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- ▶ [2006](#)
- ▶ [2005](#)
- ▶ [2004](#)
- ▶ [2003](#)
- ▶ [2002](#)
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- ▶ [1999](#)
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## Physicists find new clue in coronal heating mystery

Jan 6, 2011 [17 comments](#)

Spicules in action on the Sun

The latest research from a team of international astronomers could help to explain the long-standing mystery of why the Sun's outer atmosphere – or corona – is so much hotter than its surroundings.

The corona, the vast gossamer atmosphere of plasma visible from Earth during a total solar eclipse, can notch up temperatures in excess of one million degrees Kelvin (MK). Several rival explanations have jostled to account for why the corona is unexpectedly over 200 times hotter than the visible surface, or photosphere, of the Sun. However, in recent years one theory has charged from the back of the pack to become a frontrunner in the race to solve the mystery: spicules – or fountain-like jets of plasma. These emanate from the chromosphere, a relatively thin layer separating the photosphere and corona.

Previously, the spicule theory was largely discredited due to an absence of correlating phenomena in the corona itself. Then, in 2007, researchers led by Bart De Pontieu at the Lockheed Martin Solar and Astrophysics Laboratory in California, US, found a new breed of spicule, which they dubbed "Type II"; Type II spicules are shorter-lived but faster moving than their Type I cousins. In his latest research, published in *Science*, De Pontieu and colleagues now believe they have found evidence implicating Type II spicules in the heating of the corona.

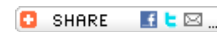
### Tell-tale signature

"Spicules play a significant role in coronal heating, which doesn't fit any of the current theories. This also suggests that there is significant heating going on in the first few thousands of kilometres [of the corona], which is very different from what people have assumed before," De Pontieu told *physicsworld.com*. When the spicule jets occur on the solar disc they leave a tell-tale signature in the spectral lines observed in the chromosphere: fast-occurring blue-shifts, known as rapid blue-shift events (RBEs). De Pontieu used data from the Solar Optical Telescope (SOT), aboard the Sun-orbiting

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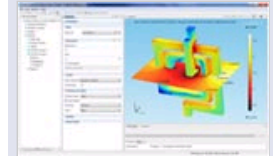
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Hinode spacecraft, to build up a catalogue of RBEs, which he then compared to coronal data from NASA's Solar Dynamics Observatory.

"The high temporal and spatial resolution of this generation of solar observatories allowed us to discover that spicule events in the chromosphere are correlated to brightenings in the corona," De Pontieu explained. The team found that the vast majority of the spicule plasma is only heated to between 0.02–0.1 MK and sinks back down into the chromosphere. However, the key finding is that a small but significant portion of the plasma is heated beyond 1 MK and uplifted into the corona. The researchers found this process to be ubiquitous across the Sun.

**We haven't completely solved the problem, but we've certainly added a significant new wrinkle to it**

**Scott McIntosh, NCAR**

However, the search for a definitive answer to the coronal heating mystery isn't over. "We haven't completely solved the problem, but we've certainly added a significant new wrinkle to it," second author Scott McIntosh, at the National Center for Atmospheric Research (NCAR) in Colorado, explained.

### Combination of different mechanisms

Lucie Green of the Mullard Space Science Laboratory at University College London, who was not involved in the research, agrees: "My hunch is that the solution to the [coronal heating] problem is a mix of answers, a combination of different mechanisms. We shouldn't be looking for just one 'golden' answer," she said. "However, this research is something new and it will definitely sit alongside the other explanations," she added.

Whatever mechanism, or mix of mechanisms, is responsible for the soaring temperatures of the corona, finding an answer is important. "Heating causes the corona to expand outwards, forming the solar wind. This is ultimately what drives lots of processes throughout the solar system, so it would be great to better understand how that heat is being put into the solar atmosphere," said Green.

In order to pinpoint the exact role of spicules in coronal heating and to understand what drives and heats them in the first place, De Pontieu hopes to exploit an upcoming NASA mission. "Fundamentally we need new instrumentation. The Interface Region Imaging Spectrograph (IRIS), is due to launch in December 2012 and it is really focused on the physics of the region between the solar surface and corona," De Pontieu explained. "That would really help us to follow up this research," he added.

The research is described in [Science](#).

### About the author

[Colin Stuart](#) is a science writer and astronomer based in London

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### 17 comments

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1

**pluton**

Jan 6, 2011 10:37 PM  
Novokuibyshevsk, Russian Federation

#### "Friction" about vacuum?

It is possible to assume interaction of a crown of the sun with "a dark matter" (or something another not the known) because of a great speed. The dark matter can be non-uniform and influence intensity of a luminescence and heating. "Friction" about vacuum?

