The Planetary Nebula Spectrograph Successfully Commissioned

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The Planetary Nebula Spectrograph (PN.S) was successfully commissioned on the William Herschel Telescope on the night of 2001 July 16. This instrument was designed and built by an international consortium with members in Australia, The Netherlands, Italy, the UK, ESO and the USA (a full list of contributors can be found at `http://www.astro.rug.nl/~pns/pns_team.html`). The PN.S is specifically designed to detect large numbers of planetary nebulae (PNe) in external galaxies and measure their line-of-sight velocities in a single exposure. In essence, it comprises twin slitless wide-field spectrographs behind a narrow band 5007Å filter. These spectrographs disperse light in opposite directions, so that images of PNe, which emit most of their light in the 5007Å [OIII] emission line, are shifted in opposite directions in the two arms of the spectrograph by amounts proportional to their Doppler shifts. Thus, by matching up pairs of PN images in the two arms, it is possible simultaneously to determine the locations of PNe, measure their brightnesses, and determine their line-of-sight velocities. A more complete description of the instrument, the technique, and its application to studying galaxy dynamics, can be found in *ING Newsletter*, **4**, 23.

The commissioning team, led by Nigel Douglas (Kapteyn Institute), mounted the PN.S at the Cassegrain focus of the WHT (see Figure 1) over the weekend of 2001 July 14–15. Integrating the instrument with the telescope and ING CCDs went very smoothly. Focussing and wavelength calibration proved straightforward using the telescope's calibration lamps to illuminate a grid of holes in a moveable mask inside the spectrograph. The Observatory Open Day on July 15 gave plenty of opportunity for quantifying the negligible flexure in the PN.S as the telescope was slewed around the sky for the visitors (and the commissioning team made an interesting extra "exhibit" on the tour!). On the commissioning night of 2001 July 16, the instrument was put through its paces on the sky. Photometric conditions allowed confirmation that the instrument meets its designed 30% sky-to-detector efficiency –this high throughput is made possible by the custom design of the instrument to observe the single 5007Å line. Unfortunately, exceptionally poor seeing (more than five arcseconds at times!) meant that the full potential of the PN.S to detect faint point-source PNe could not be fully tested.

Poor seeing, broken cloud and dust on the following three nights of the science run (jointly awarded by the UK and Netherlands TACs) restricted the range of science that could be attempted, but some data was obtained for nearby galaxies and Galactic calibration sources. An example of the raw data from the two arms of the spectrograph, and the ease with which they can be combined to detect PNe and their kinematics, is shown in Figure 2.

In September, a six night observing run coincided with some rather better weather, and excellent observations were made of a number of flattened early-type galaxies. Figure 3 shows the kinematics that were derived from a preliminary analysis of an observation of the S0 galaxy NGC7457. With data of this quality, the study of stellar dynamics in early-type galaxies is set to be revolutionized. ¤

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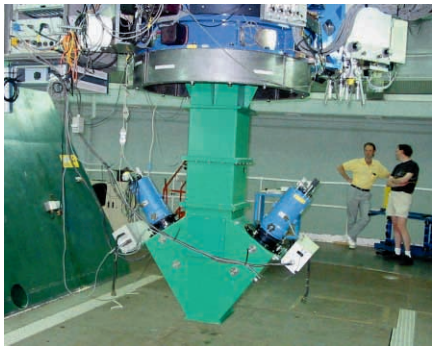

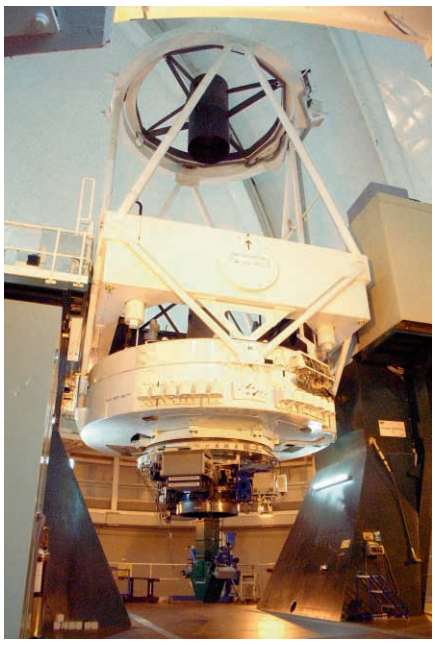

Figure 1. Top left: The Planetary Nebula Spectrograph fully assembled and integrated with the WHT, and EEV CCDs and controllers mounted on each arm of the spectrograph. Bottom left: First light commissioning team. Right: General view of the PN.S and the WHT.

