Solar Dynamics Observatory

From Wikipedia, the free encyclopedia

Solar Dynamics Observatory

- *The Solar Dynamics Observatory (SDO) is a NASA mission which has been observing the Sun since 2010.*
- *The goal of the SDO is to understand the influence of the Sun on the Earth and near-Earth space by studying the solar atmosphere on small scales of space and time and in many wavelengths simultaneously.*

The Solar Dynamics Observatory (SDO) is a NASA mission which has been observing the Sun since 2010. Launched on February 11, 2010, the observatory is part of the Living With a Star (LWS) program.

The goal of the LWS program is to develop the scientific understanding necessary to effectively address those aspects of the connected Sun–Earth system directly affecting life and society. The goal of the SDO is to understand the influence of the Sun on the Earth and near-Earth space by studying the solar atmosphere on small scales of space and time and in many wavelengths simultaneously. SDO has been investigating how the Sun's magnetic field is generated and structured, how this stored magnetic energy is converted and released into the heliosphere and geospace in the form of solar wind, energetic particles, and variations in the solar irradiance.

General

- *Some consider SDO to be a follow-on mission to the Solar and Heliospheric Observatory (SOHO).*
- *SDO is a 3-axis stabilized spacecraft, with two solar arrays, and two high-gain antennas, in an inclined geosynchronous orbit around Earth.*
- *The SDO spacecraft was developed at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and launched on February 11, 2010, from Cape Canaveral Air Force Station.*

The SDO spacecraft was developed at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and launched on February 11, 2010, from Cape Canaveral Air Force Station. The primary mission is scheduled to last five years and three months, with expendables expected to last for ten years. Some consider SDO to be a follow-on mission to the Solar and Heliospheric Observatory (SOHO).

SDO is a 3-axis stabilized spacecraft, with two solar arrays, and two high-gain antennas, in an inclined geosynchronous orbit around Earth. The spacecraft includes three instruments: the Extreme Ultraviolet Variability Experiment (EVE) built in partnership with the University of Colorado at Boulder's Laboratory for Atmospheric and Space Physics (LASP), the Helioseismic and Magnetic Imager (HMI) built in partnership with Stanford University, and the Atmospheric Imaging Assembly (AIA) built in partnership with the Lockheed Martin Solar & Astrophysics Laboratory. Data which is collected by the craft is made available as soon as possible, after it is received.

Helioseismic and Magnetic Imager (HMI)

- *HMI observations will enable establishing the relationships between the internal dynamics and magnetic activity in order to understand solar variability and its effects.*
- *The Helioseismic and Magnetic Imager (HMI), led from Stanford University in Stanford, California, studies solar variability and characterizes the Sun's interior and the various components of magnetic activity.*

The Helioseismic and Magnetic Imager (HMI), led from Stanford University in Stanford, California, studies solar variability and characterizes the Sun's interior and the various components of magnetic activity. HMI will take high-resolution measurements of the longitudinal and vector magnetic field over the entire visible solar disk[how?] thus extending the capabilities of SOHO's MDI instrument.

HMI produces data to determine the interior sources and mechanisms of solar variability and how the physical processes inside the Sun are related to surface magnetic field and activity. It also produces data to enable estimates of the coronal magnetic field for studies of variability in the extended solar atmosphere. HMI observations will enable establishing the relationships between the internal dynamics and magnetic activity in order to understand solar variability and its effects.

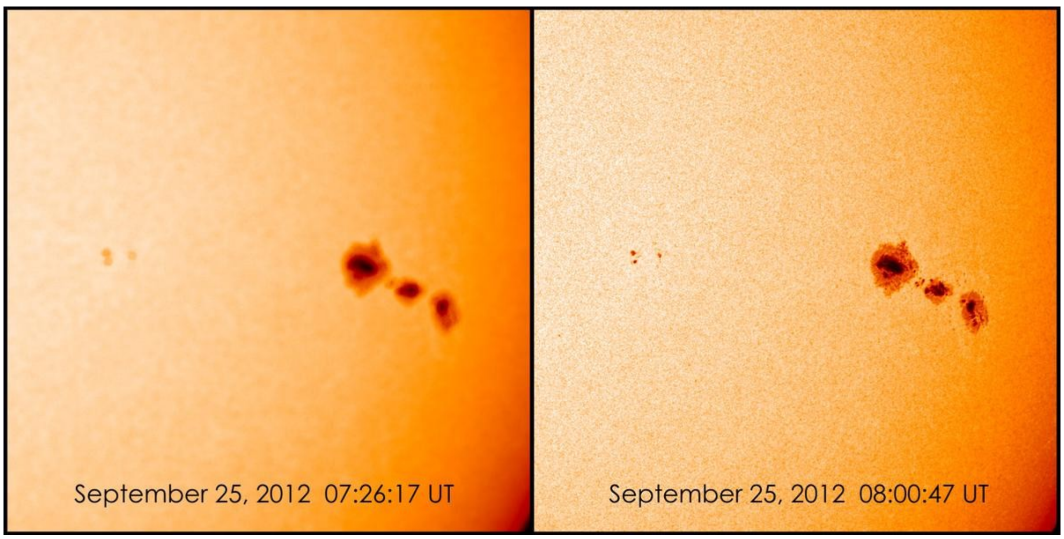
Extreme Ultraviolet Variability Experiment (EVE)

