UCD Impact Case Study

EIRSAT-1: Ireland's first satellite

EIRSAT-1 Team

UCD Schools of Physics, Mechanical & Materials Engineering, Mathematics & Statistics, Electrical & Electronic Engineering, Computer Science

ACADEMIC · CULTURAL · ECONOMIC · SCIENTIFIC · SOCIAL · TECHNO-LOGICAL · TRAINING

SUMMARY

Ireland is about to become an independent spacefaring country. UCD is designing, building and testing a research satellite to detect gamma-ray bursts, evaluate advanced materials, and demonstrate a new method of spacecraft control.

EIRSAT-1 is the first spacecraft to be developed in Ireland. It will be delivered to the European Space Agency (ESA) in 2020. The EIRSAT-1 project is carried out with the support of the Education Office of the European Space Agency, under the educational Fly your Satellite! Programme.

EIRSAT-1 will position UCD and Ireland to take a leading role in international space missions, support growth of the Irish space industry, deliver highly skilled graduates into the workforce, and continue to inspire school children in STEM subjects.

The project has been presented to media outlets, to primary and secondary schools, to senior ESA and NASA management, and to government.

> "This is an incredibly exciting project with great potential to have significant impact beyond those directly participating in the project, including the expanding space industry sector in Ireland."
>
> Minister of State for Training, Skills, Innovation, Research and Development, John Halligan TD

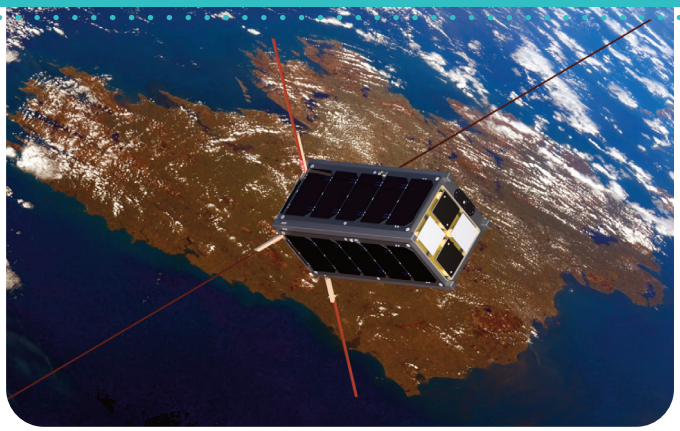
RESEARCH DESCRIPTION

The Educational Irish Research Satellite (EIRSAT-1) is an ongoing project by an interdisciplinary team across UCD, with industry support. It began in 2017.

EIRSAT-1 involves the design, development, assembly, test, launch and operations of a small spacecraft. EIRSAT-1 will fly three scientific experiments on board, all designed and developed in UCD, Ireland's leading university for space research. These experiments contain technology from Irish industrial partners that will be flown in space for the first time, marking an important step in proving their ability to perform in space.

The primary experiment on-board EIRSAT-1 is a novel gamma-ray detector, called GMOD. It aims to detect gamma-ray bursts, the most energetic explosions in the universe, which occur when some stars die or collide.

The second experiment, EMOD, is an in-flight demonstration of thermal management coatings, called "Solar White" and "Solar Black", developed by UCD and the Irish company ENBIO Ltd.



Render of a fully operational EIRSAT-1 in orbit. (Credit: Joe Thompson)

These are newly developed coatings to protect a spacecraft from extreme temperatures.

The third experiment, called Wave-Based Control, or WBC, tests a UCD-developed algorithm to control the orientation of EIRSAT-1 relative to the Earth and the Sun. Data will be downlinked to the ground station at UCD for analysis and dissemination to the research teams and to the general public.

The spacecraft will be delivered to the European Space Agency (ESA) at the end of 2020.

