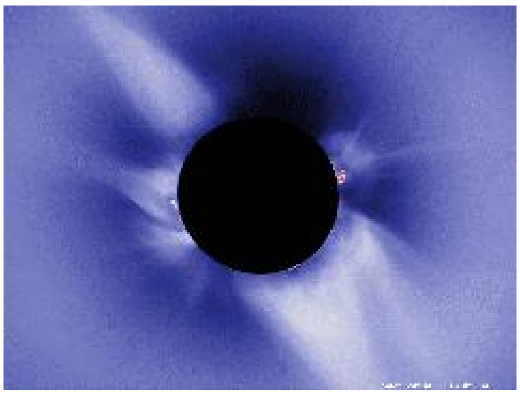
Heating the solar wind

April 3 2013



A picture of the solar corona as seen during an eclipse. A new paper presents a model that is able to explain previously puzzling aspects of the coronal wind. Credit: UCAR/NCAR

(Phys.org) —The Sun glows with a surface temperature of about 5500 degrees Celsius. Meanwhile its hot outer layer (the corona) has a temperature of over a million degrees, and ejects a wind of charged particles at a rate equivalent to about one-millionth of the moon's mass each year. Some of these wind particles bombard the Earth, producing radio static, auroral glows, and (in extreme cases) disrupted global communications.

There are two important, longstanding, and related questions about the corona that astronomers are working to answer: how is it heated to temperatures that are so much hotter than the surface? And how does the corona produce the wind? A related puzzle of the solar wind is why certain of its ions are hotter than others; one might naively expect uniform heating of the gas, but the temperature of helium ions, for example,is on average five times higher than that of the much lighter mass hydrogen ions.

The answers to these questions appear to involve turbulence and magnetic fields in the Sun's atmosphere. Writing in the latest issue of *Physical Review Letters*, CfA astronomers Justin Kasper and Michael Stevens, with their collaborators, present a new model that demonstrates how waves in the hot ionized gas, called "cyclotron waves," will heat the gas, and do so preferentially for heavier ions. These waves correspond to oscillations in the circular motion of ions as they twist around the magnetic fields present. The new model explains how energy from these waves is transferred to the particles, thereby heating them. The astronomers were able to use their new model to explain successfully the measured ion temperatures over 17 years of data accumulated from the Wind spacecraft. The new results represent a major advance in our understanding of how the solar wind works.

Provided by Harvard-Smithsonian Center for Astrophysics