The Voyager flyby missions of the early 1980s posed several intriguing mysteries. Why is the leading hemisphere of the outer moon Iapetus dark? Are there lakes of hydrocarbon below Titan’s enshrouding haze? Is the small inner moon Enceladus geologically active? Here David Harland gives an update of the Cassini–Huygens mission’s investigation of Saturn, its magnetosphere, rings and satellites.
AS CASSINI made its approach to Saturn in early 2004, it monitored the solar wind heading for the planet and radio emission from the planet’s auroral activity while the Hubble Space Telescope took imagery of the ultraviolet emission. Large gusts in the solar wind on 17 and 25 January changed both the aurora and the radio emission. As viewed from space, an auroral display is a ring of light around a magnetic pole that is emitted by atoms and molecules that are excited by the electrons that flow in the magnetic field. In the case of Earth, the emission is mostly from oxygen atoms and nitrogen molecules, but on Saturn it is from atomic and molecular hydrogen.

On 8 March Cassini began to resolve discrete features in the atmosphere, and on 19–20 March it observed the merger of two storms in the southern hemisphere, each of which was about 1,000 km in diameter. Both were drifting westwards, the more northerly one at twice the rate of the southerly one. When they met, they spun around each other in a counterclockwise manner. The resulting storm was elongated in the north-south direction with bright clouds on either end, but within 2 days it had adopted a more circular shape and the bright clouds were in a circumferential halo. It was only the second time that a merger had been observed on Saturn. In addition, there was a distinctive dark circular spot right on the south pole. This matched an infrared observation by the Keck Observatory on 4 February showing this location to be warm. In fact, it was the warmest place on the planet.

The mystery was not that

Left: Seen by the Hubble Space Telescope, Saturn’s aurora appears as a ring of glowing gases circling the planet’s south polar region. Observations in conjunction with those from the Cassini spacecraft suggest that Saturn’s auroral storms are driven mainly by the pressure of the solar wind—a stream of charged particles from the Sun—rather than by the Sun’s magnetic field. This image acquired on 28 January 2004 showed a strong brightening in the aurora which corresponded with the recent arrival of a large disturbance in the solar wind. Astronomers combined ultraviolet images of Saturn’s southern polar region with visible-light images of the planet and its rings to make this picture. Image courtesy NASA, ESA, J. Clarke (Boston University), and Z. Levay (STScI).