The heliosphere is a region in the interstellar space filled with the solar wind plasma, emitted by the Sun. Since the Sun is traversing a partly ionized, magnetized cloud of interstellar gas, the solar wind expansion must be eventually arrested at a certain distance to the Sun. This happens in the locations where the solar wind pressure becomes equal to the pressure of the interstellar matter. Ultimately, however, the solar wind matter cannot accumulate infinitely inside the heliosphere and must find an exit path to the interstellar space. But where exactly is this path located? And is there just one evacuation path or more? These questions cannot be answered directly because up to now there have been just two active space probes – Voyager 1 and 2 – to reach the boundary regions of the heliosphere, and this happened in the regions least suspect of being anywhere close to the solar wind evacuation path. Therefore, answering these question can only be done by remote-sensing measurements and theoretical modeling.

The laws of physics suggest that given the known expansion of the solar wind, the shape of the heliosphere depends on the speed of the Sun's motion through the interstellar gas, the density of this cloud, and the intensity and direction of the interstellar magnetic field. The key factor is the pressure balance between the solar wind and interstellar matter. The interstellar magnetic field exerts a certain stress force on the heliosphere, which can be conveniently represented as an additional pressure term known as the magnetic pressure. The magnitude of this pressure is proportional to the square of the strength of magnetic field. The ram pressure of the ionized component of interstellar matter is proportional to the total density of the interstellar plasma and to the square of Sun's speed relative to the surrounding interstellar plasma. If the magnetic field is so strong that the magnetic pressure is much larger than the ram pressure, then the heliosphere is expected to be approximately round in shape and the solar wind is evacuated via two channels parallel to the direction of the local magnetic field. If, however, the ram pressure is much larger than the magnetic pressure, the heliosphere will take an elongated, comet-like shape, and the solar wind will be evacuated via one channel directed "backwards", i.e., along a long tail pointing approximately opposite to the Sun's motion. An extensive dedicated study on the shape of the heliosphere for various combinations of the ram and magnetic pressures was published in 2017 by two scientists from the Laboratory for Solar System Physics and Astrophysics, CBK PAN: Andrzej Czechowski and Jolanta Grygorczuk in this paper: http://iopscience.iop.org/article/10.1088/1742-6596/900/1/012004/meta
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Based on the available extensive insight from experimental and modeling studies using various measurement techniques it had been concluded that most likely, the interstellar dynamic pressure is much larger than the magnetic pressure, and consequently the heliosphere has a comet-like form, albeit somewhat distorted from axial symmetry by the magnetic pressure. Therefore, a hypothesis, published in 2017 in *Nature Astronomy* by a team of US scientists, that the heliosphere is approximately round in shape came as a surprise.

The US researchers considered measurements of the flux of energetic neutral atoms (ENAs) with the energies of several dozen keV (i.e., and order of magnitude larger than typical energies of solar wind protons), performed by the INCA instrument onboard Cassini space probe. They found that (1) variations in time of the flux are unexpectedly rapid; (2) they are strongly correlated with the phase of the 11-year cycle of solar activity and with time variations of in-situ point measurements of energetic ions in the outer heliosheath, performed by the LECP experiment onboard the Voyager space probes (these ions are considered the parent population for the ENAs observed by INCA); and (3) the fluxes of these ENAs from the upwind and downwind sides of the heliosphere have magnitudes similar to each other and are correlated in time. On this basis, the team of US researchers concluded that the distances to and the dimensions of the source region of these ENAs must be very similar for all directions. Consequently, the heliosphere must be approximately round, and if so, then it must be shaped by a strong interstellar magnetic field.

This hypothesis is at odds with the previous views on the shape of the heliosphere because the strength of the interstellar magnetic field, the plasma density, and the speed of Sun's motion through the local interstellar medium have been measured with a sufficiently good accuracy. However, the INCA observations used by the aforementioned team of scientists cannot be ignored. Nathan Schwadron from the University of New Hampshire and Maciej Bzowski from the Laboratory for Solar System Physics and Astrophysics CBK PAN were able to explain the INCA observations based on the conventional, comet-like paradigm of the heliosphere. In a paper (http://iopscience.iop.org/article/10.3847/1538-4357/aacbcf/meta) just published in *The Astrophysical Journal*
they explained the reasons for the correlation between the observed fluctuations of INCA ENAs, the fluctuations of the charged particles observed by the Voyager, and the solar activity phase. The ENA fluctuations are related to their production rate, which is strongly dependent on the fluctuations in the temperature and density of the solar wind plasma penetrating the solar wind termination shock. This shock is a quasi-stationary shock wave structure that separates the hypersonic and subsonic regimes of the solar wind outflow.

When a portion of plasma with an increased density and speed crosses the termination shock, the plasma just downstream of the termination shock is heated and before cooling it propagates with the plasma flow in the inner heliosheath. The temperature of such plasma flow is much larger than that of the shock-processed "regular" solar wind plasma. Therefore, the charge exchange rate between the protons in the heated plasma and the ambient interstellar neutral H atoms increases rapidly, and consequently an enhanced flux of ENAs is produced for a certain time before the heat dissipates. Since the occurrence of the fast and dense gusts of the solar wind increases during high solar activity and these gusts have a global range on one hand, and the difference in the arrival times between various locations along the shock is relatively small (a few months) on the other hand, eventually a strong spatial correlation between time fluctuations of the ENA flux from various regions of the termination shock appears, as well as a correlation between the charged energetic particles processed by the termination shock and measured by the Voyagers, and the ENA fluxes measured (with some well-understood time delay) by INCA.

Consequently, the seemingly strange observation effect reported by the team of US researchers can be naturally explained on the basis of the conventional heliospheric paradigm, and the heliosphere, as announced in the title of the paper by Schwadron and Bzowski, is not round!