Solving a mystery of the Sun's corona

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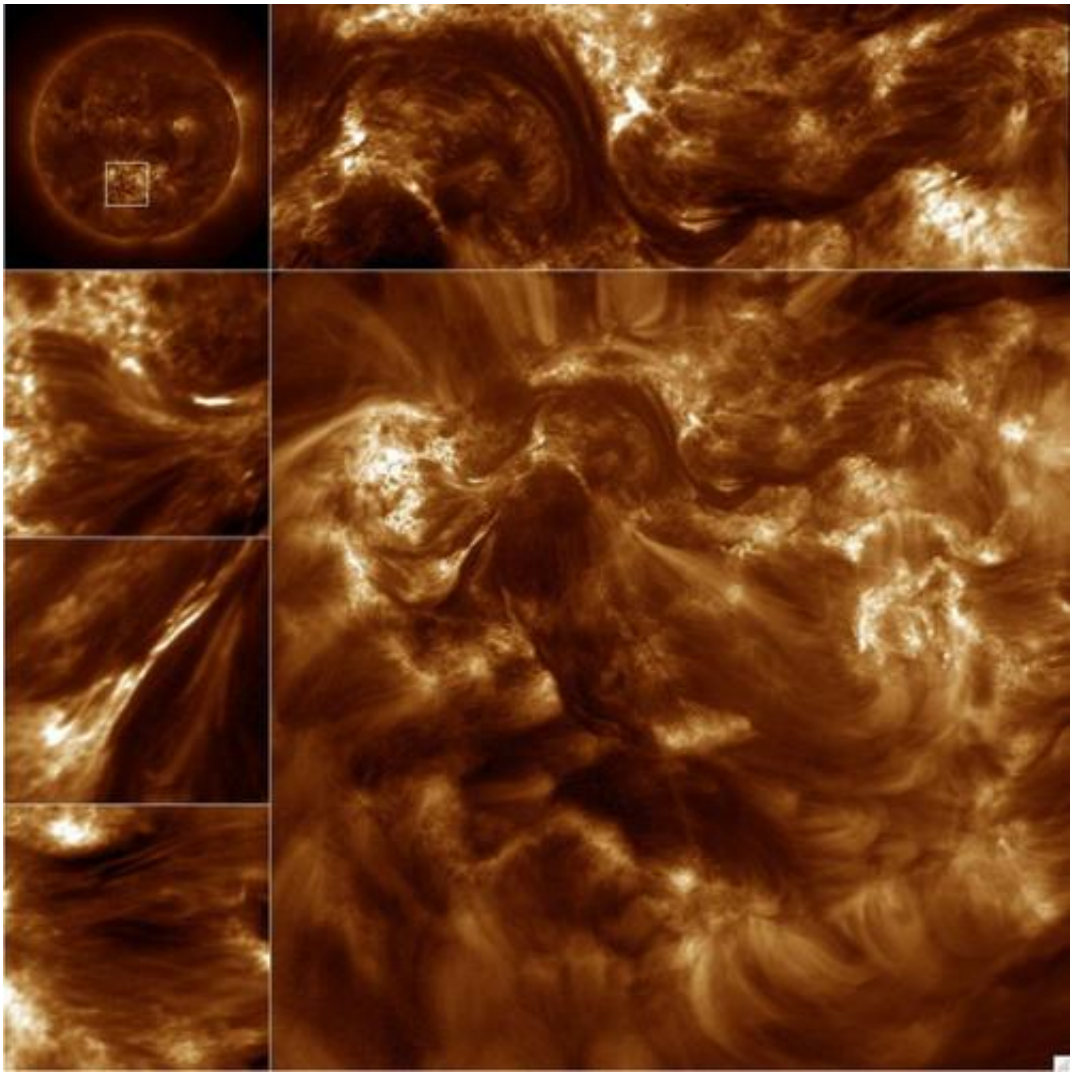

The solar corona and several of its regions, as seen in the extreme ultraviolet by the Hi-C rocket, which was launched last July. Analysis of Hi-C images provides convincing evidence that braided magnetic field effects heat the gas to temperatures of millions of kelvin. Credit: NASA and Hi-C

(Phys.org)—The corona of the sun is the hot (over a million kelvin), gaseous outer region of its atmosphere. The corona is threaded by intense magnetic fields that extend upwards from the surface in braids that are twisted and sheared by the convective stirrings of the underlying dense atmosphere. Understanding the corona and its physical processes is essential to the development of a long-range space weather prediction capability.

The mechanisms that heat the corona are poorly understood, but are thought to be of two kinds. The first mechanism is heating from the solar interior carried to the surface by waves in the hot gas. It is thought that this "wave heating" can raise the temperature of the corona to about 1.5 million kelvin, its temperature in its quiescent phase. The active Sun, however, has sunspots and regions that can reach temperatures up to four million kelvin. This second stage of heating has been attributed to the energetic unraveling of braids of powerful magnetic fields generated by the movement of charged particles in the corona. Because proof of this mechanism relies in part on images capable of seeing these braids at work, this explanation has been difficult to verify.

CfA astronomers Leon Golub, Kelly Korreck, Mark Weber, and Patrick McCauley were key members of the team that has resolved this long-standing puzzle. The CfA scientists, in collaboration with colleagues at NASA's Marshall Space Flight Center, produced the finest mirrors for extreme ultraviolet light ever made for a space mission and launched them in a telescope on a sub-orbital rocket, the Hi-C mission, last July. The rocket flight lasted only 10 minutes, but the high resolution images it obtained in that time enabled the scientists to directly observe the hypothetical magnetic braid activity.

Writing in the last issue of the journal *Nature*, the astronomers report that the sizes and activity of the braids they observe are in agreement with the properties needed for the magnetic heating theory to be correct.

Although the short mission duration still leaves many unanswered questions about coronal heating, the new results are a key breakthrough in understanding the solar corona and its behavior.

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