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Thomas Reiter carries out PK-3 Plus experiment on complex plasmas

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Between 17 and 19 August 2006, German ESA astronaut Thomas Reiter will continue research on complex plasmas onboard the International Space Station (ISS). He will work with the German-Russian PK-3 Plus experiment, which has been onboard the ISS since the beginning of 2006. The system is the result of a partnership between the Max Planck Institute for Extraterrestrial Physics, in Garching, Germany, and the Institute of High Energy Densities at the Russian Academy of Sciences in Moscow. The German portion of the project is being financed by the Space Agency of the German Aerospace Center (DLR).

Thomas Reiter with the PK-3 Plus training model

Since scientific research began on the ISS in 2001, each Russian cosmonaut has carried out at least one series of experiments with complex plasmas during their time on board. Between 2001 and 2005, they were able to use the PK-3 system. In early 2006 this was replaced by the upgraded PK-3 Plus, which offers much greater scope for experimentation.

German ESA astronaut Thomas Reiter, who is replacing one of the Russian cosmonauts, is now continuing the tradition. During his training, he acquired the scientific and technical knowledge required to perform experiments using the PK-3 Plus system.

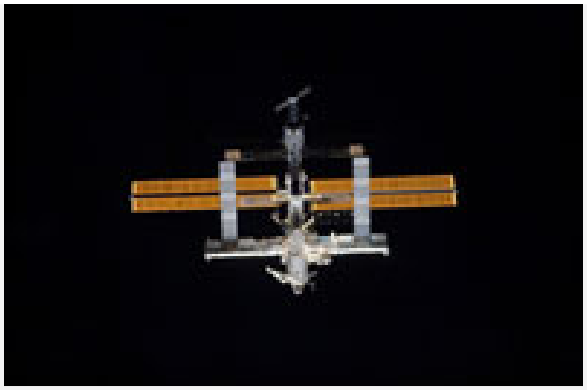
By 17 August 2006, everything will be ready to go. For a period of three days, Thomas Reiter will continue analysis of what are known as 'phase transitions' in complex plasmas. Reiter's colleague Pavel Vinogradov had already set up the system and started the experiments on 10 August 2006. On the ground, a team of scientists from Germany, Russia and France is particularly interested in the transition from a liquid to a gaseous state, especially the critical point at which the differences between fluid and gas cease to apply.

A complex plasma consists of an electrically charged gas with free electrons and ions (like the illuminant found in fluorescent tubes, for example) and tiny particles, or 'dust', measuring 1 - 20 micrometres in size (1 micron equals 0.000001 mm).

These particles are electrostatically charged in the gas and interact together in such a way that the gas and particles behave like a single substance. During the experiment, the plasma-generating electric field and the gas pressure are varied. Depending on these experimental conditions, the particles in the

complex plasma move like the atoms in a gas or liquid, or even arrange themselves into regular, three-dimensional shapes - like the kind found in crystals, forming what is known as a 'plasma crystal.'

During the change from one state to another, the behaviour of each individual particle or 'atom' can be visually observed, making complex plasmas a good model for 'normal' materials which cannot be observed in this way.



International Space Station seen from Space Shuttle Discovery

The experiments will generally be run automatically, using programs that were sent to the ISS by email before the series of experiments began. Scientists will track the progress of the experiments in the Russian control centre in Korolev, near Moscow. They normally receive images from the ISS for just 10 minutes per day as the space station passes over Russia, and once a day they receive feedback on the experimental parameters and technical measurement data.

In all other respects they must rely on the cosmonaut who is observing the experiment on board. Experience from previous experiments has shown that it is sometimes necessary to modify pre-programmed settings or parts of a program, for example by changing the electric field in smaller or larger steps. After receiving instructions from the team of scientists by radio, the cosmonaut implements the modifications to the experiment manually.

The actual scientific image data from the experiment's four cameras is stored on hard disc and will be transported back to Earth on a Russian Soyuz capsule during the next ISS crew changeover. Only then can the real scientific analysis begin.

Before returning to Earth towards the end of 2006, Thomas Reiter is scheduled to perform another series of experiments with the PK-3 Plus. His new Russian colleague will be cosmonaut Michail Tyurin of Expedition Crew 14, who has already worked with PK-3 in 2001.

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