The 1.0-m Jacobus Kapteyn 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 JKT has a parabolic primary mirror of diameter 1.0 m. It is equatorially mounted, on a cross-axis mount and instruments can be mounted at the f/15 Cassegrain focus. The role of the telescope is as a facility for CCD imaging.

The construction, operation, and development of the ING telescopes is the result of a collaboration between the United Kingdom and the Netherlands. The site is provided by Spain, and in return Spanish astronomers receive 20% of the observing time on the telescopes. The operation of the site is overseen by an International Scientific Committee, or Comité Científico Internacional (CCI). A further 75% of the observing time is shared by the United Kingdom and the Netherlands. On the JKT the international collaboration embraces astronomers from Ireland as well. The remaining 5% is reserved for large scientific projects to promote international collaboration between institutions of the CCI member countries.

Scientific Highlights

Cosmic flow of galaxies across one billion years of the universe. According to the 'cosmological principle', the large-scale universe should be smooth and well behaved. Distant galaxies ought to be evenly distributed in space, and their motions should correspond to a pure 'Hubble flow', a uniform expansion of space in all directions. In other words, the universe, in some average sense, is homogeneous and isotropic. But galaxies have other peculiar velocities, over and above the general cosmic expansion.

All galaxies execute some kind of peculiar motion as a consequence of the gravitational influence of the lumpy distribution of material around them. In 1988, a study of streaming motions in a sample of elliptical galaxies revealed evidence for a systematic flow, simple modelling of which suggested that it could be explained by a hypothetical object about 60 megaparsecs away from the Milky Way, which became known as the 'Great Attractor'.

Later the Streaming Motions of Abell Clusters Collaboration using the JKT and other telescopes were able to go far beyond the proposed location of the Great Attractor and they still saw outward motion of galaxies beyond it. The reported bulk flow is of amplitude 630±200 km/s with respect to the cosmic microwave background.

Comet LINEAR blows up in full view of the JKT. For the first time, the JKT followed up the complete disruption of the nucleus of a comet, comet LINEAR, the brightest comet of 2000. Comet LINEAR did not appear to have broken into individual fragments in the way that Comet Shoemaker-Levy 9 did in 1993. Instead, it completely blew apart. Further observations with the Isaac Newton Telescope confirmed the initial discovery and provided new insight into what the reason for the comet disruption could be: the evaporation of all the ice in the nucleus.

First detection of gravitational microlensing. One of the most dramatic manifestations of gravitational lensing is exhibited by the quasar 2237+0305, which has a redshift of 1.70. The quasar is located exactly behind the centre of a bright spiral galaxy with a redshift of only 0.04, and the quasar image is split into four separate components separated from each other by less than 2 arcseconds. The light paths through the galaxy to each of the images may pass close to other stars or other compact objects in the galaxy, producing gravitational lensing effects manifested as brightness changes in the images. Such effects are termed "microlensing" events.

The Moon

M57 Planetary Nebula

M 92 Globular Cluster

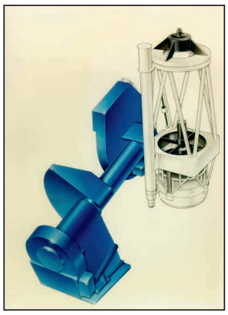
NGC 7331 Galaxy

M 95 Galaxy

Working with images from the WHT, the researchers made the first detection of a gravitational microlensing event. The group found that the brightest of the four images had increased in brightness by 0.5 magnitudes over a period of less than a year and possibly on a timescale of only a month. The team followed up the detection with a monitoring campaign on the JKT.

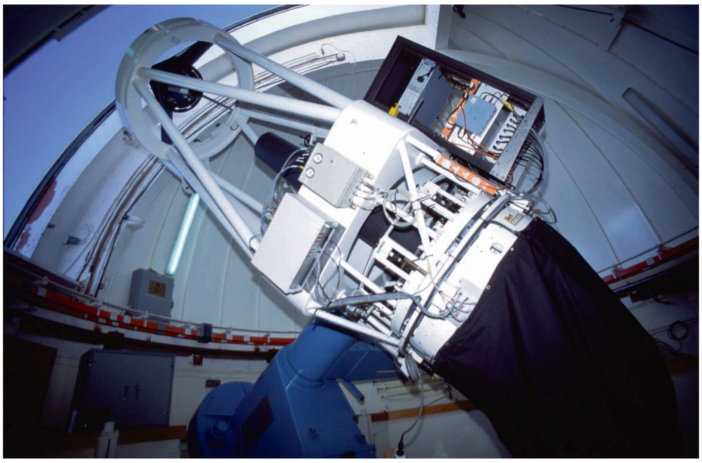
Technical Description

The optics and the mounting. The Jacobus Kapteyn Telescope has a parabolic primary mirror of diameter 1.0 m with two interchangeable secondaries. The f/8.06 Harmer–Wynne system uses a spherical secondary and a doublet corrector to give a field of 90 arcmin diameter. The other secondary is a hyperboloid, which gives a conventional f/15 Cassegrain focus. The JKT normally operates in f/15 mode.

