

## Detection of electrons with SOHO/EPHIN\*

L. del Peral<sup>1</sup>, R. Gómez-Herrero<sup>1</sup>, M. D. Rodríguez-Frías<sup>1</sup>, H. Kunow<sup>2</sup>, R. Müller-Mellin<sup>2</sup>, and H. Sierks<sup>3</sup>

<sup>1</sup>Departamento de Física. Universidad de Alcalá. Madrid. Spain

<sup>2</sup>Institut für Experimentelle und Angewandte Physik. Universität Kiel. Germany

<sup>3</sup>Max Planck Institut für Aeronomie. Katlenburg-Lindau, Germany

\*SOHO is an ESA-NASA collaboration.

**Abstract.** Characterization of EPHIN (Electron, Proton and Helium Instrument) response to electron detection is presented here. A Monte Carlo simulation code based on GEANT 3.21 has been used. The geometrical factor dependence on the energy has been evaluated and contamination of EPHIN channels with other energy electrons has been obtained.

### 1 Introduction

Monte Carlo simulation of the SOHO/EPHIN instrument response to electrons has been carried out making use of GEANT 3.21, developed by CERN (Brun, R. et al., 1993). Response of the EPHIN sensor to electrons has been simulated. The energy of the incident electron in the sensor has been obtained randomly; from several power-law energy distributions with spectral index between -5 and 1. Angular direction and incidence position have been selected randomly according to an isotropic flow of electrons hitting uniformly on a circular surface, located on the acceptance window of the sensor.

In Figure 1 of Gómez-Herrero et al. (2001) is shown a sketch with the sensor parts introduced in the Monte Carlo simulation and a brief description of the simulation is given. Here we have focused our study on the simulation of EPHIN response to electrons. There have been simulated  $5 \cdot 10^7$  electrons in the energy range 0.05-15.05 MeV uniformly and randomly distributed in a  $90^\circ$  acceptance angle. Flat, linear and power-law ( $\gamma = -2$ ) energy spectra have been simulated.

### 2 Energy range for electron detection with SOHO/EPHIN obtained from Monte Carlo simulation

Electrons present important scattering in their paths through materials, hence the resulting trajectory may be extremely complex. Therefore, it is very difficult to estimate the path of the electrons inside the detectors. This does not affect the

Correspondence to: L. del Peral (luis.delperal@uah.es)

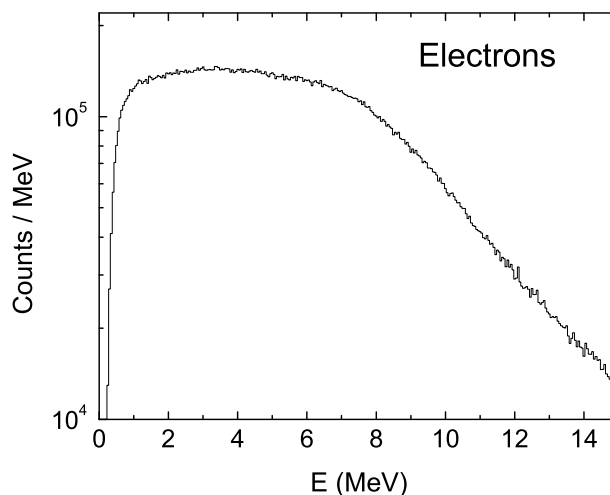


Fig. 1. Energy range obtained from Monte Carlo simulation for electrons.

total energy determination, but it can produce an incorrect particle identification.

The difference between real and measured energy in the sensor has been estimated from Monte Carlo simulation, obtaining for the total flux a 20.6 % average reduction in energy, for parallel incidence a 17.6 % and for central acceptance a 9.9 % reduction. For ions the maximum value found for this reduction was 10.8 %.

It is more difficult to estimate the EPHIN sensor energy range for electrons. Figure 1 shows the sensor sensibility dependence on the electron energy. We have applied the same agreement to determine the detection energy range that for ions: less than 50 % of electrons lost. We have obtained by this procedure, that the energy range of EPHIN for electron detection is 0.35-10.22 MeV.

The energy range of the counting rate channels of the EPHIN sensor have been determined with the Monte Carlo simulation. We have obtained that E150 channel is suitable for de-

tection in the energy interval 350-810 keV. The E300 flux channel includes the interval from 810 keV to 3.6 MeV. The E1300 channel counts electrons with energy between 3.02 and 7.40 MeV and, finally, for the E3000 channel the energy range obtained was 5.7-10.22 MeV.

Figure 2 shows the distribution of incident particles in the flux channels of the EPHIN sensor. It can be observed as the detected particles are counted mainly in the corresponding channel flux. Nevertheless some important deviations are observed. That is the case of some electrons amount that are stored as protons, mainly at low energies in P4. The presence of electrons in the protons channels are relevant because of the high abundance level of the electrons and the difference in the energy. Moreover it has to be pointed out the presence of Helium isotopes in P8. Nevertheless the deuterium incidence in electron channels is not a serious problem because of its low abundance ratio.

