# Simulating space in Göttingen

27 October 2011

**DLR commissions a vacuum chamber to test electric propulsion systems for spacecraft**

Right in the heart of Göttingen - 236 cubic metres of outer space! The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) will now be able to conduct research on electric spacecraft propulsion systems under realistic conditions. The new test facility, inaugurated on 27 October 2011, will be known by an acronym derived from the German version of the name 'Göttingen Propulsion Beam Simulation Facility - Electric Thrusters' (Simulationsanlage für Treibstrahlen Göttingen - Elektrische Triebwerke; STG-ET). At its heart is a vacuum chamber where researchers will be able to investigate electric propulsion systems at temperatures as low as minus 268 degrees Celsius. With the STG-ET, Göttingen becomes a significant focal point for European spacecraft propulsion research.

**European benchmark**

"This investment represents new technological possibilities for developing electric propulsion systems and will set the new benchmark in Europe for testing them," said Johann-Dietrich Wörner, Chairman of the DLR Executive Board, during his opening speech. The size of chamber at this facility – 12 metres in length and a diameter of 5 metres – will enable the testing of entire sections of satellites. This is where long-term testing of electric spacecraft propulsion systems will take place, as well as research into the impact of engine plumes on satellites. "With its exceptionally realistic conditions, this facility stands apart from existing European facilities. The background vacuum that we can create here is unique," explained Andreas Dillmann, Head of the DLR Institute of Aerodynamics and Flow Technology.

DLR Göttingen has been conducting research into the interaction between exhaust plumes from chemical propulsion systems and spacecraft for decades. The STG-ET extends the scope of their investigative capability to electric propulsion. The STG-ET is intended to augment the scope of existing facilities, and those currently under construction, to create a competence centre for small and micro propulsion units in Lower Saxony. "The new centre is an outstanding facility for performing research under space conditions.This will, not only turn Lower Saxony into a significant centre for European research into satellite propulsion systems, but will also serve as an attractive platform for young scientists," stated Johanna Wanka, Minister of Science and Culture for the state of Lower Saxony.

**Science fiction and reality**

Electric propulsion systems – one example being the ion engine – have long been familiar, particularly to readers of science fiction. Rocket pioneer Hermann Oberth discovered the principle back in the 1920s. Today, electric propulsion is becoming increasingly important to the future of spaceflight. More specifically, its significance will grow in relation to compact satellites, interplanetary missions and formation flying satellites. To generate thrust, atoms of a propellant (usually xenon gas) are ionised, accelerated in an electric field and then ejected at a very high speed. Used in this way, thrust is generated much more efficiently – measured in terms of the amount of thrust produced for a given rate of propellant consumption – than conventional chemical propulsion systems, in which the fuel is either combusted with an oxidiser or undergoes catalytic decomposition.

The impingement of some of the ions from the engine plume on parts of the spacecraft is unavoidable and may cause damage. For example, solar panels, the power source for satellites, can turn dark and, ultimately, fail altogether. The aim of the researchers in Göttingen will be to study this with a view to reducing the amount of damage. To accomplish that, they need to gain a precise understanding of the ion beam and its effect on the surfaces of various materials, and ensure the most realistic simulation possible of the vacuum conditions in space. This is all made possible by the new STG-ET facility with its helium-based cryogenic pump. To prevent the exhaust plume from being reflected off the walls of the chamber and affecting their measurements, the researchers are employing a trick; the gas particles freeze solid as they strike the ultra-cold walls of the chamber.

Four million euros have been invested in the construction of the STG-ET facility.

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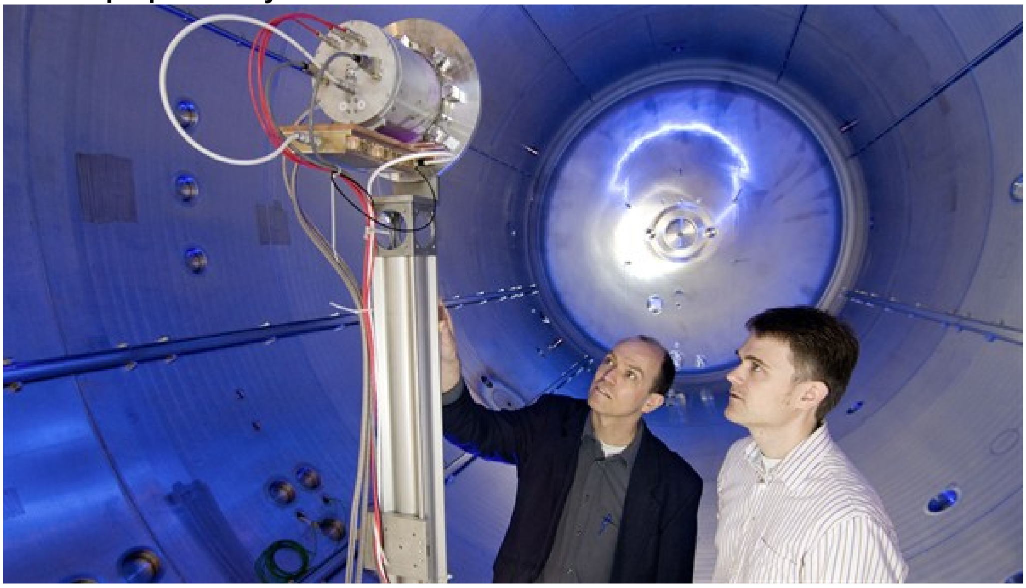
### Enormous size

A length of 12 metres and a diameter of 5 metres make the STG-ET one of the largest simulation systems for electric propulsion systems in Europe.

