

Comparison of multiple scattering models in Geant4

Daren Sawkey
Varian Medical Systems

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Methods and Materials

- scattering through thin foil
- measure fluence vs. angle
- example extended/medical/electronScatter2
- Geant4 version 9.4.patch2 and version 9.5
- scattering models tested:
 - Option 0, Option 3, Goudsmit-Saunderson, single scattering
- use Root to fit central part of peak to Gaussian
 - central part == y between $y(x=0)$ and $y(x=0)/e$
- extract characteristic angle $\theta_{1/e}$
 - $\theta_{1/e}$: angle at which fluence fell to 1/e of its value on central axis
- compare to measured values (Ross PMB 2008)

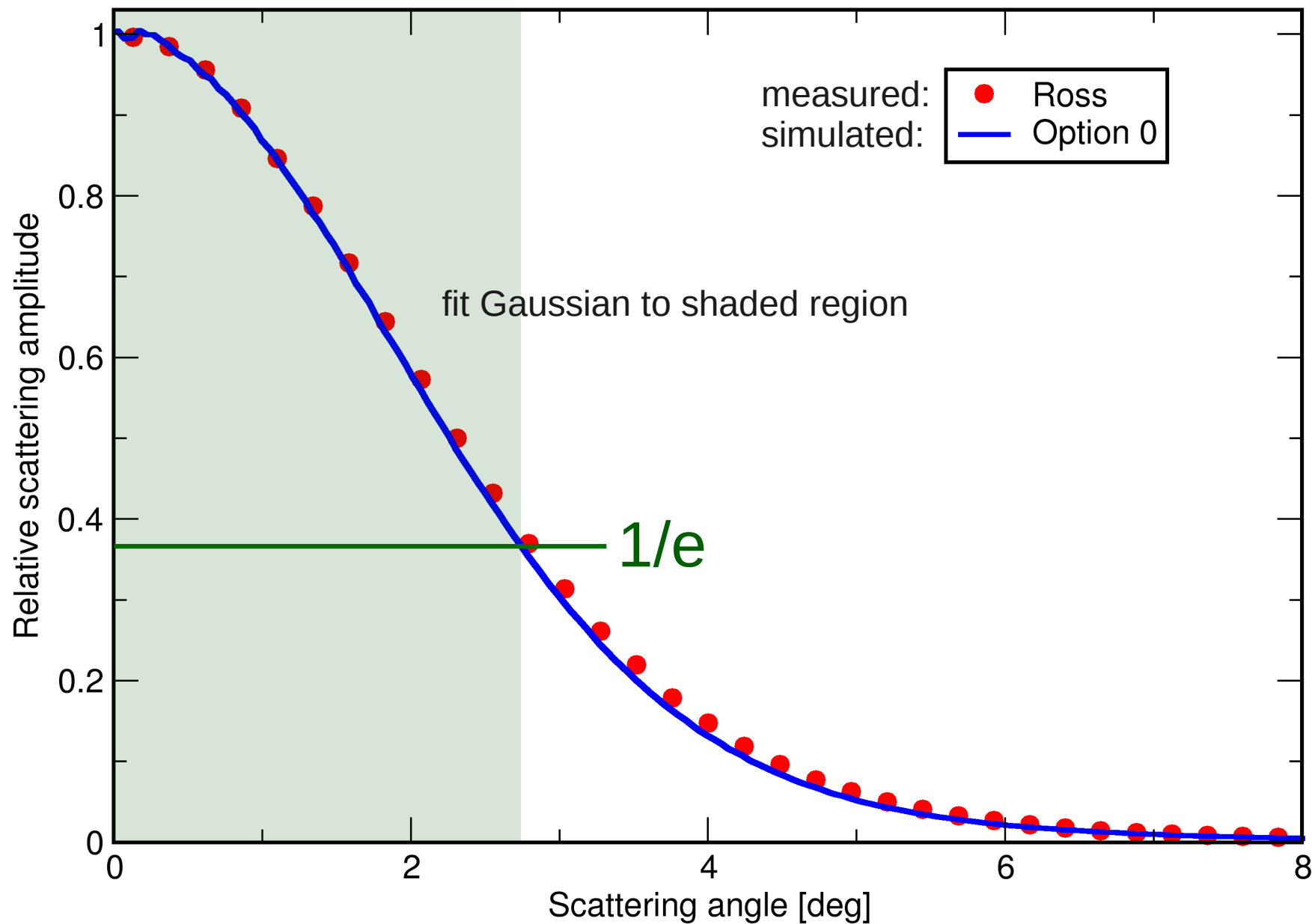
Note regarding single scattering:

single scattering used 9.4.patch1

9.4.patch1 and 9.4.patch2 results same for Urban
(5 targets * 2 energies tested)

