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Recent Results from IBEX ENA and Direct Interstellar Neutral Observations and Implications for the Outer Heliosphere

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The Interstellar Boundary Explorer (IBEX) is the first mission to directly observe the global interaction of our heliosphere with the local interstellar medium. IBEX measures Energetic Neutral Atoms (ENAs) from ∼0.1-6 keV, produced through charge exchange in the outer heliosphere. These observations led to the discovery of the IBEX ribbon of enhanced emissions, ordered by the external, interstellar magnetic field, which is superposed on a more smoothly varying globally distributed ENA flux. The first three years of IBEX observations have been recently culled and corrected for various backgrounds to produce a quantitative data set with significantly reduced statistical uncertainties. These observations show that from 2009-2011, both the ribbon and globally distributed ENA fluxes have been decreasing for all regions except the heliotail. The energy and spatial distributions of the ENAs indicate a quite direct recycling of solar wind ions into returned ribbon ENAs. In addition to ENAs from the outer heliosphere, IBEX also directly measures the interstellar neutral atoms entering from the interstellar medium; these observations include the first direct measurements of interstellar neutral H, O, and Ne. IBEX observations of interstellar He show that the heliosphere is moving more slowly with respect to the LISM than thought from previous Ulysses observations. The combination of this slower speed, IBEX and Voyager observations indicating a relatively strong interstellar magnetic field, and several independent models indicate that there is currently no Bow Shock ahead of the heliosphere. This paper summarizes these and other recent IBEX results and discusses the implications for our understanding of the outer heliosphere.