

APR20-2020-020212

Abstract for an Invited Paper
for the APR20 Meeting of
the American Physical Society

The Parker Solar Probe and Its Remarkable Findings

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The birthplace of the solar wind is the corona of our Sun, where unidentified mechanisms heat the plasma to millions of Kelvin and magnetic pressure dominates over thermal pressure. Coronal plasma is accelerated away from the Sun by pressure gradients, becoming supersonic at a heliocentric distance of a few solar radii and super-Alfvénic at tens of solar radii. More than half a century since the theoretical prediction of the solar wind and its detection at the start of the space age many questions related to the physics of coronal and solar wind heating and acceleration remain unanswered because there have been no direct observations of the state of the plasma near the Sun. Here the first observations of the Parker Solar Probe are presented. Launched in August 2018 with its first perihelia at 35 and 27 solar radii, the probe is already the closest mission ever to the Sun, revealing young, low-Alfvén-mach-number solar wind still in the grip of the Sun and solar corona. The structure of the young solar wind will be discussed, including measurements of significant rotational flows, field reversals, kinetic-scale fluctuations and other surprises. Over the next six years PSP will pass closer to the Sun culminating in encounters below 10 solar radii, but these first observations collected may already call for an overhaul in our understanding of the origin and energization of the corona and solar wind.