop, "GAMLEG—A FORTRAN Code to Produced Multigroup Cross Sections for Photon Transport Calculations," Los Alamos Scientific Laboratory Report LA-3267 (1965).

9. Material Available: FORTRAN deck and test problem available from the Oak Ridge Shielding Information Center.

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