Low energy electron scattering testing update

P. Dondero, A. Mantero
SWHARD SRL

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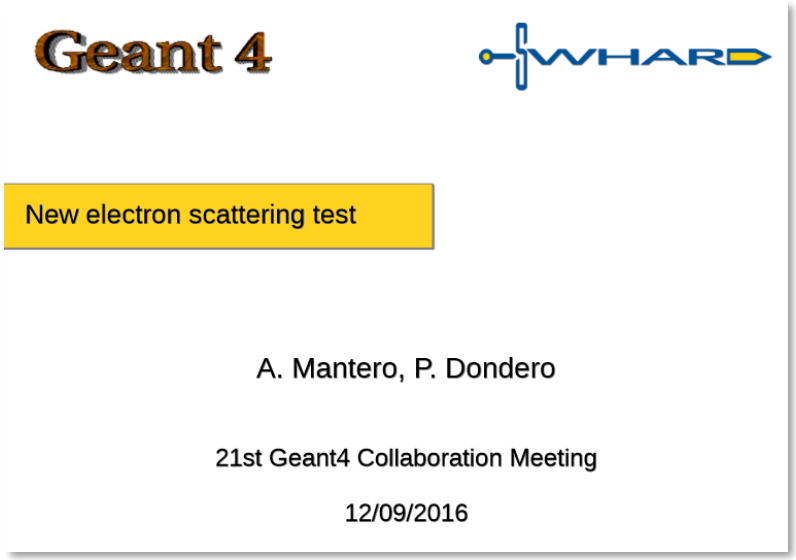
University of Wollongong, Australia

Introduction

First results presented last year in Ferrara

- A couple of benchmark materials
- Extensive study only for Aluminium
- Geant4 10.2



New results and updates:

- New materials
  - Hints from ESA AREMBES project
- Dependency on the lowest electron energy cut
- Results with Geant4 10.3

Introduction

Backscattering coefficient (percentage of backscattered electrons) from several experimental datasets

- Incidence angles from 0 to 75 degrees
- Various target materials (Al, Be, Ca, Ti, U, Cu, Au, W…)
- Electron beam energies from 100 eV to 1 MeV

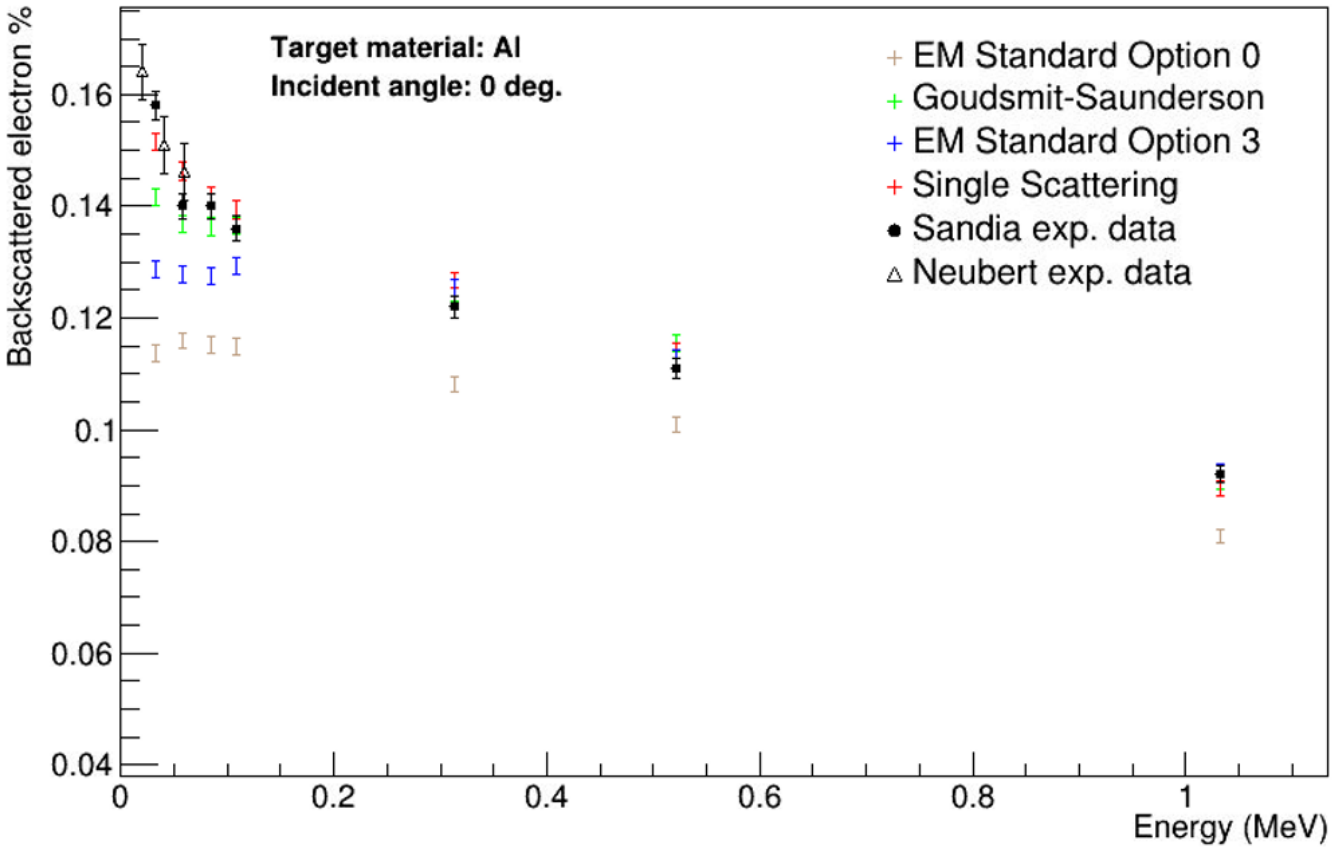
All results obtained with Geant4 10.3.

