TO THE PROBLEM OF SOLAR NEUTRON PROPAGATION THROUGH THE EARTH'S ATMOSPHERE

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We develop our simulation and analytical calculation results of solar neutron propagation in the Earth's atmosphere for different initial zenith angles Zo, taking into account not only scattering and attenuation, but also neutron energy decrease (what leads to increase both of cross-section of interaction and scattering angles, what is especially important for small energy solar neutrons). We test the usually used suggestion that solar neutron propagation through the atmosphere of depth h at some initial zenith angle Zo is the same as for vertical direction, but for depth h/cosZo. Our calculations of multi-scattering of neutrons on small angles with attenuation and energy change for different initial zenith angles, show that this suggestion is not correct. Taking into account the neutron energy change shows that with decreasing of solar neutron energy the asymmetry in solar neutron propagation and refraction effect became stronger. We show that during the propagation through the atmosphere the effective zenith angle of solar neutron flux sufficiently decreases. These decreases are especially great for the big initial zenith angles what gives expected solar neutron fluxes many times bigger than in the frame of previous theory of solar neutron propagation. We show also that the optimum direction of solar neutron telescope must be not the direction on the Sun (as for gamma-ray telescope), but between the Sun and vertical in dependence of Sun's zenith angle and effective energy of neutrons.