# Longitudinal profile comparison between PROPOSAL and AIRES

Juan Ammerman Yebra
Enrique Zas Arregui
Jaime Álvarez Muñiz

Instituto Galego de Física de Altas Enerxías

Universidade de Santiago de Compostela

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# Program versions

- PROPOSAL 7.0.2 through Corsika 8 was used.
- Branch used proposal_new_installation_and_bugfixes (commit 0a545e1d).
- To solve issue with low energy particle cuts branch 280-assumption-of-no-continuous-between-two-stochastic-losses (commit e2395650) was merged into the previous one.
- AIRES 19.04.00 with EGS energy loss formula, needed for a good tracking of very low energy particles (below 1 MeV).

# Simulations parameters

- Linsley's model for a standard atmosphere was used.
- Particle cut was set to 5 MeV.
- Particle cross cut was set to 2.5 MeV.
- For Corsika 8 em_shower.cpp example was used.
- All data shown is averaged over 50 showers.

# Longitudinal distribution 1 TeV shower

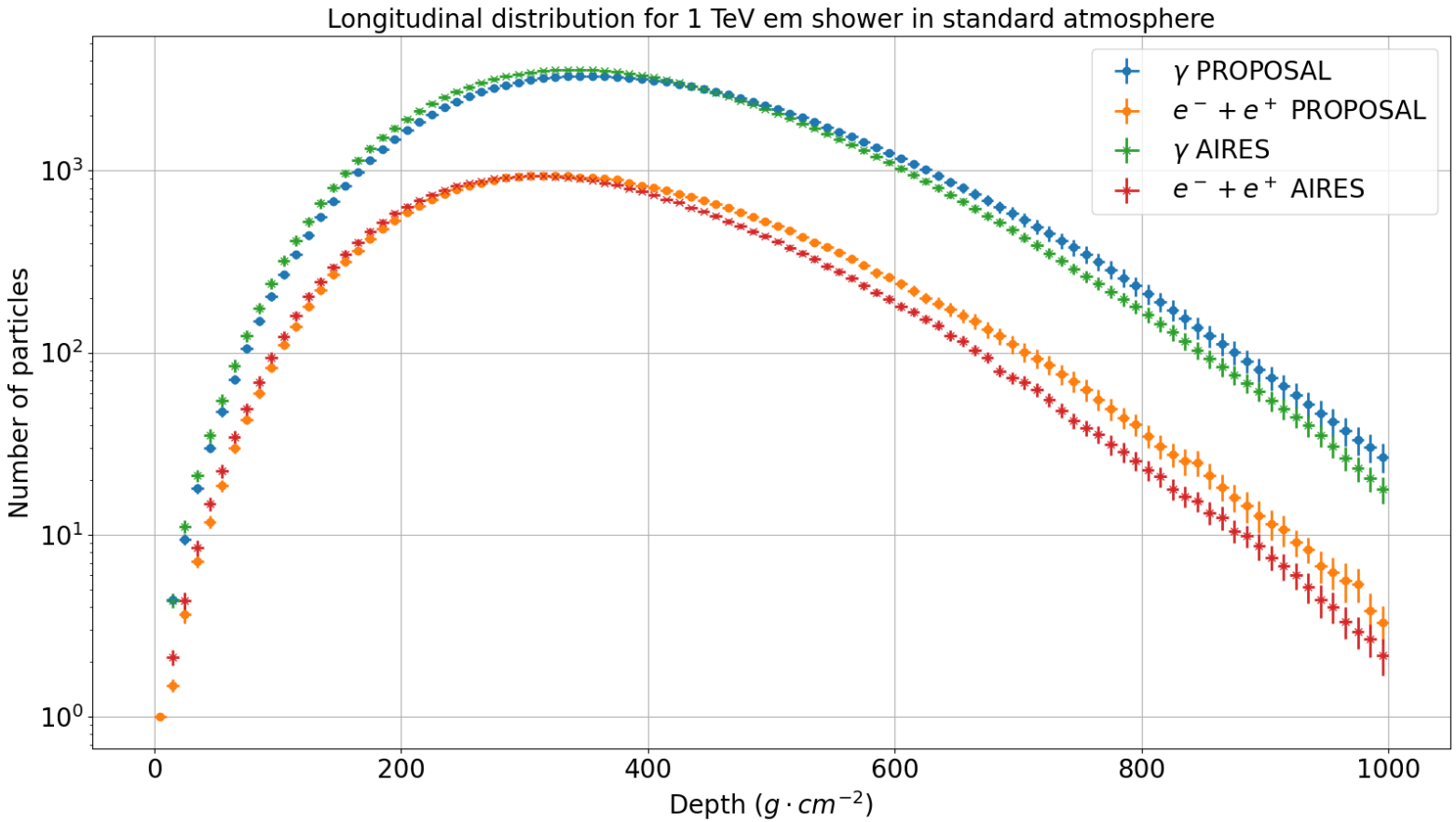


Figure: Longitudinal development of the average number of particles for a 1 TeV shower initiated by an electron.

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# Charge excess 1 TeV shower

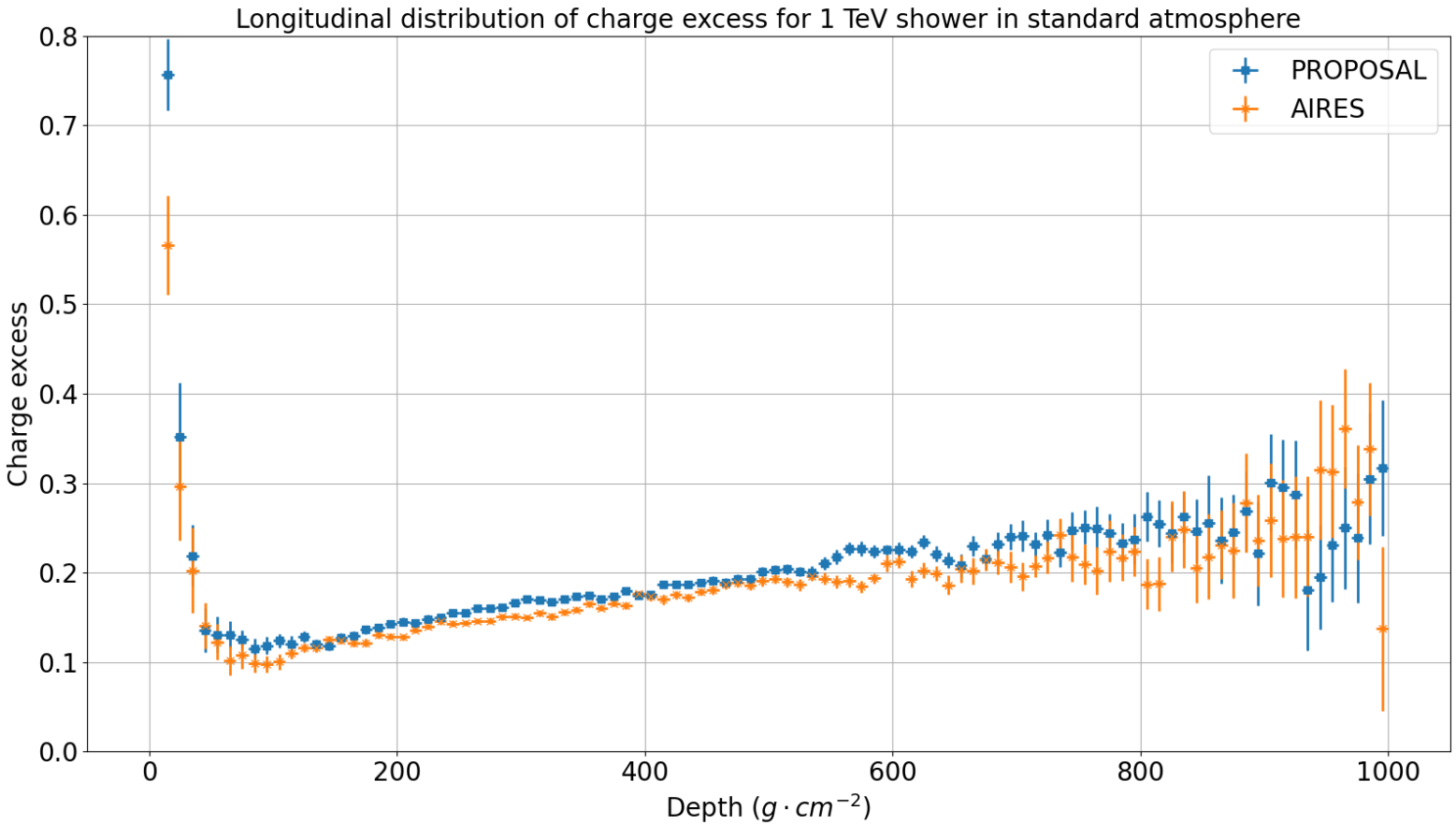


Figure: Longitudinal development of the charge excess for a 1 TeV shower initiated by an electron.