Tested the consistency with previous results (10.2).

Normal incidence on Al

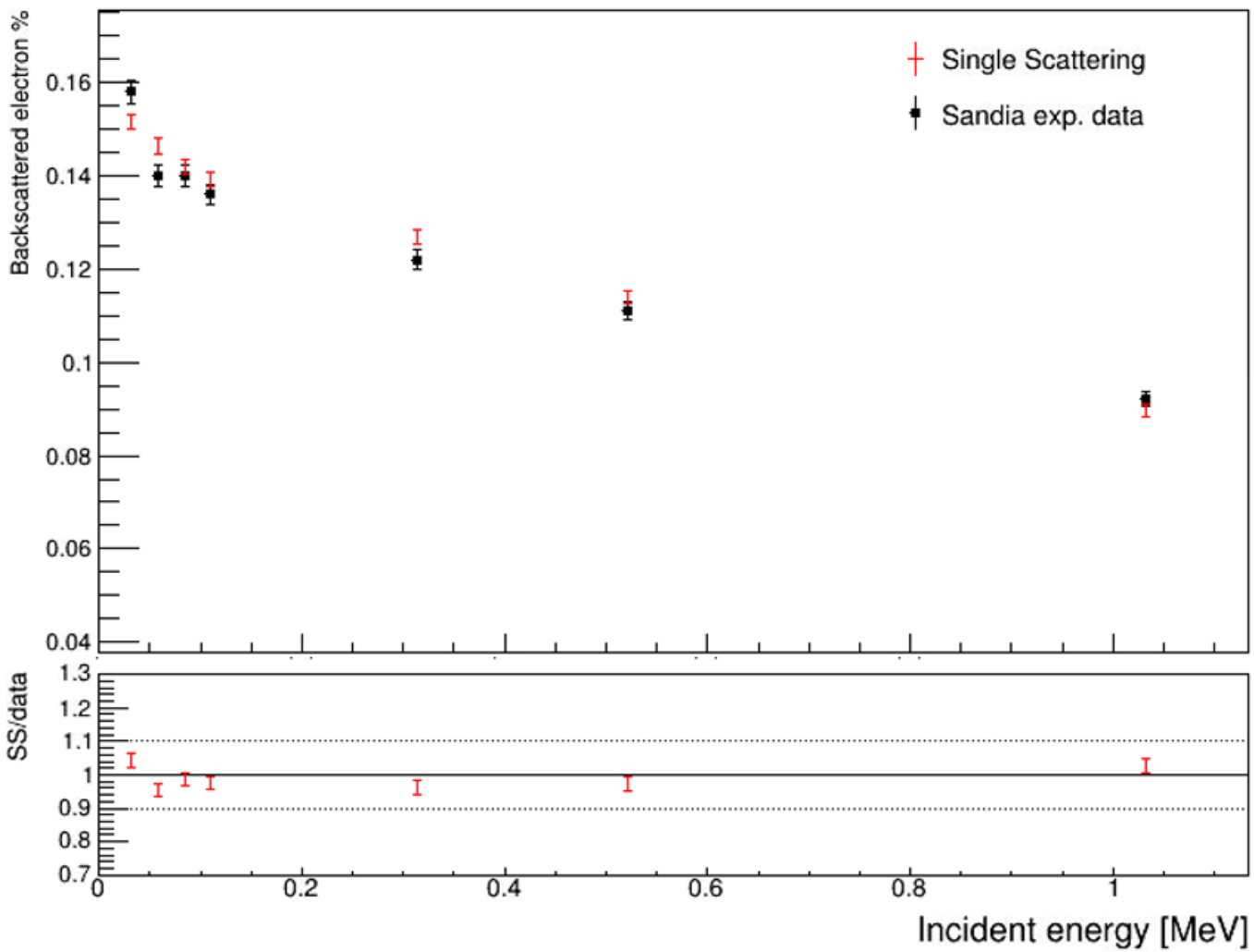
Normal incidence:

- above 0.2 MeV good results from all the physics lists tested (except opt0)
- below 0.2 MeV best SS and GS

