William Herschel Telescope

The Isaac Newton Group of Telescopes (ING) consists of the William Herschel Telescope (WHT), the Isaac Newton Telescope (INT) and the Jacobus Kapteyn Telescope (JKT). The ING is owned and operated jointly by the Particle Physics and Astronomy Research Council (PPARC) of the United Kingdom, the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO) of the Netherlands and the Instituto de Astrofísica de Canarias (IAC) of Spain. The telescopes are located in the Spanish Observatorio del Roque de Los Muchachos on La Palma, Canary Islands which is operated by the Instituto de Astrofísica de Canarias (IAC).

The WHT is one of the world's largest single-mirror telescopes. Until 1993, when the American Keck I telescope was inaugurated, the WHT was considered the most powerful telescope in the world, because of its cutting-edge technology combined with the superb sky quality of the Roque de Los Muchachos Observatory. The WHT is also the largest telescope in Europe.

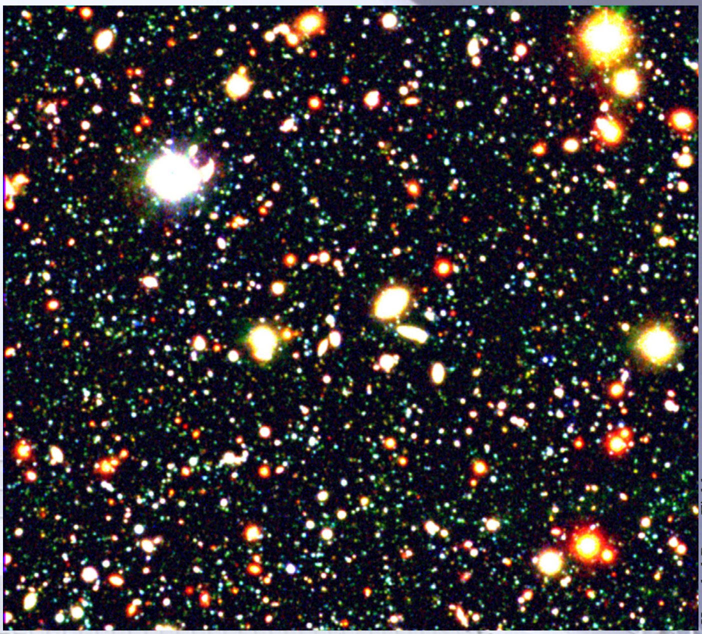
Scientific Highlights

The Edge of the Observable Universe: The WHT has played a crucial role in modern observational cosmology. Deep exposures taken by the WHT have led to the discovery of the most distant objects ever observed, for example the galaxy 8C1435+635, found in 1995, more than 650,000,000,000,000,000,000,000 kilometers away, was the most distant such object known. Moreover, the WHT has taken one of the deepest image ever obtained from the ground. This is the so-called 'Herschel Deep Field' and it amounts to 70 hours of integration. This image shows galaxies almost as faint as the famous Hubble Deep Field but over a 10 times larger area of sky.

Optical Counterparts of Gamma Ray Bursts: On the 28th of February, 1997 the WHT took the first image of the optical counterpart of a Gamma-ray Burst (GRB), an explosion which emits in a few seconds more energy than the Sun in its whole lifetime. This was probably the most powerful explosion mankind had witnessed until then. GRBs were discovered in the early seventies and their origin has remained unsolved. Thanks to this first detection in the optical wavelengths, and later investigations, we now know that these explosions take place outside our Galaxy.

Brown Dwarfs: For decades researchers have speculated about the existence of Brown Dwarfs, celestial objects which probably constitute a link between stars of very low mass and giant planets, such as Jupiter. However, despite many searches, their existence had not been unequivocally proved. In 1994 the WHT took spectra which confirmed the discovery of one of the coldest quasi-stellar objects known in the Universe, a Brown Dwarf.

