ATV Georges Lemaître set to reach Space Station on 12 August

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The fifth space freighter marks the end of an era in European ISS transporters – interview with DLR ATV Programme Manager Volker Schmid.

Following its textbook launch on 30 July 2014, the fifth and final supply spacecraft in the European Automated Transfer Vehicle (ATV) series is on its way to the International Space Station (ISS). The freighter – which is named after Belgian physicist Georges Lemaître, father of the Big Bang theory – is roughly the same size as a London double-decker bus and, together with its payload, weighs more than 20 tons. Scheduled to dock with the Space Station at 15:34 CEST on 12 August, it will supply the ISS with fuel, food and new experiments; it will remain attached to the Station for at least five months. Germany has been a leading participant in the European Space Agency (ESA) ATV programme and has financed some 48 percent of the contributions to the around three billion euro programme. Volker Schmid, ATV Programme Manager at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) Space Administration, explains the role and significance of the most complex space transporter ever built in Europe.

Interview by Elisabeth Mittelbach

Where is the ATV located at present and what has been happening since its launch from the European Spaceport in French Guiana on 30 July?

Everything is running according to plan. Following its launch on board an Ariane 5 rocket, Georges Lemaître was placed in orbit at an altitude of around 260 kilometres. Before the planned docking on 12 August, ATV-5 will complete various fully automatic flight manoeuvres to gradually approach the Space Station. The Laser Infra-Red Imaging Sensors (LIRIS) campaign is planned for Friday, 8 August. This involves the space transporter flying below the ISS, then increasing its altitude and allowing the Space Station fly past beneath it. Unlike the previous ATVs, ATV-5 is carrying yet another new set of experimental sensors on its front that can image the ISS with unprecedented quality. The ATV usually calculates its relative position and orientation from optical data obtained by reflecting its laser off the outside of the Russian Zvezda module. We are hoping for better sensor data from LIRIS. This is a prerequisite for image analysis, so that future systems can be made more ‘intelligent’ and operate without reflectors. Such new systems might also be used with ‘lost’ satellites and their de-orbiting process.

It took the first ATV three weeks to dock with the ISS, but the docking of the Soyuz spacecraft with Alexander Gerst on board took just six hours. Why is there such a difference?

In theory, an approach and docking could be done within three or four days. However, this depends on the time window in which the correct conditions exist for this highly complex manoeuvre. For example, the angle of the Sun with respect to the orbital plane of the Space Station determines the relative orientation of the ISS in its orbit around Earth – this is critical for a constant supply of energy from the solar arrays and also for thermal control on the ISS and on the ATV. In addition, the camera that monitors the docking manoeuvre must not be blinded by glare. And of course, prior to the arrival of any space transporter, the astronauts must take care of various preparations, which takes a certain amount of time. Furthermore, it also depends on how busy the docking node is. The Russian Progress and Soyuz spacecraft are already berthed on the Russian Zvezda module at the ‘back’ of the ISS.

With Jules Verne – the first ATV, which was launched in 2008 – all the tests and emergency procedures were simulated during the approach; consequently, this took a relatively long time. In my opinion, the minimum is three days in flight. 12 August was determined as the ideal docking window for the last ATV.

What is the docking procedure for ATV-5, and what does German ESA astronaut Alexander Gerst, who is already on board the ISS, have to do?

The first holding point for the final approach phase begins at around 40 kilometres behind and five kilometres beneath the ISS, which is between three and three and a half hours prior to arrival at the Space Station. This is also a critical moment, as this is when the ATV and the ISS start to communicate. At that point, in accordance with the ISS on-board procedures, the ‘Kurs’ docking monitoring system is switched on and the axes of the solar arrays are locked. When the ATV approaches, the encounter must not be too rough – after all, 20 tons are docking. This is very different to Progress, for example, which weighs seven tons. Alexander Gerst will be monitoring the manoeuvre from the control station in the Zvezda module. ATV must aim for the ISS within a four-degree conical approach corridor. Gerst can use a template on the screen to check this. From the console, he can stop the ATV, reset it to the last holding point, restart the approach or even trigger an emergency stop function. But there has never been a problem with docking to date.

What are the main differences between the ATV and other ISS space transporters?

ATV is the heaviest, largest, most complex and versatile space vehicle. This does not mean that the others are not versatile – all of the transporters are very well matched to their tasks. The development of the ATV and the Japanese H-II Transfer Vehicle (HTV) started around 20 years ago. The ATV is the only vehicle of its size and mass that can dock with the ISS fully automatically. The Russian Progress module can also dock fully automatically, but it is much smaller and so has a smaller payload. The ATV uses the telemetry system and the docking adapter from the Progress and Soyuz, because these are proven technologies. Like Progress, the ATV can raise the orbit of the ISS and also pump 860 kilograms of fuel into the Russian Zvezda service module. The HTV freighter can carry a maximum of 16 tons of cargo and flies to the US section on the ‘front’ of the Space Station. The HTV does not dock automatically. It ‘parks’ at a distance of about 10 to 15 metres in front of the ISS and is then brought manually to the Station by the manipulator arm, operated by the astronauts. Also, the HTV does not carry out orbit adjustments or fuel transfers. Because of this, its docking adapter has a clearance width of 1.20 metres – meaning that experimental equipment and racks can be transported into the ISS in one piece. The opening to the Zvezda module is smaller, so the racks have to be dismantled into their individual shelves. For example, with ATV-5, Alexander Gerst will have to reassemble the German Electromagnetic Levitator (EML) experiment on board the ISS. Then, there are the two US commercial space freighters, Cygnus and Dragon, which replaced the Space Shuttle in 2012, but which cannot dock automatically.

