

## **Technology Advances Enable Science-Oriented CubeSat Missions**

**Thomas N. Woods**<sup>1</sup> [tom.woods@lasp.colorado.edu], James Mason<sup>1</sup>, Christopher Moore<sup>1</sup>, Andrew Jones<sup>1</sup>, Rick Kohnert<sup>1</sup>, Amir Caspi<sup>2</sup>, Phil Chamberlin<sup>3</sup>, Scott Palo<sup>4</sup>, and Stan Solomon<sup>5</sup>.

<sup>1</sup> Laboratory for Atmospheric and Space Physics (LASP), University of Colorado, Boulder, CO, USA.

<sup>2</sup> Southwest Research Institute (SwRI), Boulder, CO, USA.

<sup>3</sup> NASA Goddard Space Flight Center (GSFC), Greenbelt, MD, USA.

<sup>4</sup> Dept. of Aerospace Engineering Sciences (AES), University of Colorado, Boulder, CO, USA.

<sup>5</sup> High Altitude Observatory (HAO), National Center for Atmospheric Research (NCAR), Boulder, CO, USA.

Key enabling technologies for most solar science missions include the sensors for the science instruments, 3-axis precision pointing by the spacecraft attitude determination and control systems (ADCS), and high data rates for communication downlink. There are now commercial off-the-shelf (COTS) solutions for the later two technologies for nanosatellites (e.g., CubeSats), such as the Blue Canyon Technologies' ADCS with better than 7 arc-sec pointing capability in 3 axes and Syrlinks X-band radio with better than 50 Mbits/sec (Mbps) downlink capability. With these CubeSat technology advances, there is now a great desire to compact the science instruments, not in capability but in size, mass, and power. We anticipate that the next generation of small solar missions could include compact magnetographs, solar imagers, and solar irradiance spectrometers and radiometers to further advance the understanding of the solar dynamo, solar eruptive events (SEEs), and solar irradiance variability important for climate change and space weather research. The technology and science of the Miniature X-ray Solar Spectrometer (MinXSS) CubeSat is presented as an example for a science-oriented CubeSat mission. The objective for the MinXSS mission is to better understand the energy distribution of solar soft X-ray (SXR) emissions and their impact on Earth's ionosphere, thermosphere, and mesosphere (ITM). MinXSS is a solar-pointed, 3-axis-controlled, 3 Unit (3U) CubeSat to observe the solar SXR spectrum between 0.04 and 2.5 nm (0.5 to 30 keV). The MinXSS is scheduled to launch to the International Space Station (ISS) in November 2015 and then be deployed from ISS in January 2016.