ARCHIVED REPORT

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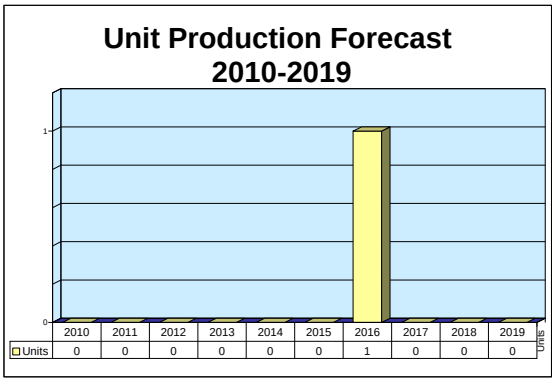
Solar Orbiter

Outlook

- In March 2009, ESA and NASA selected the scientific organizations that will provide mission payloads for Solar Orbiter
- ESA will choose two missions for its Cosmic Vision 2015-2025 program in 2010; Solar Orbiter is one of the candidates



Orientation

Description. The Solar Orbiter spacecraft is designed to travel to the Sun, obtain images, and collect data.

Sponsor. ESA is the sponsor of the mission, and is discussing joint participation with NASA under the U.S. space agency's International Living With a Star program.

Status. Currently in the formal definition phase, the Solar Orbiter is competing for a launch opportunity in 2017 as part of the ESA Cosmic Vision 2015-2025 program.

Total Produced. None

Application. The Solar Orbiter will study the solar atmosphere from near-Sun and out-of-ecliptic vantage points. It will also provide in-situ measurements of the inner heliosphere.

Price Range. The Solar Orbiter is expected to cost at least $526 million.

Contractors

Note(s): Contractor selection has not begun.

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Design Features. The spacecraft is based on a three-axis stabilized platform that points toward the Sun at all times. The telemetry package consists of X-band low-gain antennas and a two-axis steerable Ka-band

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high-gain antenna. Solar Orbiter will use solar electric propulsion technology tested by SMART-1 and the Bepi Colombo mission to Mercury. The Solar Electric Propulsion System will consist of four plasma thrusters.

The Solar Orbiter will operate in an elliptical orbit around the Sun and approach as close as 48 solar radii. The mission profile is composed of three phases: the **cruise phase**, in which flybys of Venus drive the semi-major axis changes and the inclination increases (~1.9 years, 3 orbits); the **nominal mission phase**, during which the main scientific mission is performed and the orbit is typically 150 days with inclination increases to over 30° (~2.9 years, 7 orbits); and the **extended mission phase**, when further Venus flybys will help achieve higher inclination (~2.3 years, 6 orbits).

In October 2007, ESA and NASA issued announcements of opportunity to the scientific community soliciting proposals for participation in the payload complement of Solar Orbiter. In March 2009, ESA announced the instruments selected as the scientific payload for Solar Orbiter. The instruments are as follows:

Energetic Particle Detector (EPD), provided by the University of Alcala, Spain;

Extreme Ultraviolet Imager (EUI), provided by the Royal Observatory of Belgium;

Magnetometer (MAG), provided by Imperial College London, United Kingdom;

Coronagraph (METIS/COR), provided by INAF-Astronomical Observatory of Turin, Italy;

Visible Imager & Magnetograph (PHI), provided by Max-Planck-Institut für Sonnensystemforschung, Germany;

Radio and Plasma Waves (RPW), provided by LESIA, Observatoire de Paris, France;

