Corsika 8 (with PROPOSAL) EM showers comparisons

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Overview

1. 100 TeV showers in homogeneous air
   - Longitudinal profile comparison (C8, ZHS, AIRES)
   - Energy distribution at differents depths (C8, ZHS)

2. 100 TeV showers in standard atmosphere
   - Longitudinal profile comparison (C8, C7, AIRES)

Homogeneous atmosphere parameters

- Composition as of AIRES: 78.47 N, 21.05 O and 0.47 Ar (Argon was not used in C8 runs).
- Medium density: 0.0012 $g \cdot cm^{-2}$.
- Particle thresholds: 20.866 MeV for e^- and e^+, 20.6075 MeV for photons.
- All results in this presentation where averaged over 50 showers and initiated by a 100 TeV electron.
- Link to C8 file to replicate simulations.

Hom. atm.: longitudinal distribution photons

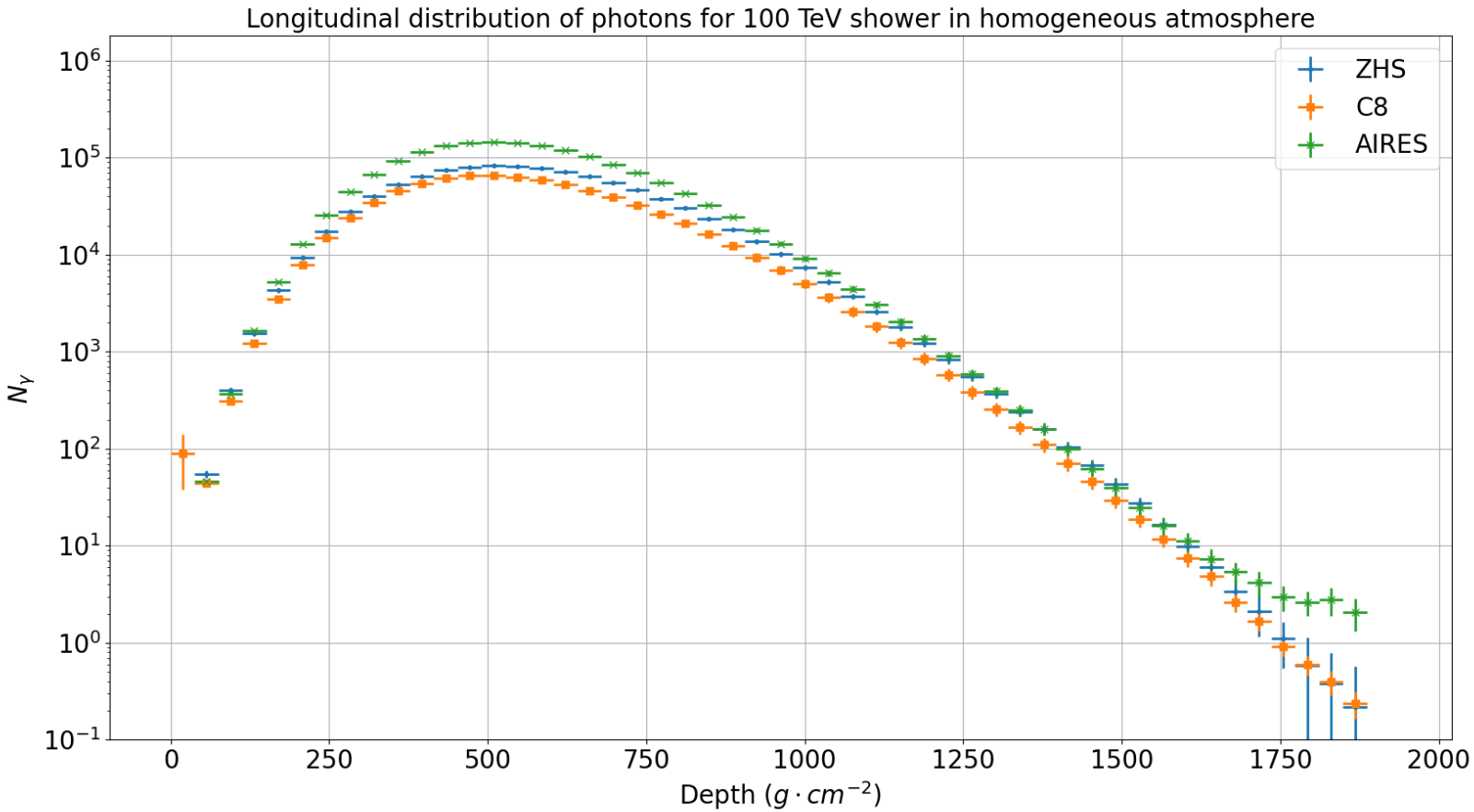

Figure: Longitudinal development of the average number of photons for a 100 TeV shower initiated by an electron.

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Hom. atm.: longitudinal distribution e^- and e^+