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# Relative differences

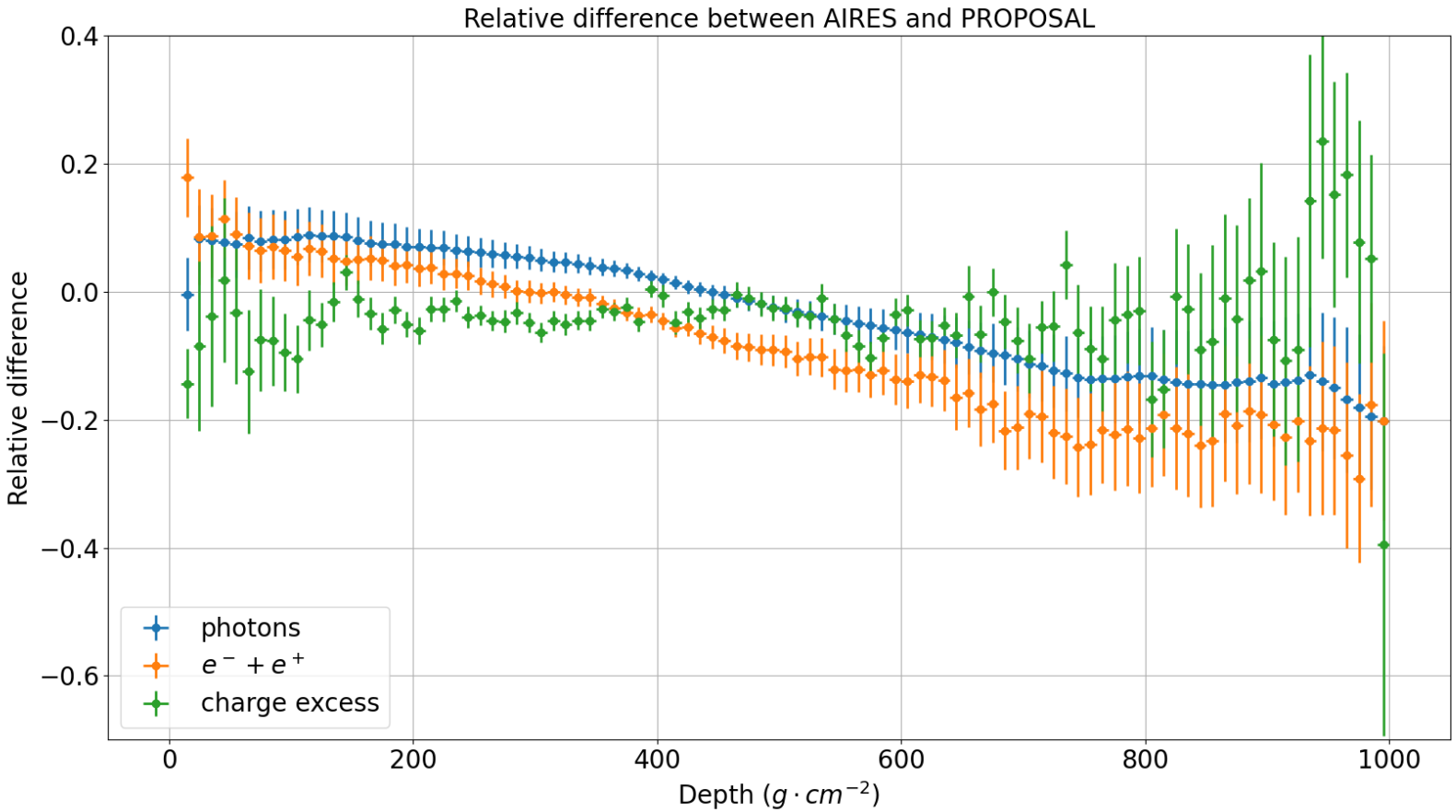


Figure: Longitudinal development of relative differences between AIRES and PROPOSAL for a 1 TeV shower initiated by an electron.