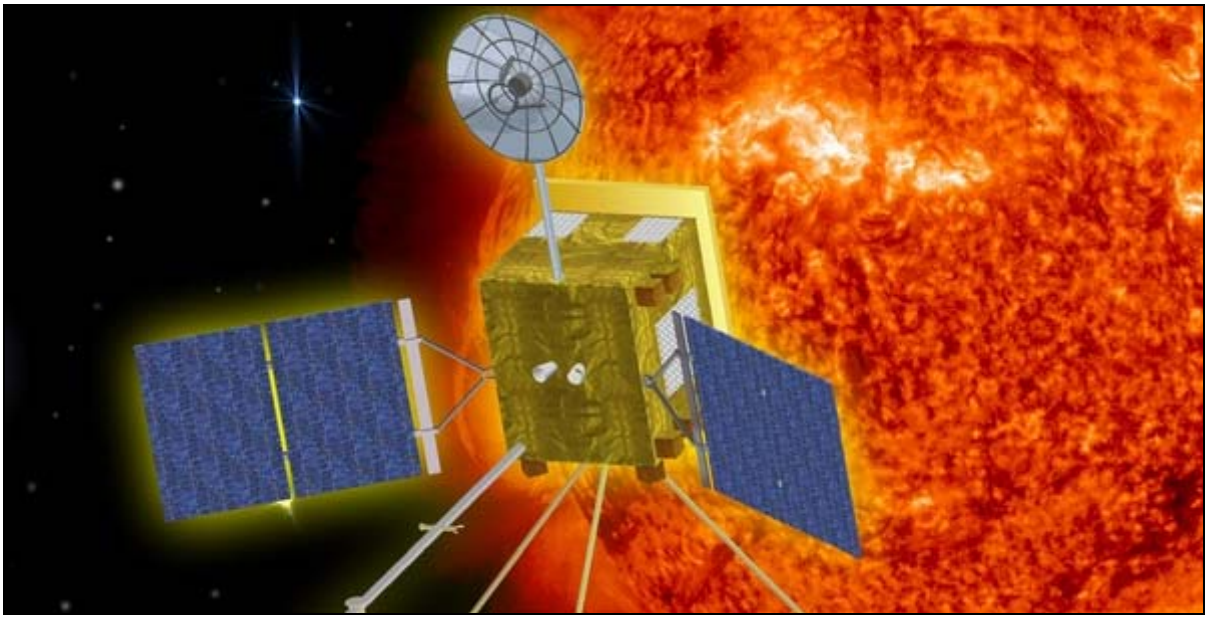
Heliospheric Imager (SoloHI) [Funded by NASA], provided by the U.S. Naval Research Laboratory, USA;

EUV Spectrometer (SPICE) [Funded by NASA], provided by the Southwest Research Institute, Boulder, Colorado, USA;

X-ray Imager (STIX), provided by Institute of Astronomy, ETH Zurich, Switzerland;

Solar Wind Plasma Analyser (SWA), provided by Mullard Space Science Laboratory, United Kingdom;

Suprathermal Ion Spectrograph (part of EPD) [Funded by NASA], provided by Applied Physics Laboratory in Columbia, Maryland, USA.



Artist's Impression of the Solar Orbiter

Source: European Space Agency

	Metric	U.S.
Dimensions		
Spacecraft	3 x 1.2 x 1.6 m	9.8 x 3.9 x 5.2 ft

	Metric	U.S.
Antenna (diameter)	1.5 m	4.92 ft
Weight		
Total Mass	1,345 kg	2,959 lb
Payload Mass	167.8 kg	369 lb
Performance		
Design Life	5 yr (consumables sized for 7 yr)	
Power	125 W	

Program Review

Background. The Solar Orbiter was selected by the Space Science Advisory Committee and approved by the ESA Council in October 2000. The mission is part of the F2 (Flexi-mission) program within the Horizon 2000 Plus program.

In November 2001, The European Space Agency invited industry to submit Letters of Intent to participate in working groups. The groups studied instrumentation that may be used in the mission.

The ESA has established a number of working groups to analyze requirements and instrumentation that may be used on the spacecraft. In the meantime, the ESA plans to select additional Flexi-missions for study.

Concerns Surface. In March 2002, 168 participants of the SOHO-11 symposium in Davos, Switzerland, expressed their concerns to the European Space Agency about possible delays to the Solar Orbiter mission. With the intent of gaining international participation to ensure timely progression, the group asked ESA to negotiate with NASA to make Solar Orbiter part of the International Living With a Star program. They recommended that in return, the ESA offer its support of the ILWS – particularly for the related Solar Dynamics Observatory – but not to the extent that it would detract from or further delay the Solar Orbiter effort.

In the ensuing months, ESA suggested to NASA that the Solar Orbiter and Bepi Colombo missions be included in the ILWS program. NASA is actively seeking to increase cooperation among the few and expensive inner heliospheric missions to optimize costs and maximize the returned science. Representatives of both agencies met to discuss the collaboration and agreed that the programs were similar enough to warrant further investigation.

The space agencies agreed to form the Joint ESA/NASA Solar Orbiter/Solar Sentinels Working Group, in which five or six members each from the European and U.S. communities will jointly study the synergies between the two programs. The plan is to "identify key science objectives that can only be accomplished jointly." The result will be options for a combined mission scenario to accomplish the ILWS goals.

