Vela as a source of Galactic Cosmic Rays above 100 TeV and neutrinos below 100 TeV

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Abstract

This poster is based on [8, 9] . One of the most prominent features for the cosmic ray spectrum is the knee, a break in the all-particle energy spectrum at the energy $E_k \simeq 4\,\mathrm{PeV}$. One of the possible explanations for the origin of the knee is that the spectrum below the knee is dominated by a single, nearby source [1, 2].

In [3] the authors showed that to be consistent with B/C ratio, the diffusion should be sufficiently anisotropic and the magnetic field contains a non-zero component perpendicular to the Galactic disk. As a result, the number of sources contributing to the locally observed flux is reduced by two orders of magnitude. Thus only few sources contribute to the local CR flux at energies above 200 GeV.

In the energy range between 200 GeV and 100 TeV a 2–3 Myr old local supernova can dominate the local CR flux, as shown in Refs. [4, 5].

We suggest in [8] that Vela, a 11 kyr old supernova remnant at the distance 270 pc, is the source dominating the local CR flux above 200 TeV. We study the expected CR flux from Vela, which is connected with the Solar system by a magnetic field line in models of the global Galactic magnetic field as, e.g., the Jansson–Farrar model [10], taking into account that the Earth is located inside the Local Superbubble. We use a simplified model for the structure of the magnetic field inside the Local Superbubble similar to the one of Refs. [11], and follow individual CR trajectories solving the Lorentz equation. We obtain a good description of the fluxes of individual groups of CR nuclei in the knee region and above. Adding additionally the CR flux from the 2–3 Myr old source, the CR spectra in the whole energy range between 200 GeV and the transition to extragalactic CRs are described well combining the fluxes from only these two local sources.

We study possibility that both excess in IceCube astrophysical neutrino flux and gamma-ray excess at high galactic latitudes come from interactions of PeV cosmic rays from recent nearby source, like Vela in the walls of Local Bubble.

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