Herschel HIFI instrument resumes quest for water in Universe

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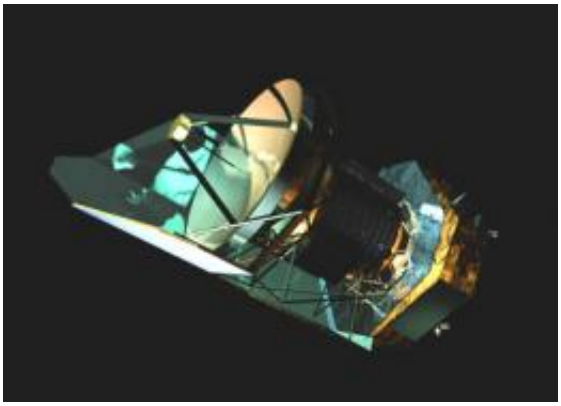

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The back up system of HIFI, the state of the art Dutch space instrument on ESA's Herschel space telescope, has been switched on successfully.

Due to an unexpected voltage peak in the electronic system HIFI has been inactive for more than 160 days, but on Thursday evening 14 January Mission Control in Darmstadt confirmed that HIFI is now fully capable of performing groundbreaking observations in space again. The coming three years HIFI, built under the supervision of SRON Netherlands Institute for Space Research, will investigate the physics and chemistry of interstellar clouds of gas and dust. The infrared spectrometer will chart the amount of carbon and water in these gas

clouds, which is expected to shed new light on the birth and early development of stars and planets.

Finally, after months of tension and hard work, the engineers and researchers of SRON, the HIFI partners and the European Space Agency (ESA) could breathe freely again that Thursday evening. After some minor last obstacles had been overcome - it took an extra day warming up the back-up Local Oscillator Control Unit (the module in which the malfunction took place) to a degree that would ensure that the switch on would bear no risks whatsoever - HIFI is now in full swing again. Just like most space instruments HIFI has a back up system in case of a failure in the electronic system, and all tests have shown convincingly that the control units of the back up system function perfectly. Moreover, the sensors of HIFI perform on the same high level as in the beginning of August 2009, when the infrared spectrometer astonished the scientific community with the first, crystal clear observations of ionized carbon, the most challenging aspect of the measurement programme.

Strange readings

The first indication that something was wrong with HIFI came from mission control in Darmstad on 3 August 2009. "Groningen, we have a problem." In the daily communications with Herschel/HIFI strange readings had been received. HIFI was in a state that was not described in the manuals. After months of intensive investigations and deliberations only one consistent scenario for this anomaly remained. Due to an unknown cause - possibly a cosmic ray hit in the computer memory of one of the auxiliary computers- the processor of the Local Oscillator Control Unit (LCU) detected an error, rebooted and lost communication with the instrument's main computer. In this process after a little over a second inadvertently the standby switch was activated. This standby switch has been designed to protect the LCU against power drops on the

main power line from the satellite, but now fully powered sent a voltage peak through the system. This peak was fatal for one of the diodes in one of the LCU DC/DC convertors.

The past months scientist from ESA, SRON and the HIFI partners have worked intensively to first determine the nature of the problem, and then on the necessary changes in the software to monitor the integrity of the computer memory and to prevent the malfunction from happening again. The first task in this process was to disable the standby switch that normally protects the Local Oscillator Control Unit (LCU) against sudden power drops. Normally it protects the precious Local Oscillator chains but now it got activated at the wrong moment. It was also necessary to subdue or eliminate any remaining voltage peaks in the system. The team achieved this by cutting back in all relay switching activities. Finally a software change ensured that communications with the LCUwill not be disturbed again."

Complex technological puzzle

HIFI Project leader Peter Roelfsema: “It turned out to be a very complex technological puzzle that we had to solve based on limited information and under a great deal of pressure. But for all researchers involved, quickly finding an answer to this question was a matter of professional pride. We had to - and would - crack the problem with HIFI as soon as humanly possible, but we also had to take the time to be thourough. Scientists all over the world were waiting on the observations from HIFI. There are no certainties in space research; instruments that have to do precision work in the hostile environment of space will always be vulnerable. But we are confident that HIFI can now carry out all scientific observations.”

The scientific observations focus on the quest for ionized carbon and water in the Universe. Principal investigator Frank Helmich says:

“Ionized Carbon is important to astronomers because it is a good idicator for the warming up and cooling down of the gas from which stars and planets take shape. Therefore with HIFI we get a better idea of how the ‘thermostat’ of the Universe works. Water is probably the lubricant of the proces which gives birth to stars and planets. The molecule takes care of cooling extremely hot gases - just like ionized carbon - which enables them to concentrate to new suns. And HIFI also charts the atmospheres of planets and comets in our solar system. All in all we count on a rich scientific output again. This is really thanks to the great efforts made by all of the researchers at ESA, SRON and the HIFI partners, who have worked together as a single team. The motivation to crack this problem came from the depths of the professional pride of the staff themselves. While I hadn’t expected anything else, I’m really very proud of this.”

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