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This Week's Citation Classic

Silverstein E **A.** Calculation of the *G* factor for gas scattering experiments. *Nucl. Instrum. Methods* 4:53-66, 1959. [University of Wisconsin, Madison, WI]

In gas scattering experiments a beam traverses the target gas and scattered particles enter the detector through two defining apertures in parallel planes. The 'G factor' relating the yield to the beam intensity, target density, and scattering cross section and its derivatives is calculated for several types of aperture boundaries. The case of a circular front and rear aperture is treated in addition to the usual case where the front aperture consists of two parallel edges. [The *SCI*® indicates that this paper has been cited over 140 times since 1961.]

Edward A. Silverstein
Nuclear Medicine Section
Northwestern University
Medical Center Chicago, IL 60611

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"As a graduate student at the University of Wisconsin in Madison in low energy nuclear physics, I wished to design a small volume gas scattering chamber with the detector system outside the chamber while at the same time permitting a continuous choice of scattering angle. This could be accomplished by bringing the detector up out of the horizontal plane and pointing it at the center of the chamber, the detector axis thus moving in a cone. However, if I had used the customary arrangement of defining apertures with a straight edged front aperture, it would have been necessary to adjust the rotation angle of the front slits for each scattering angle so that their edges would be perpendicular to the scattering plane. By using a system of circular front and rear apertures, the inconvenience of this adjustment could be avoided and the resulting chamber would have only one rotating seal.

"The only problem was that the G factor was not known for this geometry and appeared difficult to calculate. (The C factor, or geometrical efficiency of the system, relates the scattered particle yield to the beam intensity, target density, and scattering cross section and its derivatives.) Before attempting to calculate the C factor for this geometry, I tried to reproduce a calculation[1] of the G factor for the simpler vertical front slit case as these results were used in obtaining accurate p-p cross sections at Wisconsin. I was unable to reproduce these results. Furthermore, others[2] had obtained different higher terms. After getting this involved, I saw that it would be possible to resolve the differences by undertaking a systematic calculation. It then became apparent that the case of circular front and rear apertures could be treated by the methods developed.

"This paper has been highly cited for several reasons. My results were written up in very detailed form with the intent of producing a convenient reference. The analysis and expressions in this paper have been found useful for those involved in gas scattering experiments. The circular front and rear aperture geometry continues[3] to be used."

1. **Breit G, Thaxton H M & Eisenbud L.** Analysis of experiments on the scattering of protons by protons.*Phys. Rev.* 55:1018-64, 1939.
2. **Critchfield C L & Dodder D** C. On the scattering of protons in hydrogen. *Phys. Rev.* 75:419-25, 1949.
3. **Alderliesten C, Djaloeis A, Bojowald J & Mayer-Boricke** C. Two body final states in the d + d interaction in the 50-85 MeV incident energy range. *Phys. Rev. C* 18:2001-6, 1978.