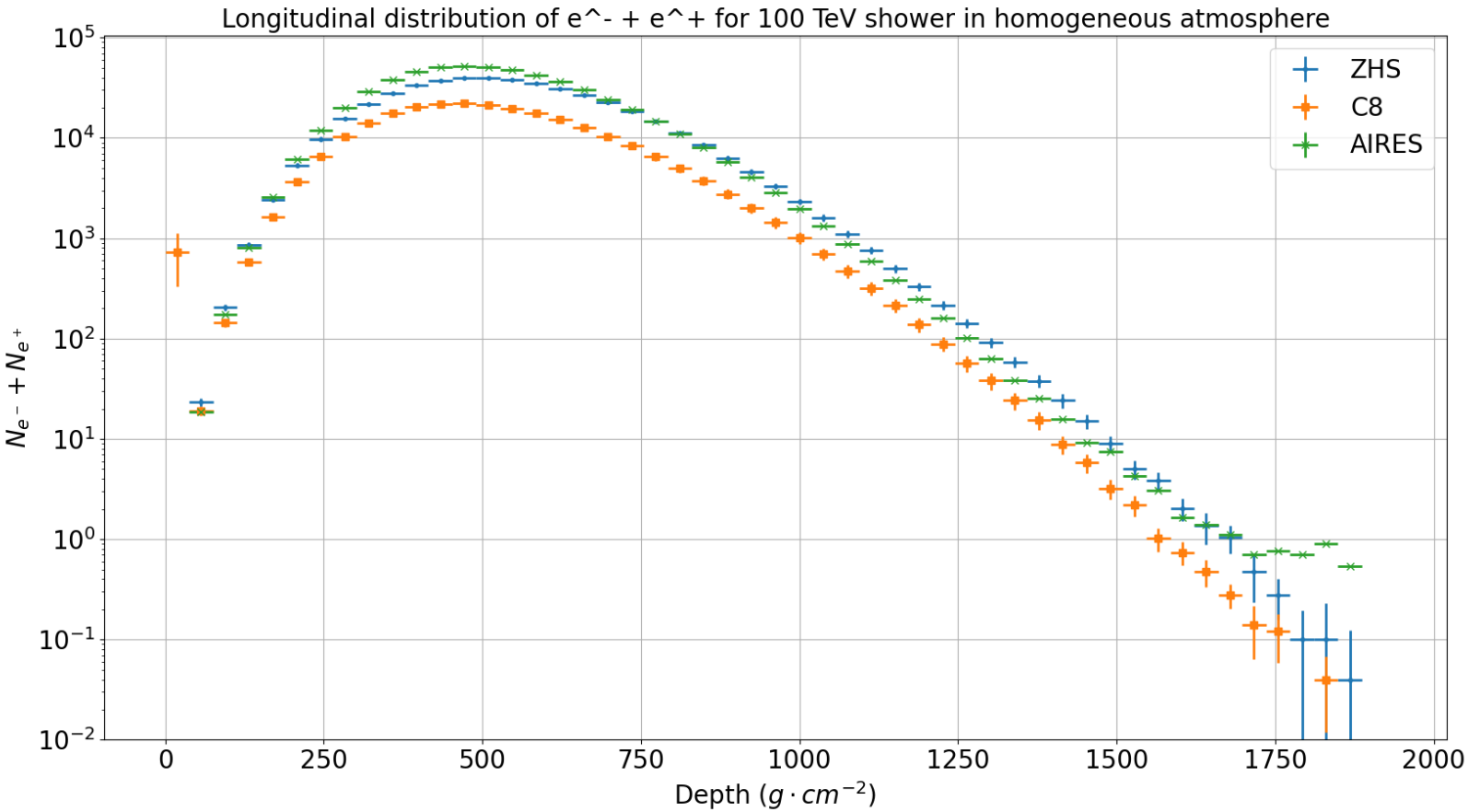

Figure: Longitudinal development of the average number of electrons plus positrons for a 100 TeV shower initiated by an electron.

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Hom. atm.: longitudinal distribution charge excess

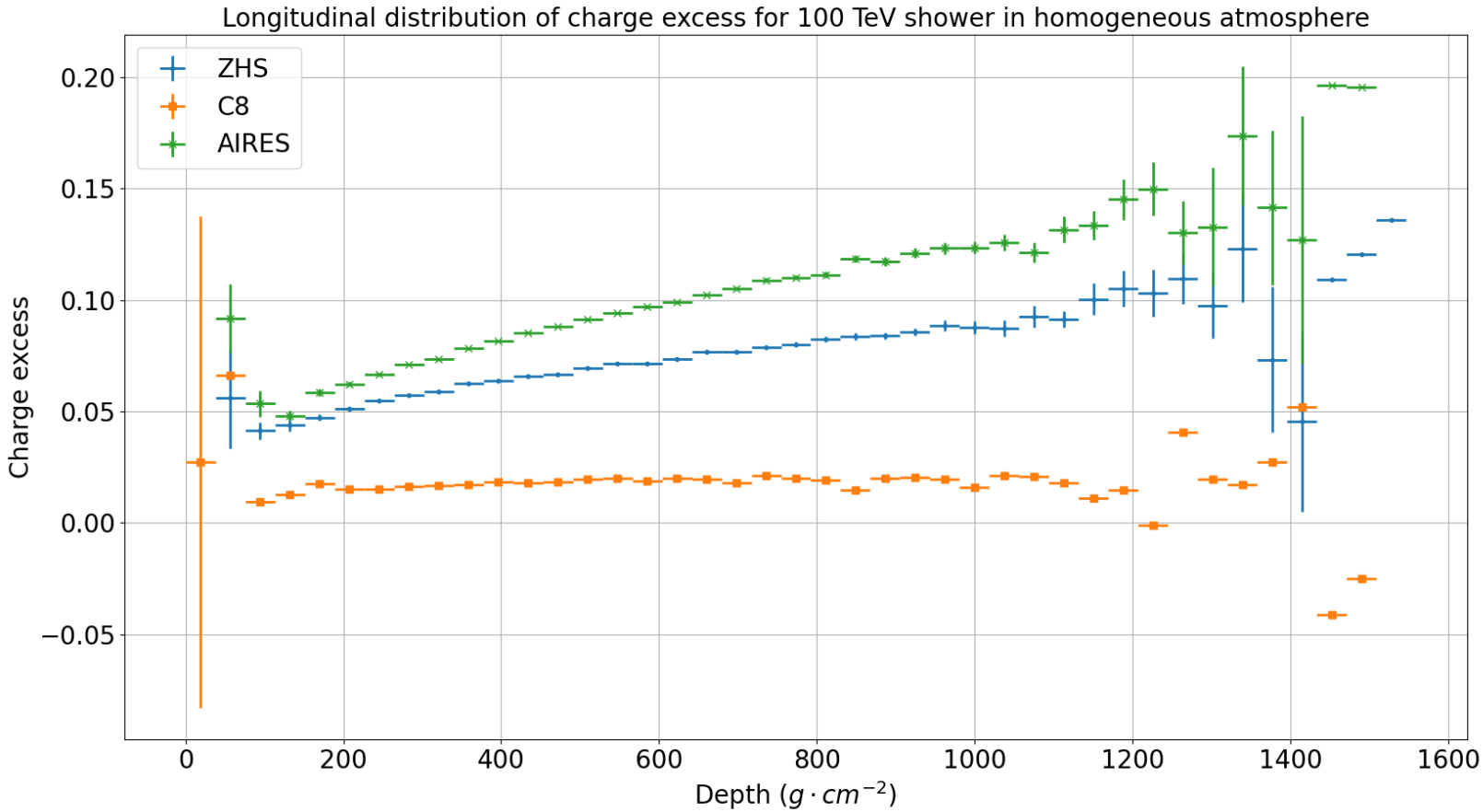

Figure: Longitudinal development of the charge excess $\frac{N_{e^-} - N_{e^+}}{N_{e^-} + N_{e^+}}$ for a 100 TeV shower initiated by an electron.