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# Summary

- Shower maximum seems to be displaced between the two programs, maybe due to small differences in cross sections.
- 4% difference in photon distribution maximum and less than 0.1% for electrons plus positrons.
- Difference in longitudinal profile starts in 10% and goes to -15/-20% at the end, but very high error at the end due to very few particles.
- Around 3-4% more charge excess in PROPOSAL.

# Comparison with original AIRES

- AIRES is now set to the same particle cut (5 MeV) but uses a 1 MeV particle cross cut parametrization for energy loss.
- Same environment parameters for both PROPOSAL and AIRES.

# Longitudinal distribution 1 TeV shower

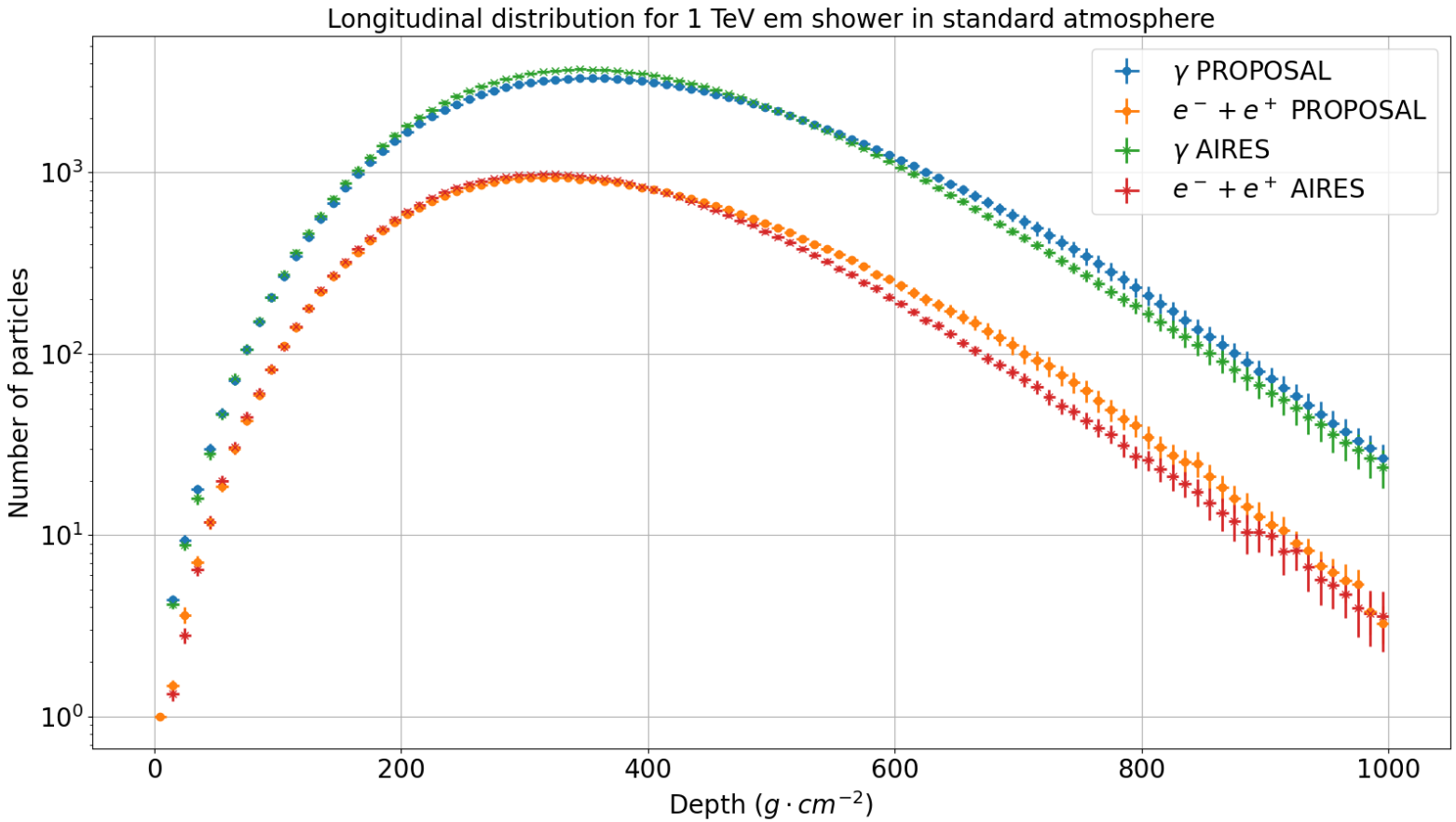


Figure: Longitudinal development of the average number of particles for a 1 TeV shower initiated by an electron.

