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HH 111 LINE RATIOS FROM STIS SPECTRA

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A STIS spectrum of the HH 111 Herbig-Haro jet has recently been obtained. We have used this spectrum to calculate line ratios as a function of position along the jet. These line ratios show the spatially dependent excitation along the jet in unprecedented detail.

The spectrum was obtained from several combined exposures, corresponding to a single slit position along the HH 111 jet, obtained with the Space Telescope Imaging Spectrograph (STIS). The position-velocity diagrams obtained from this spectrum were presented by Raga et al. (2002). Due to the rather low signal-to-noise ratio of the STIS spectrum, we applied a spatial Fourier filter to the original data, reducing the angular resolution to $\approx 0''.4$.

From the smoothed spectrum, we calculate the intensity in the different emission lines visible in the spectrum (by integrating over appropriate wavelength intervals) and compute the following position-dependent line ratios: [S II] 6716/[S II] 6731, [S II] (6717+31)/Hα, and [O I] 6300/Hα. The calculated line intensities are shown in Figure 1, and the spatially-dependent red [S II] line ratio is shown in Figure 2. Our analysis of the line ratios along the HH 111 jet shows that: (i) with the exception of knot H, all of the knots detected in the STIS spectrum coincide with electron density minima, (ii) electron density maxima are found in the low-intensity regions between the knots, and (iii) all of the knots coincide with regions in which the excitation of the spectrum (as measured by the [O I]/Hα and [S II]/Hα ratios) grows as a function of increasing distance from the source.

Interestingly, these results are in agreement with the numerical simulations of HH 111 of Masciadri et al. (2002), who find that the inter-knot regions have higher temperatures and full hydrogen ionization, as opposed to the knots, which are cooler and mostly neutral. They find that the large difference in ionization fraction produces electron density peaks in the inter-knot regions, even though the knots are about an order of magnitude denser.

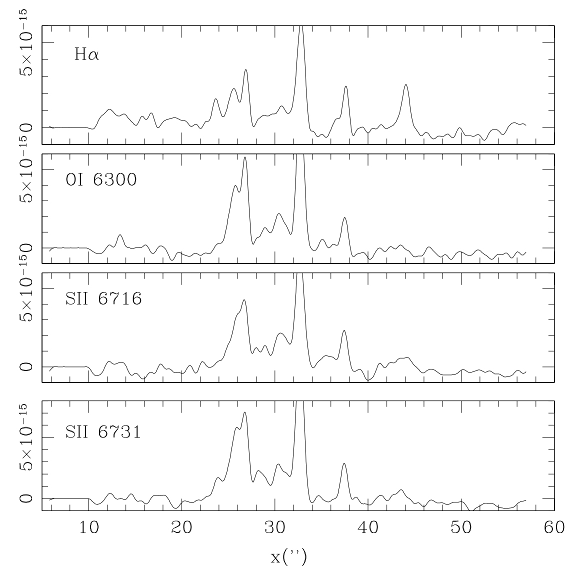

Fig. 1. Emission line intensities as a function of position obtained from the HH 111 STIS spectrum. The x-axis indicates the distance from the exciting source.

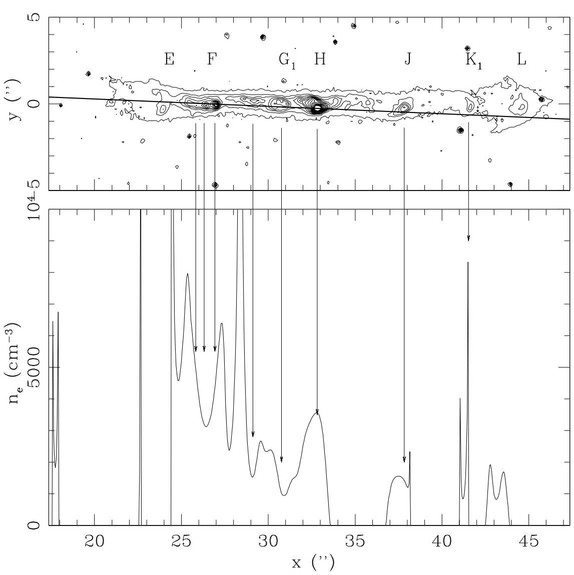

Fig. 2. The [S II] 6716/[S II] 6731 line ratio.

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