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New very local interstellar spectra for galactic protons, helium, carbon and electrons below 50 GeV.

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Low-energy galactic electrons (1-200 MeV) are significantly modulated, almost extraordinary, in the heliosheath in contrast to the rest of the heliosphere, indicating that modulation conditions in the heliosheath are quite different for these particles. In addition, Jovian electrons completely dominate galactic electrons at Earth below about 30 MeV. Low-energy protons and helium (1-100 MeV/nuc), on the other hand, are dominated by the anomalous component which originates inside the inner heliosheath so that the very local interstellar spectra for these particles had been properly concealed until recently. However, this is not the case for cosmic ray carbon. Basic mechanisms responsible for these effects are being studied with comprehensive numerical models for the transport of these particles, from the modulation boundary, through the inner heliosheath, across the solar wind termination shock, up to Earth. Together with measurements made by the two Voyager spacecraft, now with Voyager 1 beyond the heliopause and entering the very local interstellar medium, it is possible to determine heliopause spectra (HPS) at these low energies for the first time. Together with PAMELA spectra observed at Earth, these HPS can be determined accurately up to at least 50 GeV. Such spectra should be considered as the lowest possible very local interstellar spectra for galactic electrons, protons, helium and carbon, and are of great relevance to solar modulation and galactic propagation studies as tested by utilizing the well-known GALPROP code.

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Primary author: POTGIETER, Marthinus (North-West University)

Co-authors: NGOBENI, Donald (Vaal University of Technology); Mr BISSCHOFF, Driaan (Centre for Space Research, North-West University, 2520 Potchefstroom, South Africa.); Mr VOS, Etienne (Centre for Space Research, North-West University, 2520 Potchefstroom, South Africa.); Ms NNDANGANENI, Rendani (Centre for Space Research, North-West University, 2520 Potchefstroom, South Africa.); Mr NKOSI, Sibusiso (Vaal University of Technology, Dept of Physics and NDT, Vanderbijlpark, 1900)

Presenter: NGOBENI, Donald (Vaal University of Technology)

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