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# Charge excess 1 TeV shower

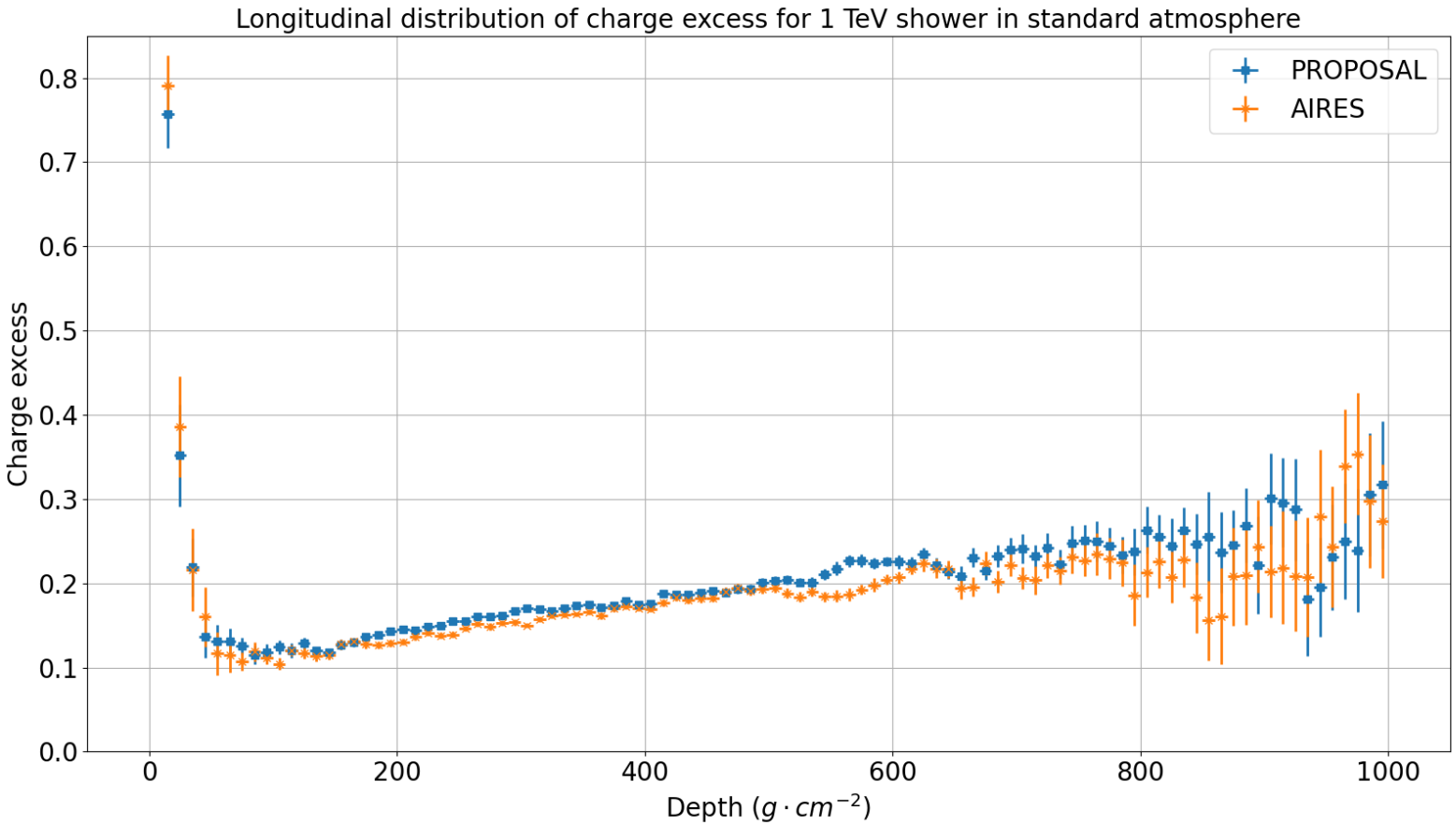


Figure: Longitudinal development of the charge excess for a 1 TeV shower initiated by an electron.

