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Indication of a Local Source of Ultra-High-Energy Cosmic Rays in the Northern Hemisphere

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The Pierre Auger Observatory (PAO) and Telescope Array (TA) collaborations report significant differences in the observed energy spectra of Ultra-High-Energy Cosmic Rays (UHECRs) above 30 EeV . In this work, we present a joint fit of TA and PAO data using the rigidity-dependent maximum energy model, and including full marginalization over all relevant parameters. We show that the presence of a local astrophysical source in the Northern Hemisphere, which is only visible by the TA experiment, can reconcile PAO and TA measurements up to the highest energies. We demonstrate that the presence of that local source is favored at the 5.6σ level compared to the scenario where both experiments observe the same UHECR flux from a cosmological source distribution.

We also quantify that the astrophysical explanation can describe the current data better than a scenario where the differences in the observations are explained by experimental systematics (i.e., energy-dependent shifts). Having tested different mass compositions emitted from the local source, we conclude that the data are best described by a source lying at a distance of about 14 Mpc that emits cosmic rays dominated by the silicon mass group; we also discuss possible source candidates.

Primary author: Mr PLOTKO, Pavlo (Deutsches Elektronen-Synchrotron DESY, Zeuthen, Germany)

Co-authors: VAN VLIET, Arjen (Department of Physics, Khalifa University, P.O. Box 127788, Abu Dhabi, United Arab Emirates); WINTER, Walter (Deutsches Elektronen-Synchrotron DESY, Platanenallee 6, 15738 Zeuthen, Germany); RODRIGUES, Xavier (Astronomical Institute, Fakultät für Physik und Astronomie, Ruhr-Universität Bochum, 44780 Bochum, Germany)

Presenter: Mr PLOTKO, Pavlo (Deutsches Elektronen-Synchrotron DESY, Zeuthen, Germany)

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