Letter to the Editor

A Comment on Anisotropic Neutron Diffusion in Lattices of the Zero-Power Plutonium Reactor Experiments

In a recent paper about anisotropic neutron diffusion in slab geometry[1] large differences between the two possible definitions of Bonalumi's x-diffusion coefficient were found. These differences are not at all surprising and have nothing to do with the definition of the diffusion coefficient. They are caused by the cell-edge normalization made in Bonalumi's definition. If the cell-edge normalization is made for the diffusion coefficient, it must be made also for the cross sections. It is clear that the cell-edge normalized cross sections are obtained by multiplying the cell-average normalized cross sections by the ratio of the cell-average flux to the cell-edge flux, because the cell-reaction rates must be preserved. If the cell-edge normalization with two different definitions of cell boundaries is made, not only the diffusion coefficient but also all cross sections become double valued. The relation between the cell-edge normalized and cell-average normalized diffusion coefficient is the same as for the cross sections. One sees it from the fact that if the flux had a cosine shape, the product DB^2 would be a fictitious cross section for the leakage. As the important physical quantities, like k_∞ and migration length, are given by ratios of cross sections and diffusion coefficients, they will not be changed by any normalization. So, the fact that the diffusion coefficients and cross sections are double valued does not mean that something is wrong with their definition.

In the direction parallel to plates, Bonalumi's definition gives the cell-average normalized diffusion coefficient, because there is no cell edge in this direction. But by making a two-dimensional calculation or comparing the diffusion coefficients in both directions, it is not possible to have two different normalizations. If we have normalized the x-diffusion coefficient to the cell-edge flux in the x direction we must normalize the y-diffusion coefficient in the same way. This simply means that we have to multiply the y-diffusion coefficient by the ratio of the cell-average flux to the cell-edge flux. If this is done, Bonalumi's definition can be used as equally well as Benoist's definition for the study of the anisotropy of diffusion.

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[1] ELY M. GELBARD, *Nucl. Sci. Eng.*, **54**, 327 (1974).