Precise arrival at 28,000 kilometres per hour

12 August 2014

The target field on the International Space Station (ISS) where the final European Automated Transfer Vehicle (ATV) cargo carrier, ATV-5 Georges Lemaître, recently docked is just 60 centimetres tall. The spacecraft arrived at 15:29:53 CEST on 12 August 2014, precisely manoeuvring automatically to arrive at the Station, at an altitude of around 400 kilometres. Astronaut Alexander Gerst had one primary task – to monitor the docking process and cancel the automated procedure in the event of an emergency. Inside the 20-ton craft are experiments such as the Electromagnetic Levitator (EML) and the DLR magnetic experiment MagVector/ MFX, together with food, coffee and clothing for the astronauts, fuel, air and drinking water, as well as a replacement pump for the water treatment system in the Columbus research laboratory. Overall, the ATV-5 transported roughly 6.6 tons of cargo into space. The sophisticated unloading process now begins for the teams in the control rooms at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) in Oberpfaffenhofen and Cologne.

Eye to eye with the Space Station

The free-flight phase of ATV-5 lasted two weeks from its launch at 13:44 CEST on 30 July 2014; now the transporter has docked with the Zvezda ISS module after a three and a half hour approach phase. About 40 kilometres before reaching the Space Station, the communications between the transporter and the ISS were activated. At 3.5 kilometres from the ISS, the telemetry system was switched on, and for the last 250 metres, ATV-5 oriented itself with optical sensors. These consist of two laser range finders and video cameras, which serve as its ‘eyes’ and allow the calculation of distance, speed and angle in relation to the coupling element on Zvezda.

Prior to the approach and docking, the European Space Agency (ESA) had tested the new LIRIS (Laser InfraRed Imaging Sensor) system, which was used in addition to the existing navigation system. The new technology could also be used to approach and grapple non-cooperative targets – for example, space debris. With the LIRIS experiment, the ISS was illuminated with a laser to obtain an evaluable image from the reflection with as much information as possible about the location and orientation of the target. "For uncooperative targets, we simply need more intelligence for the sensors and control systems," says Volker Schmid, DLR ATV Programme Manager. "Ultimately, we are conducting tests to be able to accurately grapple an object in exactly the right place in the dark." For ATV docking, the ISS has specially mounted laser reflectors on its exterior.

Exact planning for the ATV – door open, door closed

After the opening of the connecting hatch, the quality of the air in the ATV payload compartment will be tested and the connection between the transporter and the ISS will be strengthened; this will probably take place on 13 August. The first large cargo packages, containing parts of the EML, will most likely be unloaded the following day by Alexander Gerst and his colleagues and moved through the Station to their destination, the European Columbus laboratory. The EML weighs around 400 kilograms and is distributed over more than one package; it is the heaviest item in the payload.

ATV-5 is the last European space transporter to dock with the ISS. Since 2008, a total of five ATVs have been launched, which not only carried supplies to the ISS but also disposed of waste from the Station upon atmospheric re-entry. "The ATV was always very important for taking evasive action to avoid space debris and for the reboosting the ISS orbit," says Volker Schmid. The Space Station loses about 50 to 100 metres in altitude every day; with the space

transporters, it was increased several times, in each case by a few kilometres. The record is held by ATV-2 Johannes Kepler; the ISS was raised in 2011 by a total of 50 kilometres. Georges Lemaître will remain docked to the ISS for about six months, and then subsequently break apart upon its return to Earth and burn up in the atmosphere.

"ATV-5 is unfortunately no longer followed by an ATV-6," regrets Schmid, who has been involved in the ATV programme since its inception with ATV-1. "However, the experience we have gained with ATV will feed into the development of a European Service Module (ESM) for the American Orion capsule – and therefore Europe is involved in future manned missions." The ESM will provide, amongst other things, the propulsion system, the power supply and thermal control when four astronauts live and work on board the Orion capsule. The first ESM and Orion capsule will be used for an unmanned test mission around the moon at the end of 2017. "The technology developed for the ATV has given rise to the technology for future missions to the International Space Station."

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ATV-5 shortly before docking

On 12 August 2014, at 15:30 CEST, the ATV-5 docked to the International Space Station.

Credit: ESA/NASA.

ATV-5 flies under the International Space Station ISS

Prior to the approach and docking, the European Space Agency (ESA) had tested the new LIRIS (Laser InfraRed Imaging Sensor) system on the ATV-5, which was used in addition to the existing navigation system.

Credit: ESA.

Cargo compartment of the ATV-5

6555 kilograms of cargo were stowed on board the European space transporter ATV-5 ‘Georges Lemaître’. This included food for the astronauts, supplies of fuel, water and air, and scientific experiments. On 30 July 2014, the Automated Transfer Vehicle lifted off en route to the International Space Station.

Credit: ESA/CNES/Arianespace.

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