

Abstract

Two distinctive features were discovered in an optical image of the 40 arcmin diameter outer halo of NGC 7293; one resembled morphologically a bow-shock and the other a jet. These were confirmed later in GALEX NUV images. Profiles of the H α and [N II] 6584A lines have exactly the kinematical signatures expected of both classifications. The truncated jet is shown to be collisionally ionized material in a 300 km/s collimated monopolar outflow which most likely originated in the late AGB evolutionally phase of the progenitor star. The bowshock is shown kinematically to be caused by the motion of the whole of NGC 7293 with respect to its ambient medium.

Observations & Results

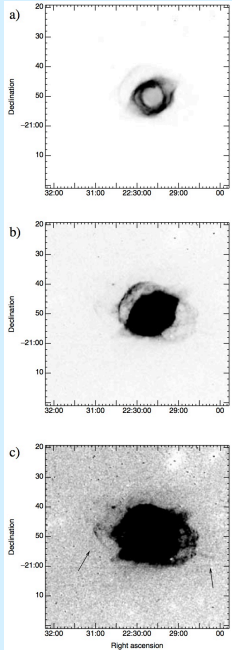


Fig.1 (left): H α + [N II] image of Helix at three contrast levels to show all features. The bow-shaped and jet-like features are both indicated with an arrow (Meaburn et al. 2005).

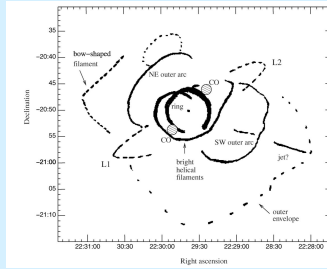


Fig.2 (left): The salient optical and UV emission features of the large-scale structure of NGC 7293 are compared with the approaching (-50 km s^{-1} – hashed circle to the south-east) and receding ($+4 \text{ km s}^{-1}$ – hashed circle to the north-west) parts of the outer CO torus discovered by Young et al. (1999). The complete outer torus is not detected in the CO or UV images as it gets confused with the brighter nebular features. The possible bipolar lobes emanating from this outer torus are L1 and L2 in which case they would have receding and approaching radial velocities, respectively, and would have to have a common axis with it. (Meaburn, Lopez, Richer 2008).

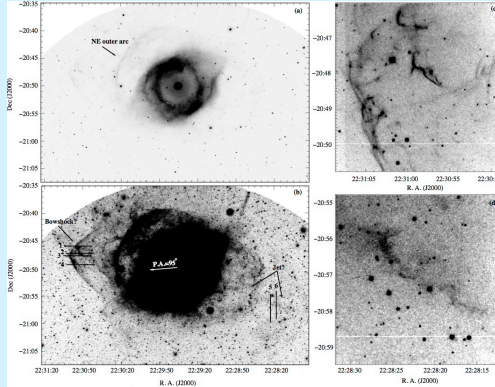


Fig.3 (left): a) A light, negative, greyscale presentation of the GALEX NUV image. The NE outer arc is indicated. b) A deeper representation of the same image reveals both the NE bow-shaped feature with EW Slits 1 - 4 marked and the SW jet-like filament with the NS Slits 5 & 6 marked. The arrowed line over the central star indicates the direction of its proper motion. c) H α + [N II] image of the bow-shaped region and d) H α + [N II] image of the jet-like feature. The horizontal white line in c) and d) is a bad column on the ccd. (Meaburn, Boumis, Akras 2013).

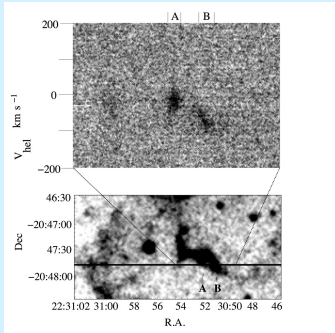


Fig.4 (left): A negative greyscale representation of the position-velocity array of H α line profiles from the EW Slit 3 in Fig. 3b is compared with an enlargement of part of the GALEX NUV image which contains the NE bow-shaped region. The small range in radial velocities confirm a bow-shock origin. (Meaburn, Boumis, Akras 2013).

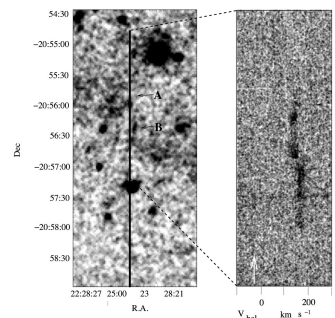


Fig.6 (left): A negative presentation of the position-velocity array of [N II] 6584 A line profiles from the NS Slit 5 in Fig. 3b is compared with an enlargement of that part of the GALEX NUV image which contains the SW jet-like filament. A collimated outflow of approx. 300 km/s is indicated (Meaburn, Boumis, Akras 2013).

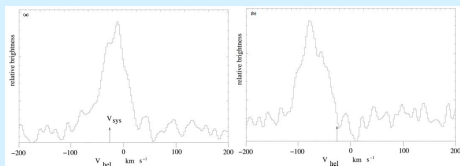


Fig.5: The H α line profiles from incremental lengths A & B marked in Fig. 4 are shown here in a) and b) respectively (Meaburn, Boumis, Akras 2013).

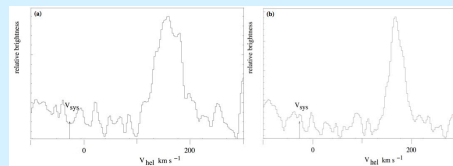


Fig.7: The [N II] 6584 A line profiles for incremental lengths marked A & B in Fig. 6 are shown in a) and b) respectively (Meaburn, Boumis, Akras 2013).

References