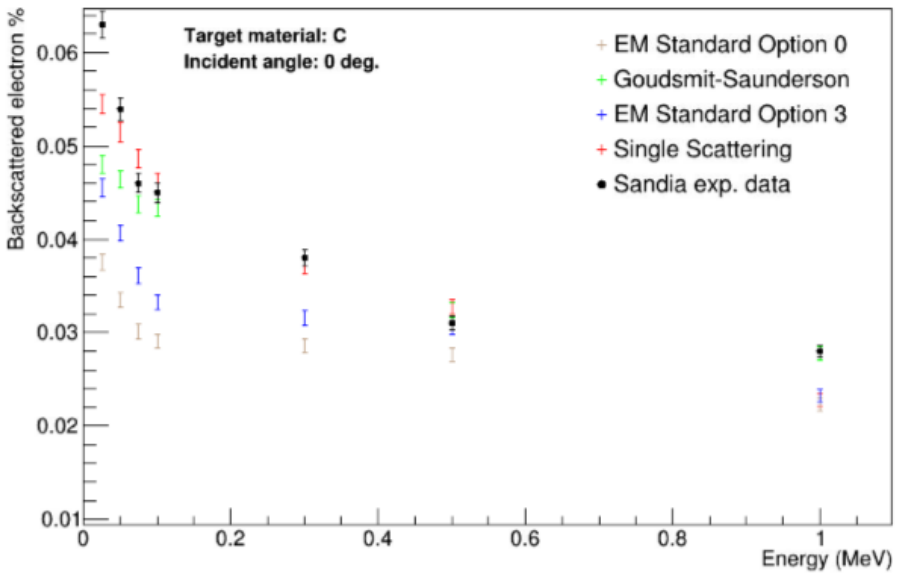


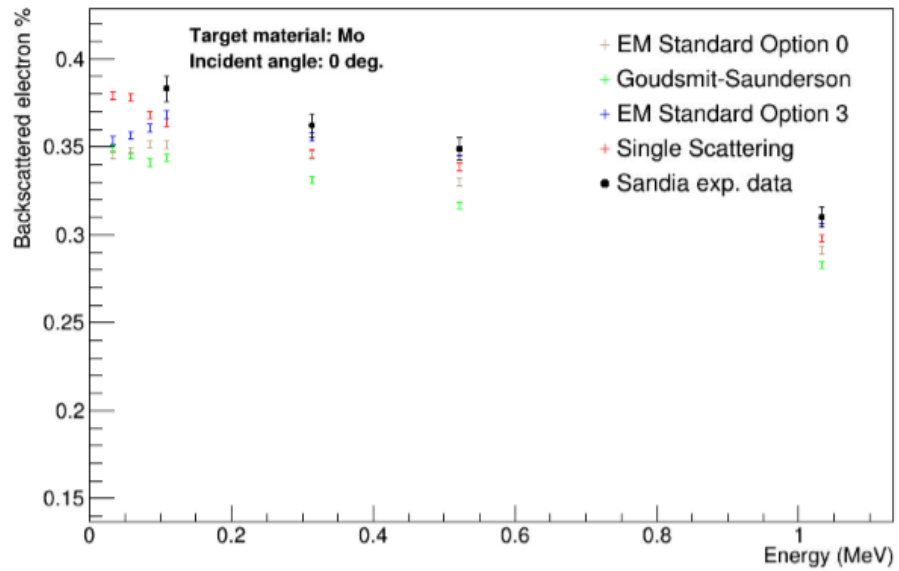
"Quantitative" comparison

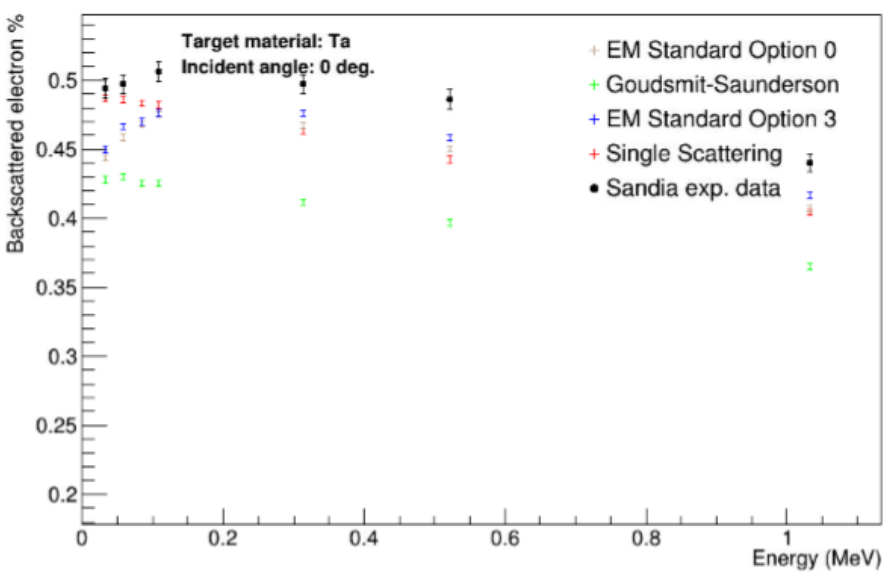
Data vs **SS**: differences below 0.2 MeV less than 10%.

