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The Sun is embedded in the Local Cloud of interstellar matter composed of ionized and neutral atoms and dust grains of various sizes. This cloud is one of many similar clouds within the Local Interstellar Medium, which is a ~200 pc remnant of a series of supernova explosions a few million years ago. The Sun is moving through the cloud, emitting the solar wind - an ever-evolving, omnidirectional, latitudinally structured, hypersonic outflow of the hot solar coronal plasma. Subjected to the ram pressure of the ambient interstellar matter, the solar wind slows down through a shock wave called the solar wind termination shock and forms the inner heliosheath. Eventually, it flows downstream, forming the heliotail. The interstellar plasma is separated from the inner heliosheath by a contact discontinuity surface called the heliopause, which is transparent for neutral atoms. In front of the heliopause is a region of interstellar matter disturbed by the heliosphere, just like a bow wave in front of a sailing ship: the outer heliosheath.

Interstellar neutral atoms, mostly H and He, penetrate the heliopause and enter the heliosphere, forming interstellar neutral wind. Some of them collide with ions from the solar wind plasma, exchanging electrons with them. As a result, the former solar wind ion becomes an Energetic Neutral Atom (ENA) and runs away freely from the reaction site, and the former neutral atom, now ion, is picked up by the flowing plasma and joins an embedded suprathermal ion population. This pickup ion population can be compared to steam from evaporation of the neutral interstellar “drizzle” in the blowing hot solar wind. This "steam" forms a "mist", which is a marker of the solar wind, since it is mostly this population of plasma that forms the ENAs we can observe. The ENAs created in the charge exchange reaction are like photons in astronomy: they carry information of the remote regions of the heliosphere.

The first space observatory devoted to astronomy of neutral atoms is the Interstellar Boundary Explorer (IBEX) – a NASA Small Explorer satellite launched in 2008 into a highly elliptical orbit with a perigee almost as high as the orbit of Moon. It has two neutral atom detectors, IBEX-Hi and IBEX-Lo. The first of them is able to see H atoms with energies from ~400 eV up to 6 keV, and the other one observes H, He, O, and Ne with energies up to 2 keV. In a addition to ENAs from the heliosphere, IBEX-Lo is able to see interstellar neutral atoms (mostly He) incoming directly from the Local Interstellar Cloud the Sun is traveling through.

Analyzing the flux of these latter atoms we found out how fast is the Sun moving through this cloud and what is the LIC temperature. Now we would like to learn more. We have discovered that in addition to the interstellar wind blowing from the “nose” of the heliosphere, there exists an additional breath of neutral He gas, pretty much rarefied, warmer and slower than the interstellar wind, coming from the portside bow. We dubbed it the Warm Breeze. What is its origin? We suspect it is a kind of a splash of interstellar wind, coming up from charge exchange with the interstellar matter flowing past the heliopause in the outer heliosheath. May be it is inflowing a little from the side because the heliosphere is distorted from axial symmetry due to the action of interstellar magnetic field, embedded in the local interstellar matter? Hence it may be indirectly related to the Ribbon that IBEX discovered shortly after launch. Ribbon is an arc-like region in the sky of enhanced ENA emission. We do not fully understand why it is there, but we suspect that it comes up due to a complex mechanism related to the local magnetic field. If so, then the center of the Ribbon should coincide with the direction of the local magnetic field. A good test for this hypothesis would be to find out if the center of the Ribbon is in the plane defined by the directions of inflow of the interstellar wind and the Warm Breeze. Within the Project, we will attempt to check if the Warm Breeze indeed originates in the outer heliosheath (and if so, we will then find out the physical conditions prevailing in this region), if its deflection to the side is related to the deformation of the heliosphere by magnetic field, and if the hypothesis of the magnetic field direction pointing towards the center of the Ribbon is supported.

Together with researchers from the US and other countries, we make the Science Team: the IBEX crew who work together to accomplish the goals of the mission. Part of our duties among the crew is “dusting off the charts”. The Sun destroys some of the ENAs via ionization by solar wind and solar EUV radiation before they reach the IBEX instruments and thus distorts the image of the heliosphere that IBEX sees. Details depend on the solar activity level and many other factors that need to be taken into account to work out statistical correction for these distorting losses. We have the necessary well tested tools and experience to accomplish this task, so we were assigned to carry this out for the common benefit within the IBEX Project.