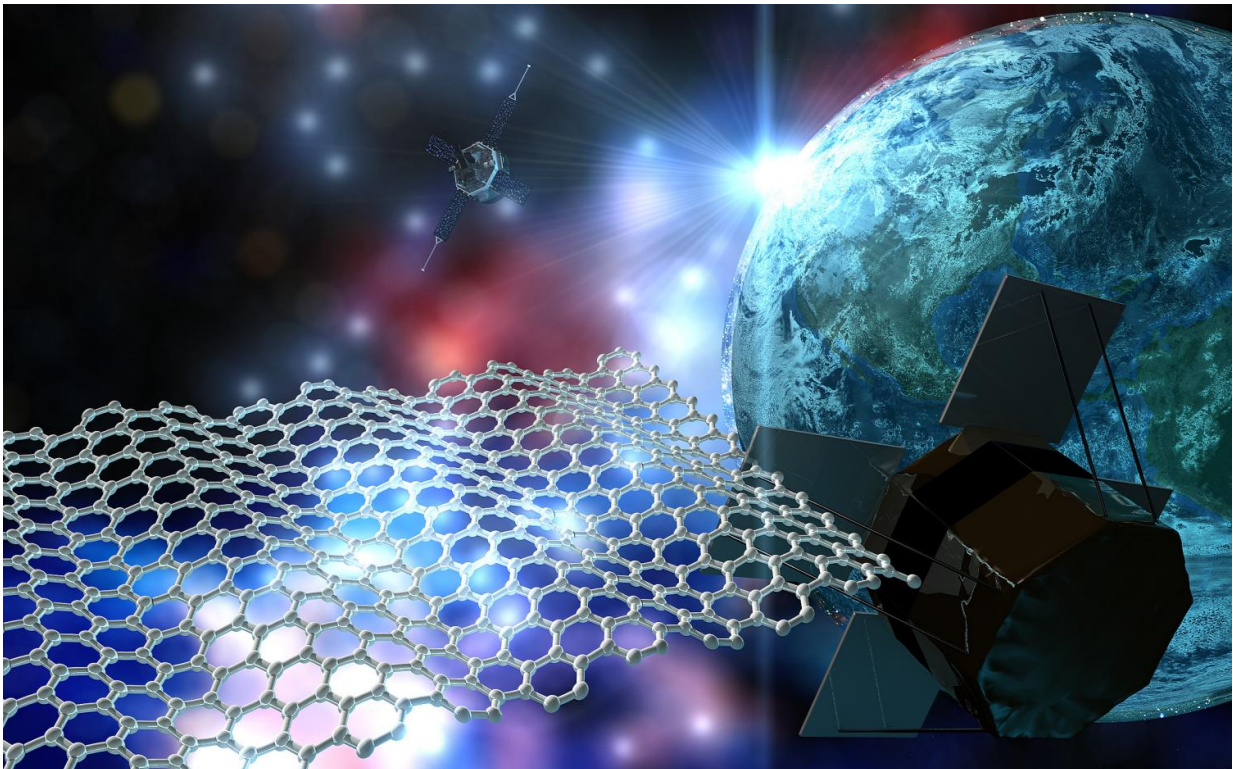


# Zero gravity: Graphene for space applications

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Two experiments this year will test graphene in different space-related applications for use in satellites. Graphene-based solar sails will be tested in microgravity in a drop-tower experiment, while graphene-modified heat pumps for onboard satellite electronics will be tested in a parabolic flight. Credit: Graphene Flagship

Researchers and students in the Graphene Flagship are preparing for two

exciting experiments in collaboration with the European Space Agency (ESA) to test the viability of graphene for space applications. Both experiments will launch between 6-17th November 2017, testing graphene in zero-gravity conditions to determine its potential in space applications including light propulsion and thermal management.

The Graphene Flagship is a pan-European research initiative dedicated to developing new technologies based on graphene, the single-atom-thick allotrope of carbon with excellent electrical, mechanical, thermal and optical properties. A fundamental aspect of the Graphene Flagship is training students and young researchers. These ambitious space-related experiments are an excellent opportunity for Flagship students and researchers to gain new [experiences](#) in cutting-edge research. Join the Graphene Flagship as we follow the progress - from the early stages in the laboratory to the moments of weightlessness!