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# Relative differences

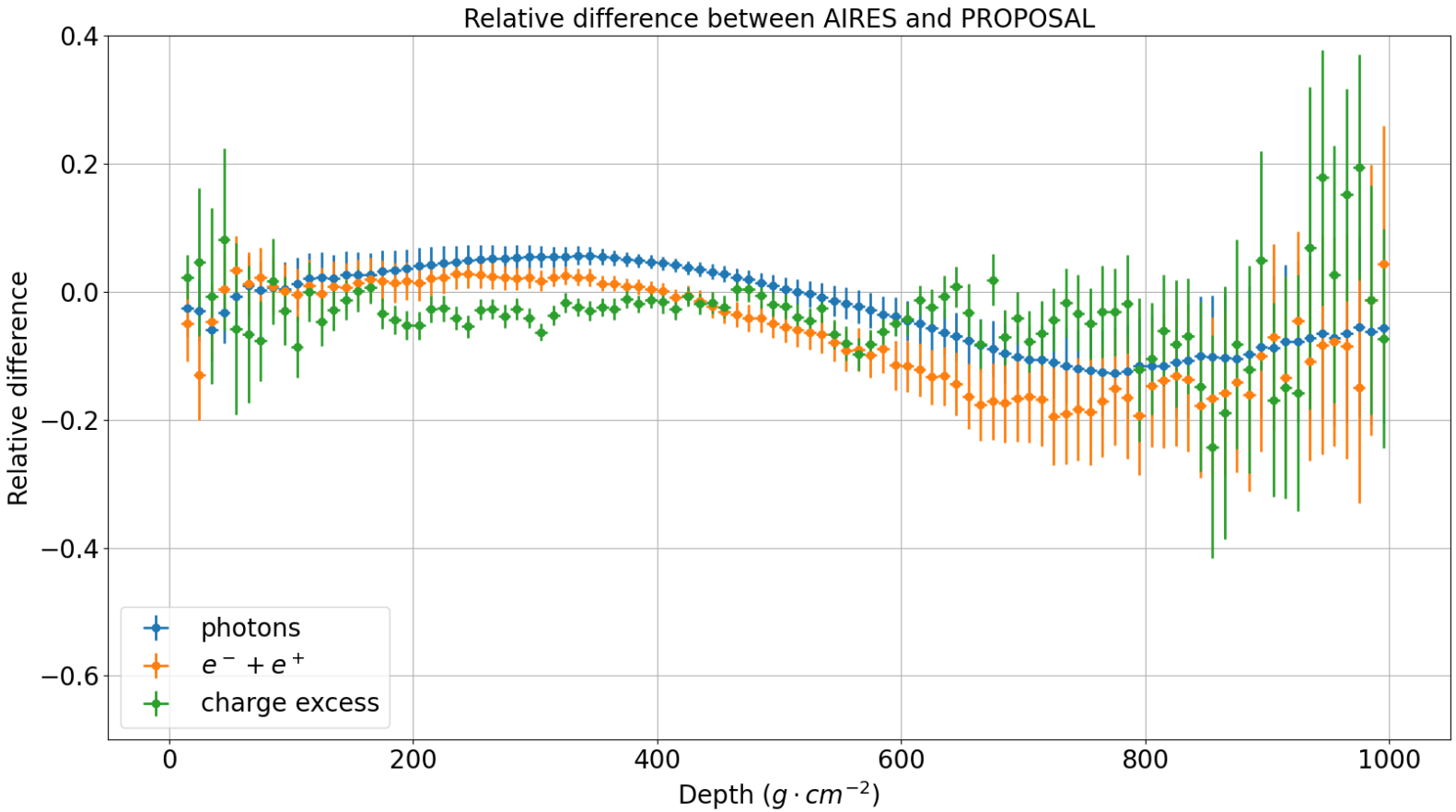


Figure: Longitudinal development of relative differences between AIRES and PROPOSAL for a 1 TeV shower initiated by an electron.

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# Summary

- With this parametrization longitudinal profiles seem to agree a little bit more.
- 5.5% difference in photon distribution maximum and 2.3% for electrons plus positrons, increased with this parametrization.
- In both cases there are still differences but simulations start to agree considering all the variables that have an influence on the results.