**Electric propulsion system in the vacuum chamber**



Andreas Neuman and André Holz viewing an electric propulsion system installed in the vacuum chamber. The STG-ET has been specially built for research into electrical propulsion systems for space.These systems have different applications than do conventional chemical propulsion systems.

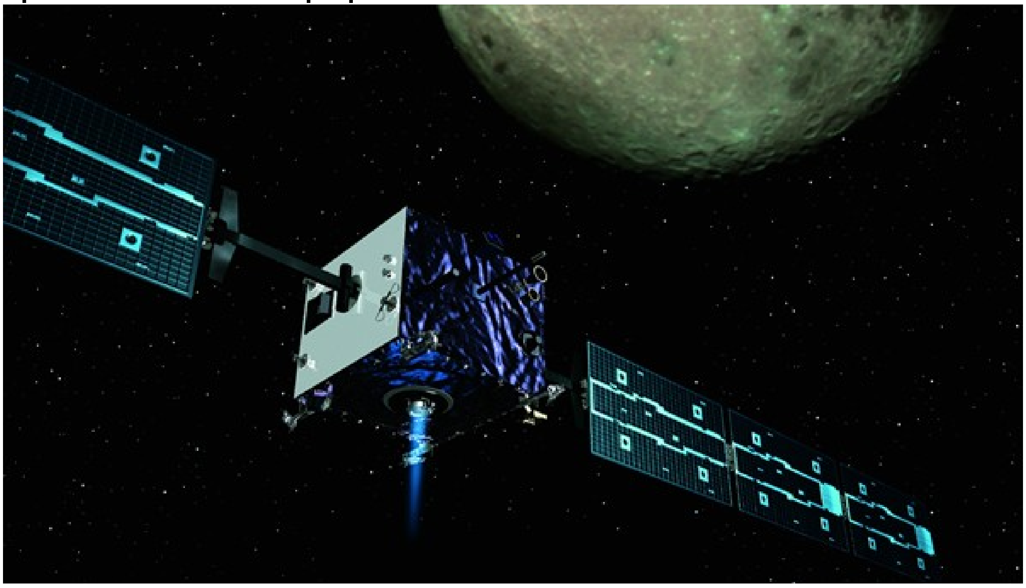
Credit: DLR (CC-BY 3.0).

**Side view**

Future electric propulsion systems for spacecraft will be tested in the STG-ET.

Credit: DLR (CC-BY 3.0).

**Spacecraft with electric propulsion**



SMART-1 was the first ESA spacecraft to explore the Moon. It was powered by an ion engine. The blue light comes from accelerated xenon ions.

Credit: ESA.

**The lid**

The cover of the 25-ton STG-ET weighs 4.5 tons.

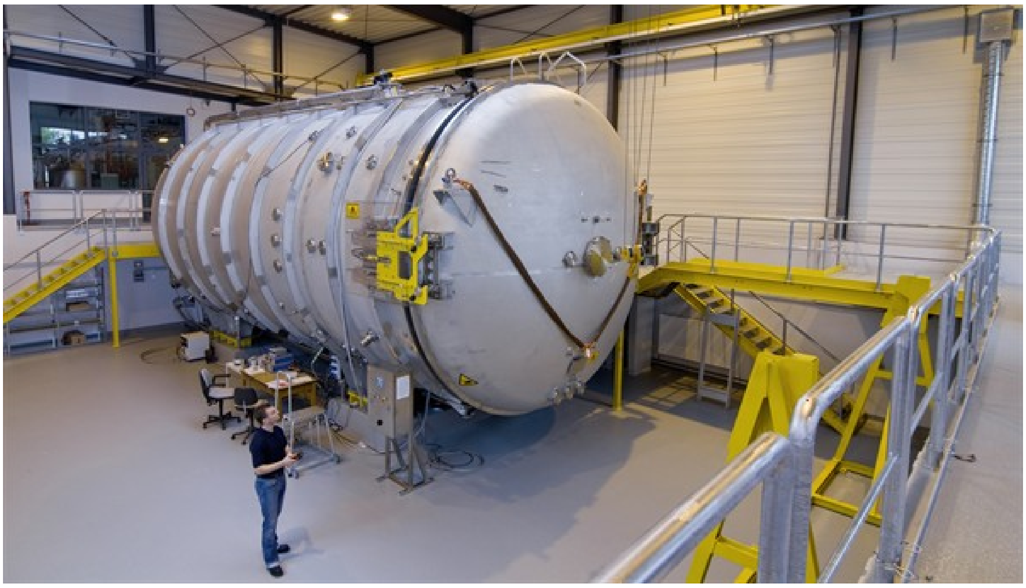
Credit: DLR (CC-BY 3.0).

**Looking into the vacuum chamber**

A vacuum is created inside the chamber, where the temperature is reduced to minus 268 degrees Celsius – close to absolute zero.



**The vacuum chamber**



The STG-ET enables ground-breaking research into electric space propulsion systems under realistic conditions.

**Andreas Neumann**

Andreas Neumann of the DLR Institute of Aerodynamics and Flow Technology in the new facility.

Credit: DLR (CC-BY 3.0).

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