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Cosmic-ray hardenings in the light of AMS-02

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Recent precise observations of cosmic rays (CRs) by AMS-02 experiment clearly show (1) harder spectra of helium and carbon compared to protons by ¥$proptoR^{0.08}$, and (2) concave breaks in proton and helium spectra at a rigidity R¥sim300 GV. In particular the helium and carbon spectra are exactly similar, pointing to the same acceleration site. We examine possible interpretations of these features and identify a chemically enriched region, that is, superbubbles as the most probable origin of Galactic CRs. We further show that CRs originate primarily from the supernova ejecta in the superbubble core, mixed with negligible interstellar medium, and predict similar spectra for heavy nuclei.

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