Contribution ID: **9** Type: **Oral report**

Creation of radioactive C-14 under thunderstorm atmospheric flashes

Saturday 25 September 2021 15:15 (25 minutes)

The occurrence of lightning is preceded by the fast development of electron avalanche in electric fields with strengthof about ˜ 300 kV/m [1]. The growth of avalanche in number of relativistic electrons ensures an energetic terrestrial gamma-ray bursts, that can ensure the photonuclear reactions on atmospheric isotopes (with significant cross sections for hard photons E_γ =20-60 MeV) in the main neutron production channels ($^{14}\mathrm{N}(\gamma,n)^{13}\mathrm{N}$, $^{16}\mathrm{O}(\gamma,n)^{15}\mathrm{O}$, $^{40}\mathrm{Ar}(\gamma,n)^{39}\mathrm{Ar}$). In turn the knowing of the neutron flux allows to evaluate the generation of radiocarbon $^{14}\mathrm{N}(n,p)^{14}\mathrm{C}$, and another isotopes in the reactions $^{40}\mathrm{Ar}(n,\gamma)^{41}\mathrm{Ar}$, $^{14}\mathrm{N}(n,a)^{11}\mathrm{B}$, $^{14}\mathrm{N}(n,\gamma)^{15}\mathrm{N}$ [2,3].

It was proposed the spherical-layer-model for calculation of radiocarbon C-14 (knowledge of which creation is exclusively important for radiochronology) and other isotope production in the air under thunderstorms. The simulation were realized at the several altitudes of the lower part of the atmosphere at the altitudes: 1, 3, 5, 7, 10, 13 and 15 km. Decrease of the atmospheric densities at increase of the altitude is critical for electron avalanche evolution and is included in the model. It was obtained that yield of radiocarbon C-14 cannot compete not only with it cosmogenic production (but it also significantly lower compare to the yield from Sun irradiation) that allows to take off the problematic and discussed question on it significant yield to the total production in the Earth atmosphere (˜ 472 g-mole/year) under thunderstorms.

An unimportance of thunderstorm 14C yield is agreed with increase of radiocarbon in tree rings in the time distance AD 774–775 at intensive Sun activity [4].

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Session Classification: Section 2. Experimental and theoretical studies of nuclear reactions

Track Classification: Section 2. Experimental and theoretical studies of nuclear reactions.