Messier 83 Galaxy

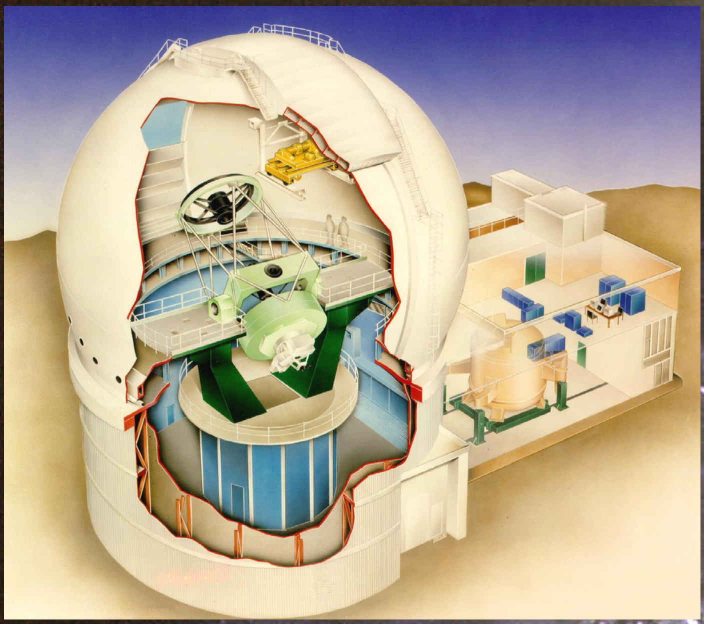


Herschel Deep Field

Will the Universe Expand Forever or Collapse? For some time, astronomers have considered using type Ia supernovae to determine the extragalactic distance scale. Supernovae of this type occur in the late stages of evolution of a binary star system consisting of a white dwarf star orbiting a companion star. When the white dwarf mass reaches a critical value, the nuclear fuel ignites explosively. The intrinsic luminosity of the explosion is thought to be independent of distance and therefore usable as a 'standard candle'. The distances and redshifts of these supernovae provide a measure of the deceleration parameter of the Universe and hence can be used to determine the ratio of the present density of the Universe to the critical density. Since 1992 a systematic search for high redshift supernovae has been made on the WHT and INT telescopes, which has led to the discovery of the most distant supernovae ever observed. Astronomers using this technique now believe that we live in an open Universe, which means that there isn't enough matter in the Universe to stop the expansion (a closed Universe would imply that there is sufficient material to stop the expansion, and as a consequence, the end of the Universe would be a 'Big Crunch'). This discovery was considered by *Science* magazine the science Breakthrough of the Year for 1998 .

TECHNICAL DESCRIPTION

The WHT is of classical Cassegrain configuration, with a paraboloidal primary mirror and convex hyperboloidal secondary mirror. The diameter of the primary mirror is 4.2 m. The mirror is made of a glass-ceramic, Cervit, with nearly zero coefficient of thermal expansion. The aluminium mirror surface reflects about 87% of the light falling on it, and is renewed in the aluminising tank every 2–3 years.



Schematic view of the WHT and its building

The focus of the uncorrected primary mirror incorporates a three element correcting lens to give an unvignetted field of 40 arcminute diameter. The effective focal ratio of the primary mirror with corrector is f/2.8.

When not operating at prime focus, a convex hyperboloidal secondary mirror, made of Zerodur, 1.0 m in diameter, directs the light through a central hole in the primary mirror to the main instrumentation mounted at the Cassegrain focus beneath the primary mirror cell. The telescope also incorporates a third main mirror, a flat, angled at 45 degrees, which can be driven into position at the intersection of the axes, just above the primary mirror, so that the light from the secondary is diverted sideways through one of the two altitude bearings to the Nasmyth platforms where large instruments can be placed. As required during the night, instruments mounted at any of these three stations can be selected within minutes by moving the 45° flat mirror. The effective focal length of the telescope for the Cassegrain and Nasmyth foci is 46.2 m (f/11). The unvignetted field diameters are 15 arcminutes at the direct Cassegrain focus and 5 arcminutes at the Nasmyth foci.

Panoramic view of the observatory

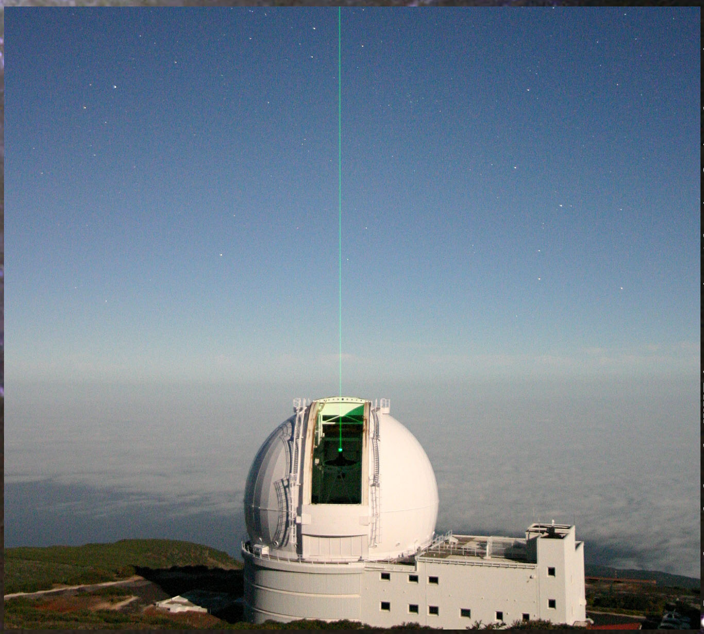
The Foundations of the William Herschel Telescope

The WHT's conception dates back to the late 1960s, when the Anglo-Australian Telescope (finished 1974) was being designed. Astronomers wondered what telescopes of comparable power they should build in the Northern Hemisphere. There was particularly strong pressure for a powerful instrument which could be used for observing very faint galaxies in the Northern Hemisphere.

The Science and Engineering Research Council (SERC) of the UK started to plan the WHT in 1974. The precise diameter of 4.2 metres was determined by the availability of the mirror blank, made by Owens-Illinois. The mirror was figured at Grubb Parsons. It was believed that this was the most accurate large mirror yet made at that time. In 1981, SERC negotiated a 20% participation by the Netherlands. That year was also the 200th anniversary of Herschel's discovery of Uranus, and the name of the new telescope was announced. Construction of the telescope building began in 1983. The telescope was shipped to La Palma in 1985 and first light was on 1 June 1987, using TAURUS-2 instrument.

The WHT mounting is of alt-azimuth design, which requires a computer to calculate 20 times per second the motions needed in altitude and azimuth to track an object on the sky. The telescope weighs about 200 tonnes and floats on a layer of oil 0.1 mm thick, pumped through 6 supporting pads. There is so little friction that the telescope can be pushed around by hand.

The telescope is a general-purpose facility, instrumented to allow a wide range of astronomical observations, from the optical wavelengths to the infrared, and from imaging to spectroscopy. Through continued development of instrumentation, particularly in the field of adaptive optics, the telescope remains at the forefront of astronomical research.



Laser launched at the WHT for supporting Adaptive Optics observations