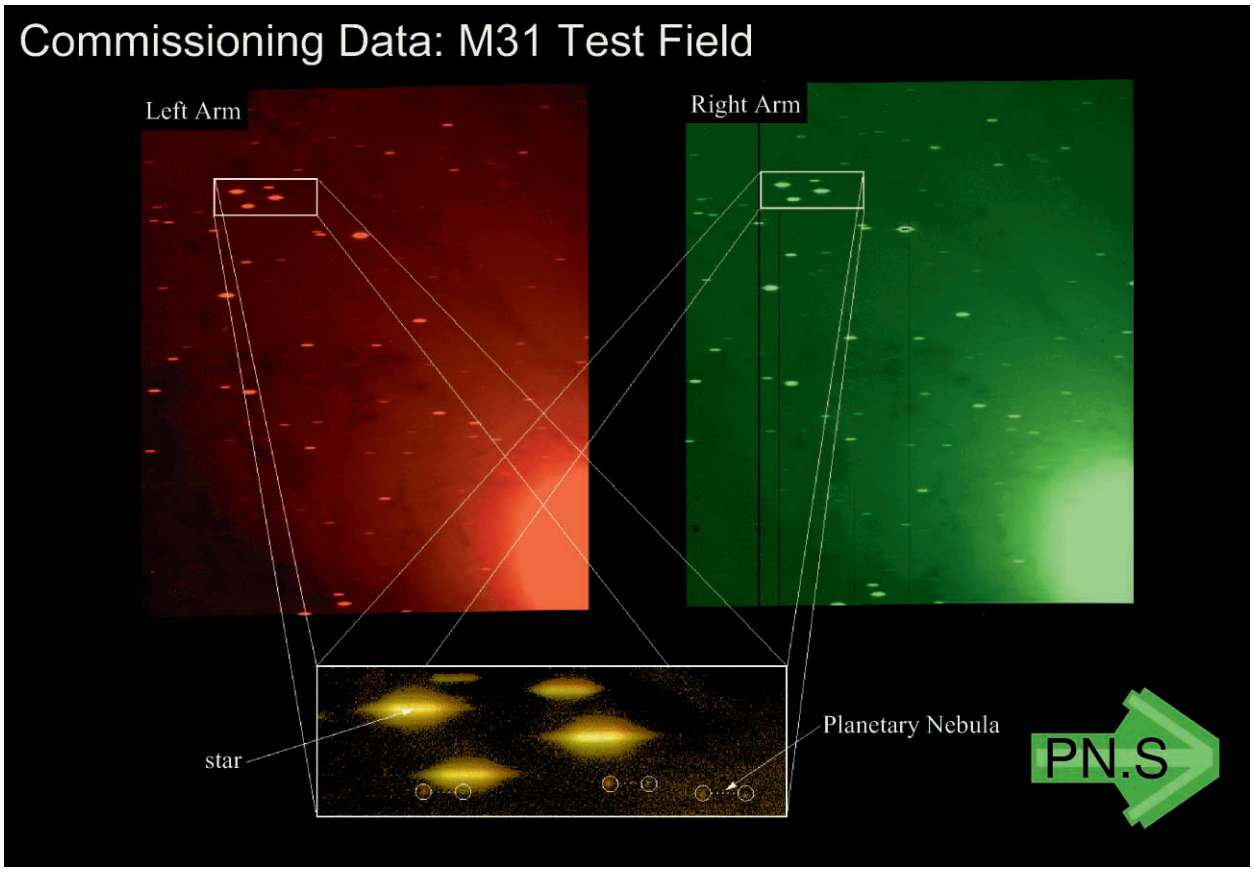

Figure 2. One of the observed fields in M31, showing the data recorded by the two arms of the spectrograph, colour coded in red and green. The inset combined image shows how stellar spectra appear as superposed continua, limited in length by the response of the narrow-band filter, whereas planetary nebulae show up as point sources, offset between the two arms by an amount depending on each nebula's Doppler shift.

