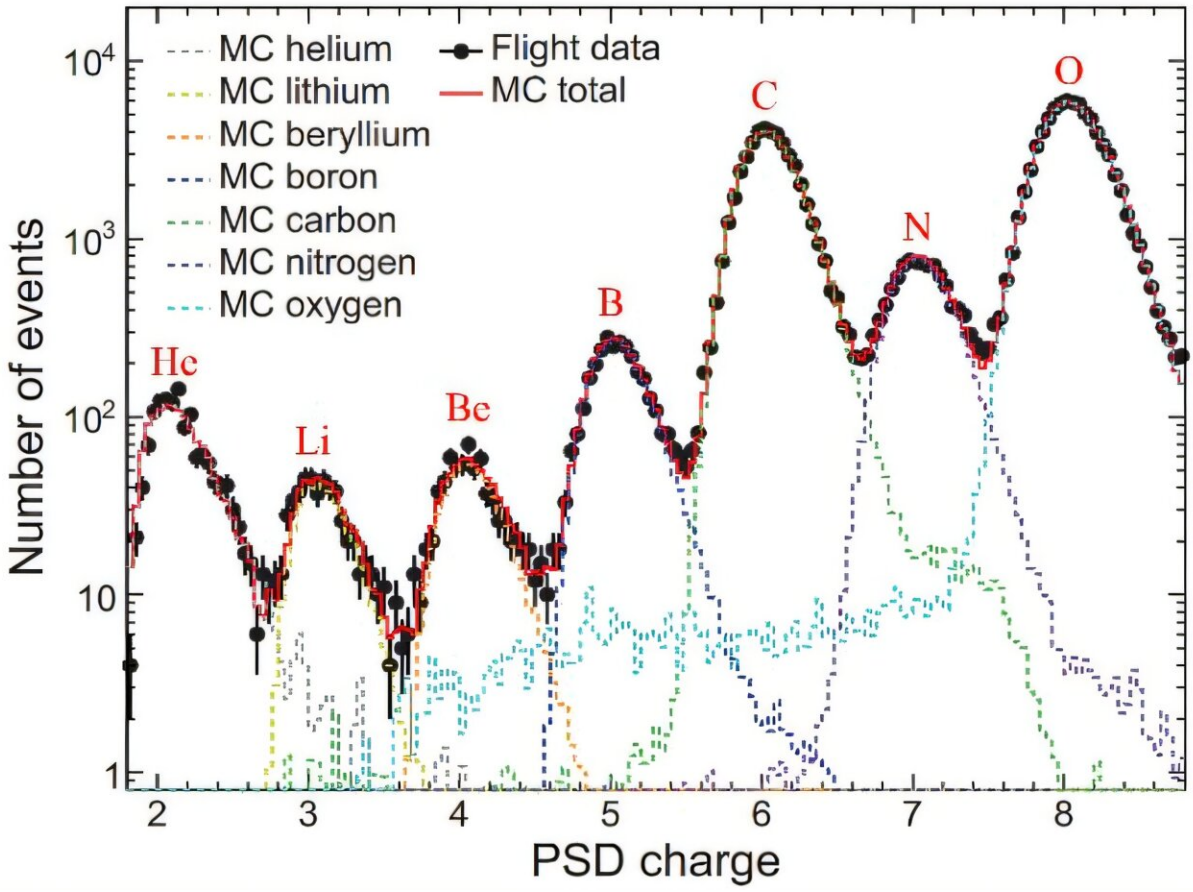
Dark Matter Particle Explorer obtains high-precision cosmic-ray boron spectrum

