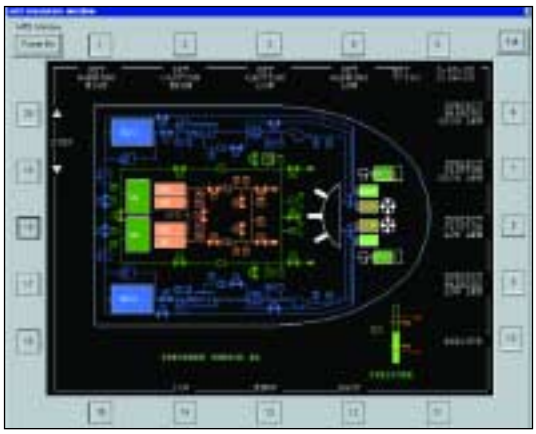
SAS and the CRV program

The CRV programme is a joint ESA/NASA programme. The prime contractor role in Europe is performed jointly by MAN Technologie AG and Alenia Spazio. Within this programme an ESA, NASA and Belgian industry team is developing man-machine interfaces, display techniques and cockpit concepts for the Crew Return Vehicle (CRV), the next generation manned spacecraft. ESA and NASA astronauts are closely involved in this work, including the Belgian astronaut trainee, Frank De Winne. The CRV provides the crew of the International Space Station with the capability to leave the ISS at any time, with a few minutes notice in case of emergency, damage to the ISS, or if one of the crew requires medical attention, not available on orbit.

The CRV (Crew Return Vehicle)

The CRV 'cockpit MMI' project is being performed partly in Space Applications Services offices in Zaventem, Belgium and partly at NASA Johnson Space Centre, Houston USA and graphically illustrates how multi-disciplinary skills applied in a professional and flexible manner within a development programme which incorporates operational flight testing can produce results far in excess of the customers expectations.

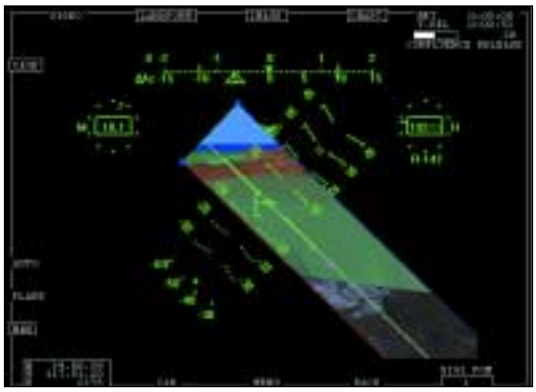
Starting from very limited information regarding the CRV and its mission the work has designed and developed advanced man-machine interfaces allowing the astronauts of the International Space Station to operate the Crew Return Vehicle during its return to Earth. The team identified the activities to be performed by the crew to operate the entire vehicle, which information the crew needs to make correct decisions in the various mission phases, has specified the MMI architecture and implemented the MMI.



3D Entry Display

The cockpit MMI presents only the information needed by the crew, and displays it in a meaningful way, the goal being to provide as much situational awareness to the crew operating the vehicle as possible, to reduce the crew work load during the different tasks and provide the crew with an overview that enables them to overide the automated systems at any moment.

The CRV cockpit concept is based on Multi Functional Displays. The architecture has been designed so that each display layout can be seen on each of the six display screens located in front of the two CRV operators. The primary flight display and the map display are such that their features are slightly modified according to the particular flight phase. All the displays include a link to the menu page, and a link to previously displayed pages. The start point for the ISS crew to interact with the CRV on orbit will be a choice of departure mission, on-orbit maintenance and check-out or simulation activities. The small number of displays required to operate such a complex vehicle is noteworthy.
The results of the work have been so well received that the cockpit MMI is now installed in a van equipped as a mock-up of the CRV interior which is used as a remote cockpit to operate the X-38 (a precursor to the CRV) during free flight, drop tests, where the X-38 is dropped from a carrier aircraft and piloted to a safe landing at Edwards Air Force Base in California, from the van.



System Display

During inital drop tests telemetry received from the X-38 was monitored using the cockpit MMI. Subsequently the cockpit MMI has been used to command the X-38 during its flight. Future activities plan to apply the cockpit MMI to the orbital flight test of the X-38 in order to validate the whole system before proceeding with full development of the CRV.