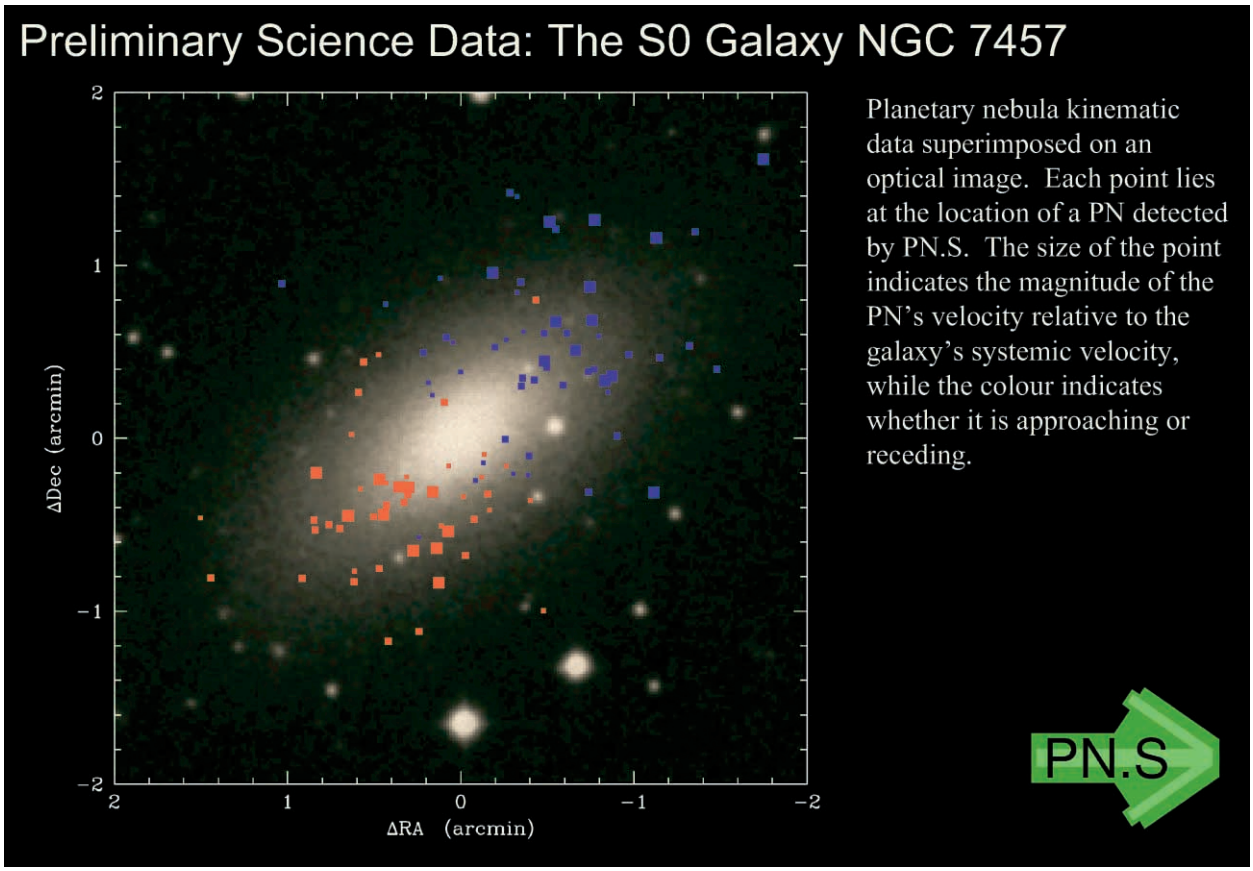

Figure 3. Preliminary analysis of a PN.S observation of the S0 galaxy NGC 7457.