=> compare single scattering in version 9.4.patch1 to Urban
MSC in 9.4.patch2

Example: 48.2 μm Cu, 20 MeV



Plotting results:

Create index for each target:

i*100: material (i increases with Z)

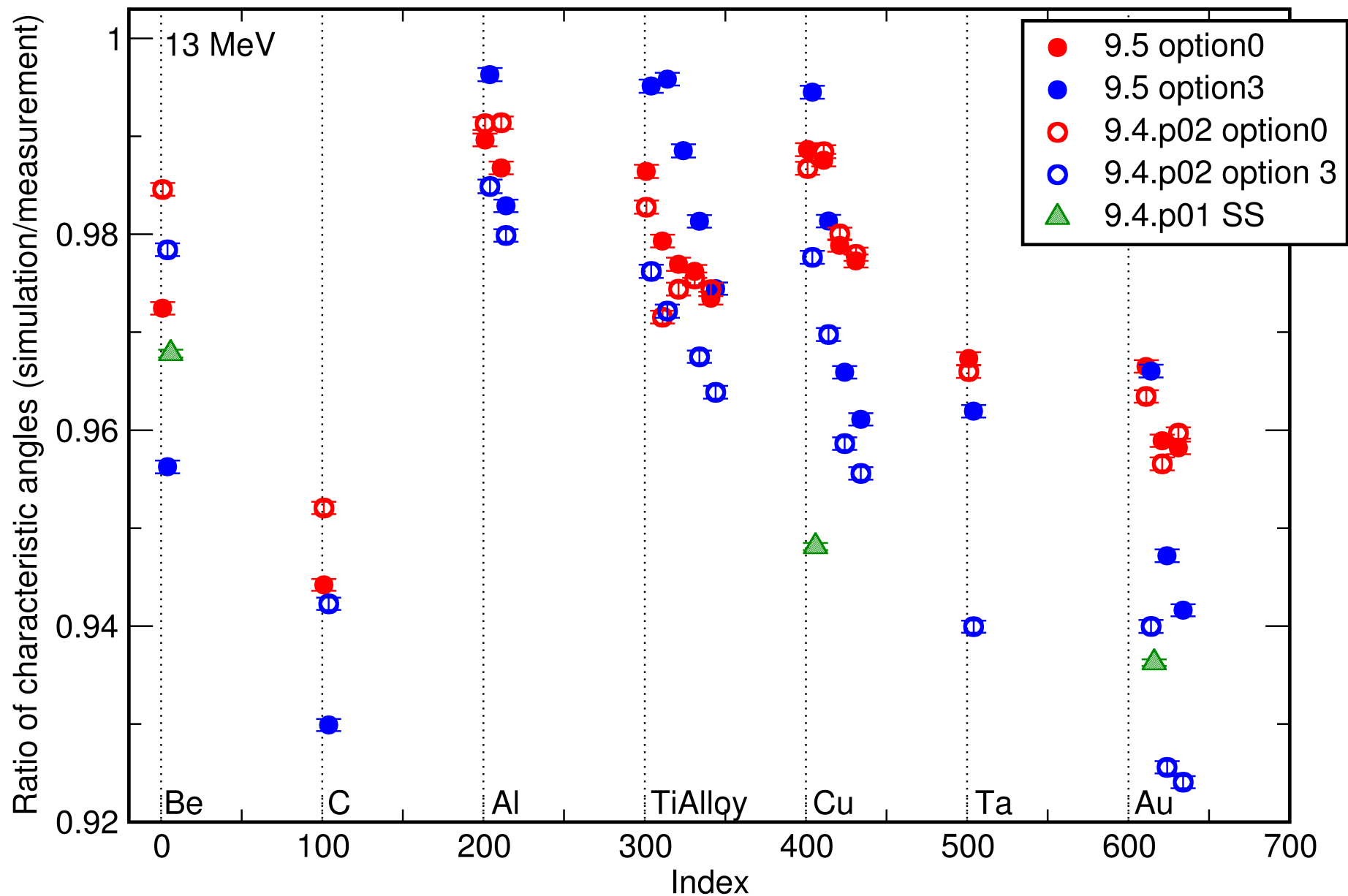
j*10 : thickness (j increases with thickness)

