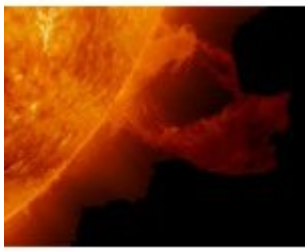
Solar tornadoes are not tornadoes !



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Observatoire de Paris - PSL Centre de recherche en astronomie et astrophysique

In spite of their appearance, «solar tornadoes» do not rotate. That is the conclusion of a team of European scientists, among whom is an astronomer from the Paris Observatory-PSL, announced on Friday April 6th 2018, at the European Week of Astronomy and Space Science (EWASS) conference at Liverpool.

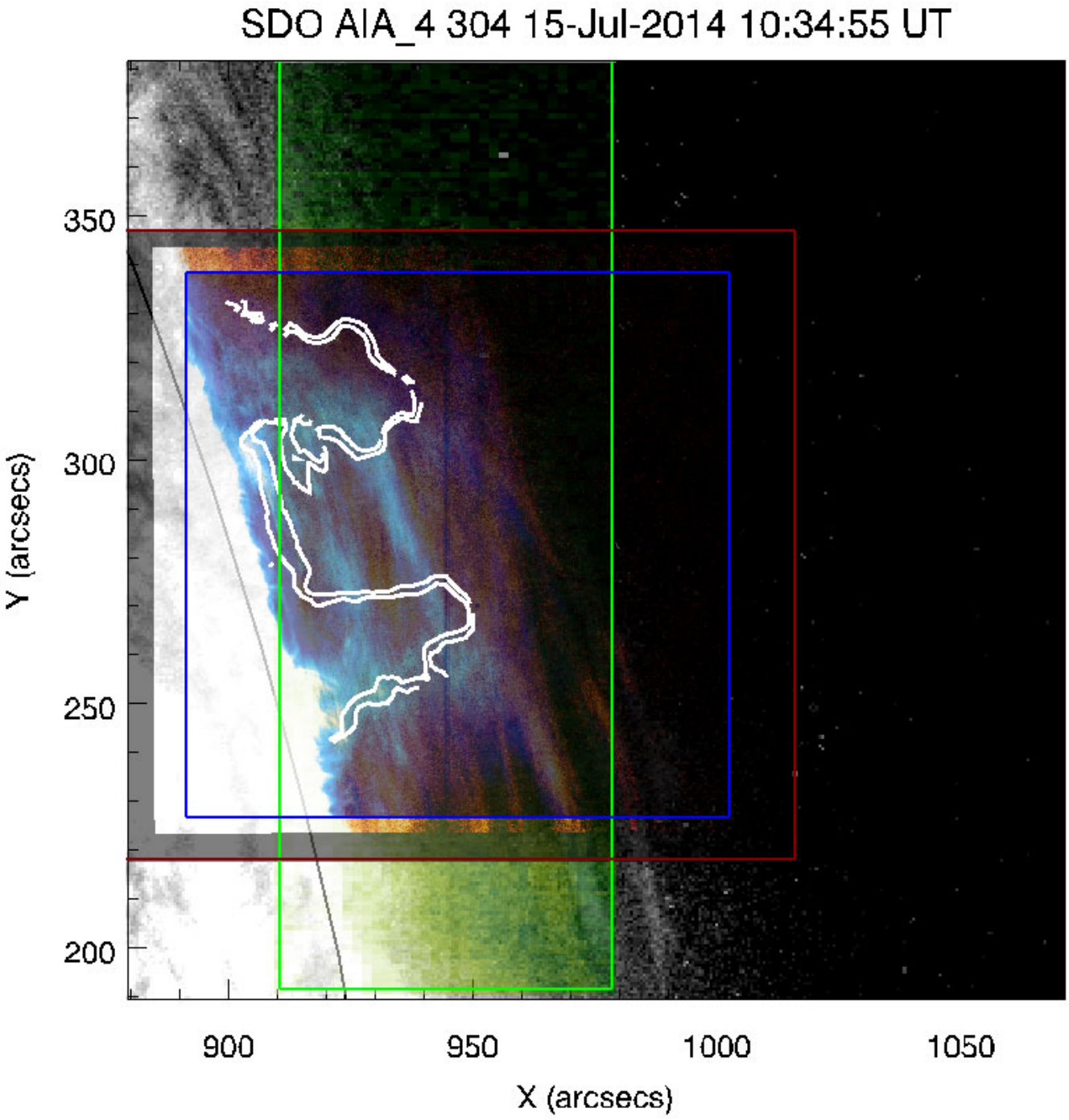
Recent analysis of solar tornadoes, gigantic structures observed on the solar surface and which can be as large as several times the size of the Earth, has shown that this phenomenon has been badly labelled, as it has been observed only via two dimensional images.

