Geometric Factor Calculation

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Provided below is Equation 4 from Johnstone et al. (1987)

$$GF = \left(eA_f \Delta v^{'} \Delta\theta\Delta\phi / I_0 T\right) \sum_b N_b S_b \tag{1}$$

Where e is the charge of an electron, A_f is the area of the anode, $\Delta v^{'}$ is the range(?) of velocities of the incoming particles, $\Delta\theta$ and $\Delta\phi$ are the range of angles used, I_0 is a standard current for the energy level and flux of the electron beam, T is detection time, N_b is the number flux, and S_b is a weighting factor where $I_0/S_b = I_b$ and I_b is the current response of the instrument.

To use this equation we could combine the simulation results with the testing we did of the SHERPA. We can solve for the particle velocities from their initial energies in the simulation. We would need to know the conversion factor from the voltage output of the SHERPA to the current response, as well as how the current response differs from the "standard current," defined above. To solve for the flux we would need to use the percentages from the simulation results multiplied by the original population, then we may sum the different flux values (multiplied by their different weighting factors) associated with the range of angles and velocities (energies) tested in the simulation. The exact definition of the standard current for the beam is slightly difficult for me to understand, but it would need to solved for or chosen separately from the actual instrument response. It can be related to the response by two equations, the first is:

$$\int f_b(v)\, dv = I_b / e v_b A_f \tag{2}$$

Where $f_b(v)$ is the distribution function of the electron beam, v_b is the velocity of the beam, and all other variables are as defined previously. Combining this with the equation:

$$I_0/S_b = I_b \rightarrow S_b = I_0/I_b \tag{3}$$

From above, that is the only way the current response of the instrument factors into Equation 1, through the solved for weighting factors, S_b. If we can solve for a standard current I_0 for our electron distribution, we could use the energy range to find $\Delta v^{'}$, use the angular range for $\Delta\theta$ and $\Delta\phi$, and the percentages multiplied by the weighting factors based on the instrument current response at different selection screen values, we can use this equation. My main questions at this point are the interpretation of I_0 and $\Delta v^{'}$, and if we should average the current response for different energy values at the same selection screen value, since the simulations used an equal distribution. Also since our testing in the lab so far has not included a range of angles, Laura suggested we use an estimate of the beam spread in the lab as our angular range, and use the data in the simulations for 0° from instrument centerline.

Source:
https://iopscience.iop.org/article/10.1088/0022-3735/20/6/038