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**State Secretariat for Education,
Research and Innovation SERI**
Space Office

Oliver Botta, 18 July 2014

Factsheet

ATV-5 *Georges Lemaître* ready for launch

The fifth and last of the successful series of European Automated Transfer Vehicles (ATVs) is ready for launch on a mission to resupply the International Space Station (ISS). At the end of last month, the ATV was loaded onto an Ariane 5 ES launcher at the Centre spatial guyanais (CSG) in Kourou, French Guiana. The launch is scheduled to take place on 30 July 2014 Central European Time (CET), 01:47 (29 July at 23:47 local time) and the ATV will dock autonomously with the ISS a few days later. In the tradition of its predecessors, ATV-5 is also named after a famous scientist: *Georges Lemaître*, the Belgian who formulated the Big Bang Theory.

About the ATV

Ever since its maiden voyage in April 2008, the unmanned automated transfer vehicle (ATV) has played a critical role in the logistics of the International Space Station (ISS). Together with other spacecraft built by international partners, the ATVs have brought supplies and fuel to the ISS and its crew.

After docking with the Russian part of the ISS, the cosmonauts will open the porthole of the pressurised Integrated Cargo Carrier (ICC). Dry items such as clothing, food, replacement parts and materials for scientific experiments will be unloaded and stored onboard the ISS. At the end of the mission, the ICC will be used as a "waste container" for waste and supplies that are no longer needed onboard the ISS. However, ATVs also bring other important cargo to the ISS, in particular fluids and gases. For this reason, the ATV has several types of tanks (containing such things as fuel for manoeuvring operations controlled by the Russian segment, air, oxygen and water). Over the course of the mission, these fluids and gases will be pumped from the ATV to the ISS storage tanks through various tubes. Just before the end of the mission, the empty tanks will then be filled with wastewater, which will also be disposed of.

A further important function of the ATV is to 'reboost' the ISS to a higher orbiting altitude, using the propulsion system incorporated in the service module. This is done to counter the effects of atmospheric drag, which causes the ISS to gradually lose altitude over time. The same propulsion system can also be used for trajectory correction manoeuvres.

Teamwork

Once the ATV-5 is separated from the Ariane 5 ES launcher, its flight is monitored and controlled by the ATV Control Centre (ATV-CC) in Toulouse, France. Docking with the ISS is automatic but closely monitored by the ATV-CC in conjunction with NASA's Mission Control Center (MCC-H) in Houston and Roscosmos Mission Control Center (MCC-M) in Moscow. At the first sign of a malfunction, the ISS crew members, including ESA astronaut Alexander Gerst, also have the ability to interrupt the automated approach manoeuvres at the last minute by pressing an emergency button.

During its entire flight, the ATV's functions will be monitored and controlled by ATV-CC. The ATV will remain docked with the ISS until February 2015. After it disengages from the ISS, the ATV will stay in orbit for a few days before it performs a braking manoeuvre involving brief activation of its forward thrusters. This will allow the ATV to descend into the Earth's atmosphere where it will burn up on re-entry.

To name one's fate

The ATV maiden flight (ATV-1 *Jules Verne*) took place in 2008 and was considered to be a test flight. The successful operational use of ATVs began in February 2011 with ATV-2 *Johannes Kepler*, followed by ATV-3 *Edoardo Amaldi* in 2012 and ATV-4 *Albert Einstein* in 2013. Of the original nine planned ATVs, only five were built due to cost constraints. As a result, this short but very successful era of ATVs for European aerospace draws to a close with ATV-5 *Georges Lemaître*. The knowledge and technologies that the ESA and European aerospace industry have gained from the ATV programme will be used in future projects, such as in the development of the service module for NASA's new manned *Orion* space capsule.

The ATV-4 *Albert Einstein* as it approaches the ISS in July 2013 (Photo: NASA).

New technologies and a fiery end

The ATV-5 *Georges Lemaître* carries a total payload of 860 kg fuel for the ISS propulsion system, 855 kg of water and 100 kg of gases. In addition, the ATV-5 has a dry payload capacity of 2,622 kg and 2,118 kg of fuel for reboost manoeuvres. This brings the total payload capacity to 6,555 kg. If we add the ATV-5 unladed mass of 12,039 kg, and the weight of the adapter for the launch vehicle, the total weight is 20,275 kg.

In addition to important transport capacities, the ATV-5 *Georges Lemaître* also serves as a platform for development of new technologies. There is a new infrared sensor that will be tested during the ATV approach with the ISS that may prove useful when manoeuvring towards so-called 'uncooperative' objects such as decommissioned satellites or other space debris. In the future, such technologies could be used for satellites that remove space debris from orbit. Another new technology is a camera system built inside the ATV to film and transmits data as the ATV re-enters and disintegrates in the Earth's atmosphere. This camera system will be similar to the "black boxes" found on aircraft. Since the re-entry for ATV-5 will be carried out at less of an acute angle, useful knowledge will be gained concerning the effects of re-entry on large satellites. This is particularly important when the ISS is slated for re-entry into the Earth's atmosphere at the end of its life cycle. The infrared camera was developed and manufactured by the Swiss company RUAG in Zurich.

Installation of ATV-5 *Georges Lemaître* on Ariane 5 ES launcher at the satellite preparation complex Guiana Space Centre in Kourou, French Guiana. (Photo: ESA).

Swiss technology on board

The assembly of the individual elements of the ATVs (ICC, service module, adapter for the Ariane 5 rocket) is carried out by Astrium GmbH in Bremen, which is the main contractor for production of the ATV. The Swiss aeronautics industry also plays an important part in the development and production of ATVs. RUAG Space in Zurich (formerly Contraves and Oerlikon Space) manufactures the main structure and APCO Technologies in Aigle manufactures the micrometeoroid protection panel system for the service module. Syderal in Gals makes electronic components to regulate the temperature of the ATV. Finally, the company Clemessy in Basel contributes important electronic components. This involvement and the experience gained as a result has enabled Swiss industry to position itself for the ESA's future development activities in the field of manned space flight. In addition, Swiss researchers are also able to take part in microgravity experiments conducted on board the ISS and the *Columbus* laboratory. Swiss participation therefore brings benefits not only to Swiss industry but also advances Swiss research.

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