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Hom. atm.: longitudinal distribution

- C8 systematically produces less particles in a homogeneous atmosphere.
- Electrons and positrons in C8 are half of those produced in ZHS and AIRES near shower maximum.
- Strange generation in C8 of particles between 0 and 37.73 $g \cdot cm^{-2}$.
- Charge asymmetry does not increase as the shower develops and has a very low value compared with AIRES and ZHS.

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Hom. atm.: energy distribution of photons

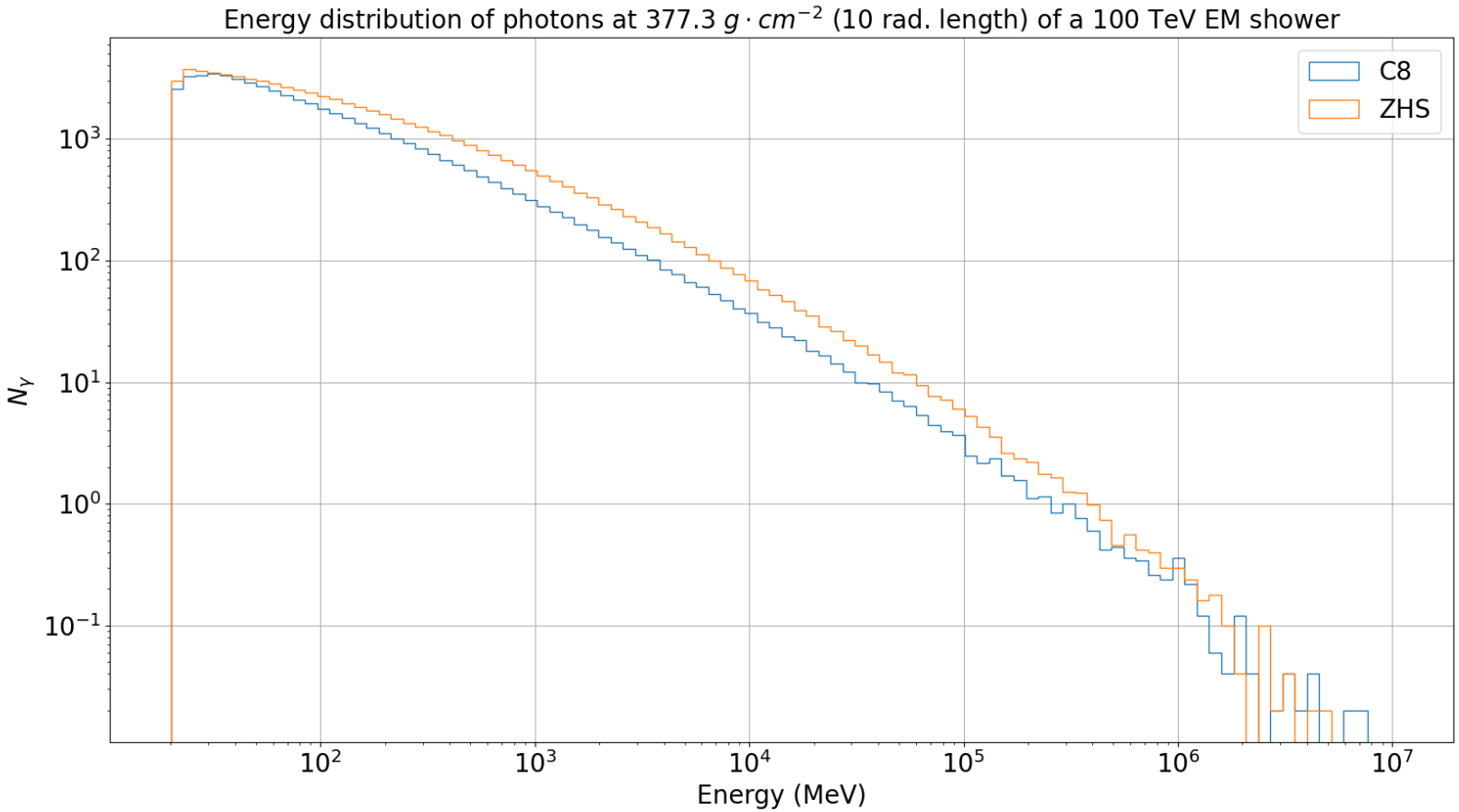

Figure: Average energy distribution of photons at 377.3 g·cm^{-2} for a 100 TeV shower initiated by an electron.

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Hom. atm.: energy distribution of photons

