Modeling of the galactic cosmic ray long-period variations for the time dependent interplanetary magnetic field turbulence

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***Abstract*. We develop two-dimensional time dependent theoretical model based on the Parker's transport equation [1] to describe the long period variations of the Galactic Cosmic Ray (GCR) intensity. Besides the very known fundamental processes the exponent γ of the rigidity R spectrum $\frac{\delta D(R)}{D(R)}$ ($\frac{\delta D(R)}{D(R)} \propto R^{-\gamma}$) of the GCR intensity variations is implemented in transport equation as a time dependent parameter. This assumption is justified by the dependence of the rigidity R spectrum exponent γ of the GCR intensity on the IMF turbulence demonstrated in our previous paper [2].**

For the diffusion-convection approximation the exponent γ of the rigidity R spectrum of the GCR intensity variations in the main is determined by the parameter α showing the character of the dependence of the diffusion coefficient *K* on the rigidity *R* of GCR particles, as $K \propto R^{\alpha}$ [2]. On the other, the parameter α according to the quasi linear theory depends on the exponent ν of the power spectral density (PSD), as α=2-ν (where PSD$\propto f^{-\nu}$, *f* is the frequency) [3]. Based on the experimental data analysis and theoretical modeling it was shown that an apparent relationship exists between the rigidity spectrum exponent γ and the exponent ν. So, the temporal changes of the rigidity spectrum exponent γ can be considered as a vital index to study the 11-year variations of the GCR intensity [2, 4].

The 11-year variation of the GCR is modeled based on the Parker's transport equation. We include in the transport equation the changes of the rigidity spectrum exponent γ (represented in Figure) as a time dependent parameter with other very known fundamental processes-convection, diffusion, energy changes and drift of the GCR particles.

We show that the time profile of the 11 year variation of the GCR intensity changes could be reasonably explained by the proposed theoretical model of transport equation.

***Keywords*: long-period variations, rigidity spectrum, interplanetary magnetic field turbulence, time dependent model**

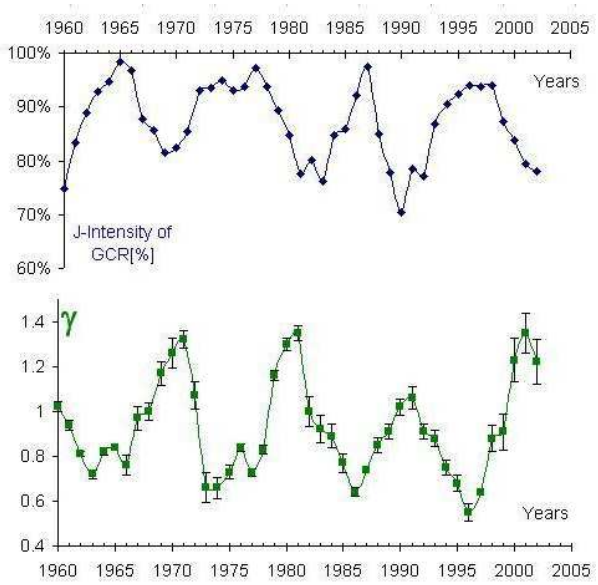

Fig. 1: Changes of the amplitude of the 11-year variation of the GCR intensity and the temporal changes of the rigidity spectrum exponent γ obtained based on the experimental data.

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