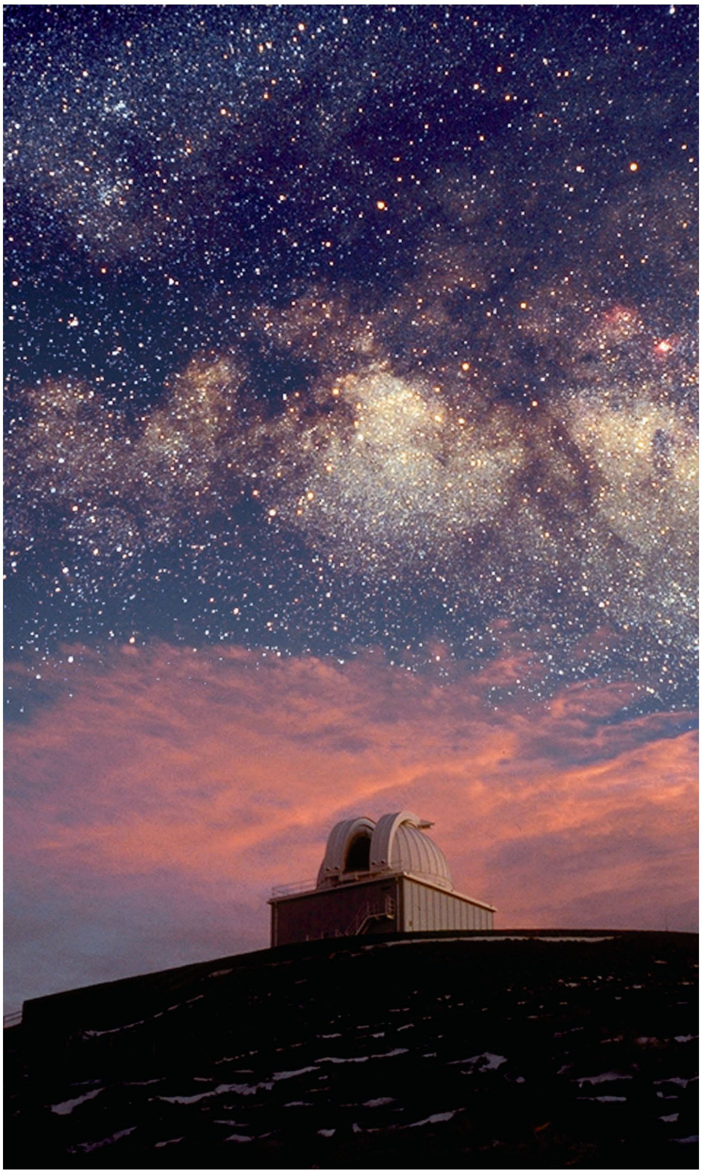


It is equatorially mounted, on a cross-axis mount, which allows operation east or west of the pier. Normally it is east of the pier. Total weight of the telescope is about 40 tonnes.

The instrumentation. As of 1998 the JKT is a single-instrument telescope, that can only be used for CCD imaging. The JKT is operated with the JKT Acquisition and Guiding unit (JAG) mounted at Cassegrain. The JAG holds the autoguider, the acquisition TV, the CCD shutter, and the filter wheel with 6 slots for 50×50mm filters. The CCD cryostat is mounted under the JAG. Currently, the default detector is SITe2, a device with 2048×2048 24 micron pixels. For SITe2 the image scale is 0.33 arcsec/pixel, giving an unvignetted field of view of about 10×10 arcmin.



Recently the JKT has evolved to a low-cost operation simple telescope.



The Foundations of the Jacobus Kapteyn Telescope

In the early 1960s there was a flourishing school of photographic astrometry at the Royal Greenwich Observatory (RGO). It was found that very accurate proper motions of celestial objects could best be determined by comparing plates taken 50 or more years apart with the same telescope. Therefore thoughts turned to the design of a dedicated astrograph incorporating the latest technology, especially in optical design.

The 1973 Scientific Case for the Northern Hemisphere Observatory (NHO) called for three telescopes, the smallest to be a 1 metre. In order to reduce aberrations, match the local seeing to the photographic grain available at that time and flatten the field of view, the astronomers decided on the final design of the telescope.

The design of the telescope was fixed by 1977 well in advance of the Science and Engineering Research Council (SERC) decision to support the NHO project or the firm decision to site the observatory on La Palma. The telescope was erected on the ground floor of the Isaac Newton Telescope (INT) building at Herstmonceux in 1982 and interfaced to its computer. It was shipped to La Palma in the summer of 1983; its base plate served as the landing pad for a Royal Navy Sea Harrier which landed on the cargo ship *Alraigo* after losing its aircraft carrier.

The telescope was erected in the dome on La Palma in October 1983 and the building handed over in January 1984. The first photographic plate was taken in March 23 1984 and the first scheduled astronomers used the telescope on May 29.

It was an initial user requirement that the telescope should have an uninterrupted horizon in all directions so that whenever a supernova, bright comet or other interesting transient object appeared, at least one of the La Palma telescopes should always be able to observe it. For this reason the JKT was sited to the south of the INT and 22 metres above it close to the Caldera de Taburiente lip. A limiting condition was the ruling by the National Park Authority (ICONA) that all the telescopes must be below the skyline when viewed from Cumbrecita on the opposite Caldera wall so as not to affect the natural beauty of the national park. The ability to view the horizon in all directions is aided by the telescope's cross axis mounting design which allows any star in the sky to be observed from above the intersection of the axes.