

Spectroscopic data analysis of the supernova remnant IC 443: Technical Report

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Observations:

Observations of the SNR IC 443 were carried out during November 19-26, 2012 at San Pedro Martir Observatory in Mexico (observer P. Boumis). During this observing run high-resolution optical spectra of selected filamentary structures of the supernova remnant IC 443 were acquired using the 2.1m telescope. In particular, we have taken spectra in the emission lines H α + [N II] and [O III] in different positions in order to study their kinematics. The MES-SPM high-resolution spectrometer was used with the 300 micron slit width giving a resolution of 22 km/s, in order to get enough photon counts to be able to study the filamentary structures. The H α and [N II] 6548, 6584 lines were observed in the 87th echelle order and the [O III] 5007 line separately in the 114th, in order to cover the outer parts of the ionization regions. A satisfactory coverage was obtained for each order with a 1800 sec integration time. The latter is appropriate in order to have enough photon counts for each position's high velocity features and to achieve a satisfied signal-to-noise (S/N).

Data reduction:

The raw data were first treated in a standar (bias subtraction, flat-field correction and sky background correction). Then, the long-slit spectra were cleaned of cosmic rays and calibrated in wavelength to ~ 1 km/s accuracy using the STARLINK Figaro software. Following that, we convert the wavelength to heliocentric velocity for each emission line separately. An example of the greyscale representation of the position-velocity (pv) arrays of the H α and [N II] line profiles for the whole slit length for Slit position B are shown in Fig. 1.

The H α line profiles from two of the highest speed knots, moving towards and away from the observer with velocities greater than 200 km/s are shown in Fig. 2. In particular, high-speed knots have been found to move towards us at $V_{\text{hel}} = -210$ km/s and away from us with even greater velocities, i.e. $V_{\text{hel}} = 260$ km/s. These high-speed knots are of great interest and they are going to be study in detail. Furthermore, morphologically, the filamentary structures confirm an evolved SNR origin for IC 443.

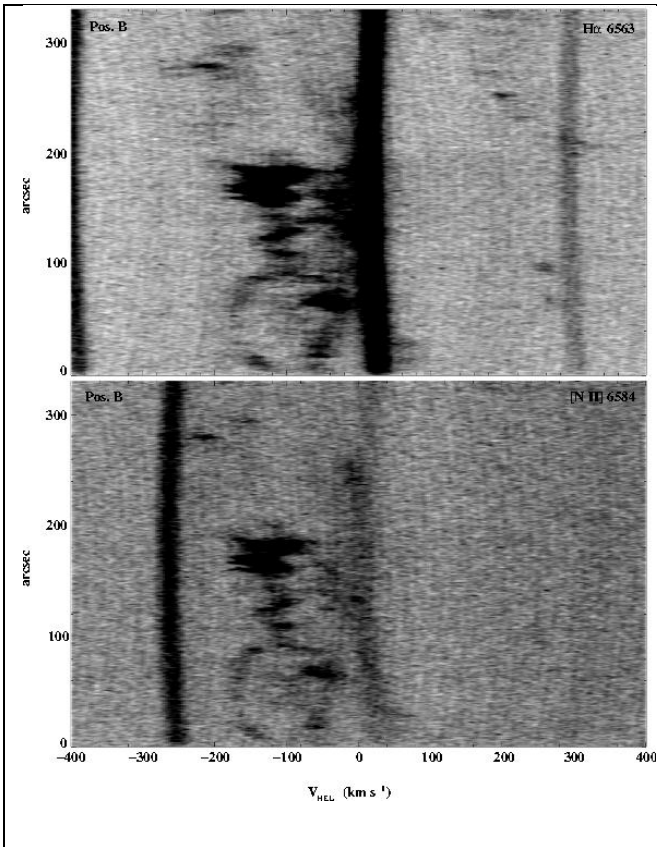


Fig. 1: PV arrays showing reduced, longslit H α and [N II] λ 6584 \AA SPM-MES spectra of IC 443, slit position B, aligned N-S, to show the nebular structure. North is to the top of the array. The velocity axis is heliocentric velocity, V_{hel} . The vertical lines are airglow lines.

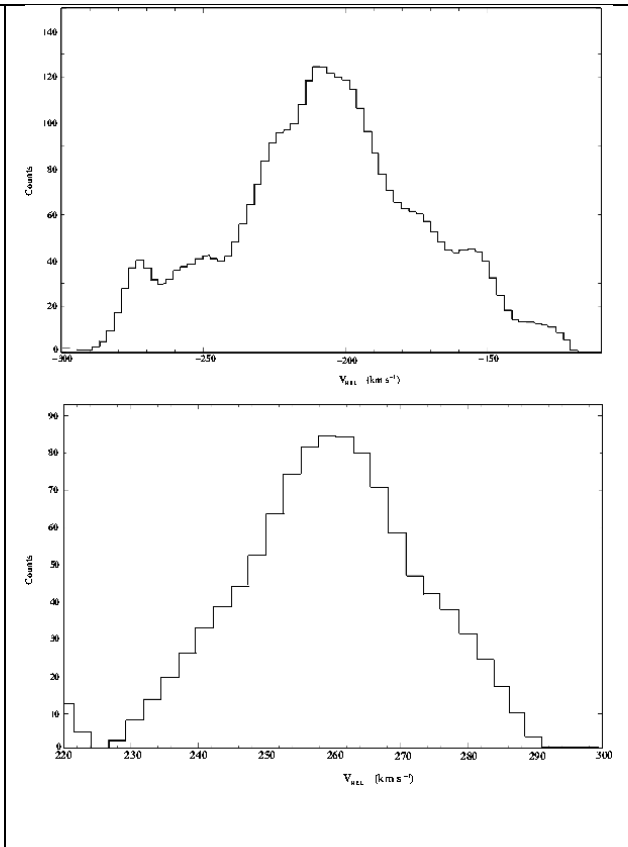


Fig. 2: The H α line profiles from the highest speed knots, moving towards and away from the observer with velocities greater than 200 km/s.