In a fully student-led experiment, a team of Graphene Flagship graduate students from Delft Technical University (TU Delft; Netherlands) will participate in ESA Education's Drop Your Thesis! programme. Their successful proposal will use [microgravity conditions](#) in the ZARM Drop Tower (Bremen, Germany) to test graphene for light sails. By shining laser light on suspended graphene-membranes from Flagship partner Graphenea, the experiment will test how much thrust can be generated, which could lead to a new way of propelling satellites in space using light from lasers or the sun.

The PhD student team - named GrapheneX - consists of Santiago Cartamil Bueno, Davide Stefani, Vera Janssen, Rocco Gaudenzi, all research students in Herre van der Zant's research group in TU Delft. Santiago Cartamil Bueno, project leader for the GrapheneX team, said "We split tasks between the team and things are working well. We are very ambitious with the quality of the experiments. We really want to do it properly, so we are committed to do real science in this project."

ESA Education's Drop Your Thesis! programme offers students the opportunity to design an experiment for the ZARM Drop Tower in Bremen, Germany, which simulates the low gravity and vacuum conditions of space. The 146 m ZARM Drop Tower creates extreme microgravity conditions down to one millionth of the Earth's gravitational force. In vacuum, a capsule containing the experiment is catapulted up and down the tower, providing a total of 9.3 seconds of weightlessness.

Running concurrently is an experiment investigating how graphene can improve efficiency in heat transfer in loop heat pipes - cooling systems used extensively in satellites and aerospace instruments. The experiment is a collaboration between Graphene Flagship partners at the Microgravity Research Centre, Université libre de Bruxelles, Belgium; the Cambridge Graphene Centre, University of Cambridge, UK; Institute for Organic Synthesis and Photoreactivity, National Research Council of Italy (CNR), Italy; and Leonardo Spa, Italy, a global leader in aerospace, producing of a variety of components and systems for space applications.

A significant part of the loop heat pipe is the wick, typically made of porous metal. In this experiment, the wicks will be coated with different types of graphene-related materials to improve the efficiency of the heat pipe. The coated wicks will be tested in a low-gravity parabolic flight operated by ESA in partnership with Novespace, France. During each 3-hour flight, the specially modified plane will make a series of 30 parabolic ascents with around 25 seconds of weightlessness in each parabola.

Involved in the experiment are Graphene Flagship researchers Vanja Mišković and Fabio Iermano, both working at the Microgravity Research Centre, and Lucia Lombardi and Yarjan Samad, both at the Cambridge Graphene Centre. As well as the on-ground experiments, the young

researchers will experience weightlessness on board the low-gravity flights in November.

"I'm really excited because this will be my first zero gravity experience," said Lombardi. "The idea is to use graphene to improve the thermal conductivity and the capillary pressure by growing a sponge in the pores of the wicks," she added.

"We want to test different kinds of coatings since the graphene and graphene oxide have different properties, but we are hoping to achieve good results with both of the coatings," added Miškovi?. "I'm very excited, I know that not a lot of people get this opportunity."

Andrea Ferrari (University of Cambridge), Science and Technology Officer of the Graphene Flagship and chair of its management panel added "Space is the new frontier for the Graphene Flagship. These initial experiments will test the viability of graphene-enabled devices for space applications. The combined strengths of the Graphene Flagship, Flagship partners and the European Space Agency as well global leader in aerospace applications Leonardo, give a strong basis to reach a high technology readiness level."

Jari Kinaret (Chalmers University of Technology, Sweden), Director of the Graphene Flagship, said "These two projects exemplify the two-fold character of the Graphene Flagship: the loop heat pipe project is targeting a specific application, while the light sail project is firmly linked to basic research and builds upon the unique combination of properties that only [graphene](#) can offer. I am particularly proud of the fact that one of these projects was initiated by students working on area completely disconnected from space applications: this demonstrates the creativity of the next generation of researchers, and shows the sometimes surprising links between different parts of our Flagship - or maybe I should say spaceship?"

Follow the progress at <https://graphene-flagship.eu/material/Zero%20Gravity%20Graphene/Pages/default.aspx>

Provided by Graphene Flagship

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