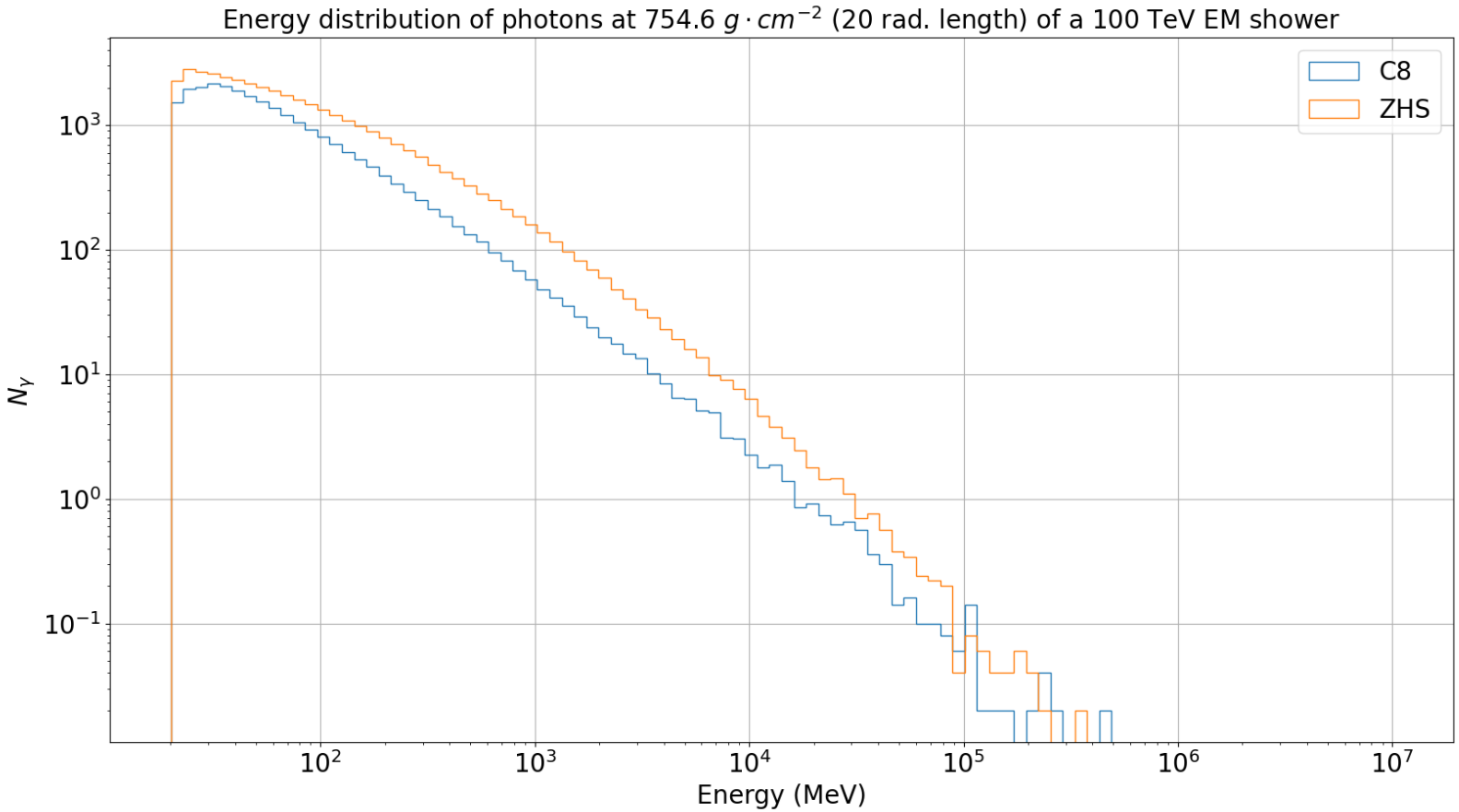

Figure: Average energy distribution of photons at 754.6 g·cm^{-2} for a 100 TeV shower initiated by an electron.

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Hom. atm.: energy distribution of electrons

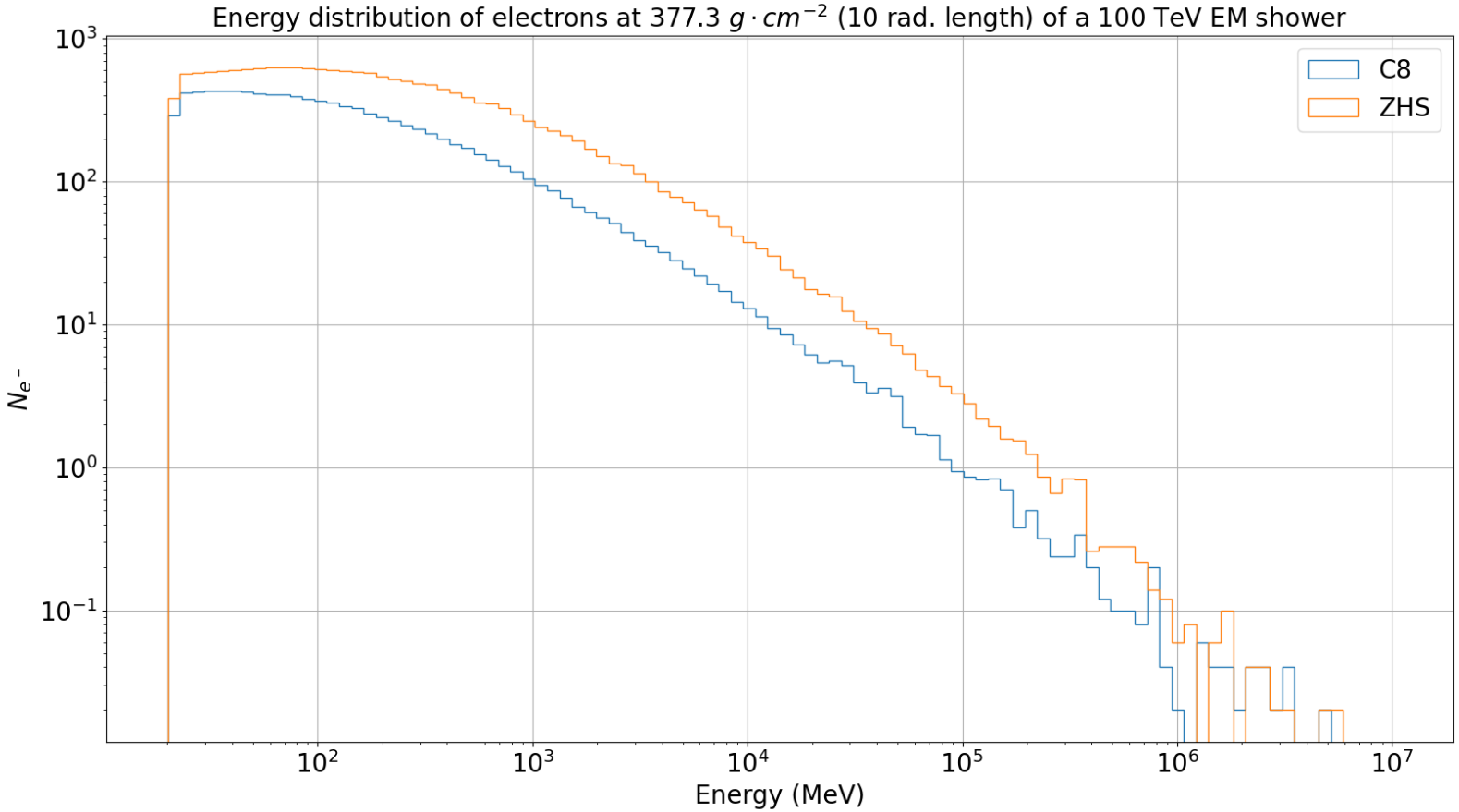

Figure: Average energy distribution of electrons at 377.3 g·cm^{-2} for a 100 TeV shower initiated by an electron.