### 3 Geometrical factors from Monte Carlo simulation

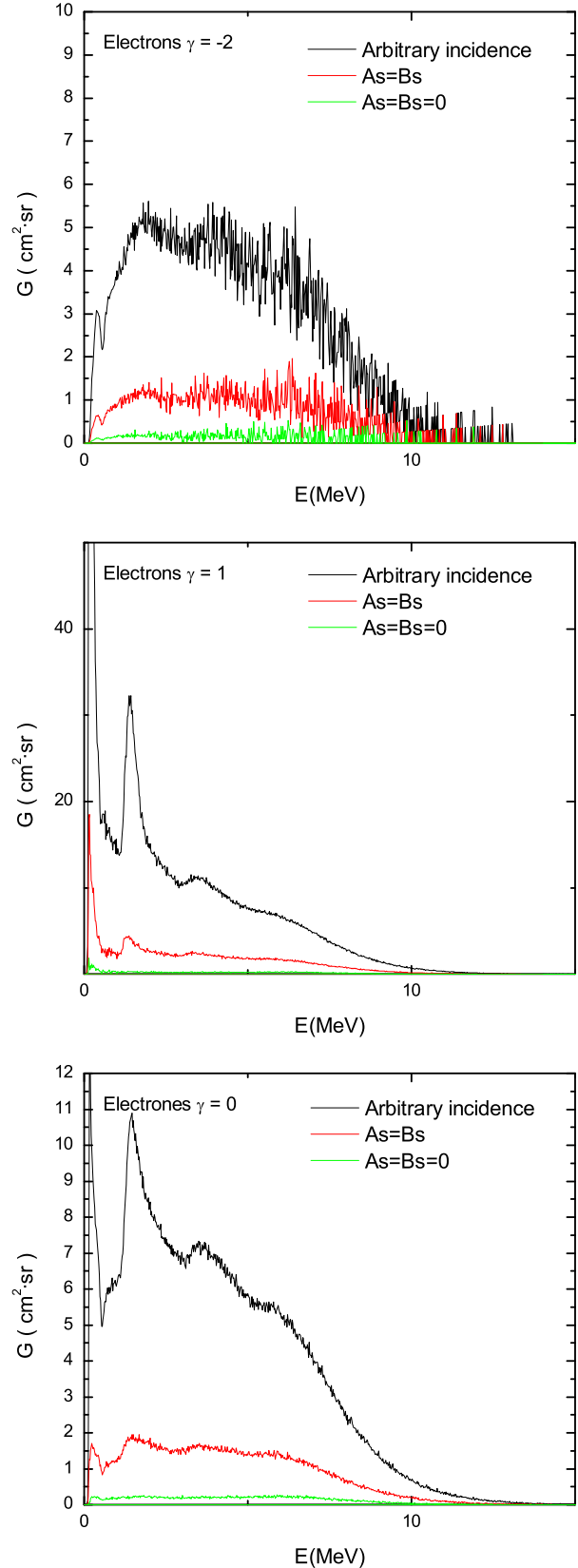
One of the main aims of this work is to obtain geometrical factors and its energy dependence. We have studied with the Monte Carlo simulations this dependence in three incidence of the particles requirements; for arbitrary incidence, with parallel incidence, when incidence sector of the A and B detectors that are sectorized in EPHIN is the same, and central incidence, that is only central sector incidence required in A and B detectors. Figure 3 shows dependence of geometrical factor on the electron energy obtained from the Monte Carlo simulation with uniformly distributed energy spectra.

Geometrical factors for several energy spectral forms have been obtained for electrons. We have observed differences in the geometrical factors depending on the spectral index. Figure 4 shows the energy dependence of the geometrical factors when electrons have a spectral index of -2, 1 and flat spectrum for arbitrary, parallel and central acceptance.

