The discovery of credible evidence for acceleration in the expansion rate of the Universe is certainly one of the more surprising cosmological results in modern astronomy.

The fact that two independent groups using Type-Ia supernovae as distance indicators—the High-z Supernova Search (High-z SN) team, founded by Brian Schmidt of Australian National University and Nicholas Suntzeff of Cerro Tololo Inter-American Observatory (CTIO), and the Supernova Cosmology Project (SCP) led by Saul Perlmutter of the University of California at Berkeley—both arrived at the same conclusion helped to speed the acceptance of such an unexpected result.

Subsequent data from ground-based and space-based programs, including studies using tools other than SNe, have confirmed the initial results, although the nature of the “dark energy” that is apparently driving this acceleration is still uncertain. The first reports, though, were the product of essentially ground-based programs that relied heavily on the resources of the National Optical Astronomy Observatory.

At the time when the two groups were developing their programs, new observations of Type-Ia SNe showed that they were not homogeneous standard candles. Early CCD observations of SN 1986G obtained at CTIO showed it to be unusual. In 1991, two SNe (the overluminous SN 1991T and the underluminous SN 1991bg) provided unquestionable evidence that SNe Ia are heterogeneous, with a spread of 2.5 magnitudes at peak brightness.

Fortunately, the Calan/Tololo SN survey had begun in 1989. This search was led by Mario Hamuy, Mark Phillips, Nicholas Suntzeff (all CTIO astronomers at the time), and Jose Maza (Universidad de Chile). They used the CTIO Curtis Schmidt camera to search for SNe, timing the observations to catch SNe soon after explosion. Most of the photometry of the newly discovered SNe was obtained with the CTIO 0.9-meter telescope, while the CTIO 1.5-meter and Blanco 4-meter telescopes provided most of the spectroscopy.

Analysis of this well-observed and well-calibrated SNe sample showed that the peak brightness of a Type-Ia SN was correlated with the light-curve shape. Using the light curve, one could transform a relatively diverse set of Type-Ia SNe into “calibratable” standard candles. Without this calibration, neither team could have obtained luminosity distances to high-redshift SNe with the precision necessary to detect the subtle effect introduced by the acceleration of the expansion. These SNe also provided the low-redshift anchor for the cosmology derived from the high-redshift SNe. The Calan/Tololo survey was essential to the success of each cosmological program.

The techniques for finding high-redshift SNe began with a Danish group using the 1.5-meter telescope at ESO. They adopted a timing scheme similar to that used by the Calan/Tololo survey. Expanding on this, the SCP started using the Kitt Peak Mayall 4-meter and 2.1-meter telescopes for searches and photometry. With these facilities, they refined the strategy of observing blank fields to catch high-redshift SNe early in their development. These early runs often shared fields with other programs to extend the utility of the data, a practice continued with many later SNe searches.

In order to find large numbers of SNe at high redshift, both teams employed the wide-field imaging capability of the Blanco 4-meter telescope at CTIO. Initially, they used the prime-focus CCD camera, switching to the Big Throughput Camera when it became available. Previously obtained template images were subtracted from frames during SNe searches. Promising new objects could then be observed spectroscopically to securely identify the new object as a Type-Ia SN. Multiple epochs of photometry (often with the Blanco 4-meter) produced light curves that could be anchored using the calibration provided by the Calan/Tololo sample.

The WIYN 3.5-meter telescope at Kitt Peak was used by the High-z SN team and the SCP to observe many of the high-redshift SNe found by the Blanco 4-meter telescope. One of the reasons that WIYN was particularly useful was that it was operating with a queue schedule at that time. For transient objects such as SNe, the ability to obtain observations on demand is a tremendous resource. Both teams explicitly acknowledged the importance of the WIYN queue observers to their projects.

NOAO facilities continue to play an important role in studies of dark energy. The Blanco 4-meter is the host of the NOAO Survey project Equation of State: SupErNovae trace Cosmic Expansion (ESSENCE), which is searching for more high-redshift Type-Ia SNe in order to constrain the equation-of-state parameter of dark energy (see www.ctio.noao.edu/essence). NOAO supports both ESSENCE and the Canada-France-Hawaii Telescope SN Legacy Survey in their use of the Gemini Observatory to obtain spectra of high-redshift SNe.

The Blanco Cosmology Survey (www.cosmology.uiuc.edu/BCS) will also attempt to constrain dark energy through observations of clusters of galaxies. In the near future, the Dark Energy Survey (www.darkenergysurvey.org) will build the 500-megapixel Dark Energy Camera for the Blanco, dramatically expanding survey capabilities for NOAO and its user community, and enhancing the observatory’s historic place in the quest to understand the mystery of the accelerating universe.