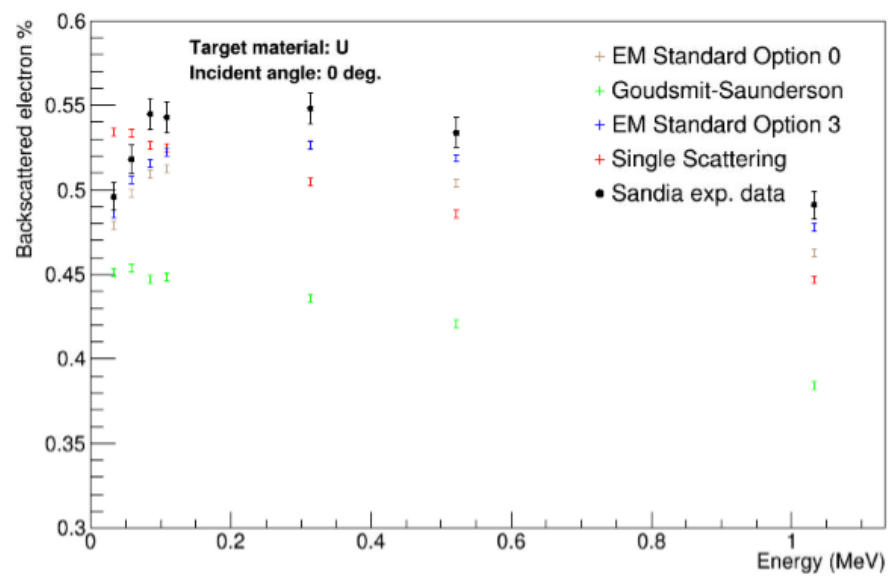


C, Mo, Ta, and U at normal incidence

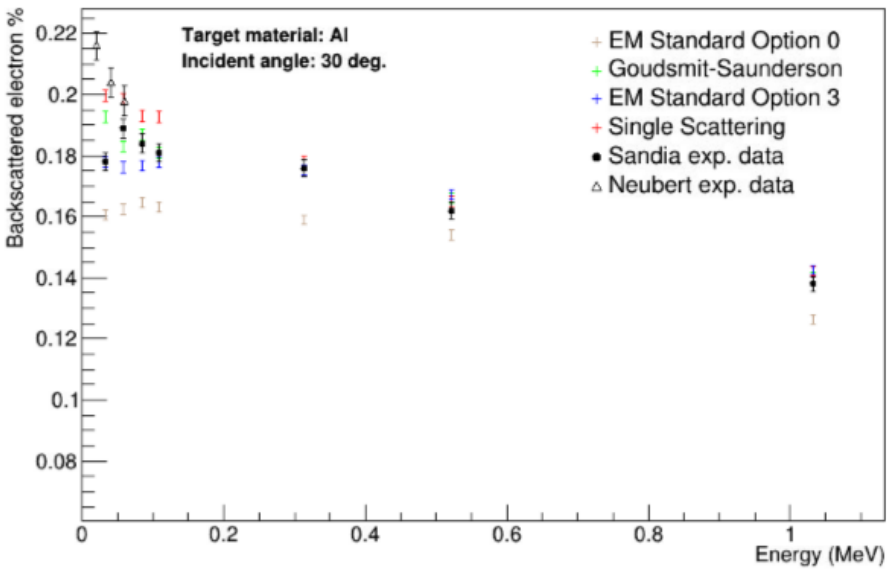


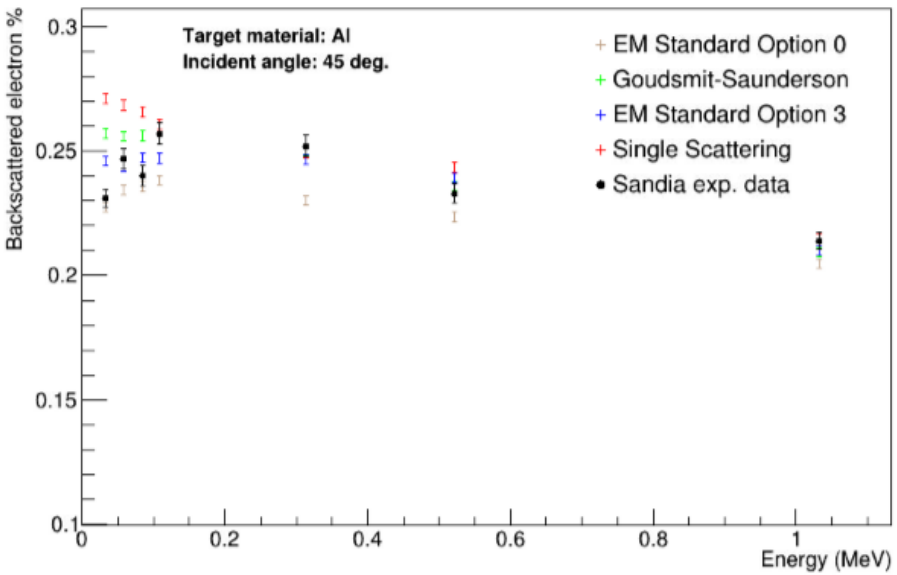


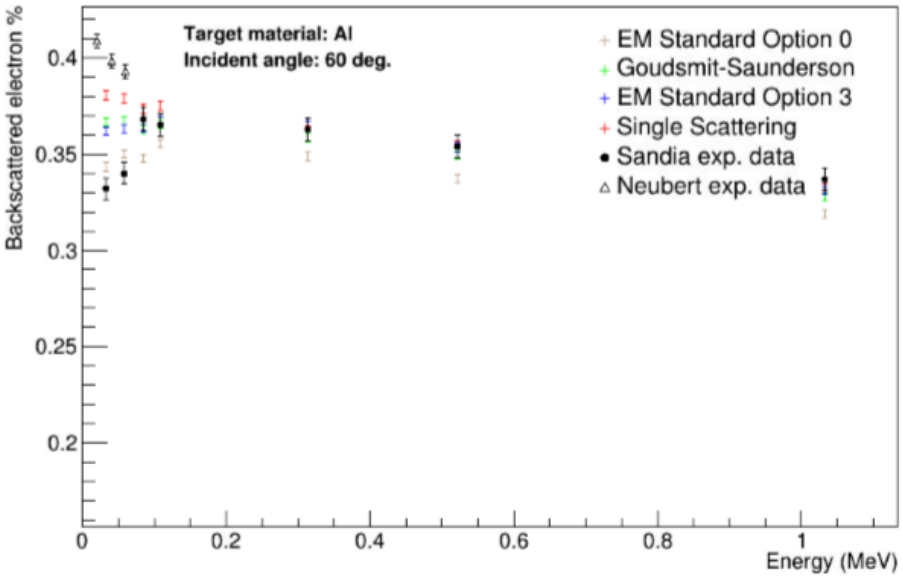


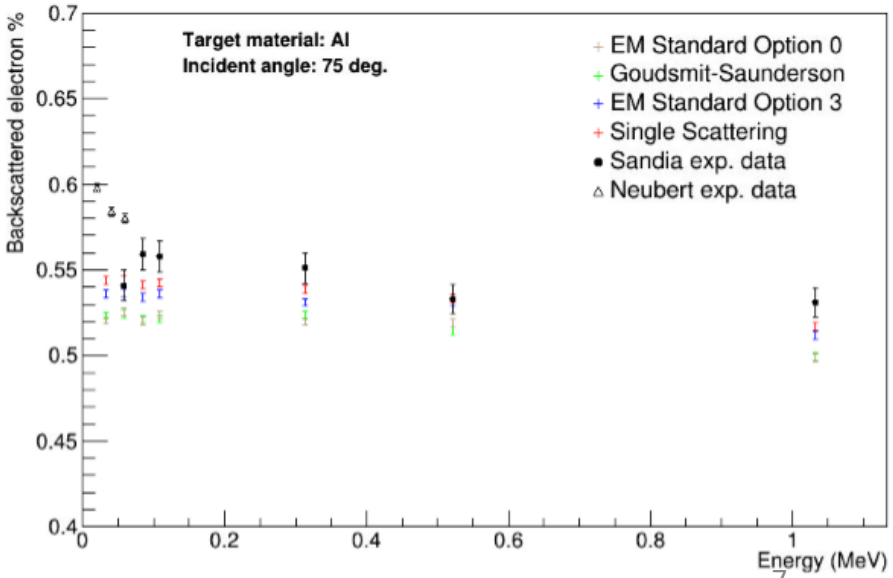


30, 45, 60, 75 deg. incidence on Al





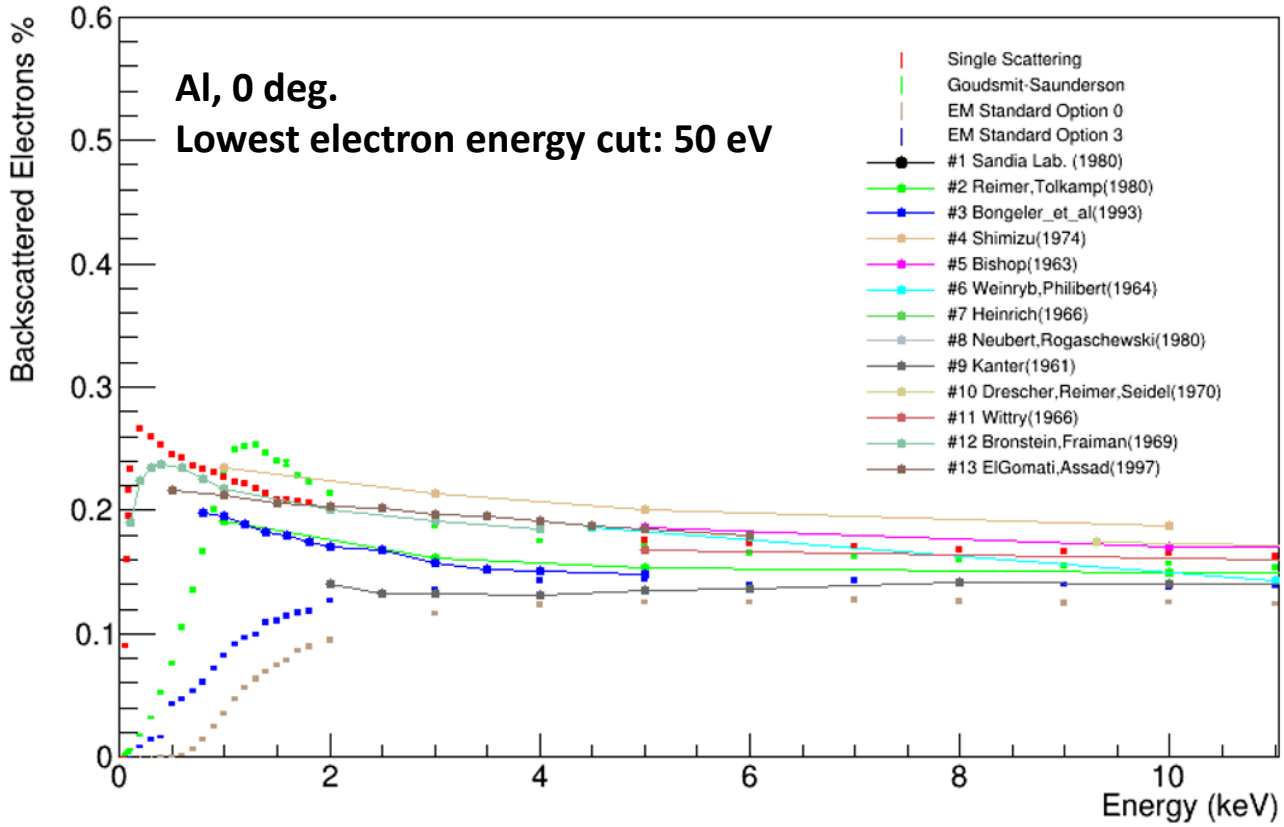