How ‘German’ is ATV-5?

Between 45 and 48 percent of the components in the ATV come from Germany. All ATVs are assembled and tested at Airbus Defence & Space (ADS) in Bremen. In total, more than 30 companies in 10 European countries are involved – ADS is the Prime Contractor for ESA, and MT Aerospace AG and OHB System AG are responsible for the tanks and cabling in the propulsion section. ADS integrates the propulsion section, assembles the ATV and tests it. Jena Optronik GmbH supplies the sensors and AZUR SPACE Solar Power GmbH the solar arrays – just to give an idea. The DLR Space Administration manages the project and assumes the delegate function at ESA to control the programme. Communication between the Mission Control Centre in Moscow and the ATV Control Centre in Toulouse is coordinated by the German Space Operations Center (GSOC) at the DLR site in Oberpfaffenhofen. DLR Göttingen was involved in the development of the thruster nozzles. Also, the current payload has a very significant German/DLR element.

What will be happening in space transport after the Georges Lemaître mission?

The European Service Module (ESM) for the new US Orion capsule (Multi-Purpose Crew Vehicle; MPCV) is largely based on the European ATV technology. This is the first time that our US partners have entered a definite dependency and involved us in a critical path. All of the ATV missions so far have been successful – almost nobody really expected that of us Europeans. Travelling at 28,000 kilometres per hour with millimetre precision and docking ‘softly’ is something truly unique. The ATVs represent true cutting-edge technology. As the D1 and D2 Spacelab missions were the entrance ticket for the Columbus laboratory and elevated European human spaceflight to the level of the Russians and Americans, so ATV is now a guarantee that we will be participating in the US MPCV. There is no way that we would be in a position to equip and build an Orion service module without ATV. In March 2011, ESA decided to discontinue the ATVs and repurpose ATV-6 for the development of the MPCV service module. The financial investment of 452.3 million euros for the MPCV ESM is the price of the ATV-6, which we have now converted. This means that the technology will not migrate to the United States. It is a barter arrangement; we build something here – the ATV – and get usage time on the ISS in return. Like the ATV, the MPCV will be developed and built principally in Bremen.

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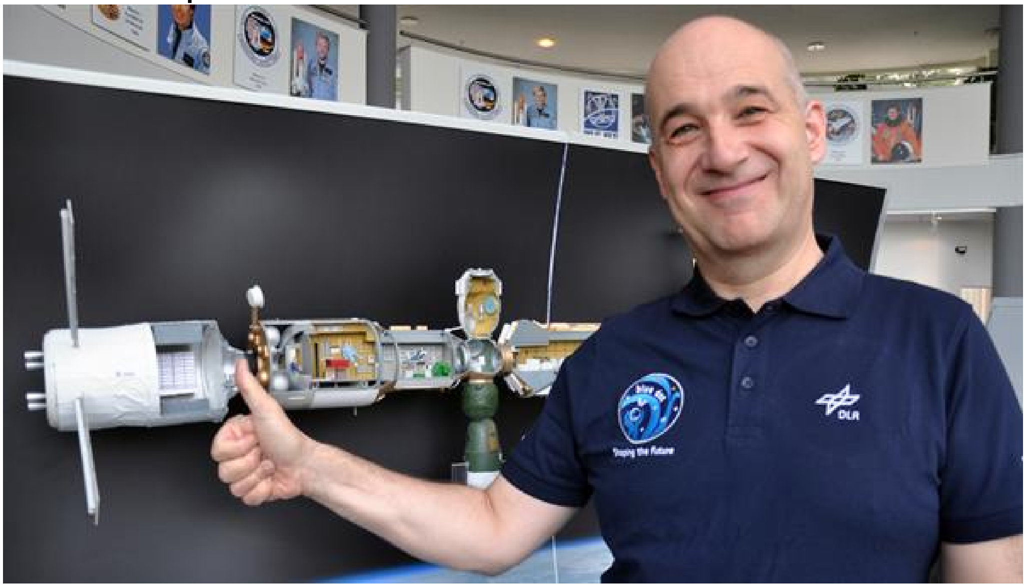
View of ATV-5 Georges Lemaître from above, just before installation of the Ariane launcher fairing.

The optical sensors for the approach (below), the LIRIS experiment (left), the star sensors (left and right above the docking adapters), the illuminated cross hairs (top) and the Kurs antenna (right) are all visible on the ‘front’ of the ATV.

Credit: ESA.

DLR ATV Programme Manager Volker Schmid in front of a model of the International Space Station



DLR Space Administration ATV Programme Manager Volker Schmid standing in front of a model of the International Space Station. The Automated Transfer Vehicle (ATV) is docked with the left-hand end of the model. It is the largest, most complex and heaviest spacecraft ever built in Europe.