k*1 : physics list

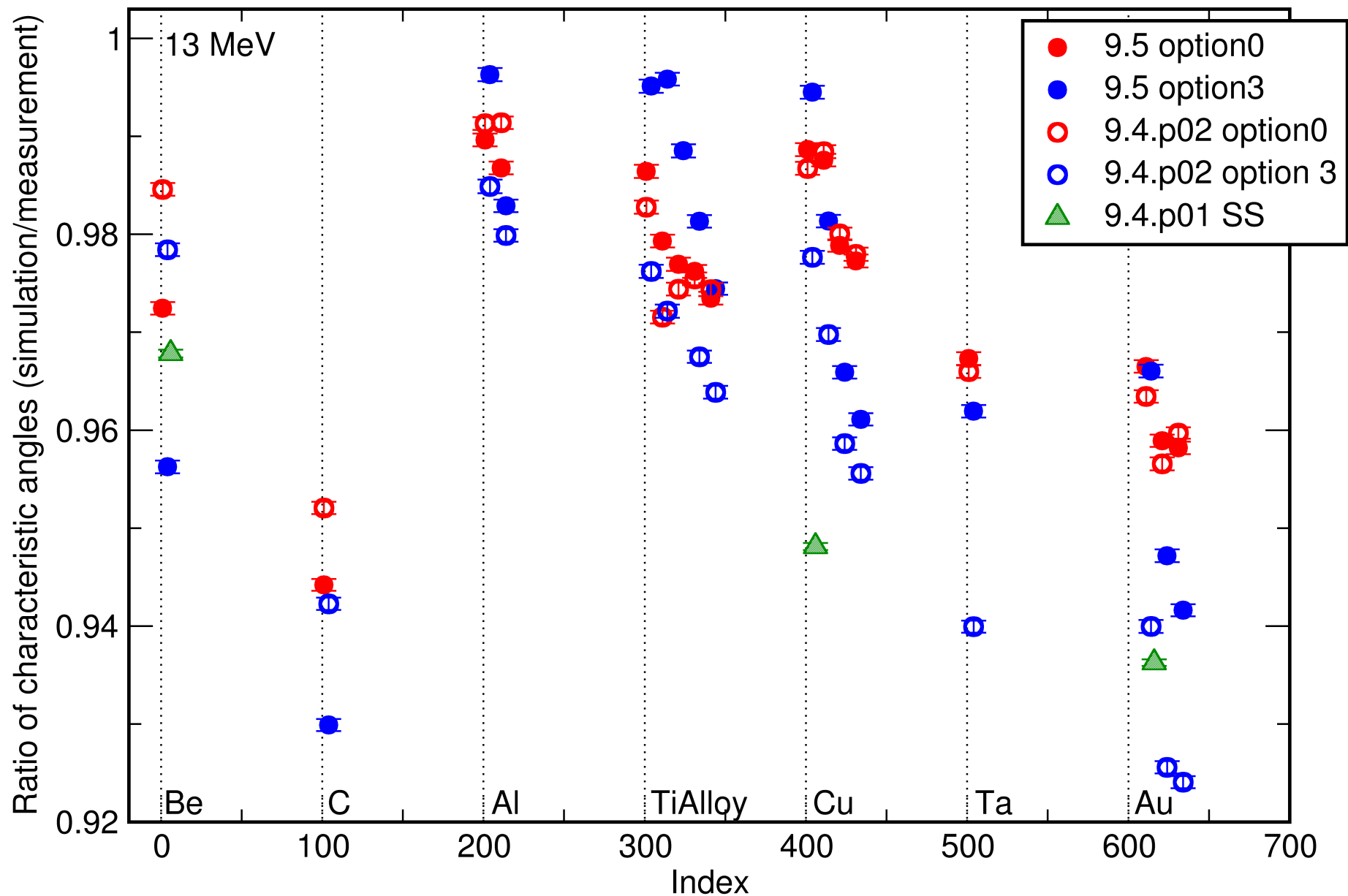
sum : index

Plot ratio of simulated to measured $\theta_{1/e}$

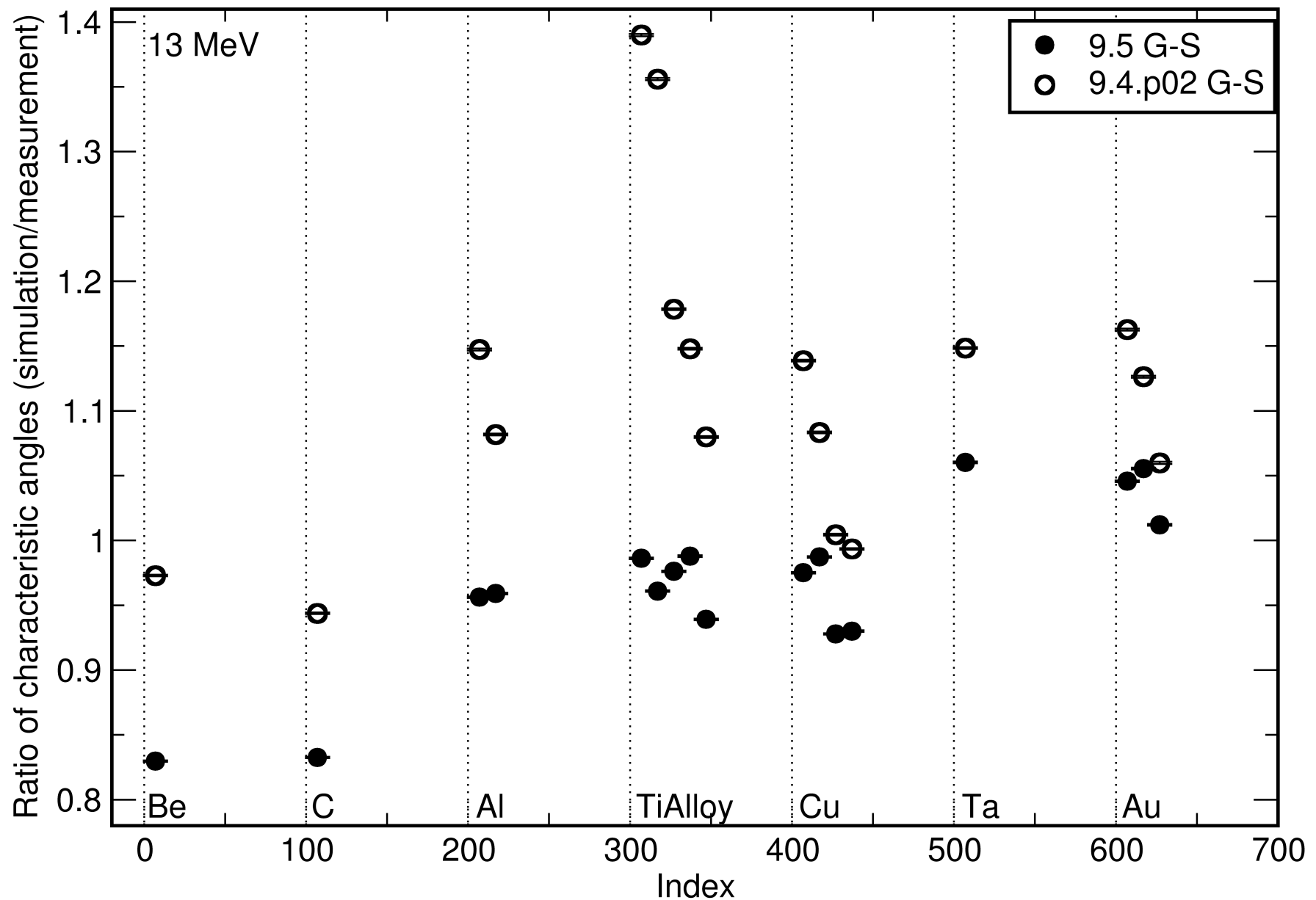
13 MeV, Urban, SS



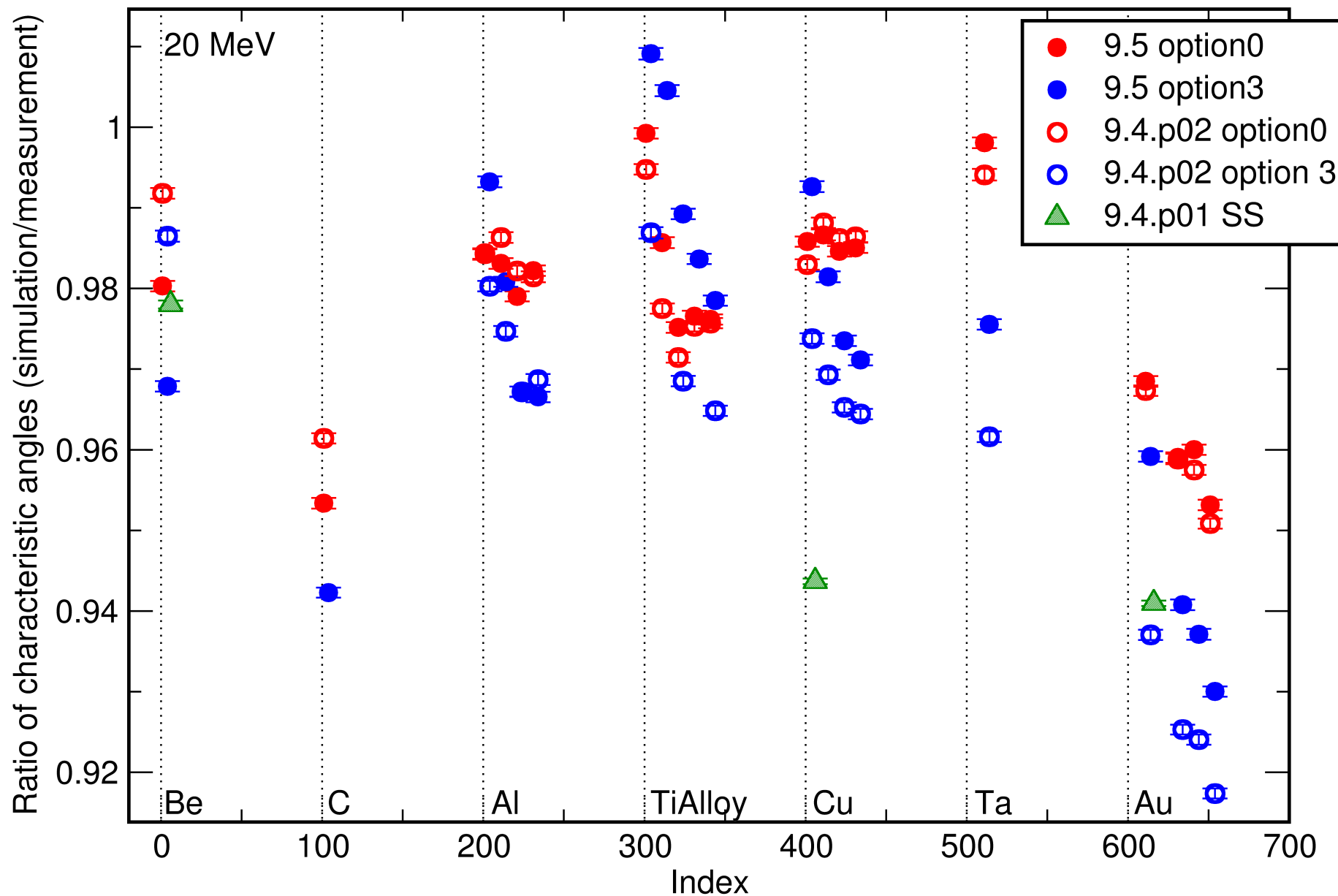
13 MeV, Urban, SS