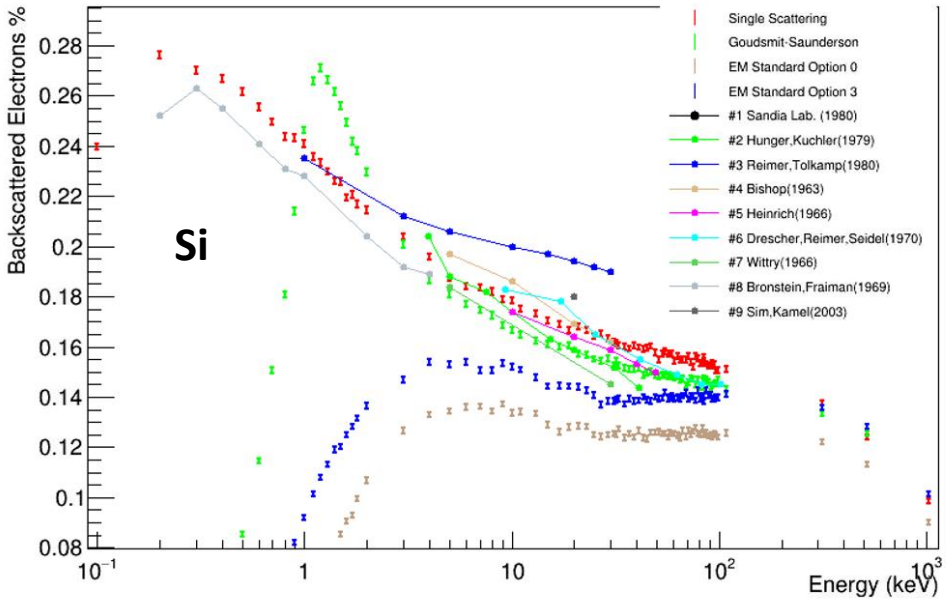
Al, normal incidence, 0.1 – 10 keV range

Experimental data not always in agreement

- Data are from different experiments, different kind of measurement
- Discrepancies below 10 keV
- Differences between G4 results with different physics lists
- Dependence on the lowest electron energy cut



