Using the Sun to illuminate a basic mystery of matter

July 8 2013

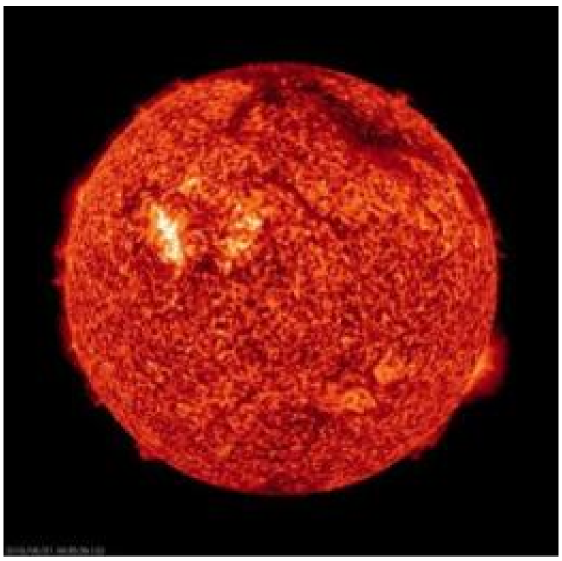

Image of sun courtesy of NASA.

Antimatter has been detected in solar flares via microwave and magnetic-field data, according to a presentation by NJIT Research Professor of Physics Gregory D. Fleishman and two co-researchers at the 44th meeting of the American Astronomical Society's Solar Physics Division. This research sheds light on the puzzling strong asymmetry between matter and antimatter by gathering data on a very large scale using the Sun as a laboratory.

While antiparticles can be created and then detected with costly and complex particle-accelerator experiments, such particles are otherwise very difficult to study. However, Fleishman and the two co-researchers have reported the first remote detection of relativistic antiparticles—positrons—produced in nuclear interactions of accelerated ions in solar flares through the analysis of readily available microwave and magnetic-field data obtained from solar-dedicated facilities and spacecraft. That such particles are created in solar flares is not a surprise, but this is the first time their immediate effects have been detected.

The results of this research have far-reaching implications for gaining valuable knowledge through remote detection of relativistic antiparticles at the Sun and, potentially, other astrophysical objects by means of radio-telescope observations. The ability to detect these antiparticles in an astrophysical source promises to enhance our understanding of the basic structure of matter and high-energy processes such as solar flares, which regularly have a widespread and disruptive terrestrial impact, but also offer a natural laboratory to address the most fundamental mysteries of the universe we live in.

Electrons and their antiparticles, positrons, have the same physical behavior except that electrons have a negative charge while positrons, as their name implies, have a positive charge. This charge difference causes positrons to emit the opposite sense of circularly polarized radio emission, which Fleishman and his colleagues used to distinguish them. To do that required knowledge of the magnetic field direction in the solar flare, provided by NASA's Solar and Heliospheric Observatory (SOHO), and radio images at two frequencies from Japan's Nobeyama Radioheliograph. Fleishman and his colleagues found that the radio emission from the flare was polarized in the normal sense (due to more numerous electrons) at the lower frequency (lower energy) where the effect of positrons is expected to be small, but reversed to the opposite sense at the same location, although at the higher frequency (higher energy) where positrons can dominate.

More information: Fleishman, who is affiliated with the NJIT Center for Solar-Terrestrial Research, worked with Alexander T. Altyntsev and Natalia S. Meshalkina, Institute of Solar-Terrestrial Physics, Siberian Branch of the Russian Academy of Sciences. They are presenting their research in a paper titled "Discovery of Relativistic Positrons in Solar Flares" at the 44th meeting of the Solar Physics Division of the American Astronomical Society, held in Bozeman, Montana, July 8-11.

Provided by New Jersey Institute of Technology

Citation: Using the Sun to illuminate a basic mystery of matter (2013, July 8) retrieved 24 April 2024 from https://phys.org/news/2013-07-sun-illuminate-basic-mystery.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.