# Solar flares set the Sun quaking

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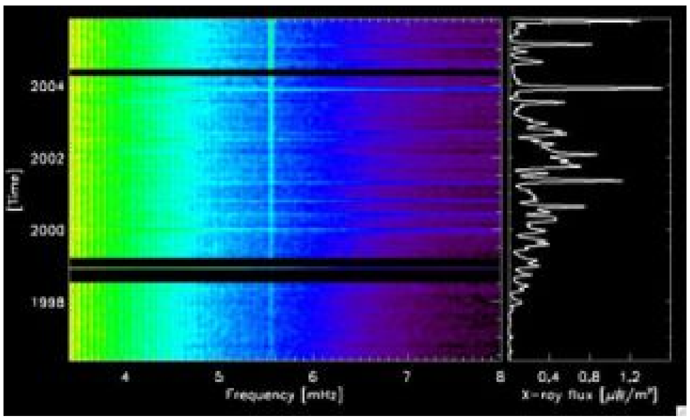


A frequency-time diagram of global oscillations in the Sun as measured by SOHO. The colour-coding represents the strength of the oscillations. The bright horizontal lines are strongly correlated with solar flares, represented by the solar X-ray flux in the right panel. These lines are most prominent in the high-frequency region of the spectrum. The vertical line at 5.55 mHz in the left panel is an instrumental artifact. Credits: SOHO/VIRGO (ESA & NASA)

Data from the ESA/NASA spacecraft SOHO shows clearly that powerful starquakes ripple around the Sun in the wake of mighty solar flares that explode above its surface. The observations give solar physicists new insight into a long-running solar mystery and may even provide a way of studying other stars.

The outermost quarter of the Sun's interior is a constantly churning maelstrom of hot gas. Turbulence in this region causes ripples that criss-cross the solar surface, making it heave up and down in a patchwork pattern of peaks and troughs.

The joint ESA-NASA Solar and Heliospheric Observatory (SOHO) has proved to be an exceptional spacecraft for studying this phenomenon. Discovering how the ripples move around the Sun has provided valuable information about the Sun's interior conditions. A class of oscillations called the 5-minute oscillations with a frequency of around 3 millihertz have proven particularly useful.

According to conventional thinking, the 5-minute oscillations can be thought of as the sound you would get from a bell sitting in the middle of the desert and constantly being touched by random sand grains, blown on the wind. But what Christoffer Karoff and Hans Kjeldsen, both at the University of Aarhus, Denmark, saw in the data, was very different.

"The signal we saw was like someone occasionally walking up to the bell and striking it, which told us that there was something missing from our understanding of how the Sun works," Karoff says.

So they began looking for the culprit and discovered an unexpected correlation with solar flares. It seemed that when the number of solar flares went up, so did the strength of the 5-minute oscillations.

"The strength of the correlation was so strong that there can be no doubt about it," says Karoff.

A similar phenomenon is known on Earth in the aftermath of large earthquakes. For example, after the 2004 Sumatra-Andaman Earthquake, the whole Earth rang with seismic waves like a vibrating bell for several weeks.

The correlation is not the end of the story. Now the researchers have to work to understand the mechanism by which the flares cause the oscillations. “We are not completely sure how the solar flares excite the global oscillations,” says Karoff.

In a broader context, the correlation suggests that, by looking for similar oscillations within other stars, astronomers can monitor them for flares. Already, Karoff has used high-technology instruments at major ground-based telescopes to look at other Sun-like stars. In several cases, he detected the tell-tale signs of oscillations that might originate from flares.

“Now we need to monitor these stars for hundreds of days,” he says. That will require dedicated spacecraft, such as the CNES mission with ESA participation, COROT. The hard work, it seems, is just starting.

Citation: ‘Evidence that solar flares drive global oscillations in the Sun’ by C. Karoff & H. Kjeldsen will be published in *The Astrophysical Journal Letters* on 1 May 2008.

Source: European Space Agency