EML furnace performs test run on the Space Station

10 November 2014

Even before its scientific use on the International Space Station (ISS), a stubborn bolt and complex assembly tasks in space made the Electromagnetic Levitator (EML) a particularly challenging experiment. The German ESA astronaut Alexander Gerst and the team in the control room at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), together with engineers from Airbus Defence and Space, have worked to prepare the furnace for initial test runs. Gerst is now on his way back to Earth, but the team continues to control the furnace, testing it in preparation for initial experiments.

"What comes next is a kind of 'dry run' – a specimen will be introduced into the furnace and heated, but not yet taken to its melting point," explains Angelika Diefenbach, DLR Project Manager for EML utilisation. Once the furnace is ready for use, metallic samples floating in microgravity will be melted and analysed without disruptive influences and interactions. This will provide materials scientists with data showing the thermal and physical properties of the specimens uninfluenced by external forces. Numerous meticulously planned steps are – and remain – necessary to bring the furnace to operational readiness, to test it, and finally to begin science operations.

Delivery in big packages

On 12 August 2014, the European space transporter ATV-5, 'Georges Lemaître', was launched to the ISS with the furnace on board. Nine large packages, some of them the size of a washing machine, were unloaded and transported through the ISS to their intended destination in the research laboratory Columbus during an elaborately choreographed operation. Alexander Gerst was tasked with installing the different components in the slots of an existing experiment rack in the laboratory. Detailed plans were developed, which Gerst practised repeatedly before departing for the ISS to perform the assembly and installation in space. The task objective, tools required, probable duration, precise instructions for each operation, alignment of the two cameras that the ground teams will use to monitor the work – all of this had to be listed and perfected by the team from the DLR Microgravity User Support Center (MUSC).

Installation with obstacles

Gerst installed the individual components, such as the water pump, while the team in the DLR control room watched him work, supporting the astronaut when things became difficult. A bolt got stuck in the flat surface designed to accommodate one of the furnace’s cameras. "We wrote several operating procedures in just a few days," says Diefenbach, who, at the time, had to find a solution with her team. Attempts to release the bolt using pliers failed. Gerst then had to use a saw and a file, but this presented the problem that he might breathe in particles of material released into the laboratory. There was a flash of inspiration – shaving foam! The astronaut smeared foam on the point he intended to saw – and the bolt problem was solved. "After that, installation of the EML went smoothly."

However, the bolt problem had caused a substantial delay and the astronaut's time was scarce and strictly scheduled. "It was extremely helpful that Alexander Gerst felt personally involved in the experiment and was willing to continue the work in his free time." Aided and observed by the team in the DLR control room, he set about installing the furnace built by Airbus Defence and Space on behalf of ESA and DLR – getting it ready for commissioning and the necessary testing phase.

Preparing for operation

Now the assembly and its subsystems had to be tested. "To do this, we sent numerous individual commands to the EML to test each component." The gas and vacuum system, the video cameras, the communication channels with Earth – everything was put through its paces. What follows is the final stage to enable scientific use and performance of the first experiments. DLR researchers will introduce the first specimen into the furnace and will spend four days and three nights testing the experiment sequence without actually melting the specimen.

The electromagnetic levitator will be used to perform 550 experiments next year alone. Over 50 scientists from Belgium, Germany, England, Finland, France, Italy, Austria, Switzerland, Spain and Hungary, as well as researchers from Japan, Canada, Korea, Russia, the United States and companies from the metalworking industry, will use the furnace in its first two years of operation. The DLR Institute of Material Physics in Space will prepare the experiments on behalf of industrial partner Airbus Defence and Space on an EML ground system; this also freely suspends the specimens, but not without disruptive influences, among them convective flows. The first experiments are scheduled to be performed later this year. Then, the furnace will be operated remotely, from the DLR control room.

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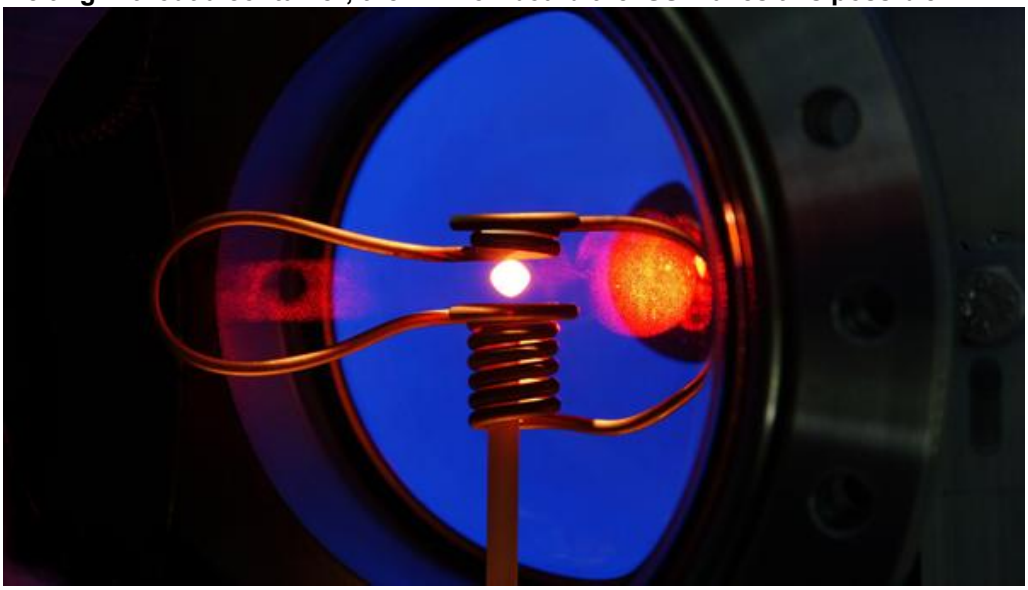
Melting without a container; the EML on board the ISS makes this possible



Melting without a container; the EML on board the ISS makes this possible.

Alexander Gerst working on the EML furnace in the International Space Station

Alexander Gerst installs components of the Electromagnetic Levitator (EML) as the team in the DLR control room observes his work, monitoring and providing support.

Credit: ESA/NASA.

Alexander Gerst with the Electromagnetic Levitator

The German ESA astronaut Alexander Gerst and the team in the control room at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), together with engineers from Airbus Defence and Space, working to prepare the Electromagnetic Levitator (EML) furnace for initial tests.

Credit: ESA/NASA.

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