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Hom. atm.: energy distribution of electrons

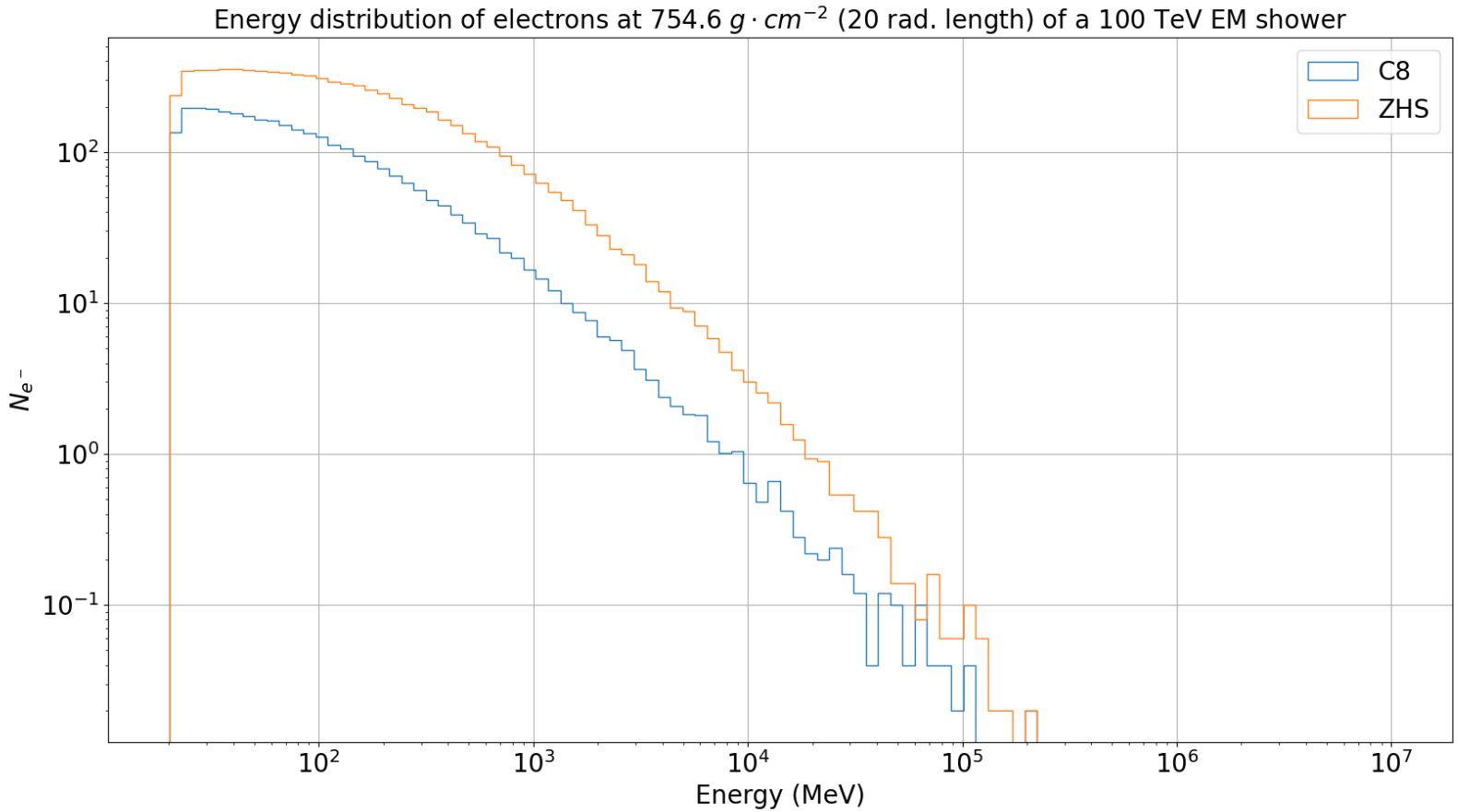

Figure: Average energy distribution of electrons at 754.6 g·cm^{-2} for a 100 TeV shower initiated by an electron.

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Hom. atm.: energy distribution of positrons