EIRSAT-1 TEAM

Lead-PI: Professor Lorraine Hanlon

Co-PI: Associate Professor Sheila McBreen, Assistant Professor David McKeown, Associate Professor William O'Connor

Programme Manager: Dr Ronan Wall

Student Team: Maeve Doyle, Rachel Dunwoody, Masoud Emam, Jessica Erkal, Gianluca Fontanesi, Andrew Gloster, Joe Mangan, Fergal Marshall, David Murphy, Conor O'Toole, Favour Okosun, Rakhi Rajagopalan Nair, Jack Reilly, Jack Kyle, Lána Salmon, Daire Sherwin, Joe Thompson, Sarah Walsh

Academic Board: Assistant Professor Antonio Martin-Carrillo, Assistant Professor Deirdre Coffey, Professor Kenneth Stanton, Associate Professor Vikram Pakrashi, Professor Anding Zhu, Assistant Professor Lennon Ó'Náraigh, Assistant Professor Barry Wardell, Professor Adrian Ottewill, Assistant Professor Derek Greene

Associates: Dr Daithi de Faoite, Dr Joe Flanagan, Umair Javaid, Dr Derek O'Callaghan, Dr Alexey Uliyanov

RESEARCH IMPACT

Facilitating Ireland's leading role in international space missions

As well as measurements of gamma-ray bursts, the gamma-ray detector experiment will also give crucial information on how it performs in space. This will increase the likelihood of future in-space collaboration with the ESA and NASA, on specific missions such as gamma-ray constellations, BurstCube and ASTROGAM.

The materials experiment, EMOD, will prove the suitability of the Solar White coating and produce updated performance data for the Solar Black coating. These data will be available to the ESA for their own thermal management coatings, the first application being on the Solar Orbiter and NEOSAT missions.

Results of the WBC experiment will be exploited in future missions with large deployable flexible structures in space, like antennae or large science instruments. With the increase in demand for communication bandwidth, this is an especially crucial capability for spacecraft. The impact will occur over the coming 3-5 years during mission studies and the use of this technology on actual missions.

EIRSAT-1's Student Team during a test at the European Space Agency facilities at Redu, Belgium.

Supporting the growth of the Irish space industry

The research directly supports the Irish space industry, contributing to the Government's vision of a sustainable and expanding space sector, as articulated in the Nation Space Strategy for Enterprise 2019-2025.

Along with the flight of the ENBIO Ltd hardware, the EIRSAT-1 team will supply performance data for Taoglas Ltd GPS antenna and cables, which are also being flown. Parameter Space Ltd are supporting the development of the ground part of the communications link to the spacecraft.

The mission will allow UCD to support industry to qualify their own technology for space, through vacuum and vibration testing and product assurance. This will also facilitate a future follow-on mission dedicated to evaluating the space-flight performance of technology from Irish companies. For the space industry, being able to say that technology has already flown and performed well is of the utmost value given the risk-averse nature of the space market.

Delivering highly skilled graduates into the workforce

The capability to prepare, build, test, launch and operate a spacecraft has not existed in Ireland before. These skills in systems, electrical, thermal, control and communication engineering, along with scientific payload development and spacecraft operations, are extremely valuable in order to support the growing space market, which has shown continuous recession-proof growth for the last 20 years. Irish companies need the right mix of skills to allow it to continue growing. All graduates from the UCD MSc in Space Science and Technology have found employment, many in the space sector, both in Ireland and abroad.

Continuing to inspire school children in STEM subjects

EIRSAT-1 has resulted in extensive cultural and educational impact – even in advance of the satellite's launch – with presentations already made to over 800 primary and secondary school pupils. The team have further plans to provide online engagement tools to widen the scope of access to the mission. Some data will be made available to allow closer interaction with the mission at classroom level. Other highly impactful activities, such as Baking in Space and astronomy festivals across the country, have attracted over 1000 people of all ages. This impact is happening now and will continue, peaking around the launch (expected in 2020).

Achieve societal impact through media

There have been many media reports, interviews and other appearances by members of the EIRSAT-1 team, which are listed in the Reference section below. This includes domestic and ESA dissemination channels.

The EIRSAT-1 team has inspired primary, secondary, third-level and public groups with its story.

