First Polish satellite launched into orbit

PW-Sat in Orbit

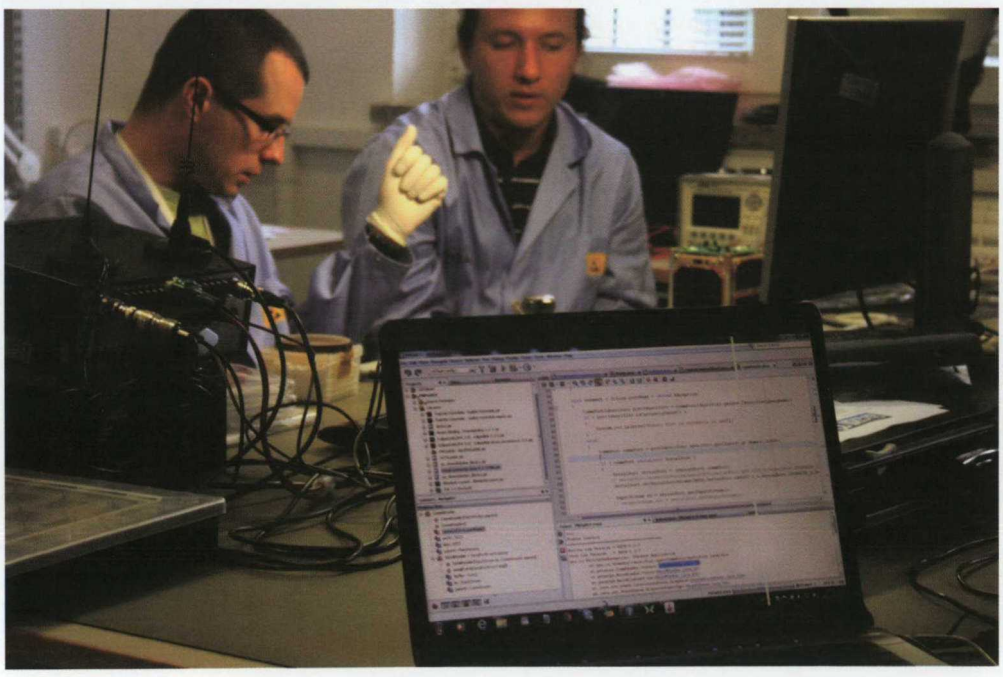
JAN POMIERNY
Science Office, Astronomia.pl
j.pomierny@astronomia.pl
Founder and publisher of Poland's leading online astronomy portal and an independent science journalist. On the day of PW-Sat's launch, he coordinated media coverage from the Guiana Space Centre.

MACIEJ URBANOWICZ
Faculty of Power and Aeronautic Engineering,
Warsaw University of Technology
maciejurbanowicz@gmail.com
Student at the Warsaw University of Technology; active in the Student Astronomy Club. Coordinator of the PW-Sat project.

PIOTR WOLAŃSKI
Faculty of Power and Aeronautic Engineering,
Warsaw University of Technology
Chairman of the PAS Committee on Space Research
wolanski@itc.pw.edu.pl
Scientific adviser to the PW-Sat project and supervisor of the education grant for the satellite's construction.

The first Polish satellite was recently launched into orbit. PW-Sat, constructed by students from the Warsaw University of Technology with support from specialists from the PAS Space Research Centre, was carried onboard the European Space Agency's VEGA launch rocket

VEGA is Europe's latest state-of-the-art rocket. Its new design enables ESA to launch satellites weighing up to 1500 kg into low Earth orbit. The qualification flight took place on 13 February this year at 11am CET. VEGA was launched from the Guiana Space Centre, and successfully delivered nine satellites into orbit: two larger ones prepared by Italian institutions – the research satellite LARES and observation satellite ALMASat-1, plus seven picosatellites built by European universities following the CubeSat standard. One of the first picosatellites placed in orbit was the Polish PW-Sat.