NASA and ESA eventually joined the two programs under the Heliophysical Explorers program.

Laying the Groundwork. The first ESA Solar Orbiter Remote Sensing Payload Working Group meeting was held at the European Space Research and Technology Center in May 2002. Members of the group laid out the project plans, listed the challenges involved, and delegated responsibility for devising solutions.

Also at this meeting, ESA's Space Science Advisory Committee recommended that the Solar Orbiter be implemented with Bepi Colombo as a single project under a cooperative arrangement in 2011/2012.

The Good with the Bad. In November 2003, the ESA was forced to re-evaluate all previously selected missions for future implementation. The net result was a cancellation of the Mercurial lander for the Bepi Colombo mission and a cancellation of the Eddington mission. For the Solar Orbiter, it was good news and bad news.

Dr. Adam Szabo at NASA's Goddard Space Flight Center, Laboratory for Extraterrestrial Physics, discussed the events with Forecast International. Dr. Szabo explained that the survival of the orbiters from Bepi Colombo proved to be a positive development for the Solar Orbiter, which will rely heavily on many components newly developed for the Bepi Colombo mission. The bad news for the Solar Orbiter is that it was pushed beyond the review period for missions to be launched before the end of 2012. Dr. Szabo also stated that "joint NASA and ESA support for Solar Orbiter is assured. Exactly what shape and form the support will take is unclear at this time."

Solar Orbiter

Solar Orbiter is now competing for a launch opportunity in 2017 as part of ESA's Cosmic Vision 2015-2025. If selected in 2010 to continue, Solar Orbiter will be one of two programs scheduled for a 2017 or 2018 launch.

Executive Report. The ESA's Science Payloads and Advanced Concepts Office identified and published the Solar Orbiter's scientific goals in June 2005.

- Determine the properties, dynamics, and interactions of plasma fields and particles in the near-Sun heliosphere
- Investigate the links between the solar surface, corona, and inner heliosphere
- Explore the structure of the Sun's magnetized atmosphere
- Probe the solar dynamo by observing the Sun's high latitude field, flows, and seismic waves

In October 2007, ESA and NASA released announcements of opportunity to the scientific community soliciting proposals for participation in the payload complement of Solar Orbiter. In March 2009, ESA and NASA selected the winners of the proposals. Winners will provide payloads that the Solar Orbiter will use to conduct its investigations once orbiting the Sun.

Funding

The bulk of funding is provided by ESA. NASA has committed $1.7 million in initial funding under its Living With a Star heliophysics program. ESA and NASA selected the other participants to provide payloads that will conduct scientific investigations. The participants, which include universities and astronomical research groups, will fund development of these payloads.

Timetable

Month	Year	Major Development
Oct	2000	Solar Orbiter selected for Horizon 2000 Plus mission
Oct	2007	Announcement of opportunity to solicit proposals of scientific investigations for solar orbiter mission
Mar	2009	ESA and NASA select payload instruments for the solar orbiter mission
	2017	Expected launch date for Solar Orbiter

Forecast Rationale

Solar Orbiter continues to make progress. In 2009, ESA and NASA announced their selections for the Solar Orbiter payloads. This was done in preparation of a decision in 2010 that will determine whether Solar Orbiter will be launched in 2017.

The payloads will be provided by universities, observatories, and other scientific agencies, which will foot the bill for the cost of development and manufacturing. These payloads will be used to conduct Solar Orbiter's mission.

Solar Orbiter is competing to launch in 2017 with five other programs under ESA's Cosmic Vision 2015-2025. ESA will decide on two of the five programs to continue in 2010. Solar Orbiter is part of the Heliophysical Explorers NASA/ESA program and receives funding from both entities. Data gathered from Solar Orbiter will be used in the NASA solar sentinel program. A number of research organizations have signed on to participate in the program as well.

Because of international participation, it is likely that the Solar Orbiter program will continue. However, launch of the satellite could be delayed, as funds are limited and Solar Orbiter is an extremely complex and ambitious program.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program		**High Confidence**				**Good Confidence**			**Speculative**			
	Thru 2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
MFR Not Selected												
Solar Orbiter **<> ESA**												
	0	0	0	0	0	0	0	1	0	0	0	1
Total	0	0	0	0	0	0	0	1	0	0	0	1