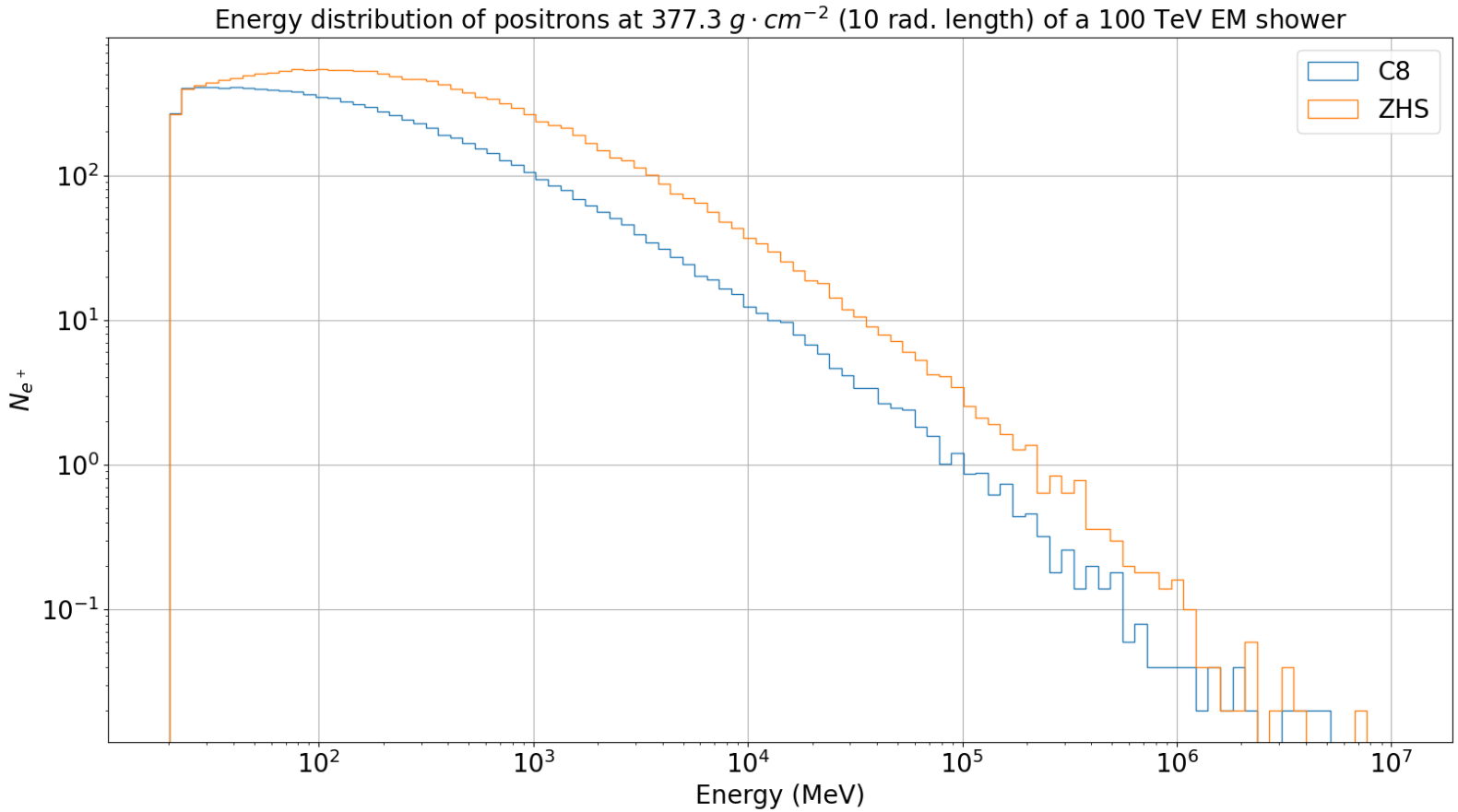

Figure: Average energy distribution of positrons at 377.3 g·cm^{-2} for a 100 TeV shower initiated by an electron.

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Hom. atm.: energy distribution of positrons

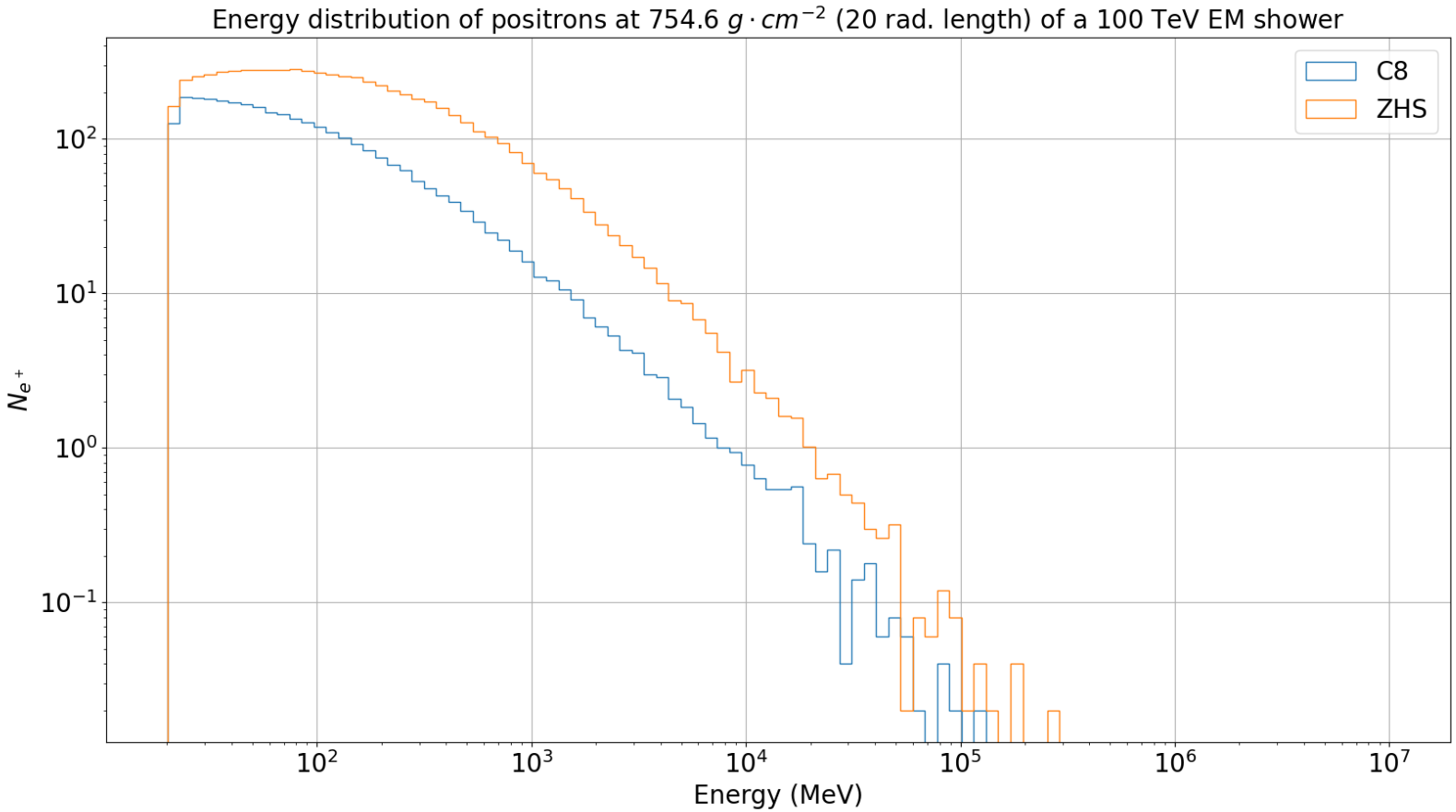

Figure: Average energy distribution of positrons at 754.6 g·cm^{-2} for a 100 TeV shower initiated by an electron.

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Hom. atm.: energy distribution

- Difference in number of particles observed in longitudinal distribution is not a consequence of different cuts.
- Possible issues with particle cross sections?

Standard atmosphere parameters

- For these simulations Linsley's model was used.
- Particle thresholds: 10 GeV for e^-, e^+ and photons.
- All results in this presentation where averaged over 50 showers and initiated by a 100 TeV electron.
- Link to C8 file to replicate simulations.