The phenomenon was observed for the first time on the solar surface in the opening years of the 20th century. More recently, close-up films have been obtained thanks to instruments such as the AIA on NASA's SDO (Solar Dynamics Observatory) probe, but the phenomenon was still, wrongly, referred to by scientists as a "tornado".

In effect, films do show a very hot plasma, visible in ultra-violet, which apparently turns on itself, creating giant structures which recall the tornadoes on the terrestrial surface.

To better understand this phenomenon, scientists have tried to capture a third dimension, by combining observational data, gathered over several years with a variety of different ground based instruments (the Paris Observatory's solar tower, the Paris Observatory's spectroheliograph, the Themis solar telescope at the Teide observatory) and space based instruments (the SDO, Hinode and IRIS satellites).

On the basis of the Doppler effect, they have been able to compute the speed of the plasma (40 km/sec) as well as the direction of its motion, its temperature and its density. They have thus been able to "reconstruct" the full magnetic structure which maintains these giant structures. They have hence deduced that in fact these structures are in fact well known and studied under the name "protuberances".



Composite image of a prominence Composite image of a prominence observed on July 15th 2014 showing in green the coronal observations of EIS, in red UV observations by IRIS and in blue those of Hinode/SOT (plasma at 10 000 degrees). The white contours show the positions of the tornadoes on the image in He D3 obtained by THEMIS. The grey background was obtained by the SDO/AIA instrument observing the plasma at 100 000 degrees.
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The giant solar tornadoes, henceforth renamed "tornado protuberances", were observed for the first time on the Sun about a century ago. They were thus named because of their apparent rotation, recalling that of terrestrial tornadoes, but this was a mistake.
It turns out that it is wrong to compare them to terrestrial tornadoes. While these latter are a product of high winds, the solar the tornado-protuberances are a product of motionless magnetized gas rooted under the solar surface. They are in fact the roots of protuberances.

«For once, reality is much simpler than what one thought was being observed», notes Brigitte Schmieder, an astronomer at the Observatoire de Paris - PSL.

«In spite of the vertical appearance of the tornadoes and protuberances on the edge of the Sun, the magnetic field which maintains them is not vertical, as it might seem, but is horizontal, parallel to the edge of the Sun. That they look vertical is due to the fact that all the structures are projected on the plane of the sky." Explains Nicolas Labrosse, a scientist at the Glasgow University (School of Physics and Astronomy).

«This effect is not unlike that of aircraft contrails on the sky. If the aircraft continues to fly at the same altitude, its contrail appears to end on the horizon. This does not imply that the plane crashed.», adds Arturo López Ariste, CNRS scientist at the Institut de Recherche en Astrophysique et Planétologie (Toulouse University).

«These protuberance-tornadoes can remain stable for many days and months before exploding and creating coronal mass ejections whose effects on the terrestrial environment are well known in the context of space meteorology», emphasizes Brigitte Schmieder. «They can perturb electric power stations, satellites and communications networks on the Earth».

References

The results of this work are published in the following papers:

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