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2

**Thinker**

Jan 7, 2011 12:22 AM  
Dallas, United States

#### Coronal heating mystery

I would tend to think that since magnetism and electricity are closely linked there is a possibility that the massive loops of material arching through the corona could be interacting with other conductive stellar material creating arcs of electricity... or solar lightning of incredible size. I would suspect that, unlike on earth, such electrical discharges would not be clearly visible. Not only is lightning a form of plasma but it may also be adding its million plus degree heat to the corona. Further, magnetic inductive heating is a

practical application here on earth and utilized in everything from steel foundries to kitchen cook tops. All that is needed is a strong magnetic field (obviously present on the sun) and a conductive material through which it can pass and plasma fills that bill nicely.

Just a thought.

*Edited by Thinker on Jan 7, 2011 12:28 AM.*

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### 3 **Ragtime** **Coronal heating mystery**

Jan 7, 2011 1:19 AM  
Prague, Czech Republic

This mechanism based on Alfvén waves doesn't work - or what?

[www.sciencemag.org...1582.abstract](http://www.sciencemag.org...1582.abstract)

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### 4 **reader01** **maybe also magnetism of sun structure**

Jan 7, 2011 9:37 AM

have its influence on blue-shift of corona. Is this blue-shift of plasma also in fusion reactors? I mean there is change to change of wavelength of plasma particles due to magnetism that keep plasma in high speed inside the tokamak. Maybe it is possible to speed up plasma in tokamak so that it have bigger temperature.

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### 5 **Jarek Duda** **Magnetic reconnections ...**

Jan 7, 2011 10:29 AM  
Cracow, Poland

To understand heating up beyond 1MK we just need to have in mind magnetic reconnections of carrying energy density magnetic field lines - here models based on 'ropes' of such twisted lines ("magnetix flux ropes") are said to give agreement with measurement within 1 percent:

[www.physorg.com...asma-clouds-sun.html](http://www.physorg.com...asma-clouds-sun.html)

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### 6 **reader01**

Jan 7, 2011 10:30 AM

Quote:

*Originally posted by **reader01***

have its influence on blue-shift of corona. Is this blue-shift of plasma also in fusion reactors? I mean there is change of wavelength of plasma particles due to magnetism that keep plasma in high speed inside the tokamak. Maybe it is possible to speed up plasma in tokamak so that it have bigger temperature.

But exist any fission reactor that use magnetism for help of driving fission reaction?

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### 7 **reader01**

Jan 7, 2011 12:03 PM

Quote:

*Originally posted by **Jarek Duda***

To understand heating up beyond 1MK we just need to have in mind magnetic reconnections of carrying energy density magnetic field lines - here models based on 'ropes' of such twisted lines ("magnetix flux ropes") are said to give agreement with measurement within 1 percent:

[www.physorg.com...asma-clouds-sun.html](http://www.physorg.com...asma-clouds-sun.html)

this is ( what I write now ) a little out of topic. Imagine twisted light ( polarised ) and its twisted magnetic and electric fields. This twisted magnetic flux that is also polarised can be used for magnetic examination of magnetic characteristic ( for example in graphene ) and many other materials.

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### 8 **mikki**

Jan 7, 2011 12:48 PM

Yes, you are getting there- but not quite there, yet...I have been working on this problem as part of "params" (dark matter) and found a complete solution as to why the temp. goes up: it is, simply, due to head-on collisions between -params and +params... we know what happens when two cars collide head-on.... Heat. NASA reviewed my work and made few "silly" comments, not on this issue- but because I proved with Eqs that Big bang, CMB, BH, Expansion of U etc.. is a pure-fiction and the reality is quite different- you know what? The same crop of scientists have convinced poor Pope Benedict of Big bang etc.. I just read it a news item... I wonder where we are going with all these Billions? Into a Black hole !

Quote:

*Originally posted by **pluton***

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### 9 **srp** **Coronal heating**

Jan 7, 2011 1:33 PM  
Quebec, Canada

Some may be interested in a personal research I did on this issue.

Paper available here:

[wbabin.net...michaud6.pdf](#)

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10

**mikki**

Jan 7, 2011 8:32 PM

Yes, I quickly read to get an idea what you are talking about- I must agree you wrote it well to the best of the knowledge available to a scientist; but, there is more to it... I certainly agree with you Corona Effect is Universal, like Kepler law on elliptical orbits...