Std. atm.: longitudinal distribution photons

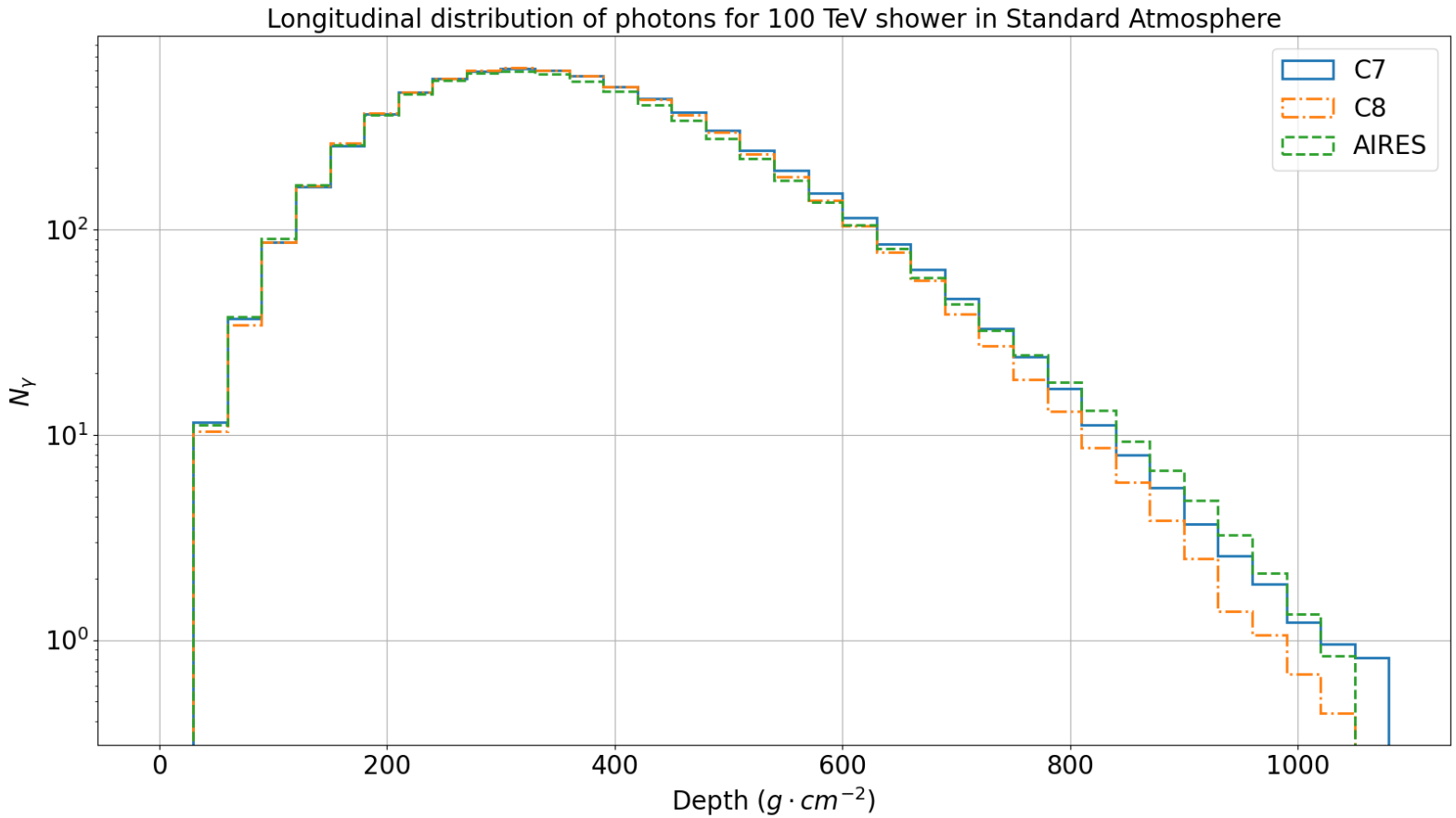

Figure: Longitudinal development of the average number of photons for a 100 TeV shower initiated by an electron.

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Std. atm.: longitudinal distribution e^- and e^+

