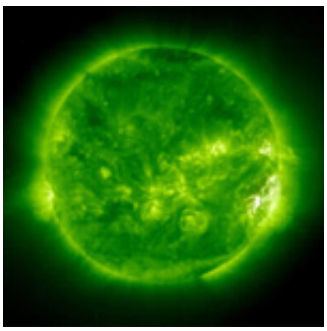
New method helps safeguard astronauts by forecasting space radiation hazards with up to one hour advance warnings

May 25 2007



The one-million-degree solar corona in extreme ultraviolet light taken by the Solar and Heliospheric Observatory's Extreme ultraviolet Imaging Telescope (EIT) in November 2003. Hazardous solar activity is only minutes away. Another SOHO instrument, the Comprehensive Suprathermal and Energetic Particle Analyzer (COSTEP), monitors space for electrons from the Sun.

One of the greatest threats to human space exploration is the sudden, unpredictable occurrence of radiation outbursts from the Sun. Researchers have long sought a method for predicting when the hazardous particles from extreme solar events, such as flares, coronal mass ejections and radio bursts, would reach humans or technology in space.

Research by Dr. Arik Posner, a research scientist at Southwest Research Institute (SwRI), has led to a new method for forecasting the appearance

and intensity of solar ion events by measuring relativistic, near light-speed electrons. Relativistic electrons are highly abundant, easy to detect outside of the magnetosphere and detectable ahead of the more dangerous ions that follow. Extreme solar events create the relativistic electrons, which have characteristics that can be exploited to predict the time and intensity of later arriving ions, predominantly protons with energies more harmful to humans.

Energetic protons and heavier ions are among the main constituents of solar particle events, and their effects on the human body result in a higher cancer risk for humans in space. Exposure to these hazardous particles can also result in acute radiation syndrome, with symptoms that include vomiting, skin burns or abruption of central nervous system function. An early warning system for the detection of hazardous particles could mitigate the risk of radiation damage to astronauts by forecasting impending levels of radiation exposure.

"This method provides advance warning up to about one hour," says Posner. "Although it seems relatively short notice, the warning can be decisive in the prevention of acute radiation sickness and will help astronauts reduce their total exposure to radiation.

"Earth's magnetic field helps prevent exposure to solar particle events, but as space exploration leads humans out of this protective magnetic cocoon toward the moon and into the unprotected seas of outer space, this and other methods of space weather forecasting will become increasingly important," says Posner.

The method is currently being considered by the NASA Johnson Space Center in the design of lunar missions. "A one hour warning would reduce the odds of being caught in a solar storm outside of a lunar habitat, where astronauts are most vulnerable, by more than 20 percent compared to current methods, and allow science missions to venture to

farther distances," says Dr. Francis Cucinotta, chief scientist for the NASA Space Radiation Program.

Further research could result in longer warnings and the prediction of an average time profile for solar particle events. Additionally, this forecasting method can help protect satellites and other systems in space, which can also be damaged by radiation from the Sun, by providing time for ground operators to turn off sensitive instrumentation.

The study is based on observations by the Comprehensive Suprathermal and Energetic Particle Analyzer (COSTEP) instrument on the Solar and Heliospheric Observatory. SOHO is a project of international cooperation between NASA and the European Space Agency. Since SOHO launched in 1995, COSTEP has provided a wealth of data covering an entire solar cycle, including the 2001 solar maximum, allowing for meaningful tests of this forecasting method.

The paper "Up to One-Hour Forecasting of Radiation Hazards from Solar Energetic Ion Events with Relativistic Electrons," by Dr. Arik Posner, will be published in the May issue of Space Weather, published by the American Geophysical Union.

Source: Southwest Research Institute