

Unseen Whirlpools on the Sun's Surface

Prelims: Current events of national and international importance | Science & Technology

Why in News?

Using the world's largest solar telescope, astronomers has captured the highest-resolution images ever taken of the Sun's visible surface (*photosphere*).

- **Instrument** - Captured using the **Daniel K. Inouye Solar Telescope (DKIST)**, located on Mount Haleakala on the island of Maui, Hawaii.
- The telescope features a 4-meter (13-foot) primary mirror.
- **Unprecedented Scale** - The telescope resolved details down to ~19-20 kilometers (12 miles) in size on the solar surface, resolving structural boundaries that previously appeared blurred or smooth.
- **Physical Mechanism**
 - The observed whirlpools are caused by **Kelvin-Helmholtz Instabilities (KHI)**.
 - KHI occurs when two adjacent layers of fluid (or plasma) slide past each other at different velocities, creating velocity shear and resulting in wave-like, curling vortices.
 - This is the exact same fluid dynamics process responsible for breaking ocean wave crests, cloud formations on Earth, and cloud bands on Jupiter and Saturn.

Scientific Significance

- While solar physicists had long hypothesized the existence of KHIs on the Sun's surface, this study provides the *first direct observational confirmation* of their presence in the photosphere.
- **Magnetic Field Braiding** - As these vortices swirl, they twist and "braid" the Sun's magnetic field lines.
- This continuous twisting stores magnetic energy that can be suddenly released through solar flares, coronal mass ejections (CMEs), and nanoflares.
- **Clue to the Coronal Heating Problem**
 - **The Puzzle** - The Sun's outer atmosphere (*corona*) is millions of degrees hotter than its visible surface (*photosphere*), defying standard thermodynamics expectations.
 - **The Link** - The mixing and twisting caused by these tiny plasma whirlpools provide a mechanism for transferring and dissipating energy from the solar interior into the higher layers of the solar atmosphere.

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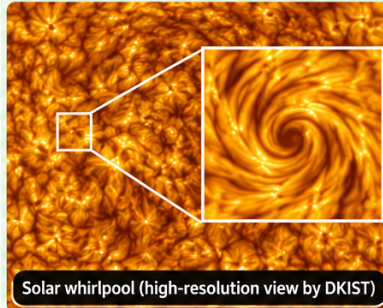
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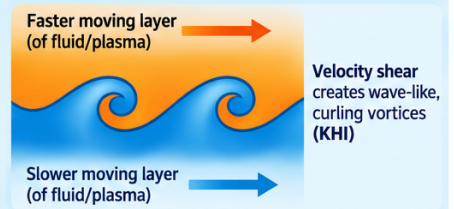
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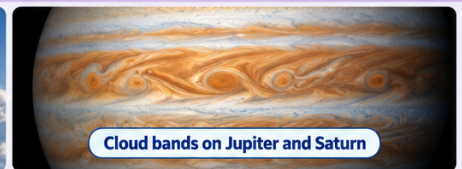
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The Same Process in Nature

Kelvin-Helmholtz Instabilities occur in many natural settings, including:



Reference

[The Hindu | Unseen whirlpools](#)