Andrzej Kotarba

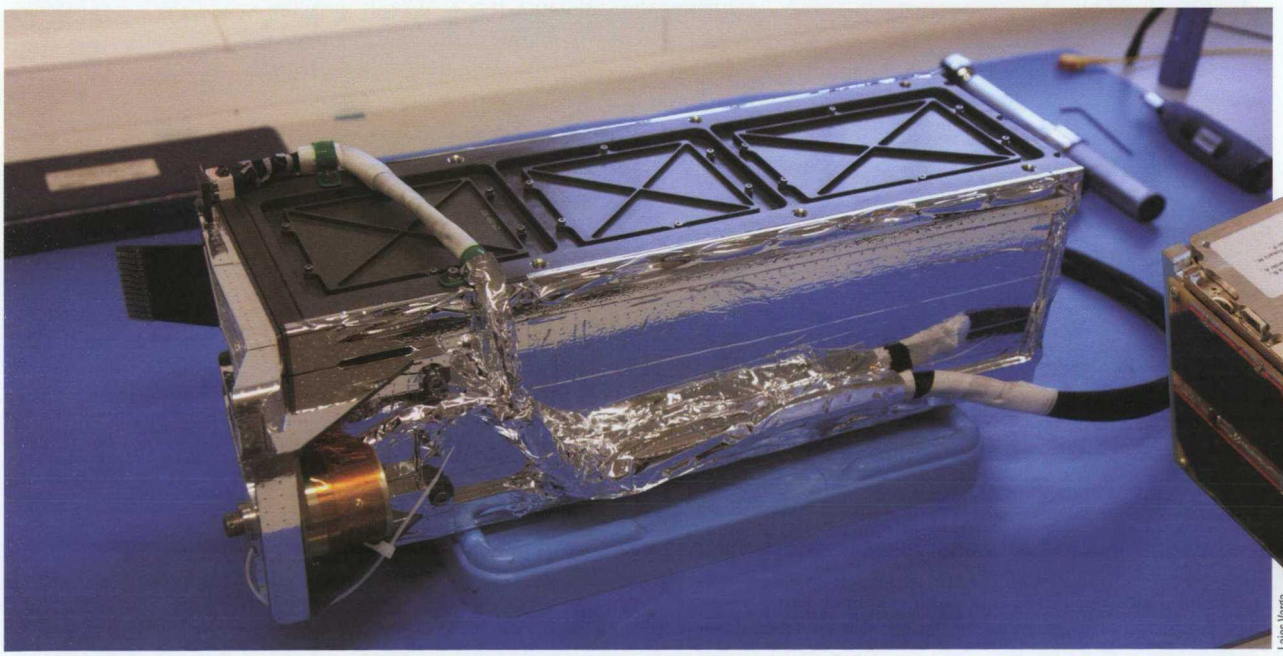
PW-Sat has been constructed by students from the Warsaw University of Technology

