MORPHOLOGY & KINEMATICS OF THE 'BORN–AGAIN' PLANETARY ABELL 78

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Abell 78 is one of a group of planetaries having an old, H–rich nebula surrounding a hot star which has more recently ejected highly–processed, H–deficient material. The A78 central star has O VI emission lines and a 3700 $\mathrm{km\,s^{-1}}$ hot wind, and is surrounded by knots of very dusty, H-deficient material. These objects are thought to have suffered a late helium shell flash which resulted in the central star (then a white dwarf) returning to the AGB and ejecting highly-processed material.

We obtained imaging and velocity data on the 4.2m William Herschel Telescope at La Palma, all in the [O III]5007Å line. Images of the central region were taken with the MARTINI image–sharpening device, with which the ambient seeing's FWHM of 1.6" was improved to 1.1". The velocity information was from the TAURUS Fabry-Perot Imaging Spectrometer, with which the central field was recorded with a a velocity step of 8.0 $\mathrm{km\,s^{-1}}$ per map channel over a free spectral range of 600 $\mathrm{km\,s^{-1}}$.

The deep images resolve new structures in the system of knots. They appear to form sets of radial, filament–like structures, which lie roughly in a plane which is almost in the line–of–sight. The (projected) expansion velocities of the knots are about 30 $\mathrm{km\,s^{-1}}$ in the radial direction.

The TAURUS data have also revealed a pair of fast-moving, diametrically opposed 'bullets', each located 13 arcsec from the star and at the two 'poles' of the disk system suggested by the knots. The bullets have (projected) expansion velocities of +103 and −103 $\mathrm{km\,s^{-1}}$, but the deprojection factor is likely to be quite large, so the bullet 'ejection velocity' could be as high as 200 $\mathrm{km\,s^{-1}}$.

A model is suggested in which the hot central star has a main sequence companion. After the late thermal pulse, the born-again AGB star transferred matter onto an accretion disk around the dwarf, and the fast bullets represent condensations in a two–sided jet which emerges at each pole with ejection velocity $v(ej) \sim v(esc)$, the escape velocity from the dwarf companion's surface.

Such a model for A78, if correct, suggests that (a) fast bullet pairs seen in other PNs originate from near the stellar surface, and not from a two–wind hydrodynamic 'focussing' mechanism; and (b) such bullet pairs may enable us to determine the orientation of unseen binary systems at the centres of a few planetary nebulae.