July 3 2025, by Zhang Nannan

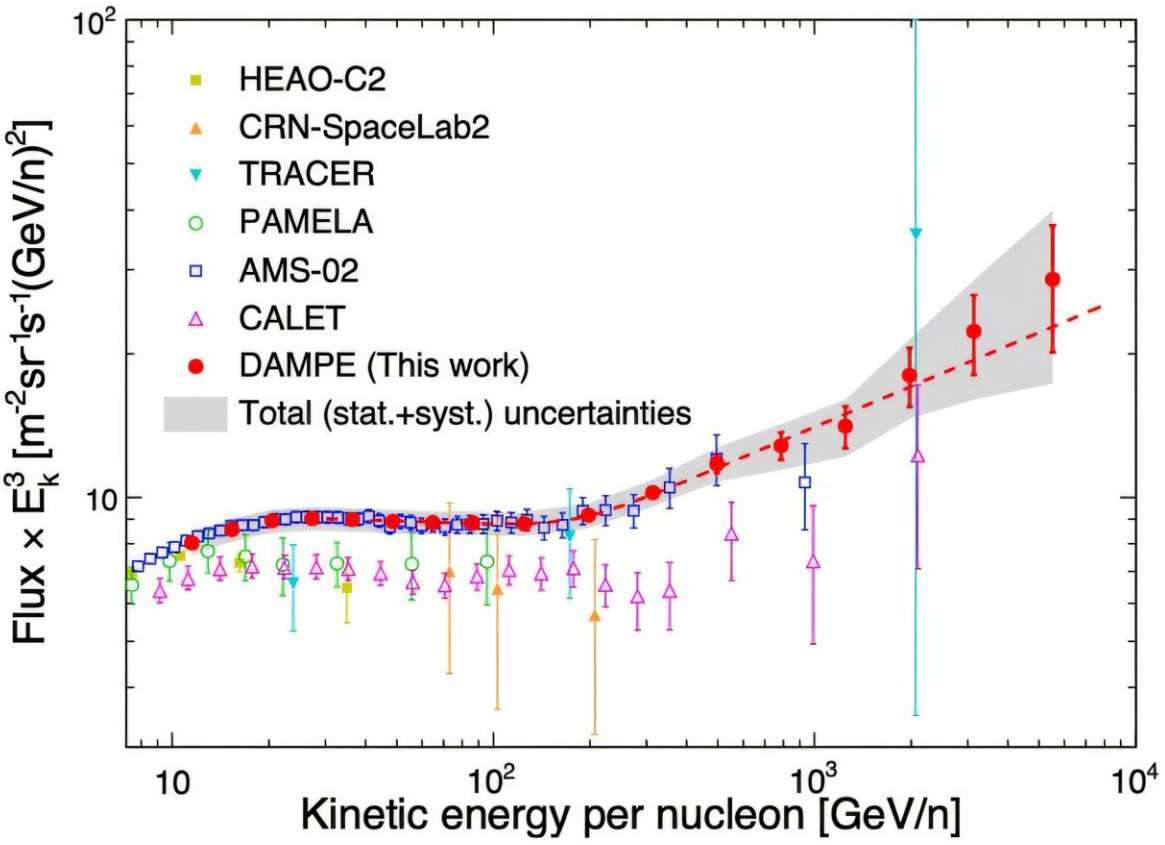


The charge spectrum from DAMPE's PSD for particle identification of cosmic rays. Credit: *Physical Review Letters* (2025). DOI: 10.1103/PhysRevLett.134.191001

The Dark Matter Particle Explorer (DAMPE, also known as "Wukong") Collaboration has obtained a high-precision cosmic-ray boron spectrum in the energy range of 10 GeV/n–8 TeV/n, and discovered a spectral "hardening" phenomenon around 182 GeV/n for the first time. The findings are published in *Physical Review Letters*.

DAMPE is a satellite mission equipped with the thickest calorimeter made of bismuth germanium oxide, providing an energy coverage range more than twice that of previous space experiments. The Plastic Scintillator Detector (PSD), developed by the Institute of Modern Physics (IMP) of the Chinese Academy of Sciences (CAS), is a core detector for identifying cosmic-ray nuclei due to its excellent charge measurement capabilities.

Using DAMPE data, researchers discovered a significant "hardening" feature in the boron spectrum around 182 GeV/n, with a confidence level of eight sigma. The study revealed that the secondary boron spectrum hardens roughly twice as much as that of primary cosmic rays (protons and helium nuclei), while remaining consistent with hardening in boron-to-carbon and boron-to-oxygen flux ratios.



The measurement results of the cosmic-ray boron spectrum by DAMPE. Credit: *Physical Review Letters* (2025). DOI: 10.1103/PhysRevLett.134.191001

These results align well with the theoretical prediction that cosmic-ray boron is produced through fragmentation reactions involving primary cosmic rays (e.g., carbon and oxygen) and interstellar matter.

This discovery not only provides crucial evidence for studying cosmic-ray propagation processes but also offers insights into refining existing theoretical models. DAMPE has set a new standard of precision in measuring cosmic-ray energy spectra at TeV energies.

Researchers from the Purple Mountain Observatory of CAS, the University of Science and Technology of China of CAS, the Gran Sasso Science Institute of Italy, and the University of Geneva of Switzerland collaborated on the study.

More information: F. Alemanno et al, Observation of a Spectral Hardening in Cosmic Ray Boron Spectrum with the DAMPE Space Mission, *Physical Review Letters* (2025). DOI: 10.1103/PhysRevLett.134.191001. On *arXiv*: DOI: 10.48550/arxiv.2412.11460

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