

The Hebrew University of Jerusalem , Special Astrophysics Seminar

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Kaplun Building, Seminar room, 2nd floor

"The New Heliosphere"

As the Sun moves through the interstellar medium it carves a bubble called the heliosphere. A fortunate confluence of missions has provided a treasury of data that will likely not be repeated for decades. The measurements in-situ by the Voyager spacecrafts, combined with the all-sky images of the heliospheric boundaries by the Interstellar Boundary Explorer mission have transformed our understanding of heliosphere. In particular one of the first surprises was that both Voyager spacecrafts found no evidence for the acceleration of the anomalous cosmic rays (ACRs) at the termination shock as expected for approximately 25 years. Another challenge are the energetically particles intensities and the plasma flows that are dramatically different at Voyager 1 and 2. There are several other observations that are key challenges to the heliospheric models such as a) Why the azimuthal magnetic flux is not conserved along the Voyager 1 trajectory? b) What causes the flow stagnation region seen at Voyager 1? c) What causes the unexpected observation of a depletion-region beginning in 2012 at Voyager 1? These observations point to the need to move past the standard description of the heliosphere.

In this talk I will review the state-of-the art of our understanding of this “new heliosphere”. I will review our model that proposes that collisionless reconnection is happening within the sector region (the region where the solar magnetic field reverses polarity) and can explain the different observational puzzles. I will review our model as well as describe its consequences for the transport, acceleration of particles as well as for the flows and fields in the heliosheath. Finally, recent observations indicate a magnetic connectivity between the heliosheath magnetic field and the interstellar medium magnetic field; where the energetic particles of the heliosheath leaked out while the galactic cosmic rays penetrated the heliosheath. I will comment on our current effort of understanding the nature of the heliopause. We argue that these observations can be explained by Voyager 1 being in the last layer of the heliosheath where the heliosheath magnetic field reconnect with the interstellar magnetic field, what we call the “porus heliosheath”. The knowledge gain from the edge of the heliosphere will have consequences for other astrospheres and astrosheaths where the magnetic nature of the winds could be much more complex than previously thought.

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