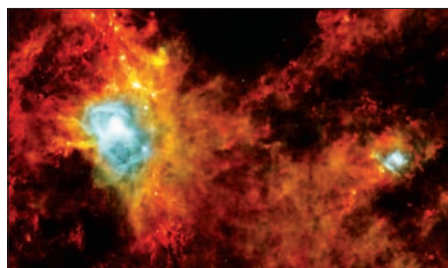


Herschel delivers first results

The first scientific results obtained by the Herschel infrared observatory have been published in a special issue of the journal *Astronomy & Astrophysics*. Based on data collected during the first few months of operation, the papers cover a range of sources, from planets through newly-forming stars in our Galaxy to distant galaxies.

The Herschel spacecraft was launched together with Planck by an Ariane 5 rocket on 14 May 2009. Both Herschel and Planck have been put into peculiar orbits round the second Lagrange point of the Sun–Earth system located 1.5 million km from Earth, on Earth’s night side. While Planck spins, slowly scanning the whole sky to map the cosmic microwave background with higher sensitivity and resolution than the Wilkinson Microwave Anisotropy Probe, Herschel performs pointed observations in the far-infrared to submillimetre range. The light collected by the 3.5 m mirror – the largest ever sent into space – can be directed towards three instruments on the focal plan, which is cooled to 2 K by superfluid helium. The temperature of the instruments’ detectors is further reduced to 300 mK by a complex system of cryo-coolers. The cooling is crucial to avoid the heat radiation of the instruments interfering with the observations, but it limits the lifetime of the mission to only 3.5–4 years.

The 152 new publications demonstrate the good performance of this challenging mission. They are all based on observations



A Herschel image of an area in the stellar nursery of the constellation of Aquila. (Courtesy ESA/ SPIRE & PACS/P André.)

of two of the three instruments because the measurements with the Heterodyne Instrument for the Far Infrared started only in February 2010 owing to a technical problem. The two other instruments have excellent imaging capabilities in different wavebands. The longer the wavelength, the cooler the temperature, which allows Herschel to map the temperature of cold gas and dust structures in the interstellar medium. Prime targets are star-forming regions where large clouds of cold gas and dust slowly collapse to form protostars, which mature into stars within a few million years. The detection by Herschel of new populations of young stars and protostars is one of the highlights and is a key to a better understanding of the processes that lead to the birth of stars. In particular, the detection of high-mass protostars at the edge of regions of ionised hydrogen seems to confirm a complex

formation scenario first proposed in 1977.

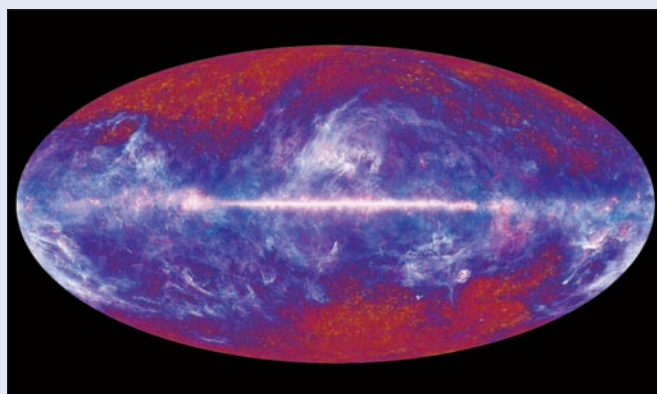
Looking at more distant targets, away from the Milky Way, Herschel can probe the evolution of star-forming galaxies over several thousand million years of cosmic history. A “must” for the early mission was to look at two prime fields already extensively observed by space telescopes such as Spitzer in the infrared, Hubble in the visible and Chandra in X-rays. Herschel opens a new wavelength window in these Great Observatories Origins Deep Survey (GOODS) fields, which have been carefully selected to study galaxies out to very high redshift. Its highly sensitive observations have pinpointed about half of the galaxies contributing to the cosmic infrared background. Herschel further finds that the main contribution to this diffuse emission comes from faint galaxies at relatively low redshift ($z < 1$). In the future, by probing the contribution at different redshifts, Herschel will allow researchers to deduce the cosmic history of star formation in the universe.

A call for open time observations with Herschel closed on 22 July and resulted in 585 proposals requesting about 900 days of continuous observing time. There is thus much more science to come from Herschel. The batch of first papers is just the proverbial tip of the iceberg, as the project scientist Göran Pilbratt points out.

Further reading

Astronomy & Astrophysics 2010 **518**.

Picture of the month



ESA’s Planck mission has finished its first survey of the full sky, producing a splendid 360° view across the “landscape” of the universe. The horizontal plane of the Milky Way galaxy is analogous to surrounding corn fields, with foreground branches and leaves equivalent to the turbulent bluish filaments of cold dust (*CERN Courier* May 2010 p9). The Magellanic Clouds are like nearby villages and the Andromeda galaxy, a bigger city behind. Distant quasars appear as white dots against the red-orange background, akin to distant snow-covered mountains on a sunset sky. Our view of the landscape around us is limited in distance by the atmospheric diffusion of sunlight, while Planck’s microwave view is limited in time by the diffusion of primordial radiation by free electrons, only 380 000 years after the Big Bang. (Courtesy ESA/ LFI & HFI Consortia.)