

Closer to the Sun

Maxon Precision Motors

Without the sun, there would be no Earth and no life. However, our knowledge about our home star is still very limited. This is about to change. In 2018, the European Space Agency (ESA) will send its Solar Orbiter into space, equipped with a thick heat shield.

It is a cautious approach. Step by step, the Solar Orbiter will change its trajectory and swing by Earth and Venus to reduce its distance from the sun to only 45 million kilometers. No other human-made object was ever this close. The way back to Earth would be three times as long.

Not a pleasant place for the Solar Orbiter: At the front, temperatures rise up to 520°C under the ceaseless pounding by solar radiation. All other sides are surrounded by the eternal cold of outer space. This combination makes for an incredibly challenging environment.

The secret of solar eruptions

Solar Orbiter is a joint project of the ESA and NASA. It is going to be an important milestone in the exploration of the sun. Even though the sun is responsible for the development of the planets in our solar system, and even though it influences the weather as well as life in general, we know far too little about it. For example, what causes the solar winds? Or solar eruptions? What forces are behind the formation of the heliosphere, the cloud of charged particles that extends past the outer reaches of our solar system?

It is going to take a while until scientists will have answers to these questions. In 2018, an American rocket will take the probe into space. It will travel for three years until it can begin its work. Solar Orbiter is going to provide a new perspective



The Solar Orbiter will change its trajectory and swing by Earth and Venus to reduce its distance from the sun to only 45 million kilometers. Temperatures rise up to 520°C under the ceaseless pounding by solar radiation. All other sides are surrounded by the eternal cold of outer space making for an incredibly challenging environment (photo credit 2016 ESA – C. Carreau).

of the sun, its surface and the polar caps. For this purpose it is equipped with around a dozen cameras and measuring instruments. Some of these systems and subsystems are being developed and built in Lausanne, Switzerland. The company Almatech (*Editor's Note: see sidebar page 25*) is involved in the development of STIX, an X-ray telescope for the observation of solar eruptions. It is expected to provide new insights into the acceleration of electrons and their projection into the depths of outer space.

Sunglasses for instruments

Just like people should not look directly at the sun, measuring instruments also need protection. After all, the intensity of the radiation on board the Solar Orbiter is 13 times higher than on Earth. The primary means of protection is a state-of-the-art heat shield that remains directed at the sun at all times. A few holes can be opened for measurements. However, the instruments need to be protected too. In the case of STIX, this is provided by permanent beryllium protective filters and the use of an aluminium grid during solar eruptions. This grid can be placed in front of the 32 X-Ray detectors by means of two Maxon RE 13 motors. The brushed DC motors are wired in parallel, enabling them to be used together or individually. This ensures a service life of ten years – the planned duration of the mission.

At Almatech, four engineers are continuously working on the detector system, which is called STIX-DEM. "It's a challenge to develop a device



The Solar Orbiter's heat shield has apertures that briefly let the instruments look at the sun (2016 ESA).

that has never been built before and to test it to prove that it is going to function reliably,” said Fabrice Rottmeier, senior project manager. “At the same time, it’s a great experience and very motivating to be part of a scientific research program that investigates questions about the origin of the universe and the origin of life.”

Lightweight drives as an advantage

Weight is a critical factor for space projects. Maxon motors come into their own here. Rottmeier: “With Maxon drives we were able to build a shield that weighs less than 200 grams and survives vibrations without problems.” The renowned reliability and high quality of Maxon motors were another selection criterion. He adds: “The support from their engineers is very flexible and all around great.” **PTE**

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Maxon’s RE DC brushed motors are well-suited for space applications. The ironless winding and the high-quality magnet provide an efficiency well above 90 percent. The drive was customized for the Solar Orbiter project with special lubrication and cables (2016 Almatech).

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Company Spotlight: Almatech

Almatech is a Swiss private SME located in the Technology Parc (PSE) of the Swiss Federal Institute of Technology (EPFL). It was founded by a team of engineers. The company has experienced steady growth since its creation and offers fully integrated, project-oriented services, from the technical requirements to the delivery of hardware. Core competencies are project management, products assurance management, analysis and structure, design, manufacturing and assembly. Almatech has very strong knowhow in the design, analysis, manufacture, assembly and test of structures for space applications. Thanks to the long experience of its engineering team and to its efficient project-oriented organization, Almatech is able to propose three types of services:

Research & Development

Skills and equipment required for R&D project are very specific to the field of research and may change from one project to another. Therefore, Almatech works in close collaboration with EPFL and other research laboratories, and is a member of EPFL Space Center. Thanks to its location and the background of its engineering team, Almatech has privileged contacts with these institutions, and has access to Class 100 clean rooms. Almatech offers a global and multidisciplinary complete service, including: technical review, patent search, test planification, execution and analysis, pre- and post-test analysis, model correlation with test data and more.

Flight Hardware

Flight hardware structures are lightweight and highly reliable structures that are exposed to harsh environments. Several design iteration are often necessary to fulfill all requirements. Almatech provides an integrated service that includes 3D computer-aided design of complex assembly using *Catia*, elaboration of manufacturing plan, selection and follow up of highly specialized and competent sub-contractors, product assurance activities, validation by numerical simulations, including quasi-static, dynamic, modal and coupled thermo-mechanical calculations using *MSC.Nastran*, integration and assembly of the different parts and performance of acceptance and qualification tests.

Test Equipment

Almatech offers its clients a high-quality and innovative service. Almatech was selected in 2009 to complete the fabrication, assembly and integration of the Bepi Colombo Laser Altimeter Receiver Baffle Unit (ESA program). This project includes the FEM verification of the whole structure and its validation/qualification through dynamic tests. The validation by testing of flight hardware specific features or behavior often requires the development of ad hoc test equipment, e.g. a microgravity simulator or apparatus for application of qualification loads. Almatech offers the following services including the design of mechanical test equipment for flight hardware, cleanliness and contamination control, hazard analysis, structural verification by numerical simulation and tests and the manufacturing and assembly of the test equipment. For more information, visit www.almatech.ch. **PTE**