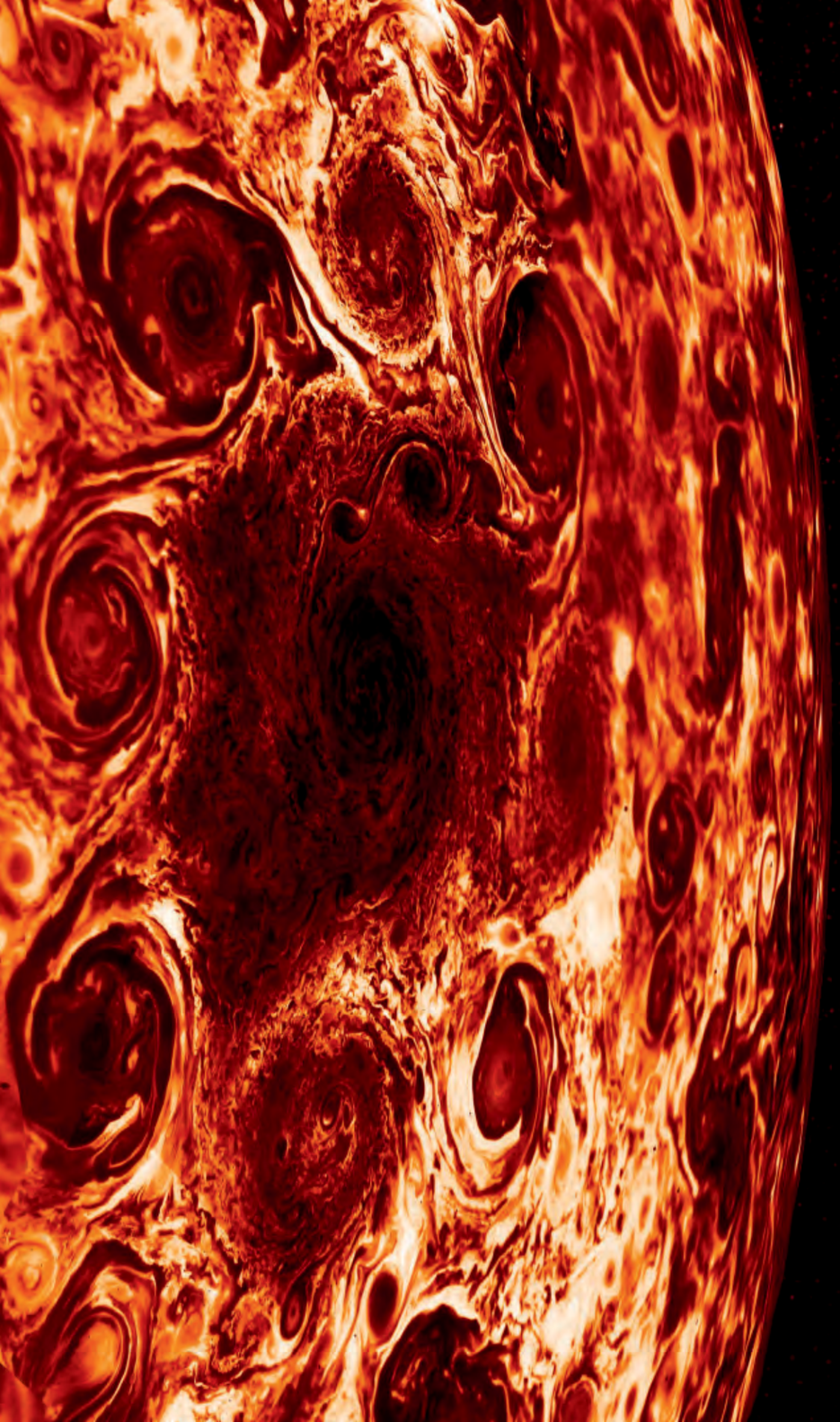

Jupiter's Unearthly Jet Streams

The Jet Propulsion Laboratory announced in March that the Juno mission to Jupiter—a mission operated by JPL on behalf of NASA—has collected data indicating that the atmospheric winds of the gas-giant planet run deep into its atmosphere and last longer than similar atmospheric processes found on Earth. The findings were part of a four-article series on Juno that was published in the journal *Nature* in March; scientists say these findings will improve understanding of Jupiter's interior structure, core mass, and, eventually, its origin.

The *Nature* articles also include Juno science results showing that the massive cyclones surrounding Jupiter's north and south poles are enduring atmospheric features and unlike anything encountered in our solar system.

"The depth of the winds on Jupiter has been debated for half a century," says David Stevenson, the Marvin L. Goldberger Professor of Planetary Science at Caltech, leader of the Interiors Working Group of Juno, and a co-author of the *Nature* papers. "It matters because it helps us understand how the planet works."

The depth to which the roots of Jupiter's famous zones and belts extend has been a mystery for decades. Gravity measurements collected by Juno during its close flybys of the planet have now provided an answer.

"Juno's measurement of Jupiter's gravity field indicates a north-south asymmetry, similar to the asymmetry observed in its zones and belts," said Luciano Iess, Juno co-investigator from Sapienza University of Rome and lead author on a *Nature* paper on Jupiter's gravity field.

On a gas planet, such an asymmetry can come only from flows deep within the planet; and on Jupiter, the visible eastward and westward jet streams are likewise asymmetric north and south. The deeper the jets, the more mass they contain, leading to a stronger signal expressed in the gravity field. Thus, the magnitude of the asymmetry in gravity determines how deep the jet streams extend.

"Galileo viewed the stripes on Jupiter more than 400 years ago," says Yohai Kaspi, Juno co-investigator from the Weizmann Institute of Science in Rehovot, Israel, and lead author of a *Nature* paper on Jupiter's deep weather layer. "Until now, we only had a superficial understanding of them and have been able to relate these stripes to cloud features along Jupiter's jets. Now, following the Juno gravity measurements, we know how deep the jets extend and what their structure is beneath the visible clouds. It's like going from a 2-D picture to a 3-D version in high definition."

The result was a surprise for the Juno science team because it indicated that the weather layer of Jupiter was more massive, extending much deeper than previously expected. The Jovian weather layer, from its very top to a depth of 1,900 miles (3,000 kilometers), contains about 1 percent of Jupiter's mass (about three Earth masses).

"By contrast, Earth's atmosphere is less than one-millionth of the total mass of Earth," says Kaspi. "The fact that Jupiter has such a massive region rotating in separate east-west bands is definitely a surprise."

The finding is important for understanding the nature and possible mechanisms driving these strong jet streams. In addition, the gravity signature of the jets is entangled with the gravity signal of Jupiter's core.