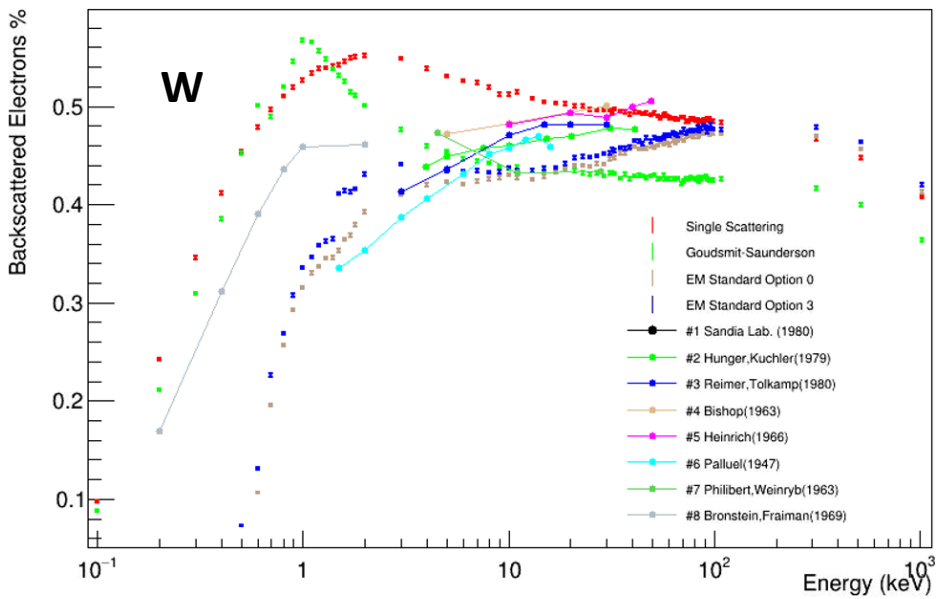
Si, Au, and W, 0.1 – 10 keV

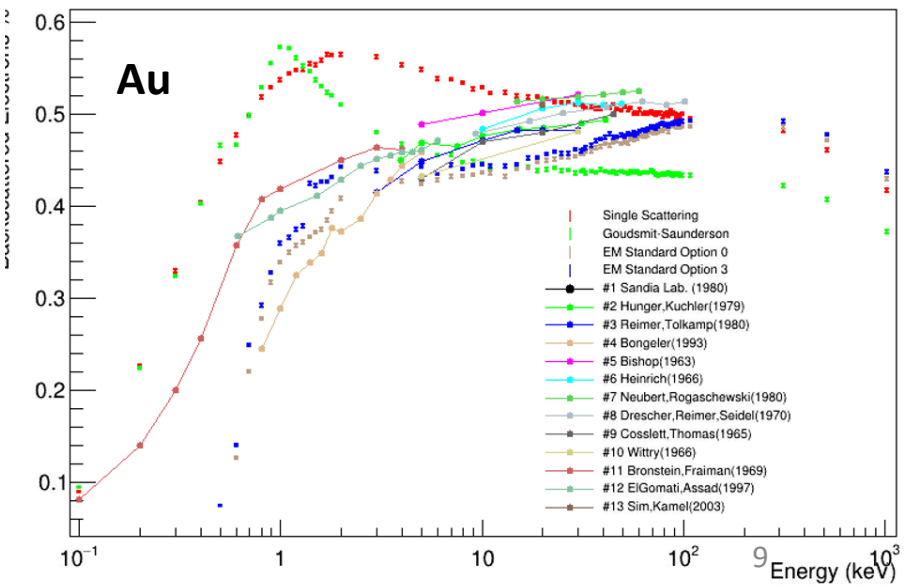


Above 1 keV: good agreement wrt SS and GS

