Researcher points to Sun as likely source of eighth-century 'Charlemagne event'

November 30 2012

(Phys.org)—Until recently, the years 774 and 775 were best known for Charlemagne's victory over the Lombards. But earlier this year, a team of scientists in Japan discovered a baffling spike in carbon-14 deposits within the rings of cedar trees that matched those same years. Because cosmic rays are tied to carbon-14 concentrations, scientists around the world have wondered about the cause: a nearby supernova, a gamma ray burst in the Milky Way or an intense superflare emanating from the Sun?

Now, Adrian Melott, professor of physics and astronomy at the University of Kansas and Brian Thomas, KU alumnus and professor of physics and astronomy at Washburn University, have examined the evidence and zeroed in on the likely source of the medieval cosmic ray bombardment—a coronal mass ejection from the Sun.

Melott said the scientists, who originally discovered the carbon-14 spike and published their findings in the journal Nature, miscalculated the implied intensity of such an event, and they mistakenly ruled out the Sun as the cause of the radiation detected for the years 774-775.

"What they concluded was that the energy emitted by the Sun would have had to have been, say, 1,000 times larger than the Carrington event—the greatest solar flare ever known," Melott said. "We just observed this simple mistake and corrected it, and the answer came out that it would be 10 or 20 times greater than the Carrington event in 1859. That means that this may be a more reasonable explanation. The

Carrington event is the greatest in the last 200 years, and this would be the greatest thing in the last 1,300 years or so, so it becomes more reasonable."

In addition, Melott noted that recent observations of stars similar to the Sun made by the Kepler satellite suggest that they are flaring at levels similar to that which they suggest—and higher—at average intervals of a few hundred to thousand years.

Other explanations for the medieval radiation burst are highly improbable, according to the KU researcher. For instance, the scientists who discovered the carbon-14 spike ruled out the possibility of a nearby galactic supernova as a source, and Melott agrees with their conclusion.

"A supernova is basically a star that comes to the end of its life and produces a spectacular explosion," said Melott. "But in order to produce effects like the ones seen in the tree rings, such a supernova would have had to have been within 100 light years or so. Such an event would have been blindingly bright in the sky, much brighter than a full moon. It would have been bright like that for months and could not have failed to be noted by every civilization on Earth. Being so close, there would be remnants of the explosion visible today, still expanding. Something so close could not have been missed."

Melott believes a third possibility for the 774-775 burst of cosmic energy—a gamma ray burst—should have been considered by the original authors, even though he deemed it unlikely.

"A gamma ray burst comes from a small fraction of supernovae," he said. "They result in a beaming of the radiation into two narrow searchlight beams going out in opposite directions from the event. Now, because the radiation is so columnated, they can nail you from quite far away. They could be hundreds or even thousands of light years away and

still nail us with enough radiation to produce the carbon-14 spike. It's a possibility, but not a likely possibility, because these things happen with intervals of 10-15 million years on average. Is it likely that such a burst would have happened 1,200 years ago? Rare events do happen, but it would be very surprising. I don't think it's a likely explanation."

Returning to the more-likely solar event, Melott said that something similar to the Charlemagne event would have disastrous consequences for today's technology-dependent world. He said such an event could occur every one or two thousand years, but unpredictably and with only a few hours' warning.

"You'd get a slight increase in skin cancer rates because of effects on the ozone layer," said Melott. "You'd get a little bit of damage to food crops, but that's not too serious—and it wasn't for the Holy Roman Empire either. But we have a problem they didn't, which is our technological level. When these things hit, the Earth's magnetic field undergoes an interaction, and the magnetic field lines move, and that produces a current in wires. If you have a long power line, you can get a huge current. Transformers get overloaded, and they burn out. And you can lose a lot of transformers. Imagine the lights going off all over the developed world—not to come on for who knows how long—because you have to build more transformers. And how to you do that without electricity? It's a real problem to prepare for it."

Work by Melott and Thomas will appear online via *Nature* magazine.

Provided by University of Kansas