Andrzej Kotarba

Satellite construction is a task requiring enormous precision

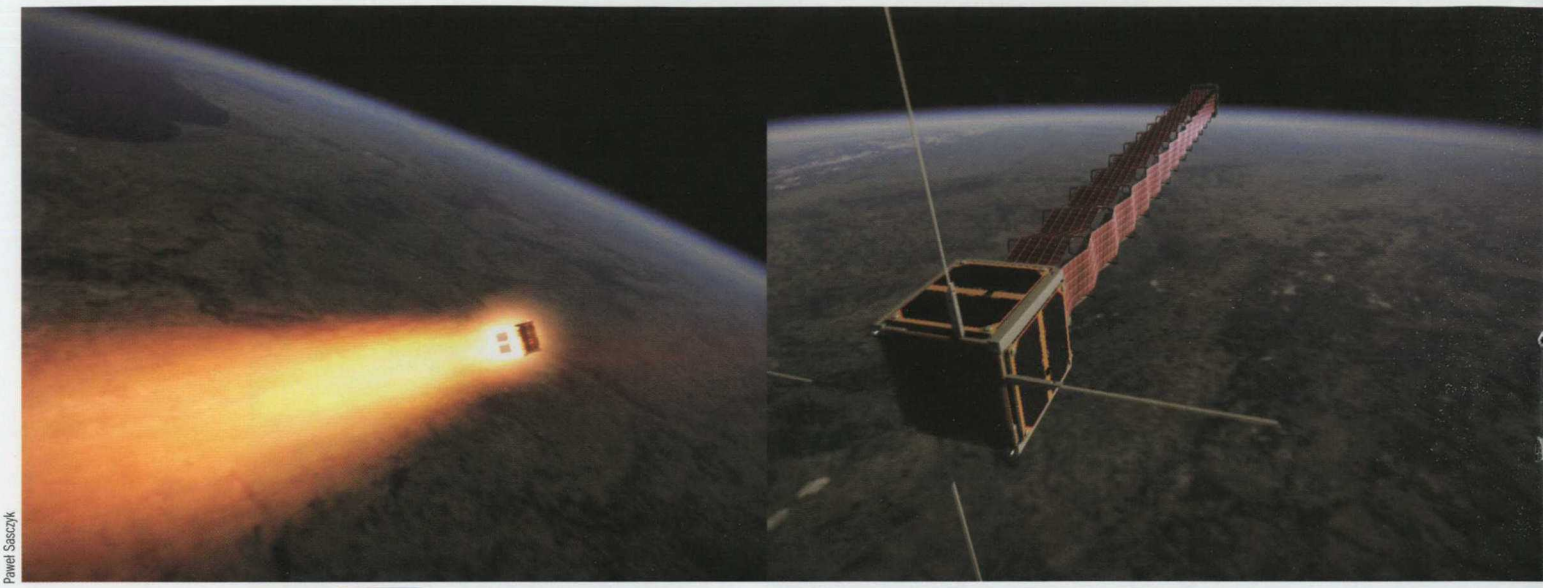
Aim: to leave orbit

PW-Sat's main purpose is to test a system for bringing down satellites which are no longer operational. Their descent from orbit is accelerated by making use of the residual air resistance present in LEO (low earth orbit). Out-of-use satellites can pose a danger to other, operational vessels such as orbiting space stations and satellites for research, observation, navigation, etc. PW-



Lajos Varga

PW-Sat is a picosatellite constructed following the CubeSat standard



Pawel Sasczyk

PW-Sat, together with eight other satellites, was launched into orbit by the VEGA rocket

Sat therefore addresses an important issue of satellite safety, which is why the project was accepted for launch even though Poland is not an ESA member. Space was made available to the Polish team on the VEGA rocket for free as part of the ESA Education Office program.

The PW-Sat system could in the future become a useful method for removing satellites from orbit on completion of their missions. As there are currently no effective methods of deorbiting used or damaged satellites from LEO, the system has the potential to become a commercial success. A recent United Nations General Assembly, on request of the Committee on the Peaceful Uses of Outer Space, adopted a resolution recommending fitting LEO satellites with systems that guarantee their deorbiting no later than 25 years after completing their missions. This opens up an attractive market in which orbital-decay technology developed in Poland could be used very successfully.

Deorbiting methods

The PW-Sat project team and the PAS Space Research Centre came together to propose an innovative mechanism for unfolding and extending a deorbiting structure. The mechanism has been miniaturized, making it possible to test it on a small satellite like PW-Sat.

The deorbiting system used in PW-Sat comprises two elements: a container housing the full deorbiting mechanism and structure, and an electronics system to automatically open the structure.

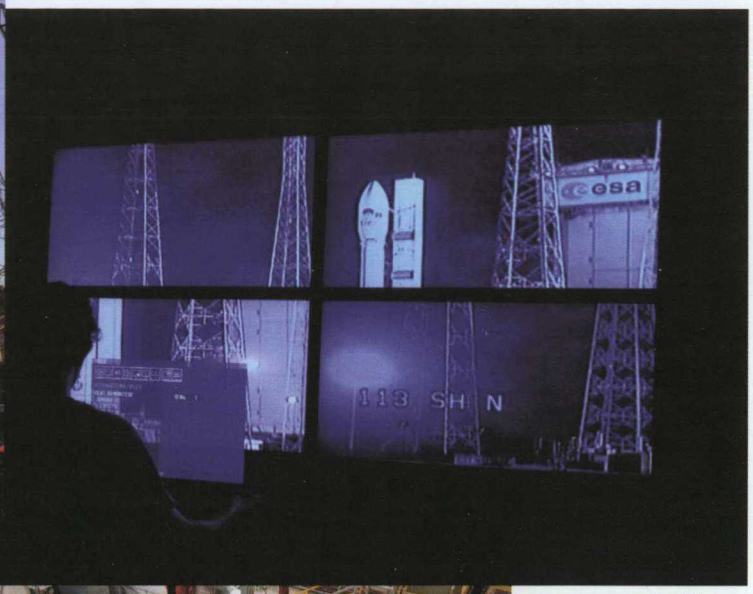
The key part of the deorbiting system includes a specially designed square cross-section spring, with elastic photoelements on the sides. The end of the system has a cover performing two functions. While the closed structure is stored in the container, the cover stops the spring from unloading. During the mission itself, it will provide tail. The cover is joined to the container by a special guard which prevents the links from breaking during opening.