- *The instrument incorporates physics-based models in order to further scientific understanding of the relationship between solar EUV variations and magnetic variation changes in the Sun.*
- *Solar EUV radiation output undergoes constant changes, both moment to moment and over the Sun's 11-year solar cycle, and these changes are important to understand because they have a significant impact on atmospheric heating, satellite drag, and communications system degradation, including disruption of the Global Positioning System.*

The Extreme Ultraviolet Variability Experiment (EVE) measures the Sun's extreme ultraviolet irradiance with improved spectral resolution, "temporal cadence", accuracy, and precision over preceding measurements made by TIMED SEE, SOHO, and SORCE XPS. The instrument incorporates physics-based models in order to further scientific understanding of the relationship between solar EUV variations and magnetic variation changes in the Sun.

The Sun's output of energetic extreme ultraviolet photons is primarily what heats the Earth's upper atmosphere and creates the ionosphere. Solar EUV radiation output undergoes constant changes, both moment to moment and over the Sun's 11-year solar cycle, and these changes are important to understand because they have a significant impact on atmospheric heating, satellite drag, and communications system degradation, including disruption of the Global Positioning System.

The EVE instrument package was built by the University of Colorado at Boulder's Laboratory for Atmospheric and Space Physics, with Dr. Tom Woods as Principal Investigator, and was delivered to Goddard Space Flight Center on September 7, 2007. The instrument provides improvements of up to 70 percent in spectral resolution measurements in the wavelengths below 30 nm, and a 30 percent improvement in "time cadence" by taking measurements every 10 seconds over a 100 percent duty cycle.



Comparison of HMI Continuum images immediately after an eclipse, and then after the sensor has re-warmed.

Atmospheric Imaging Assembly (AIA)

- *Photographs of the Sun in these various regions of the spectrum can be seen at NASAs SDO Data-website http://sdo.gsfc.nasa.gov/data.*
- *The Atmospheric Imaging Assembly (AIA), led from the Lockheed Martin Solar and Astrophysics Laboratory (LMSAL), provides continuous full-disk observations of the solar chromosphere and corona in seven extreme ultraviolet (EUV) channels, spanning a temperature range from approximately 20,000 Kelvin to in excess of 20 million Kelvin.*

The Atmospheric Imaging Assembly (AIA), led from the Lockheed Martin Solar and Astrophysics Laboratory (LMSAL), provides continuous full-disk observations of the solar chromosphere and corona in seven extreme ultraviolet (EUV) channels, spanning a temperature range from approximately 20,000 Kelvin to in excess of 20 million Kelvin. The 12-second cadence of the image stream with 4096 by 4096 pixel images at 0.6 arcsec/pixel provides unprecedented views of the various phenomena that occur within the evolving solar outer atmosphere.

The AIA science investigation is led by LMSAL, which also operates the instrument and – jointly with Stanford University – runs the Joint Science Operations Center from which all of the data are served to the worldwide scientific community, as well as the general public. LMSAL designed the overall instrumentation and led its development and integration. The four telescopes providing the individual light feeds for the instrument were designed and built at the Smithsonian Astrophysical Observatory (SAO). Since beginning its operational phase on 2010/05/01, AIA has operated successfully, with unprecedented EUV image quality.

Photographs of the Sun in these various regions of the spectrum can be seen at NASAs SDO Data-website http://sdo.gsfc.nasa.gov/data. Images and movies of the Sun seen on any day of the mission, including within the last half-hour, can be found at http://sdowww.lmsal.com/suntoday/.

Communications

- *Mission controllers operate the spacecraft remotely from the Mission Operations Center at NASA's Goddard Space Flight Center.*

SDO down-links science data (K band) from its two onboard high-gain antennas, and telemetry (S-band) from its two onboard omnidirectional antennas. The ground station consists of two dedicated (redundant) 18-meter radio antennas in White Sands Missile Range, New Mexico, constructed specifically for SDO. Mission controllers operate the spacecraft remotely from the Mission Operations Center at NASA's Goddard Space Flight Center. The combined data rate is about 130 Mbit/s (150 Mbit/s with overhead, or 300 Msymbols/s with rate 1/2 convolutional encoding), and the craft generates approximately 1.5 terabytes of data per day (equivalent to downloading around 500,000 songs).

