Unveiling the Origins of the Heating of the Sun's Corona

The Sun's outer corona exists with a temperature of a million degrees and is separated from its cool surface (the photosphere), which is 6000 degrees, by only a few hundred kilometers. A major problem in solar physics is explaining how and why the corona is so much hotter than its surface. The answer to this problem lies in the complex magnetic field which tightly woven within the atmosphere of Sun. Over the last few decades, numerous observatories in space and on the ground have provided a range of explanations for the origins of this solar coronal heating. Two competing physical mechanisms are generally accepted to explain the heating process. The first is known as magnetic reconnection, which is an explosive release of the magnetic energy, trapped in magnetic fields in the corona (otherwise known as a solar flare). The second is the energy for heating provided by oscillating magnetic fields in waves (otherwise known as Alfven waves). Detecting these magnetic field oscillations requires advanced numerical simulations combined with the highest resolution images available to solar scientists. Only now has the wave origins behind the heating of the solar corona come into full view.

An international team including researches from five countries, and lead by Professor Gerry Doyle from Armagh Observatory and Planetarium reports on a new discovery made using the Swedish Solar Telescope at La Palma, showing first ubiquitous presence of high frequency (~ 47-84 sec) waves at numerous thin magnetic flux tubes in the quiet-Sun magnetic network transferring energy into the overlying corona. They serve as substantial sources of energy flux not only to heat the solar corona but also to originate the supersonic solar wind. The work is published recently in Nature Scientific Reports (Ref: http://www.nature.com/articles/srep43147) lead by Dr. A.K. Srivastava from Department of Physics, Indian Institute of Technology (BHU), India. Other team members and co-workers are Juie Shetye, a PhD student at Armagh, Dr. Eamon Scullion from Northumbria University, Prof. B.N. Dwivedi from Department of Physics, Indian Institute of Technology, Varanasi, India, Prof. K. Murawski and Dariusz Wojcik from UMCS, Lublin, Poland, Dr Marco Stangalini from INAF, Rome and Professor Tom Ray from the Dublin Institute for Advanced Studies, Ireland.

Gerry Doyle and his PhD student Juie Shetye adds that “This new discovery provides a novel solution to a long-standing puzzle of the Sun's coronal heating. This new and novel finding on what heats the corona will provide a new horizon to understanding the physics of the solar atmosphere and energetic processes using modern age upcoming solar telescopes from ground and space, like DKIST, a 4m telescope in Hawaii where Armagh Observatory are partners. This work is a new break thought on understanding the energy generation, and its transport in the localized solar atmosphere further suggests the requirement of high-resolution and sub-second observations to reveal the dynamical plasma processes at very small-scale. In addition, it is worth mentioning that Alfvén waves have been recognized to have a potential impact on a number of fields, as for example the nuclear fusion research, or black hole jets.”

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