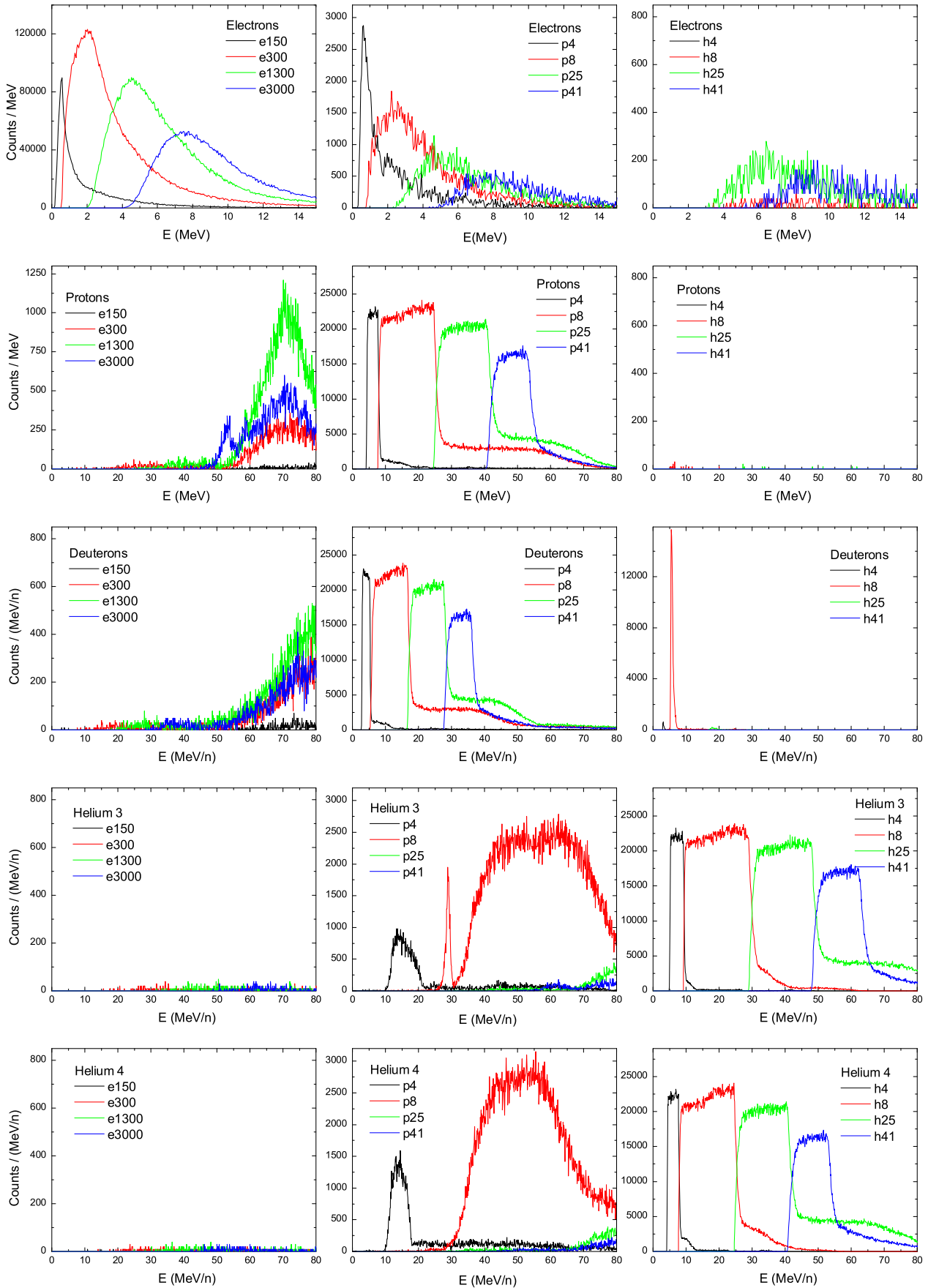
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### References

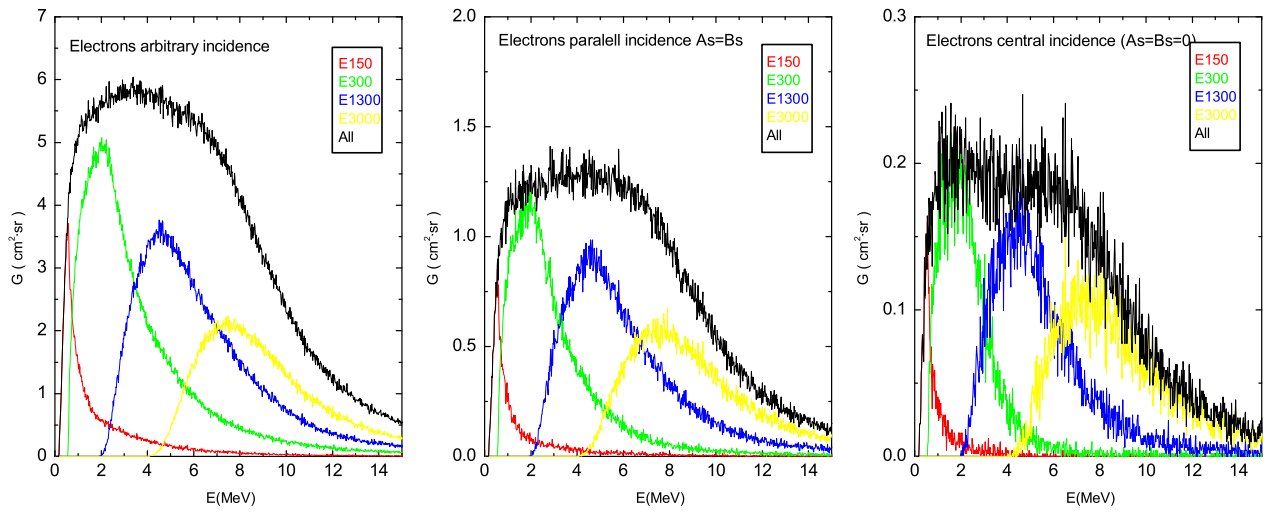
- Brun, R. et al., GEANT 3.21 (CERN Data Handling Division), 1993.  
Gómez-Herrero, R. et al., on this proceedings, 2001.



**Fig. 4.** Effective geometrical factors for electrons with energy distribution of several spectral index.



**Fig. 2.** Energy range determination with Monte Carlo simulation of the EPHIN electron, protons and helium flux channels.



**Fig. 3.** Dependence on the energy of geometrical factors for electrons.