The launch Thursday, 11 February 2010 15:23:00 UTC (10:23a.m. EST)

Launch

- *NASA's Launch Services Program at Kennedy Space Center managed the payload integration and launch.*
- *The SDO launched from Cape Canaveral Air Force Station Space Launch Complex 41, utilizing an Atlas V-401 rocket with a RD-180 powered Common Core Booster, which has been developed to meet the Evolved Expendable Launch Vehicle (EELV) program requirements.*

NASA's Launch Services Program at Kennedy Space Center managed the payload integration and launch. The SDO launched from Cape Canaveral Air Force Station Space Launch Complex 41, utilizing an Atlas V-401 rocket with a RD-180 powered Common Core Booster, which has been developed to meet the Evolved Expendable Launch Vehicle (EELV) program requirements.

Orbit

- *SDO then underwent a series of orbit-raising maneuvers which adjusted its orbit until the spacecraft reached its planned circular, geosynchronous orbit at an altitude of 35,789 kilometres (22,238 mi), at 102° W longitude, inclined at 28.5°.*
- *After launch, the spacecraft was placed into an orbit around the Earth with an initial perigee of about 2,500 kilometres (1,600 mi).*

After launch, the spacecraft was placed into an orbit around the Earth with an initial perigee of about 2,500 kilometres (1,600 mi). SDO then underwent a series of orbit-raising maneuvers which adjusted its orbit until the spacecraft reached its planned circular, geosynchronous orbit at an altitude of 35,789 kilometres (22,238 mi), at 102° W longitude, inclined at 28.5°.

Sun dog phenomenon

- *Moments after launch, SDO's Atlas V rocket flew past a sun dog hanging suspended in the blue Florida sky and when the rocket penetrated the cirrus cloud, shock waves rippled through the cloud and destroyed the alignment of the crystals of the sun dog making a visible rippling effect in the sky.*

Moments after launch, SDO's Atlas V rocket flew past a sun dog hanging suspended in the blue Florida sky and when the rocket penetrated the cirrus cloud, shock waves rippled through the cloud and destroyed the alignment of the crystals of the sun dog making a visible rippling effect in the sky.

Camilla

- *It is part of the Education and public outreach team and assists with various functions to help educate the public, mainly children, about the SDO mission, facts about the Sun and space weather.*
- *Camilla Corona is a rubber chicken (similar to a children's toy), and is the mission mascot for NASA's Solar Dynamics Observatory (SDO).*

Camilla Corona is a rubber chicken (similar to a children's toy), and is the mission mascot for NASA's Solar Dynamics Observatory (SDO). It is part of the Education and public outreach team and assists with various functions to help educate the public, mainly children, about the SDO mission, facts about the Sun and space weather. Camilla also assists in cross-informing the public about other NASA missions and space related projects. Camilla Corona SDO uses social media to interact with fans.

Image gallery

- *SDO 3-D schematic.*
- *An animation showing the deployment of SDO.*

- *SDO Instruments.*
- *SDO has now captured nearly seven years worth of ultra-high resolution solar footage.*
- *SDO:Year 5*
- *SDO ready to be placed on Atlas rocket for launch.*
- *Camilla Corona SDO.*

SDO:Year 5

Camilla Corona SDO.

SDO 3-D schematic.

SDO Instruments.

SDO ready to be placed on Atlas rocket for launch.

An animation showing the deployment of SDO.

First light image from the SDO showing a prominence eruption.

An image of the 2012 Transit of Venus taken by SDO.

This movie opens with a full-disk view of the Sun in visible wavelengths. Then the filters are applied to small pie-shaped wedges of the Sun.

SDO has now captured nearly seven years worth of ultra-high resolution solar footage. This time lapse shows that full run from two of SDO's instruments.

See also

- *STEREO (Solar TErrestrial RElations Observatory), launched 2006, still operational.*
- *Solar and Heliospheric Observatory*

Heliophysics

Radiation Belt Storm Probes (Van Allen Probes)

Richard R. Fisher

Solar and Heliospheric Observatory

STEREO (Solar TErrestrial RElations Observatory), launched 2006, still operational.

WIND (spacecraft), launched 1994, still operational.

List of heliophysics missions

References

External links

- *Where is the Solar Dynamics Observatory (SDO) right now?*
- *Solar Dynamics Observatory (SDO) mission website*

Solar Dynamics Observatory (SDO) mission website

Where is the Solar Dynamics Observatory (SDO) right now?

SDO Outreach Material, HELAS

Inbound SOHO comet disintegrates as seen in SDO AIA images (Cometal July 14, 2011)

History of SDO patch, Facebook

Sunspot Database based on SDO (HMI) satellite observations from 2010 to nowadays with the newest data. ()

Album of images and videos by Seán Doran, based on SDO imagery

Instruments

- *Joint Science Operations Center – Science Data Processing HMI – AIA*
- *Helioseismic and Magnetic Imager (HMI), Stanford*

Extreme Ultraviolet Variability Experiment (EVE), University of Colorado

ATMOSPHERIC IMAGING ASSEMBLY (AIA), Lockheed Martin

Helioseismic and Magnetic Imager (HMI), Stanford

Joint Science Operations Center – Science Data Processing HMI – AIA