The Sun's X-file under the Spotlight

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One of the Sun's greatest mysteries is about to be unravelled by UK solar astrophysicists hosting a major international workshop at the University of St Andrews from September 6-9th 2004. For years scientists have been baffled by the 'coronal heating problem': why it is that the light surface of the Sun (and all other solar-like stars) has a temperature of about 6000 degrees Celsius, yet the corona (the crown of light we see around the moon at a total eclipse) is at a temperature of two million degrees?

Understanding our nearest star is important because its behaviour has such an immense impact on our planet. This star provides all the light, heat and energy required for life on Earth and yet there is still much about the Sun that is shrouded in mystery.

"The problem is like an Astrophysics X-file! It is totally counter intuitive that the Sun's temperature should rise as you move away from the hot surface," explains Dr Robert Walsh of the University of Central Lancashire and co-organiser of the workshop. "It is like walking away from a fire and suddenly hitting a hotspot, thousands of times hotter than the fire itself."

Using the joint ESA/NASA satellite, the Solar and Heliospheric Observatory (SOHO), along with another NASA mission called TRACE, researchers have gathered enough data to form two rival theories to explain what has been termed 'coronal heating'. It is now believed that the Sun's strong magnetic field is the culprit behind this unique phenomenon. At this SOHO workshop, scientists from the UK and

around the world will look at the evidence for these two explanations and try to untangle the clues we now have available to us.

Walsh continues, "SOHO's contribution to the research has been so important because for the first time we can take simultaneous magnetic and extreme ultraviolet images of the Sun's atmosphere, allowing us to study the changes in the magnetic field at the same time as the corresponding effect in the corona. Then, using sophisticated computer simulations, we have constructed 3d models of the coronal magnetic field that can be compared with SOHO's observations."

One possible mechanism for coronal heating is called 'wave heating'. Prof Alan Hood from the Solar and Magnetospheric Theory Group at St. Andrews explains: "The Sun has a very strong magnetic field which can carry waves upwards from the bubbling solar surface. Then these waves dump their energy in the corona, like ordinary ocean waves crashing on a beach. The energy of the wave has to go somewhere and in the corona it heats the electrified gases to incredible temperatures."

The other rival mechanism is dependent on twisting the Sun's magnetic field beyond breaking point. Prof Richard Harrison of the UK's Rutherford Appleton Laboratory says "The Sun's magnetic field has loops, known to be involved in the processes of sun spots and solar flares. These loops reach out into the Sun's corona and can become twisted. Like a rubber band, they can become so twisted that eventually they snap. When that happens, they release their energy explosively, heating the coronal gases very rapidly".

The Sun is the only star astronomers can study in close detail and many questions remain. The workshop will also look forwards to future missions such as Solar-B, STEREO and Solar Orbiter that all have important UK involvement through PPARC.

Source: The Particle Physics and Astronomy Research Council