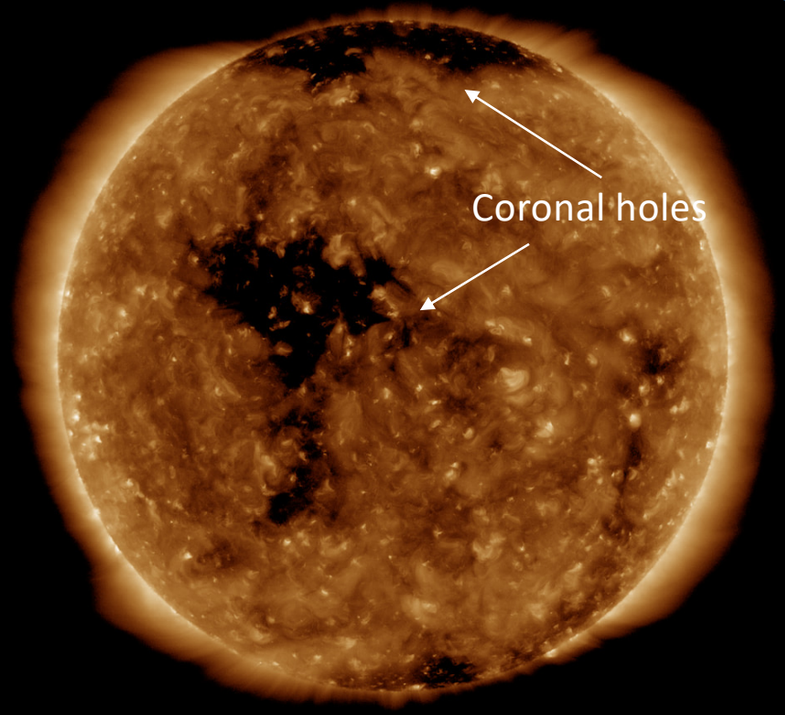
Is the Solar Wind Made From Tiny Flows of Material?

There is a lot of speculation that small streams of hot gas could be the building blocks of the big solar wind. This is because they carry enough mass and kinetic energy to power the fast or transient part of the solar wind.

The goal of this work was to find out how much of the Sun's organized small-scale transient plasma streams add to the main solar wind in the first quantitative statistical study of its kind. This study found more than 2300 small-scale jets and determined how big they were, how long they lasted, how fast they moved, and how much mass they carried, by using high-resolution extreme ultraviolet (EUV) pictures of the changing solar atmosphere above a coronal hole at the north pole.

The results strongly back up the idea that a large part of the fast solar wind is made up of small-scale streams or jets in the lower corona. All of this fits other research and observations from the Parker Solar Probe. This provides a much better understanding of the part of the solar wind that affects space weather the most, along with solar flares and coronal mass ejections. This part of the solar wind can send Earth's magnetosphere into strong, long-lasting storms that can have a big effect on our technology and our ability to go to space.

A good example of how these geomagnetic storms could affect space and technology is the recent loss of dozens of Starlink satellites due to fast solar wind.



Coronal holes appear as dark areas in the solar corona in extreme ultraviolet (EUV) and soft x-ray solar images. They appear dark because they are cooler, less dense regions than the surrounding plasma. Their open magnetic field line structure allows the solar wind to escape more readily into space, resulting in streams of fast solar wind, a common source of space weather.

Vadim Uritsky (CUA/674), Judith Karpen (674), Nour E. Raouafi (JHUAPL), Pankaj Kumar (AU/674), C. Richard DeVore (674), and Craig DeForest (SwRI), 2023: "Self-Similar Outflows at the Source of the Fast Solar Wind: A Smoking Gun of Multiscale Impulsive Reconnection?" The Astrophysical Journal Letters, 10.3847/2041-8213/acf85c