

The potential role of second order Fermi acceleration in Galactic PeVatron candidates

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The Galactic origin of multi-PeV cosmic rays is still a mystery, but recent LHAASO results indicate that regions of PeV gamma-ray emission are often associated with starforming regions. The question is then whether there are in these starforming regions there are single PeVatrons sources, such as a power (past) supernova remnant, a powerful pulsar, or one or multiple strong stellar wind shocks, or whether the starforming region is collectively a PeVatron. The latter could be the case if for example there is combined wind from the starforming region creating a collective outer termination shock. However, here I intent to focus on the prospects of second order Fermi acceleration as a source of PeV cosmic rays. I show that for a given relevant velocity (Alfven velocity) second order Fermi acceleration can be just as efficient as first order Fermi acceleration. However, the Alfven velocities are at best a few hundred km/s whereas shock velocities can be much higher. Nevertheless, I will show that even with Alfven speeds of a few hundred km/s one can accelerate protons to PeV energies within the lifetime of a cluster, provided the magnetic field turbulence level is high enough, and the density in the inner regions are diluted. I will show that both conditions are likely met based on observational data and hydrodynamical modeling.

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