Interplanetary space

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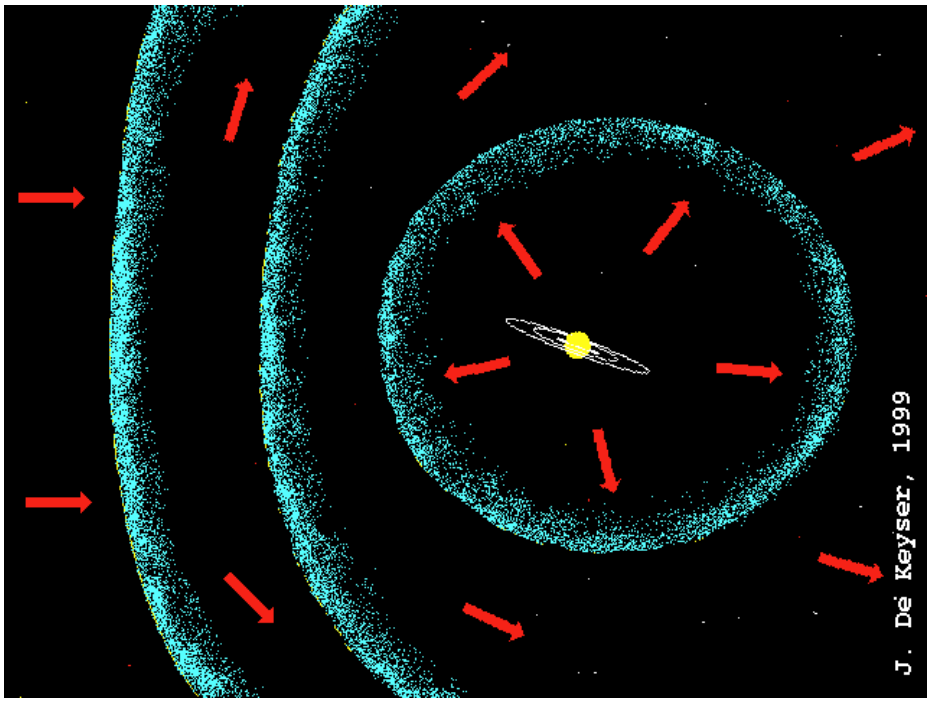
The temperature in the outer regions of the Sun's atmosphere (the corona) is very high, so that some of these particles move so fast that they can escape the Sun's gravity. These leaking particles form the solar wind, a continuous flux of plasma, flowing away from the Sun.

The composition of this plasma reflects that of the corona: mainly protons (hydrogen-nucleus), around ten percent alpha particles (helium-nucleus), and traces of heavier ions (isotopes of carbon, nitrogen, oxygen, silicon, iron, magnesium…). The high temperature in the corona is responsible for the complete ionization of hydrogen and helium, and the high level of ionization of heavier atoms like oxygen and iron. The electrons assure the electric neutrality of the plasma.

The solar wind is a very rarefied plasma: When it reaches the Earth, one finds an average of only 10 protons per cubic centimetre. Therefore the particles in the solar wind rarely collide. Electrons and ions cannot practically neutralize each other. That means that there is a direct connection between the movement of charged particles and the electric currents streaming in interplanetary space. These electric currents are connected to the magnetic field in the solar wind. In this way the magnetic field tells us a lot about the composition and the flow of the solar wind!

The magnetic field of the Sun fills interplanetary space. Within this space only the magnetospheres of a number of planets (and ionization regions around active comet cores) are strong enough to keep the solar wind out. The heliosphere is the space in which the total pressure of the solar wind plasma is stronger than that of the surrounding interstellar medium; it is the result of the interplay between the corona, as source of the solar wind, and the interstellar environment, with which the solar wind eventually merges.

The interaction zone between the heliosphere and interstellar plasma is formed by the termination shock, the heliopause and a bow shock, as sketched in the figure.



To understand this we need to bear in mind that the Sun and the heliosphere move relative to the interstellar plasma with a speed that is estimated at about 23 kilometres a second. The helioshock is formed where the interstellar plasma perceives the obstacle "heliosphere": It is forced to circumvent the heliosphere.

The termination shock is the place where the solar wind, streaming out radially, is forced to change its direction. The heliopause is the interface between the interstellar plasma and the solar wind. The solar wind eventually escapes downstream, to form a long heliotail, which gradually mixes with the interstellar gas. The distance of the heliopause is estimated to be around 100 AU. The Pioneer and the Voyager satellites are at this moment the most distant objects made by human hands; they are still within the heliosphere. There is a possibility that within several years some of these probes would pass the termination shock, and after that the heliopause.