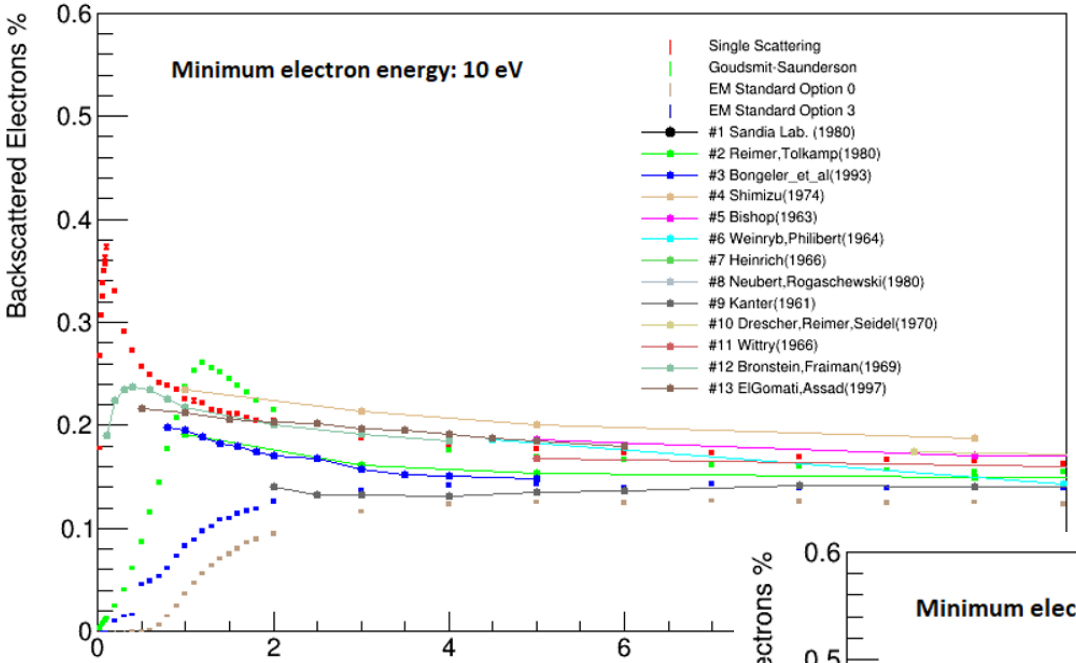
Below 1 keV: SS best

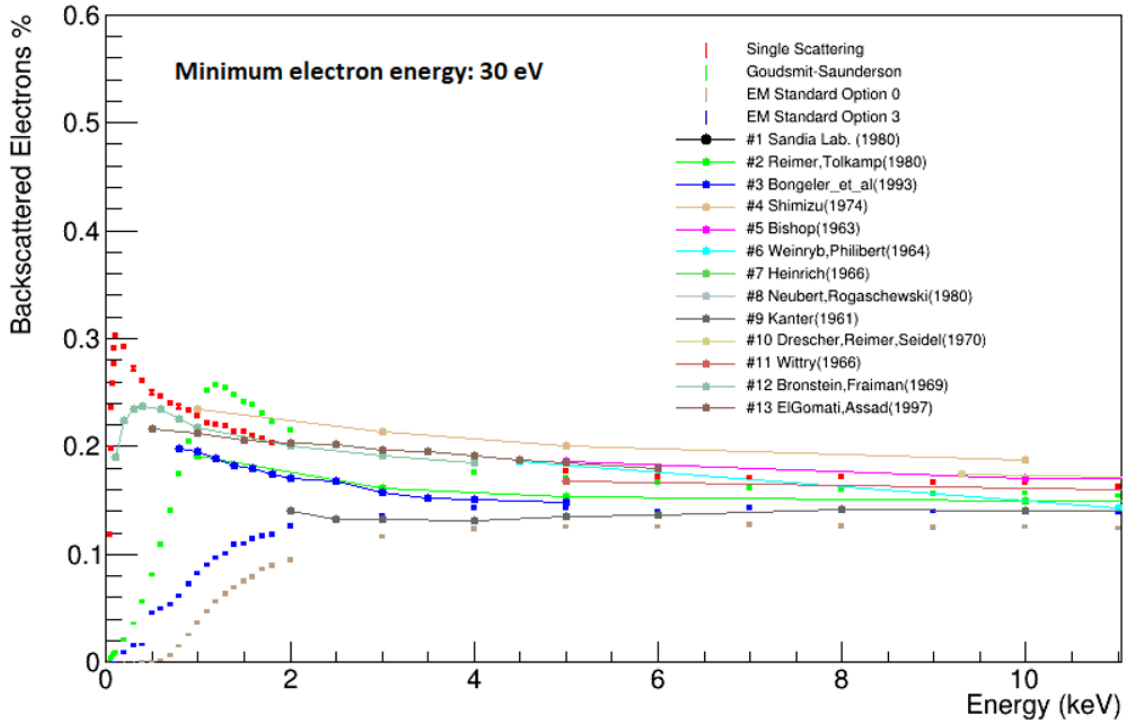
Good agreement for Al, Si, W, Cu
Difference for Au



