ID příspěvku: **105** Typ: **Poster**

Modeling the impact of thunderstorm radiation on soil with Monte Carlo transport simulation

pátek 10. listopadu 2023 10:40 (5 minut)

Thunderclouds act as giant natural generators and, due to electromagnetic processes, can reach energies up to megaelectronvolts (MeV), initiating Relativistic Runaway Electron Avalanches (RREA). These accelerated electrons pass through the atmosphere matter, emitting gamma rays via bremsstrahlung. These high-energy gamma rays can induce photonuclear reactions and interact with airborne and terrestrial nuclei. While the impact of thunderstorm radiation on the atmosphere and other materials has been widely explored, understanding its interaction with soil remains a challenge.
Finding and analyzing thunderbolt impact sites gives limited data, making simulations an excellent option to provide dose evaluations and explore potential processes per event. Transport code applications with various particle behavior models resolve the data generation issue. Similar methodologies are used in calculating particle events from cosmic radiation exposure for aircraft crew. This study uses a simplified model to assess the impact of lightning strikes on a patch of soil. A point source with an energy of approximately 20 MeV is placed 1 meter above the ground, irradiating soil with a relative density of 2.1 g/cm^3. We used the general-purpose Monte Carlo particle transport simulation code, PHITS version 3.280, to perform these simulations, estimating three key parameters: deposition, track, and interactions. The results from the Monte Carlo simulations indicate that particles penetrate only a few centimeters deep into the soil. Additionally, the injection depth affects the spread, with deeper lightning strikes (beyond 2 cm) leading to a more extensive distribution.
The deposition energy tally data shows similar findings, with a significant portion of energy deposited near the surface (1-2 cm). However, when lightning penetrates the soil beyond 2 cm, an increase in dose is observed at the top surface, possibly due to secondary particle production from photonuclear reactions and neutron generation.
The interaction tally corroborates the previously discussed information, demonstrating that injecting the source at a depth of 5 cm results in increased interactions and the generation of more secondary particles.

Přihlásit do soutěže

Hlavní autoři: RUBAN, Juliia; PLOC, Ondřej (Ústav jaderné fyziky AV ČR); ŠLEGL, Jakub (ÚJF AV CR); SIHVER, Lembit (Nuclear Physics Institute of the CAS)

Přednášející: RUBAN, Juliia

Zařazení sekce: Radon a další přírodní zdroje ionizujícího záření

Tematická klasifikace: Radon a další přírodní zdroje ionizujícího záření