

U3Astronomy 27-11/2009

ROBOTIC EXPLORERS (Or: Unmanned spacecraft)

They have been flying around – mainly within the Solar System – for about 50 years. They visited all the planets, many of their moons, asteroids and comets. One is on its way to *Pluto*, and two travelled far beyond into the distant outskirts of the Solar System.

They all carry a framework of communications equipment, they all have tools to carry out their tasks (cameras, thermometers, spectrometers etc), further a computer that is the craft's brain and a power source (solar panels, radioactive power or nuclear energy).

At their destination, they can do various things: Most of them either fly by, or orbit or land. So far there have been some 200 of these explorers, of which about 80 went to the Moon and 40 to Mars. About half of them were successful. Once the explorer is in orbit or has landed, it can begin to carry out its tasks.

Flyby's

In the beginning of space flight *most* projects were flyby's, orbits and landings being more complicated and too difficult. Very first ones: 1959: Moon, 1962: Venus, 1965: Mars, 1973: Jupiter. A famous early example are NASA's two **Voyagers**, launched in 1977. They passed the outer planets and then went beyond the boundary of the Solar System. By now they are some 16 bn km away, and NASA does still receive their messages. A further example: In January 2006 NASA launched the probe **New Horizons** with the aim to visit the dwarf planet Pluto in the outskirts of the SS and then continue into the Kuiper Belt (= area with asteroids, left-overs of the formation of the SS). It is expected to reach Pluto in 2015.

Orbits

Technically much more demanding. Large numbers of failures!

Again the **Moon** was the first destination: the first one in March 1966 (the Soviet's *Luna 10*) and the last one – for the time being – the *Lunar Reconnaissance Orbiter*, launched in June of this year. During the first years the main objectives were to obtain a detailed map of the Moon's surface, especially of its 'far side', and to find good spots for the landing of manned missions (*Apollo!*). In later years lunar orbiters collected a lot of further information about the Moon, mainly about its geology and the presence of water.

Further orbiters went to our nearest neighbouring planets: first one to Mars in 1971 and first one to Venus in 1978. The most famous one so far was *Cassini*, launched in 1997 and put into orbit around **Saturn** in 2005.

Landers

Also the first spacecraft to make a soft landing was sent to the **Moon**, the Russian *Luna 9* in 1966. In the 1970's the first soft landings were carried out on our neighbouring planets: the Russian *Venera 9* on **Venus** in 1970 and the American *Viking 1* on **Mars** in 1975.

In general, when a spacecraft has landed safely on a planet or moon (or comet or asteroid), it can carry out various tasks: It can take pictures of its surroundings, measure the temperature and pressure of the atmosphere (if there is one), or it can scoop up a bit of soil, take it inside the probe and analyse it.

A big step forward was made when landers could be fitted with rovers, that could be unloaded after landing and trundle around in order to have a proper look at places a bit further away than just the landing site. Famous are the rovers *Spirit* and *Opportunity* on Mars, which landed in January 2004 and are still active.

A very special task, carried out by some landers, has been to gather some material from the soil, and send it back to Earth to be studied in laboratories. Again the Russians were the first to carry out such an operation, with the lander *Luna 16* in the autumn of 1970.

Many robotic spacecraft have carried out many important tasks that were either too far away (outer planets), or too dangerous (Venus), or too expensive to be carried out by humans. They will undoubtedly continue doing so, but they will never get much further away than they've done so far. The outskirts of the SS form the absolute limit, as everything beyond is simply too distant. If a spacecraft were sent to the nearest star or its planets, it would take some 40,000 years to get there.

NEWS

Water found on the Moon

When, in early October, a probe smashed into a deep crater near the Moon's south pole, the expected six mile high plume of debris did not materialize. But nevertheless it was possible for the *Lunar Reconnaissance Orbiter* to study the effects of the crash. Two weeks ago NASA announced that a significant amount of water had been found. So there is a fair chance that these awfully cold craters, where sunlight never reaches the bottom, contain enormous quantities of water-ice.

Plans for Sahara solar energy

A project has been set up by a German led consortium to supply Europe with 15% of its electricity use by 2050 from solar power generated in the Sahara, and that on a profitable basis. The technology to be used is not new (mirrors, turbines etc.), but there are two important new aspects: 1. The scale of the project will make it possible to store so much hot fluid during the day that the generators can run all night. 2. New high-voltage cables will be developed, through which electricity can be transported along long distances with little loss. The consortium hopes to start delivering power to Europe already in 2015.

Shuttle *Atlantis* mission to ISS

On Monday 16/11 the shuttle *Atlantis* was launched towards the ISS – the 129th shuttle mission! On board were a crew of six and almost 15 tons of equipment and spare parts for the station. Its main aim was to bring a load of large spare parts, which may be necessary during the station's future (until 2015, possibly 2020). These larger instruments – like a pump and an oxygen tank – have to be taken to the station during these and the remaining six shuttle missions before the shuttle retires by the end of next year. Two days after its launch, the shuttle docked with the space station and on Friday 27/11 it returned to Earth.

Shuttle debris near-miss

Early November a piece of space junk was believed to pose a possible threat to the ISS. At first, NASA said that it could pass the Space Station at less than one kilometre distance, and the crew were warned that they might have to retreat into the *Soyuz* 'lifeboat'. After all, this was not necessary as there was no real threat to the Station.

Further small step on the long way to discover life elsewhere

Just over a month ago NASA told that the space telescopes *Hubble* and *Spitzer* had, for the second time, found chemicals which can be of importance for biological processes on a distant planet, some 150 light years away from us. Being a gas planet, life will not exist there, but as it is the second time in a relatively brief period of time that such a discovery is made (first one in Dec.'08), it may be an indication that the presence of materials essential for life, is pretty widespread. If this also applies to smaller, rocky Earth-like planets, the possibility of discovering extra-solar life may increase considerably.

Spirit stuck in Martian sandpit

For some time already, *Spirit*, one of the two rovers which were sent to Mars in 2004, has problems in moving because one of its six wheels doesn't work anymore. In addition to that, it got stuck in a sandpit last April, and so far it hasn't succeeded to set itself free again. So maybe it will have to stay there forever. But even then it can continue to work for the time being.

Large Hadron Collider restarted

On 20/11 the LHC on the Swiss-French border has been restarted. In September last year, shortly after the enormous instrument was started for the first time, things went horribly wrong, and it has taken more than a year – and cost an estimated £24 mln – to repair the damage and to see to it that a similar disaster cannot happen again. If everything goes well this time, we will hopefully learn a lot about what happened in the first fraction of a second after the Big Bang. Around Christmas it is hoped that the machine will work 'at full speed'.

