NASA Facts

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Spartan 201-05 to Fly on STS-95

The Sun is the closest star to Planet Earth and the foundation for all we know about stars in the rest of the Universe. The Sun drives our weather, and energetic eruptions on the Sun are capable of disrupting satellites, communication and power systems. The Sun also establishes the space environment in which our communications, weather, defense and human spaceflight resources operate. Solar eruptions, such as flares and Coronal Mass Ejections (CME's), can emit very high speed subatomic particles, called solar protons, that can pose a hazard to unprotected astronauts. The hazard becomes an important consideration for future interplanetary missions, as the Earth's magnetic field acts as a shield for astronauts traveling in lower Earth orbits. Obtaining a better understanding of CME's will go a long way toward developing ways to protect our resources in space and Earth-based communications.

Spartan 201-05 will be deployed by the Shuttle arm on flight day four. The 3,000 pound spacecraft is a carrier for two instruments that will investigate the heating of the solar corona and acceleration of the solar wind that originates in the corona. The Ultraviolet Coronal Spectrometer (UVCS) and the White Light Coronograph (WLC) will use a coronograph — a disk inside the telescope to block direct light from the Sun — so any surrounding material, which is likely to be much dimmer, can be seen. This artificial eclipse is necessary to study the solar corona, as it is approximately one billion times dimmer than the Sun.

The UVCS will use ultraviolet light emissions from electrically neutral hydrogen atoms and ions (electrically charged subatomic particles) in the corona to determine the velocities of coronal plasma within the solar wind source region along with the temperature and density distributions of protons. Ultraviolet light is not visible to the human eye, and much of it is blocked by the Earth's atmosphere, so these observations have to be made from space.

The WLC will measure visible light to determine the density distribution of coronal electrons within these same regions. The electrons, which are another type of electrically charged subatomic particle, scatter visible sunlight within the corona, revealing the density and motion of the coronal plasma.

Coronal mass ejections are some of the most powerful natural disturbances of the solar system, and the rate at which these events occur changes over the eleven-year magnetic activity cycle. At the time of the last Spartan flight in 1997 scientists expected to view a CME every day or so. At the present time, magnetic activity of the Sun has increased to the point where such events are occurring three to five times daily. It is highly probably that Spartan will gather a number of observations of CME's during its two-day flight. The WLC onboard Spartan will allow CME's to be detected quite low in the corona where the forces of pressure, gravity and magnetism are operating simultaneously. The Shuttle arm will retrieve the Spartan spacecraft on flight day six.

Like other stars, the Sun is powered by nuclear fusion reactions in its multi-million degree central core. Each second, these reactions release enough energy to power the United States for nine million years at its current rate of consumption. The visible surface of the Sun, called the photosphere, is much cooler than the core. Still searing by terrestrial standards, it is a relatively cool 10,000 degrees Fahrenheit. The photosphere is more than 800,000 miles across and is roiled by continent-sized convection cells. The cells are a result of the enormous heat in the solar interior; hot plasma (electrically charged gas) alternately rises and falls in a process called convection.

The corona is constantly changing because the magnetic fields that dominate the corona are continuously displaced by convective motions in the outer layers of the Sun just below the photosphere. An apparent paradox, the corona is much hotter than the solar surface, at up to three million degrees Fahrenheit. Many scientists suspect that the Sun has a mechanism for converting its magnetic energy to thermal (heat) energy in the corona, but the details are not understood well. The lower corona is also the source of the solar wind, an accelerated stream of plasma that flows outward from the Sun at an average velocity of 250 miles per second. Solar eruptions also occur within the corona. These events originate at the photosphere, travel upward through the Sun's lower atmosphere (chromosphere and transition region), and then into its super-hot corona before speeding out into space, sometimes towards Earth.

This will be the fifth flight of the Spartan 201 payload. Spartan last flew on Columbia in November 1997 on Shuttle mission STS-87. The deploy was unsuccessful with Spartan 201-04 failing to perform the pirouette maneuver because of an incomplete initialization sequence. The subsequent regrapple attempt failed, bumping Spartan and giving it a spin rate. Spartan 201-04 was recaptured by astronauts on a spacewalk, and the payload was re-latched into the orbiter's cargo bay. Although the Spartan 201-04 spacecraft was go for a second deployment and shortened mission, the propellant available on Columbia was insufficient for rendezvous and capture activities. Post flight testing and data tape playbacks performed at Kennedy Space Center during January 1998 confirmed that the Spartan 201 spacecraft was healthy and had performed as expected under the off-nominal conditions. All flight data correlated well with the in-flight predictions and assessments.

Spartan 201 has successfully flown on three previous missions: Spartan 201-1 on STS-56 (April 1993); Spartan 201-2 on STS-64 (Sept. 1994); Spartan 201-3 on STS-69 (Sept. 1995). Additional information about the Spartan 201 payload and its science mission can be found at the following Web sites:

http://spartans.gsfc.nasa.gov/201/homepage.html

http://umbra.nascom.nasa.gov/spartan/