REFERENCES

Project support

The project has attracted substantial public support from Irish government, space industry, and the European Space Agency:

"The project will have a significant impact on educational programmes and future skills by placing space flight know-how into students' hands for the first time. This is an incredibly exciting project with great potential to have significant impact beyond those directly participating in the project, including the expanding space industry sector in Ireland."

Minister of State for Training, Skills, Innovation, Research and Development, John Halligan TD

"The Irish Space Industry Group is delighted with the selection by ESA of the UCD-led Irish satellite EIRSAT-1 to proceed to the next phase of the Fly Your Satellite! 2 Programme. The EIRSAT-1 mission is a fantastic opportunity to develop the skills and experience necessary to support sustainable growth in the Irish space sector and provide inspiration to young people to choose an exciting career in space science and engineering."

Chair of the Irish Space Industry Group, Danny Gleeson

"Thanks to the support given to ESA's Education Programme by all ESA Member States, ESA is able to offer more frequent CubeSat-related opportunities to university teams. ESA is therefore delighted to welcome the student-built EIRSAT-1, Ireland's first ever satellite, in the Fly Your Satellite! programme."

Head of the ESA Education & Knowledge Management Office, Hugo Marée

More information on these testimonials can be seen in this press release from the Department of Business, Enterprise and Innovation: https://dbei.gov.ie/en/News-And-Events/Department-News/2017/May/23052017c.html

The project has also attracted multiple supporters from industry throughout Ireland, a list of which can be seen here: https://www.eirsat1.ie/supporters

fly your satellite!

esa

Outreach and engagement activities

The following are the outreach and engagement activities for the project so far. This is expected to increase coming up to and immediately after the satellite's launch.

Radio
- https://www.newstalk.com/shows/futureproof-234909

TV
- http://10thingstoknowabout.ie/episode-2-space/
- https://www.youtube.com/watch?v=n255XVZruas

Video
- https://www.independent.ie/business/technology/watch-as-a-kid-i-was-completely-obsessed-with-space-meet-the-team-of-students-behind-irelands-first-satellite-37366054.html
- https://www.esa.int/spaceinvideos/Videos/2019/04/EIRSAT-1_team_integrating_their_CubeSat
- https://www.esa.int/spaceinvideos/Videos/2018/12/EIRSAT-1

Media stories
- https://www.siliconrepublic.com/inooknovation/irelands-first-satellite-eirsat-1
- https://www.rte.ie/news/technology/2018/0924/995735-ireland-satellite/
- http://www.irishexaminer.com/breakingnews/ireland/first-irish-satellite-to-be-launched-in-space-790875.html
- http://www.thejournal.ie/european-space-agency-ireland-satellite-3403982-May2017/
- https://www.newstalk.com/Irelands-first-ever-satellite-moves-one-step-closer-to-launch
- https://www.irishmirror.ie/news/irish-news/space-ireland-satellite-europe-esa-13298911
- http://www.engineersjournal.ie/2018/10/02/irelands-first-ever-satellite-moves-one-step-closer-launch-space/
- https://www.irishtimes.com/business/innovation/go-boldly-students-build-prototype-for-first-irish-satellite-1.3639485

Outreach events featuring EIRSAT-1 talks
- http://festival.ucd.ie/product/passport-to-space/
- https://www.mayodarkskyfestival.ie/events
- https://pintofscience.ie
- http://www.iopireland.org/news/18/oct/page_72076.html
- https://www.smartfutures.ie/events-page/
- https://dublin.sciencegallery.com/events/2017/11/inspirespace-daychristmas
- https://www.ista.ie/the-citizen-space/

Online engagement
- https://spacem18.imanengineer.ie/profile/lanasalmon/
- www.eirsat1.ie
- https://twitter.com/EIRSAT1

Educational materials
- https://www.eirsat1.ie/about
- http://www.spaceweek.ie/wp-content/uploads/2018/10/BCO-EIRSAT-1-Resource.pdf