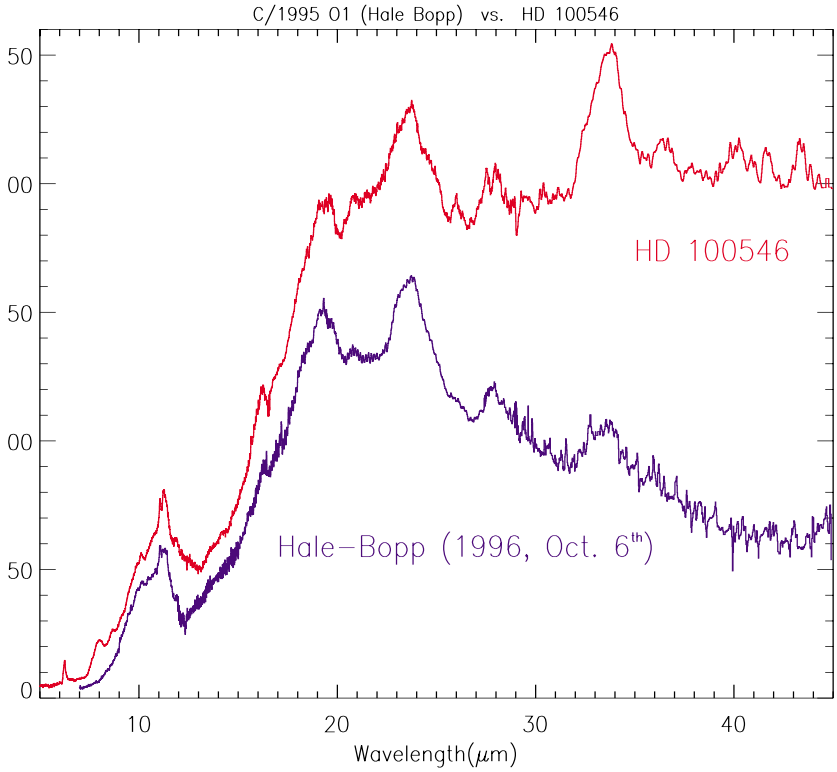
Astronomical Space Research at the K.U.Leuven

Astronomy owes much to space research, on three levels. Close to us – in our solar system – space travel has enabled the exploration in situ of other worlds. For objects in the deep universe, the two other levels are related to the ability in space to get rid of the disturbances of our atmosphere on observations: the spectacular images of the Hubble Space Telescope show clearly how much sharper vision is in space; the main aspect is, however, the possibility to record signals from stars and galaxies in wavelength bands which are absorbed by atmospheric molecules.

The mandatory space programme of ESA enables European astronomers to be competitive as well in high-energy astrophysics (gamma-, X-, and UV-rays) as at the low energies of infrared and soon the submm domain. The astronomers of the Instititute for Astronomy in Leuven and other flemish researchers gratefully exploit various facilities which are available thanks to ESA, with a certain emphasis on 'cool' astronomy, the latter thanks to a strong involvement in the consortium around one of the instruments on board ISO, the 'Infrared Space Observatory', which gathered an important harvest of data between November 1995 and April 1998.

Infrared radiation probes cool environments, i.e. those in which stars are formed, in which planetary systems form around young stars, and also matter expelled by stars during their ultimate evolutionary stages. It is a fascinating world with many intellectual challenges: why in earlier times especially mathematics and physics were needed to understand the cosmos, it now appears that also chemistry and mineralogy have become important tools for understanding interstellar and circumstellar media, and the hope even arises that 'astrobiology' will becaome a real science during the 21st century.

After the discovery in 1995 of the first planetary companion to another star than the sun, the study of the dusky disks which surround stars, disks in which planetary systems grow, has attracted much attention. With ISO it has been possible for the first time to obtain detailed spectra of such disks, which enabled the determination of the nature of the minerals occurring there as well as the distribution of density and temperature throughout these disks. Such research is illustrated on the figures with two results which attracted some attention. On the one figure a comparison is shown of the ISO spectra of the bright comet Hale-Bopp and the disk of the young star HD100546. The strong emission peaks in both spectra are caused by silicates in a crystalline form; crystallistion of silicates is rather uncommon in the cosmos, and mainly occurs in dense dusty disks and in comets, of which it is known that they were formed early in the history of the solar system. The similarity between both spectra shows that the star HD100546 is currently observed in the early stage where a gigantic comet cloud is in the process of forming a planetary system. The second figure shows a



detail of the ISO spectrum of a young star; the narrow emission peak at 3.53 mm is due to the presence around the star of hydrogenated diamonds. The modelling of the emission enables to determine as well the intensity of the radiation field (and so the distance of the diamonds to the star) as the dimensions of the diamonds. The latter appear to have typical sizes in the nanometer range, the sizes also of the diamonds which are found in some meteorites.

The diamonds which were found are unfortunately too remote to be exploited commercially. Nevertheless, a generic link exists between such research and industry. When governments invest substantial funds in astronomical space research, this is because technological and scientific challenges go hand in hand. That this common venture has been succesful since the early days of space travel, and has given rise to numerous spin-offs, hopefully is clear. Also today scientists vigorously advocate that the science program remains an important component of the activities of ESA.

For scientists and industry it is in this context important that the interests of both communities are harmonized. The institute of Astronomy is involved at the co-PI level in the development of the PACS instrument for the ESA cornerstone mission 'Herschel Space Observatory'; in an earlier newsletter a report was published about the contribution of IMEC to this project. Maybe the flemish industry can also be involved in the asteroseismology mission 'Eddington' in which we will also be partners. It certainly is our experience that the scientific return of space research is strongest in those countries where the interaction between fundamental and applied scence is best structured.

Christoffel Waelkens
Instituut voor Sterrenkunde K.U.Leuven
christoffel@ster.kuleuven.ac.be

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