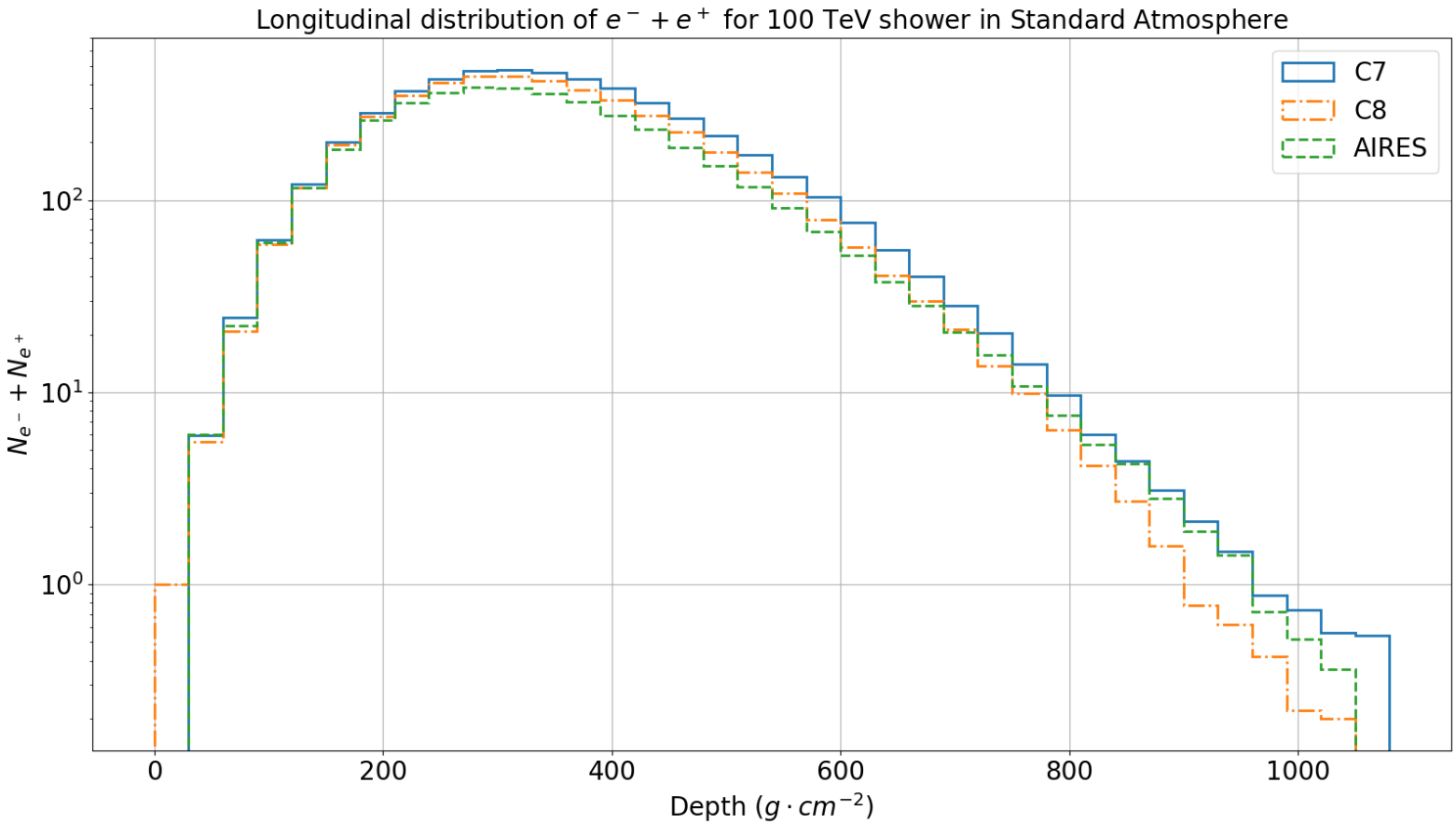

Figure: Longitudinal development of the average number of electrons plus positrons for a 100 TeV shower initiated by an electron.

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Std. atm.: longitudinal distribution charge excess

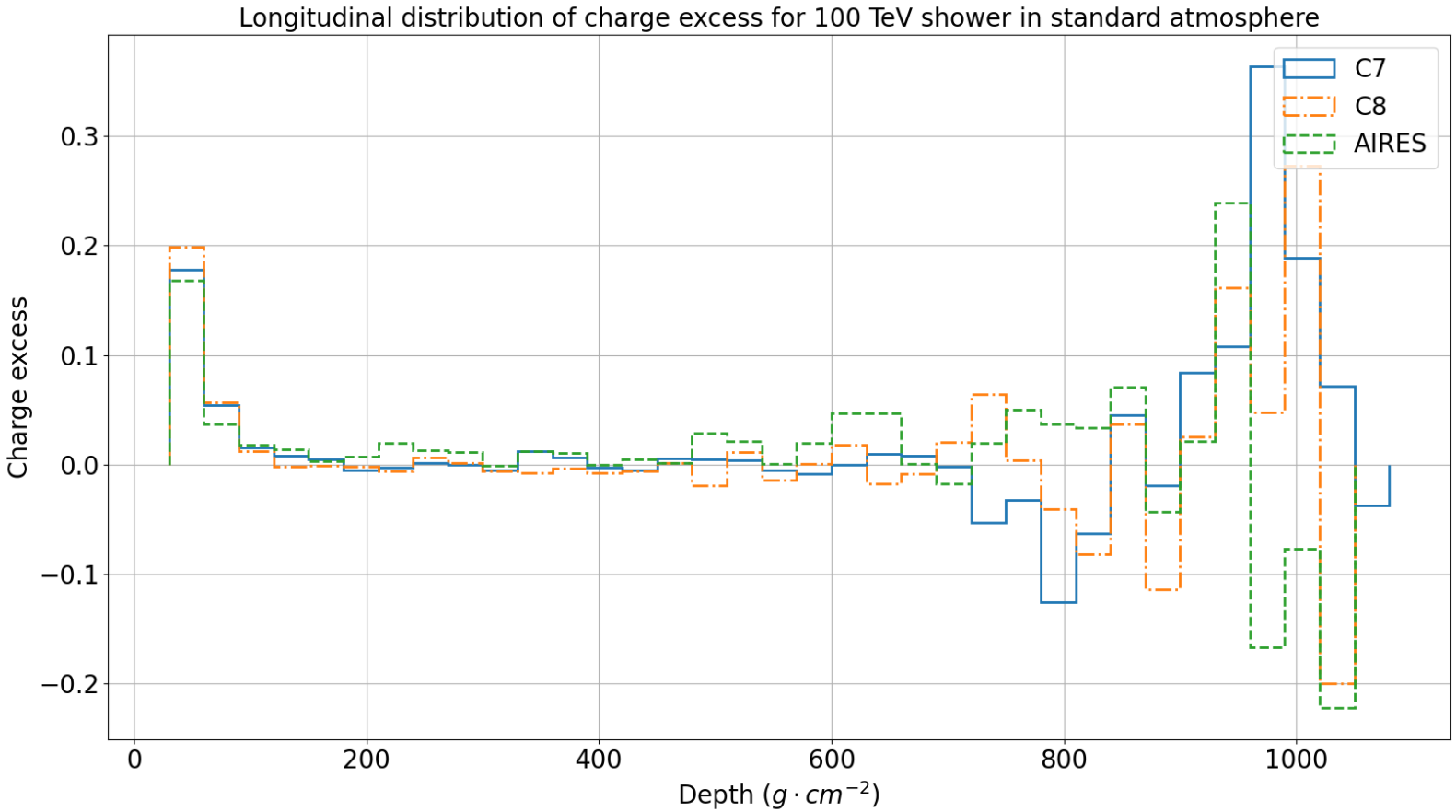

Figure: Longitudinal development of the charge excess $\frac{N_{e^-} - N_{e^+}}{N_{e^-} + N_{e^+}}$ for a 100 TeV shower initiated by an electron.

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Std. atm.: longitudinal distribution

- Better agreement between results from the three programs than previously observed in the homogeneous atmosphere.
- Initial development almost identical and then C8 stays in between AIRES and C7 for electrons plus positrons.
- Charge asymmetry is zero around shower maximum in all programs, probably caused by higher particle threshold.
- Agreement in Linsley's model may indicate a problem in how the homogeneous model is set.