The electronics system makes it possible to open the tail by using resistors to burn through Dyneema lines (made of polyethylene, making them extremely light and durable) and measuring the voltage generated by the photoelements. The entire system takes up less than half the available space.

The satellite is currently in orbit, transmitting and receiving signals. However, attempts at extending the braking structure have so far been unsuccessful. The problem is currently being analyzed and tested.

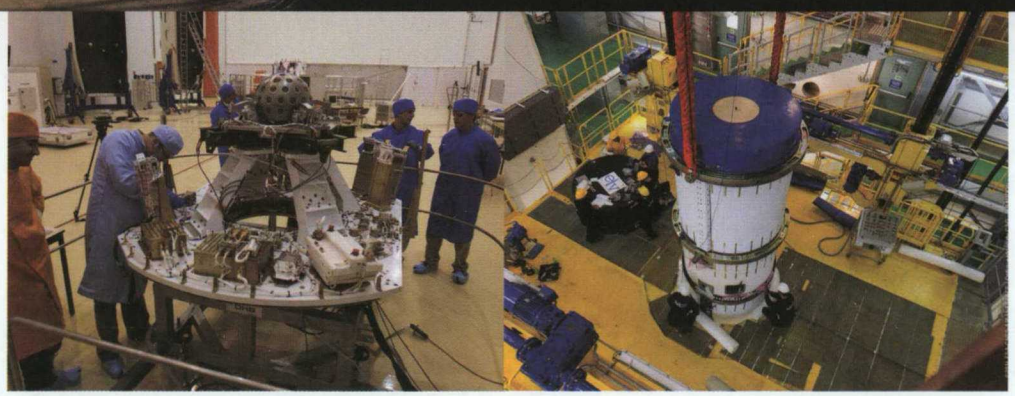
Photocells

One important solution being tested on PW-Sat for the first time consists in elastic photoelements mounted on the satellite's



Maciej Urbanowicz

ESA



The Polish satellite was launched into orbit from the Guiana Space Centre

unfurled structure. For safety reasons, the cells are not actually connected into the power system. One of the aims of the space mission is to investigate their properties using the electronics used to unfurl the de-orbiting structure.

Route to commercial success?

The entire satellite, in particular the deorbiting structure, was successfully designed so that all components fit into an almost perfect cube measuring 10x10x11.3 cm, weighing no more than 1 kg. If tests in orbit are concluded positively, the low size and mass of the Polish satellite could prove to be an attractive solution for manufacturers of space vessels.

PW-Sat was designed and constructed by students involved in research-interest clubs at two departments of the Warsaw University of Technology: the Student Astronomy Club at the Faculty of Power and Aeronautic Engineering, and the Student Space Engineering Club at the Faculty of Electronics and Information Technology. Specialists from the PAS Space Research Centre also assisted in the satellite's construction; the project was implemented as part of the educational grant awarded by the Plan for European Cooperating States (PECS) aiming to prepare Poland to join ESA.

Education was a key aspect of the program, striving to teach future constructors and operators of satellites. The enthusiasm of the young satellite engineers shows that regardless of PW-Sat's fate in orbit, its mission has already been successful. ■

Further reading:

www.pw-sat.pl
http://www.cubesat.org/images/developers/cds_rev12.pdf.