

Rapid events in the carbon-14 content of tree-ring

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Measurement of cosmogenic nuclides, which are radioisotopes produced by cosmic rays, can provide us important information to search past extraterrestrial high-energy events such as supernova, solar proton event (SPE), and so on. Until now, the contents of ¹⁴C in tree-rings and ¹⁰Be in ice cores have been used for this purpose. However, no clear evidence has been found by ¹⁴C and ¹⁰Be.

We show the results of ¹⁴C content measurement in Japanese cedar annual rings from AD 600 to 1020 with 1- to 2-year resolution, and report two findings of rapid increases of ¹⁴C content from AD 774 to 775 and AD 992 to 993. These are clear increases against its measurement errors. The shapes of the two series are very similar, i.e., a rapid increase within one year followed by a decay due to the carbon cycle. The scale of the AD 993 event is 0.6 times as large as the AD 775 event.

The ¹⁰Be flux in the Antarctic ice core also shows peaks corresponding to these two ¹⁴C events. The proportions of flux increase (¹⁴C/¹⁰Be) of the two events are consistent with each other. Therefore, it is highly possible that these events have the same origin.

Although the cause of this event can be explained by a large solar proton event (SPE) or a short gamma-ray burst, we conclude that solar activity is a plausible cause because the occurrence rate of ¹⁴C increase events is inconsistent with a observed rate of an short gamma-ray bursts.