# Giotto Description

# Mission Overview

In 1978, ESA was invited by NASA to plan a joint mission consisting of a comet Halley fly-by in November 1985 and a rendezvous with comet Tempel 2 in 1988. The mission comprised an American main spacecraft which would carry a European probe. The main spacecraft, with its array of sophisticated cameras and experiments, would complete a fly-by of comet Halley at a safe distance. Shortly before fly-by, the probe would be released towards the nucleus to make detailed in-situ observations in the innermost coma. In January 1980, however, it became clear that financial support for the Halley Fly-by/Tempel 2 Rendezvous mission could not be secured in the USA. By that time the interest of European scientists had built up such momentum that ESA considered the possibility of a purely European mission. The support for a fly-by mission was strong in Europe and went far beyond the small section of scientists specialised in cometary research. A fly-by of comet Halley was suggested to ESA by the scientific community in February 1980. Rather than having the American spacecraft deliver the probe to the comet as in the earlier concept, the Europeans proposed that the capabilities of the small probe be increased by building an independent, self-sufficient spacecraft to be launched using the European Ariane rocket. The limited time available for development and the small financial resources made it advisable to use a spin-stabilised spacecraft derived from the European Earth orbiting spacecraft Geos. This proposal was studied by ESA in the first half of 1980.

The European mission to comet Halley was named Giotto after the Italian painter Giotto di Bondone who depicted comet Halley as the ‘Star of Bethlehem’ in one of his frescoes in the Scrovegni chapel in Padua in 1304. The Giotto mission was finally approved as ESA’s first interplanetary mission on 7 July 1980. An Announcement of Opportunity was issued shortly thereafter requesting proposals for scientific payload instrumentation. NASA was still interested at this stage but could not decide whether to participate or not, partly because the American scientific community did not whole-heartedly support a cometary fly-by mission. Some scientists believed that the scientific return would not be worth the effort. Finally, NASA declined to participate and refused to provide direct financial support for any American hardware involvement. By the end of January 1981, 11 European experiments were selected to perform the diagnostic measurements during a close fly-by of comet Halley in March 1986.

The mission was a fast flyby in March 1986 after the comet’s perihelion, when it is most active. The scientific payload consists of 10 experiments with a total mass of about 60 KG: a camera for imaging the comet nucleus, three mass spectrometers for analysis of the elemental and isotopic composition of the cometary gas and dust environment, various dust impact detectors, a photo- polarimeter for measurements of the coma brightness, and a set of plasma instruments for studies of the solar wind/comet interaction. In view of the high flyby velocity of 68.4 km/sec, the experiment active time is only 4 h and all data are transmitted back to Earth in real time at a rate of 40 kbits/s. The Giotto spacecraft is spin-stabilized with a despun, high-gain parabolic antenna inclined at 44.3 degrees to point at the Earth during the encounter. A specially designed dual-sheet bumper shield protects the forward end of the spacecraft from being destroyed by hypervelocity dust impacts. The spacecraft passed the nucleus at a distance of 596+/-2 km on the sunward side. The time of Closest approach occurred at 00:03:01.84 UT on March 14 (spacecraft event time). However, at 7.6 s before closest approach, Giotto was hit by a large dust particle, whose impact caused the spacecraft angular momentum vector to shift by 1 degree. The effect of the impact was that the next 32 minutes of scientific data were received only intermittently. It is concluded that the spacecraft traversed a region of high dust concentration (dust jet). A few hours after closest approach, a number of the instruments were determined to be inoperable, probably from the passage through the dust jet. About half of the experiments worked flawlessly during the encounter, while the other half suffered damage due to dust impacts. The spacecraft also suffered some damage but it was possible to redirect it to the Earth before it was put into hibernation.

Spacecraft ID : GIO

Target name : Halley

Spacecraft Operations Type : FLYBY

# Mission Phases

## Launch

The Giotto spacecraft was launched on July 2, 1985 onboard an Ariane-1 rocket from Kourou, French Guyana.

Mission phase start time : 1985-07-02

Mission phase stop time : 1985-07-02

## Cruise

The Giotto spacecraft was initially injected into a Geostationary Transfer Orbit. After three revolutions in orbit, the onboard motor was fired near perigee to inject Giotto into a heliocentric orbit. The high gain antenna was despun three days later. The HMC was switched on in Format 3 on August 10, 1985 to monitog of its barrel, followed by the Magnetometer Experiment and Energetic Particles Experiment switch-on on August 22, 1985. After a cruise phase of 8 months, Giotto encountered Comet Halley on Mar 14, 1986. Along its trajectory, the Magnetometer and Energetic Particle experiments remained on. The other instruments followed a on/pyro firing test sequence from Sep through Oct, 1985. The science instruments will take data at various times starting on March 9, but only the magnetometer and energetic particle experiments will be able to make use of this continuous coverage. Continuous data coverage was provided in a high- data-rate mode about 50 hours before and 26.5 hours after encounter, at which point the last experiment was switched-off.

Mission phase start time : 1985-07-02

Mission phase stop time : 1986-03-12

## Encounter

There were specific periods of science data availability after the last orbit correction manoeuver that occurred on March 12 at 05:00. The time of closest approach on March 14 is 00:03:01.84 UT, given in SCET or spacecraft event time. (This time can be related to GSRT or ground station received time by the equation GSRT = SCET + 8 min 0.1 s.) Some instruments, such as EPA, MAG, and GRE, ran continuously during the encounter which lasted approximately 4 hours. Other instruments were switched-on for some intervals between March 12 and March 13, but by 20:18 on that day all instruments were functioning. Unfortunately, 7.6 s before closest approach, Giotto was hit by a large dust particle in a dust jet. Only intermittent data was received for the next 32 minutes of the encounter and damage to a number of instruments was substantial.

Mission phase start time : 1986-03-12

Mission phase stop time : 1986-03-15