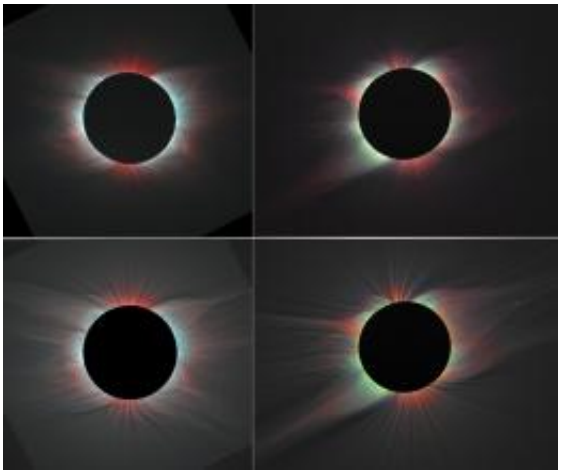
Eclipses Yield First Images of Elusive Iron Line in Solar Corona

January 4 2010, by Laura Layton



These images of the solar corona are color overlays of the emission from highly ionized iron lines for the 2006 eclipse (left column) and 2008 eclipse (right column), with white-light images added in the bottom row. Red indicates iron line Fe XI 789.2 nm, blue represents iron line Fe XIII 1074.7 nm, and green shows iron line Fe XIV 530.3 nm. These are the first such maps of the 2-D distribution of coronal electron temperature and ion charge state. Credit: Habbal, et al.

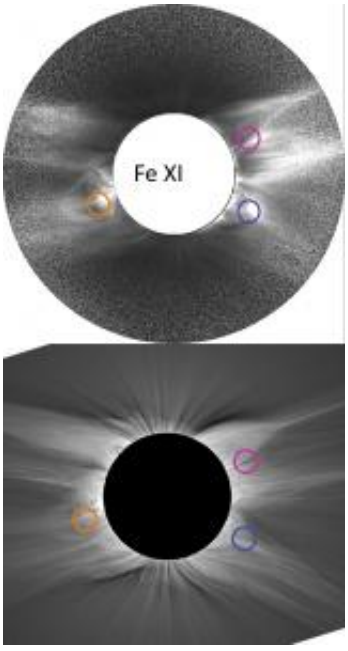
(PhysOrg.com) -- Solar physicists attempting to unlock the mysteries of the solar corona have found another piece of the puzzle by observing the sun's outer atmosphere during eclipses.

Ground-based observations reveal the first images of the solar corona in the near-infrared emission line of highly ionized iron, or Fe XI 789.2

nm. The observations were taken during total solar eclipses in 2006, 2008, and 2009 by astrophysicist Adrian Daw of NASA's Goddard Space Flight Center in Greenbelt, Md., with an international team of scientists led by Shadia Habbal from the University of Hawaii's Institute for Astronomy (IfA).

"The first image of the corona in Fe XI 789.2 nm was taken during the total solar eclipse of March 29, 2006," said Daw.

The images revealed some surprises. Most notably, that the emission extends out at least three solar radii -- that's one-and-a-half times the sun's width at its equator, or middle -- above the surface of the sun, and that there are localized regions of enhanced density for these iron ions.



Comparison of the first image of the corona in Fe XI 789.2 nm, taken during the 2006 eclipse, with a white-light image taken by Miloslav Drückmuller from Brno University of Technology in the Czech Republic. The colored circles indicate localized enhancements in Fe XI that have no correspondence in white light, while the bubble structure surrounding the yellow circled region is barely

distinguishable in white light. Credit: Habbal, et al.

Combined with observations of other iron charge states, the observations yield the two-dimensional distribution of electron temperature and charge-state measurements for the first time, and establish the first direct link between the distribution of charge states in the corona and in interplanetary space.

"These are the first such maps of the 2-D distribution of coronal electron temperature and ion charge state," said Daw.

Mapping the distribution of electron temperature and iron charge states in the corona with total solar eclipse observations represents an important step in understanding the solar corona and how space weather impacts Earth.

The scientists' results will be presented at the American Astronomical Society meeting on January 4 in Washington and published in the January issue of the Astrophysical Journal.

Provided by NASA's Goddard Space Flight Center