



Austrian Space Law Newsletter

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NPOC Space Law Event 3



UN/Austria Symposium 10



ECSL Summer Course 30

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The Austrian Satellite PEGASUS – A Technical and Legal Success Story

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On 23 June 2017 at 6 a.m. Austrian time, the Polar Satellite Launch Vehicle PSLV-C38 launched from the Satish Dhawan Space Centre in Sriharikota, India, with a very precious cargo for Austrian standards: the CubeSat PEGASUS. This launch was the peak of more than three years of development of the Austrian nanosatellite by dozens of space enthusiasts. The small satellite was designed, manufactured and built by a consortium consisting of students and experts from the University of Applied Sciences Wiener Neustadt (FHWN) and their R&D company FOTEC, a student team from the Vienna University of Technology (TU Wien Space Team) and the Space Tech Group Austria (STG-A).

The PEGASUS project was initiated in 2013 by the University of Applied Sciences Wiener Neustadt and is part of the European QB50 mission. The objective of QB50 was to send 50 CubeSats into a particular part of the Earth's atmosphere, the so-called thermosphere. Although the processes occurring in the thermosphere are significantly impacting our climate, only a very

limited knowledge of this part of the atmosphere exists. Therefore, the aim of QB50 was to close this gap with the help of a network of CubeSats built by universities and research institutions from all around the world. PEGASUS is the Austrian contribution to this international project.

A CubeSat is a relatively small satellite. PEGASUS is just 20 cm long and has a cross section of 10 cm by 10 cm. Its mass of slightly less than 2 kg, constitutes only one percent of the weight of a standard telecommunication satellite. Yet, in spite of its size, PEGASUS is a highly complex piece of technology. The systems of the small satellite are identical with those found on large satellites. To fulfil its scientific objectives, PEGASUS carries a science unit, so-called Langmuir probes, as well as an on-board computer to control the satellite and process the generated data. Furthermore, PEGASUS is equipped with a transceiver and an antenna to allow communication between the satellite and the control team in Austria, as well as with a power system to direct the electrical power, which is generated by solar cells, either to the subsystems which require power or to store the energy in batteries. A so-called Attitude

University of Applied Sciences Wiener Neustadt (FHWN):

The University of Applied Sciences Wiener Neustadt is one of the largest Universities of Applied Sciences in Austria. Since 2012, the university also offers a Master programme in "Aerospace Engineering". The project PEGASUS was initiated by the department of Aerospace Engineering as a tool for education and as means for technology demonstration. Together with its Research and Development daughter FOTEC, the FHWN has a yearly turnover of about 2 M€ in Aerospace Engineering related projects. Particular focus of the department is the development and tests of new space propulsion systems and the use of Additive Layer Manufacturing methods for astronautics and aviation. Within the PEGASUS team, the FHWN and FOTEC were responsible for the satellite structure, its thermal design as well as for the development and testing of the ADCS. In addition, the Pulsed Plasma Thruster developed at the FHWN was used as a technology demonstration on-board PEGASUS. More information can be found at: <http://pegasus.fotec.at/>

TU Wien Space Team

The TU Wien Space Team was founded in 2010 by students at the Vienna University of Technology. It is involved in a variety of projects including the construction of experimental rockets, the deve-

lopment of satellites as well as the design of lunar landing modules. The main idea behind the Space Team is to practically apply the theoretical skills acquired at university through the participation in student-led projects.

For PEGASUS the Space Team developed the Power Supply Unit, the energy management system and the On-Board Computer.

For more information see: <http://spaceteam.at/>

Space Tech Group Austria (STG-A)

STG-A is a group of Austrian amateur radio operators and hard- and software engineers, aiming at developing innovative solutions in communication and controlling of small satellites. All members have experience in data communication under sophisticated circumstances and programming of embedded systems. STG-A was founded especially for the PEGASUS project, but further projects are already in planning stage.

In the framework of the PEGASUS project STG-A developed and built the communication module and the peak energy storage for the satellite. For the ground segment STG-A engineered the ground stations, the ground station network, the Space Data Center and the Mission Control Center. After launch STG-A is operating the satellite and is responsible for data preparation and analysis.

More information can be found at:

<http://spacedatacenter.at/stg/>

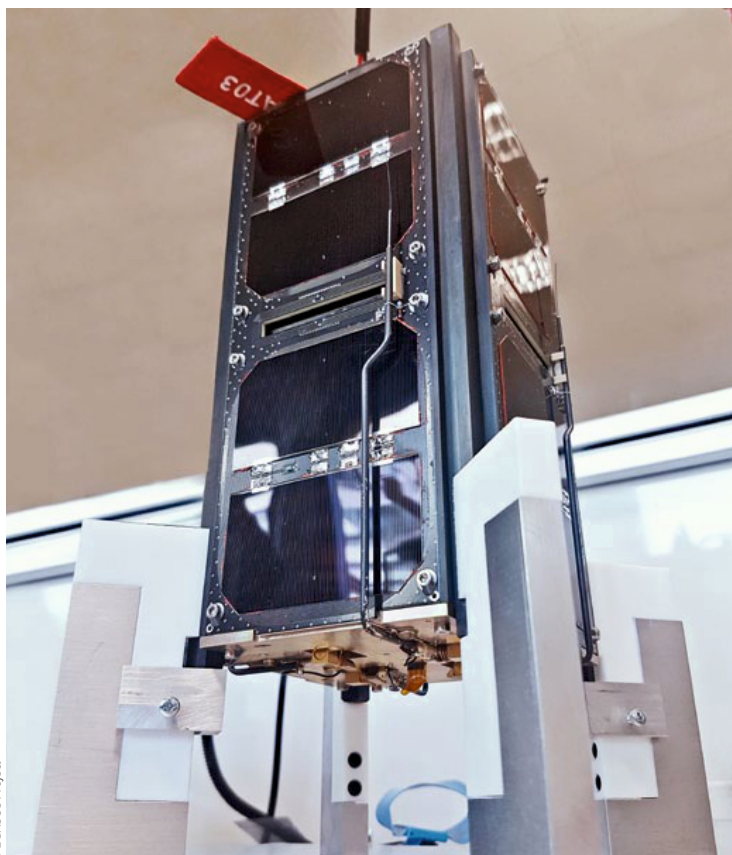
Determination and Control System (ADCS) determines the alignment of the satellite with its flight direction and corrects it, if needed. In order to allow a highly autonomous operation, a total of 12 CPUs are distributed all over the satellite, communicating with each other via a dedicated software, designed and developed for PEGASUS. Five ground stations were built in Austria to command the satellite and receive data. The received data are stored in the Space Data Center, located in Vienna, where they are processed for real time visualisation in the Mission Control Center.

Since its launch, PEGASUS has been operating successfully in space. The satellite performs plasma measurements and provides information about essential properties of the plasma in the thermosphere, such as its temperature and density. The



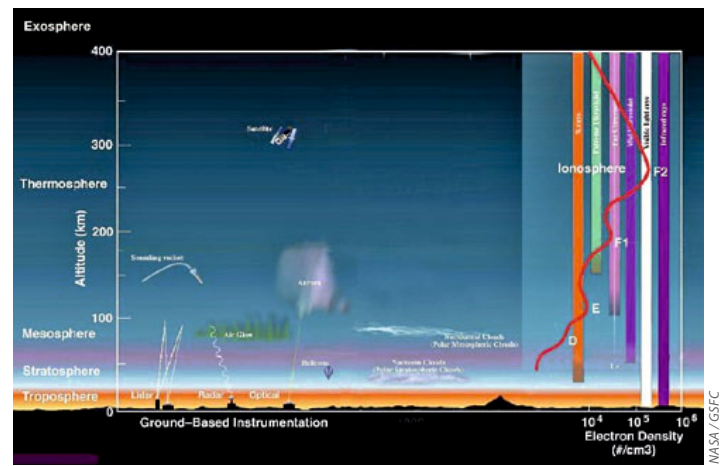
PEGASUS Project

The PEGASUS Team



The third Austrian satellite PEGASUS was launched in June 2017

provided data is expected to contribute to an improvement of the existing atmospheric and climate models which are inter alia used for weather forecasting and the assessment of phenomena such as the depletion of the ozone layer. Apart from the technical and organisational challenges of the PEGASUS project, a further aspect of this mission required specific attention. With the adoption of the Austrian Outer Space Act in 2011 and the Austrian Outer Space Regulation in 2015 a legal framework for national space activities was established in Austria. They inter alia require the authorisation of national space activities by the Austrian Minister for Transport, Innovation and Technology prior to launch. PEGASUS was the first satellite which underwent an authorisation process under the Austrian space legislation. This added a challenging aspect to the preparation of the mission. Motivated by the common wish to make PEGASUS a success, all parties did their best to fulfil all requirements and finally the authorisation to launch and operate the satellite was issued by the Ministry. In addition to all the technical lessons learned during this project, one lesson stands out, namely that a project as complicated as PEGASUS needs the cooperation and support of a large and diverse group of people. In this regard, particularly the cooperation with the Austrian Ministry for Transportation, Innovation and Technology was essential to the success of this mission. Therefore, the PEGASUS team would like to take this opportunity to thank all those who contributed to the success of PEGASUS through their support and solid belief in the project.



Integration of PEGASUS into the launch box

PEGASUS

Involved Institutions:

- University of Applied Sciences WienerNeustadt (FHWN) with its Research and Development daughter FOTEC
- SpaceTeam of the Vienna University of Technology (TU Wien Space Team)
- Space Tech Group Austria (STG-A)

Objective: Perform plasma measurements in the thermosphere as part of the QB50 mission

Operator: FHWN/STG-A

Size: 10 cm x 10 cm x 20 cm, 2U-CubeSat

Mass: 1980g

Launch: PSLV – C38, 23 June 2017 from Satish Dhawan Space Centre in Sriharikota, India

Orbit: 520 km altitude, inclination 97,8°, polar sun synchronous from dawn till dusk orbit

Ground Stations: 1 ground station in Langenleobarn (Lower Austria) at the FHWN (Lower Austria) and in Mäder (Vorarlberg) and 2 ground stations in Vienna

Space Data Center: The Space Data Server hosting the Space Data Center is located in Vienna

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