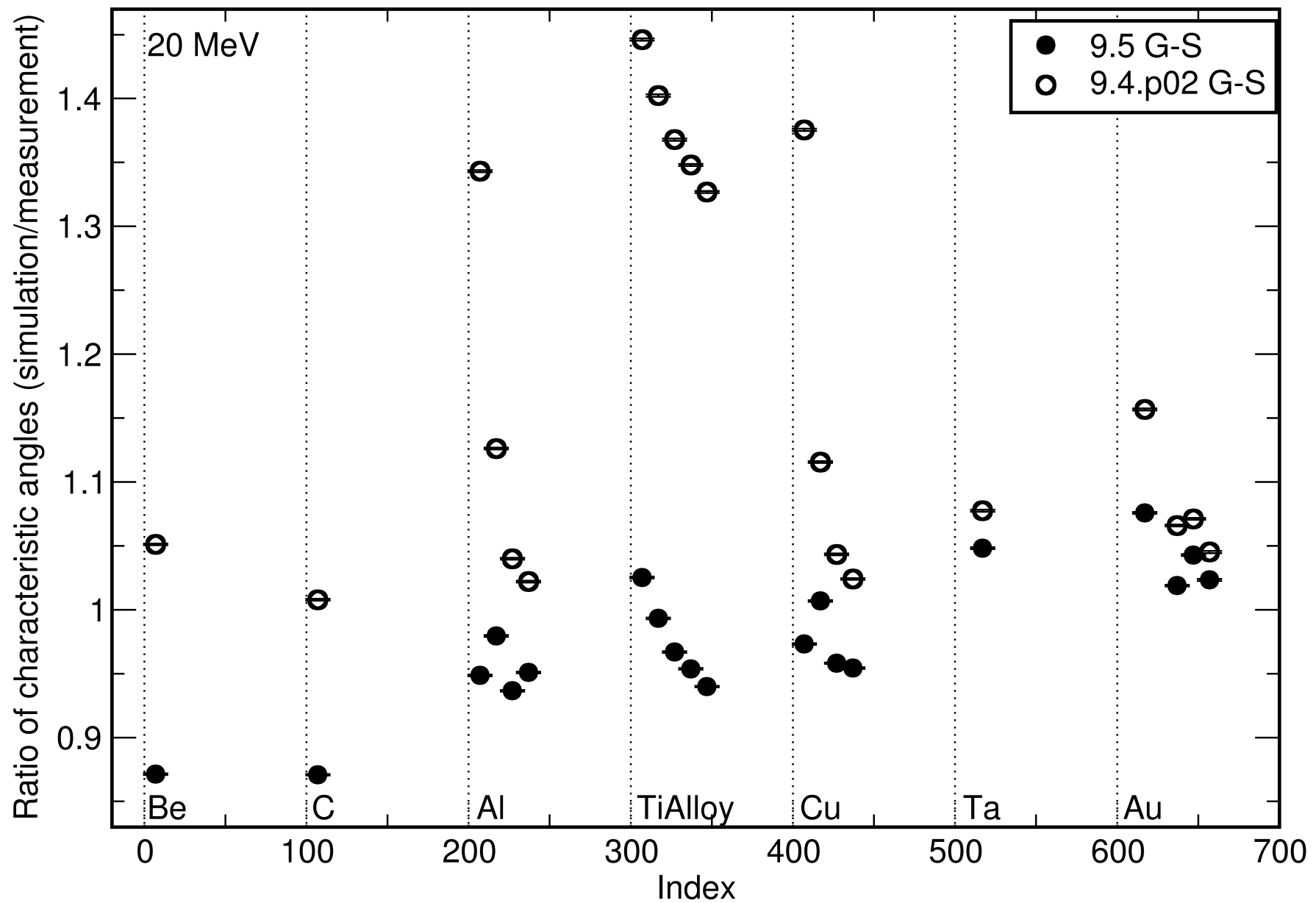
13 MeV, Goudsmit-Saunderson



20 MeV Urban, SS



20 MeV Goudsmit-Saunderson



Conclusions

- $\theta_{1/e}$ smaller than measured by up to 7% with Urban
- $\theta_{1/e}$ for option3 has gone up 1-2% from 9.4 to 9.5 for high Z, down for low Z
- option0 is still closer to expt than option3, especially at high Z
- GS in 9.5 has high Z dependence, and has angle too low for low Z and too high for high Z.
- rangeFactor of 0.01 doesn't make any difference, except at low Z where the difference is still $< 1\%$ (results not shown)
- Faddegon (2009) and Ross (2008) find EGSnrc results 0-4% smaller than measurement: with the single scattering and Urban results here, there is a *systematic discrepancy between simulation and experiment*