Antihelium-3 Fluxes near Earth using Data-Driven Estimates for Annihilation Cross Section

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Antinuclei cosmic rays could provide a smoking gun signal for dark matter as this signal is virtually background free. The study of $^3\overline{\mathrm{He}}$ cosmic rays requires knowledge about their production, propagation and annihilation. While the former two have been already estimated with data-driven methods, there were no experimental data available on the $^3\overline{\mathrm{He}}$ inelastic cross section. We measured for the first time the inelastic cross section of $^3\overline{\mathrm{He}}$ using pp and Pb–Pb collision data recorded by ALICE using the detector itself as a target. The inelastic cross sections of $^3\overline{\mathrm{He}}$ on proton and helium targets were estimated using Geant4. To study the effect of $^3\overline{\mathrm{He}}$ annihilation in the galaxy, we implemented the $^3\overline{\mathrm{He}}$ source functions in GALPROP [1] using state-of-art models available in the field [2] [3].
The transparency of our galaxy to the $^3\overline{\mathrm{He}}$ nuclei was estimated by calculating the ratio of fluxes estimated with and without inelastic interactions. The transparency for $^3\overline{\mathrm{He}}$ fluxes in the case of a dark matter source was found to be around 50%, while for the background contribution the transparency depends on the cosmic ray energy and increases from around 25% to 90%.

References

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