

## Intense geomagnetic storm during Maunder minimum possibly by quiescent filament eruption

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The sun occasionally undergoes the so-called grand minima, in which its magnetic activity, measured by the number of sunspots, is suppressed for decades. The most prominent grand minima, since the beginning of telescopic observations of sunspots, is the Maunder minimum (1645--1715), when the sunspots became rather scarce. The mechanism underlying the grand minima remains poorly understood as there is little observational information of the solar magnetic field at that time. In this study, we examine the records of one candidate aurora display in China and Japan during the Maunder minimum. The presence of auroras in such mid magnetic latitudes indicates the occurrence of great geomagnetic storms that are usually produced by strong solar flares. However, the records of contemporary sunspot observations from Europe suggest that, at least for the likely aurora event, there was no large sunspot that could produce a strong flare. Through simple theoretical arguments, we show that this geomagnetic storm could have been generated by a giant eruption from the spotless sun.

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