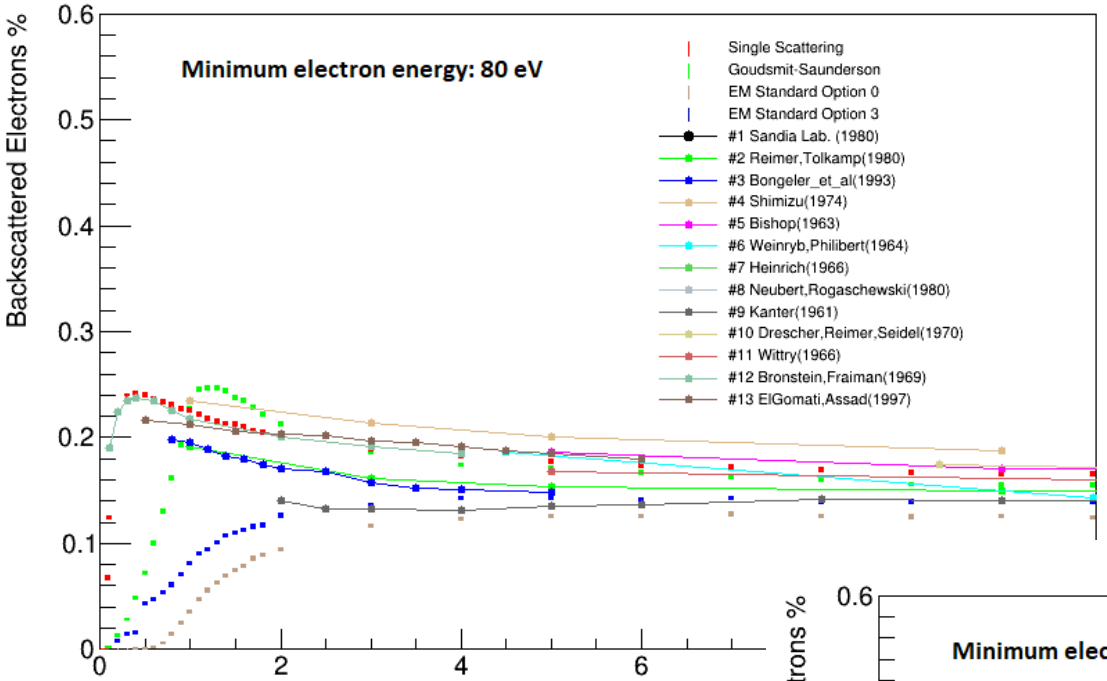


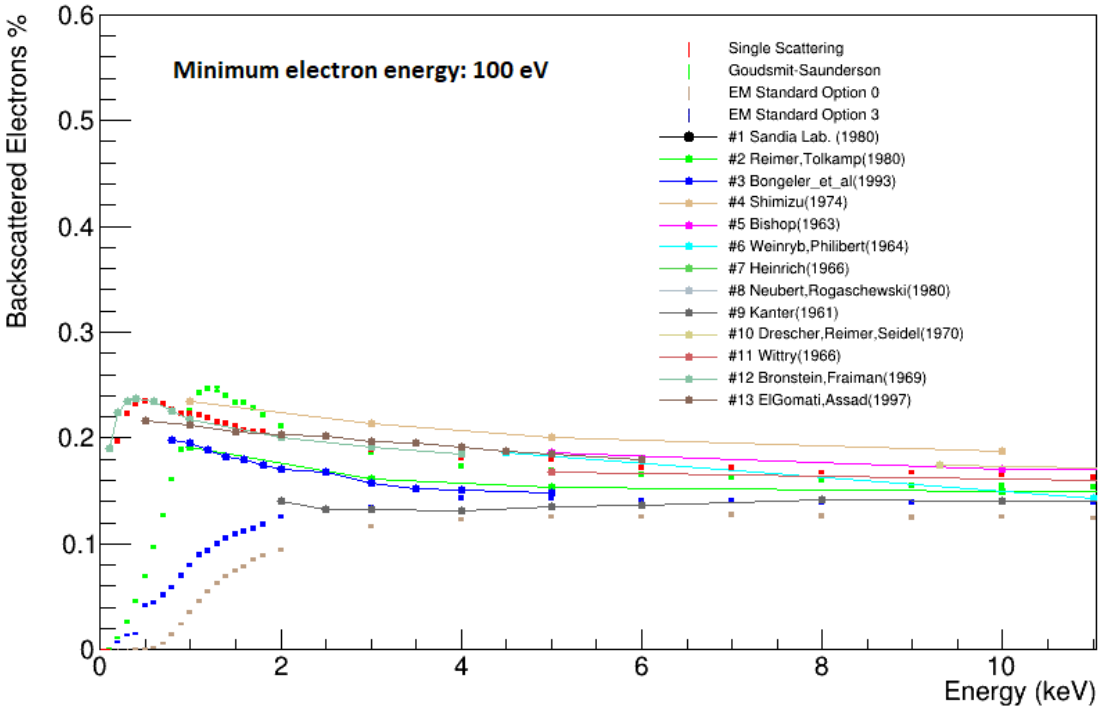
Lowest electron energy: 10 and 30 eV





Lowest electron energy: 80 and 100 eV





Lowest electron energy

Number of backscattered electrons at low energy increases for decreasing cut values

- This is understandable (less electrons killed by the cut)
- Clear effect on SS, not on GS
- Other physics list count a few electrons, the effect is not visible

A 50 eV cut seems to reproduce well most of the experimental data.

Experiments have physical cuts (thresholds, polarized grid) between 50 and 100 eV depending on the setup considered.

Conclusions

- Overall very good agreement
  - Discrepancies at low energy between experiments
  - Geant4 within the experimental data dispersion
- SS the best at low energy
  - Dependency on the lowest electron energy cut
  - Physical cut in experiments compatible with the G4 cut
- GS good, but no changes varying the energy cut
  - Hidden cut on the electron energy?
- Good agreement for most of the tested materials and angles
  - Al, C, Cu, Mo, Si, Ti, Ta reproduced well
  - Not excellent for Au and U at low energies, normal incidence