I am going to send you an e-mail, please respond so that we can continue looking into this issue.. to the best of our ability.

Quote:

*Originally posted by **srp***

Some may be interested in a personal research I did on this issue.

Paper available here:

[wbabin.net...michaud6.pdf](#)

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11

**Tom Sullivan**

Jan 8, 2011 4:46 PM

**Cherenkov effect on light.**

The particles being accelerated away from the photosphere may be producing a Cherenkov effect with some of the slower moving particles within the corona. The resulting shockwaves may cause the compression and heating of the portions of the corona they travel thru. The Cherenkov effect may also be responsible for the blue shift.

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12 **Snowball Solar System**

Jan 9, 2011 1:38 AM

**Spicule Chondrule Connection?**

I wonder if Type I, Type II spicules could explain Type I, Type II chondrules if our solar system began more energetically than generally supposed with a luminous red nova (LRN). If our sun were originally a close binary pair with a more distant tertiary stellar body in a highly eccentric orbit where the tertiary body bled angular momentum from the binary pair, then the orbits of the binary pair may have decayed and spiraled into one another at 4.567 Ga, creating a LRN along with the observed short-lived isotopes of our early solar system, including  $^{60}\text{Fe}$ . In addition to creating ordinary Type I, Type II chondrules, perhaps the the ultra-high-temperature jets of spicules also condensed micrometer-size grains of olivine which aligned themselves with the ultra-high-strength, magnetic field lines of the LRN, and the olivine grains, in turn, dragged and twisted the field lines until the olivine grains rubbed shoulders, whereupon the magnetic field disengaged and fused the grains into barred olivine chondrules.

*Edited by Snowball Solar System on Jan 9, 2011 2:10 AM.*

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13

**venkatakrishnan**

Jan 10, 2011 5:32 AM

**simplemind**

Quote:

*Originally posted by **simplemind***

HEAT RISES

SO HEAT GOES UP AND STAYS UP AND GETS HOTTER

MUCH HOTTER

I HOPE I HAVE SHUT THIS CASE FOR GOOD

STOP WASTING TIME TRYING TO FIGURE OUT NATURE

AND INVENT A REMOTE CONTROL DEVICE FOR MY SON

HES A LITTLE RASCAL HE IS

Heat does not rise, hot air rises. This process of heating is known already and is caused convective heating. It works very well in interiors of stars and sun, but does not work in the solar atmosphere, which is stable against convection. So, please note that scientists first think of the simplest possible solutions, and search for alternatives only when the simple solutions do not work. But thanks for getting involved. Maybe your son should not be controlled so that he grows up to become a great scientist!

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14

**mikki**

Jan 12, 2011 1:55 PM

Editor:

What is the matter with you? Why did you delete 3-comments posted by King and my response... Do you wish to protect the unethical behavior of Professor-scientists and the Journals by the Professors for the Professors to keep rest of us, the tax-payers in the Dark while they keep sucking Billions or Trillions with deceit and fraud...?

Please explain if you have a reason- and let me respond or encourage your Professor-scientists to challenge me at any Forum of their choice- OK

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## Deleted comments?

Quote:

*Originally posted by mikki*

Editor:

What is the matter with you? Why did you delete 3-comments posted by King and my response...  
Do you wish to protect the ...

I was starting to wonder if I'd imagined that...

Perhaps the comments section could provide a stub entry to indicate an entry that was made and the REASON for deletion?

mk

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Quote:

*Originally posted by mikki*

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Quote:

*Originally posted by pluton*

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beginning of the universe, one might think it was more complicated than just an explosion.

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My dear Brother from Russia- I am a fan of our-Great Scientist Mendeleev who utilized Sanskrit words unlike the rest who used Greek, Latin... Also, I am a fan of Kepler, Newton...Faraday, Wien etc..; of course Archimedes. Do you know Archimedes studies Sanskrit in 225BC in the Library of Alexandria? I submit, the knowledge of our Ancients is preserved in Sanskrit, the root of all present languages...

Now, getting back to your comment "beginning of the universe, one might think it was more complicated than just an explosion"- I agree with you to the extent 'explosions' happen all the time; NASA calls them GRBs- such GRBs happening all the time within you, me and the tree as well as in Space- that doesn't mean Big bang created the 'galaxies'- we will never be able to find out How or Why the Almighty-Brahman in which we live is created?

Quote:

*Originally posted by pluton*

Quote:

*Originally posted by mikki*

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