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4. High energy cosmic rays (HE-CR I)

Vela as the source of cosmic rays responsible for the formation of the knee

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Simulation of the cosmic ray propagation from a young and nearby supernova remnant demonstrates a strong dependence of the energy spectrum on the supernova age and its distance from the Earth. A comparison of model calculations with experimental data shows, that if cosmic rays leave the acceleration region soon after the supernova explosion, then the best agreement between calculations and experiments is obtained for $(9 \pm 0.5) 10^3$ y after the explosion and at its distance of (250 ± 50) pc. In this range of time and distance the most suitable source is the Vela cluster including Vela X and Vela Jr. Independently, the possible role of this source is supported by several experimental facts. The first one is the observed rise of the dipole amplitude and the change of the anisotropy phase in the PeV energy region. The second one is the analysis of the difference in the characteristics of extensive air showers the maximum of which is observed for showers coming from the direction towards this source and from an opposite direction. The third one is the closeness of Vela to the region of an enhanced intensity of showers observed at the IceTop array. These facts show that with a high probability the Vela cluster can be the source of particles responsible for the formation of the knee in the cosmic ray energy spectrum.