

TWINS Geometric factor
Philip Valek, February 2013

The TWINS Geometric factor was measured during Flight calibration performed at SwRI [McComas et al., 2009]. Each of the TWINS sensor heads were illuminated with a spatially broad (~10 cm diameter), mono-energetic ($\Delta E/E \ll 1e-3$) parallel ion beam (angular divergance $< .1^\circ$). The incidence angle was scanned from -2 to +2 degrees in the non imaging direction in 2 degree steps, and from -60 to +60 degrees in the imaging direction in 2 degree steps. The measurement was repeated for a range of energies ranging from 2.8 to 50 keV.

The geometric factor was determined as

$$G_{i,j,k,E} = \frac{1}{R} \sum_{\theta=-2}^2 \sum_{\varphi=-60}^{60} \frac{1}{T_{\theta,\varphi,E}} \frac{C_{\theta,\varphi,k,E}}{\tau_{\theta,\varphi,k,E}} D_{\theta,\varphi,i,j,k,E} \Delta\theta \Delta\varphi \cos(\theta)$$

i = Start Position Byte, j = Stop Position Byte, k = Sensor Head,

E = Incident beam energy step

$$R = \text{Measured particle flux} = \left(\frac{\text{Amptektron Rate}}{\text{Detector Efficiency}} \right) / (\text{Active Area})$$

$T_{\theta,\varphi,E}$ = Total time measuring at θ, φ, E

$C_{\theta,\varphi,k,E}$ = Total valid events for head k at θ, φ, E

$\tau_{\theta,\varphi,k,E}$ = Total *TOF* events for head k at θ, φ, E = total number of direct events

$D_{\theta,\varphi,i,j,k,E}$ = number of direct events for head k , for start/stop position i, j , at θ, φ, E

$\Delta\theta = \Delta\varphi = 2^\circ$

The intensity of the ion beam was measured using an Amptektron MD-501 CEM based detector system. The active area of the Amptektron is 0.1 cm^2 , and the Amptektron detector efficiency values are from Egidi [1969]. This determination of the geometric factor includes the efficiencies of the TWINS detectors.

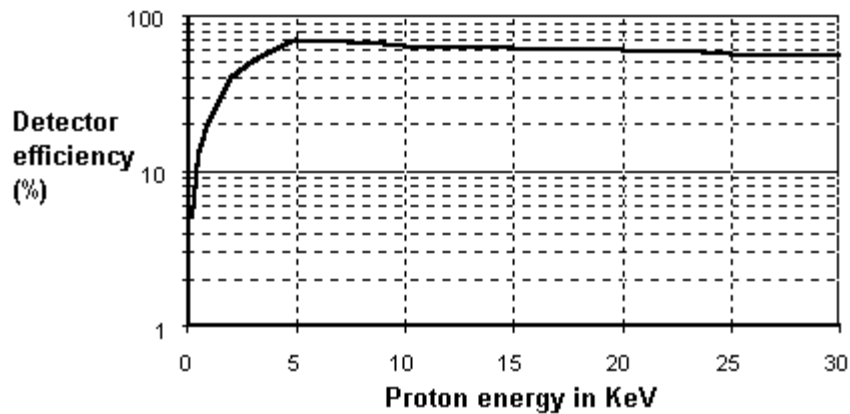


Figure 1. CEM detector efficiencies used for the Amptektron. From Egidi et al. [1969]

The geometric factor was measured for a number of discrete incident energies which ranged from ~ 2.7 to 50 keV. Both sensor heads for TWINS1 were calibrated with 4 different energies. The TWINS2 sensor heads were calibrated with > 10 energies. A fit to the Geometric factor as a function of energy was then performed. The fit was used to determine the geometric factor for the full energy range of TWINS. Finally, the energy was converted to TOF (assuming a mass of 1 AMU) to produce a mapping of the Geometric factor as a function of Stop Position, Start Position, and TOF Direct Event values.

Geometric factors are stored in IDL savesets **gfact_fmNH.sav**, where **N** is the TWINS spacecraft number, and **H** is the Head identifier. Allowable values for **N** is **1** or **2**, and allowable values for **H** is **A** or **T**. For more information on the Geometric Factor Look Up Table (LUT), see *Look-Up Table Guide*.

Reference:

Egidi, A., R. Marcono, G. Pizzella, and F. Sperli, (1969) Channeltron fatigue and efficiency for protons and electrons