# Optical spectro-imaging observations of the RY Tau jet

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## Abstract:

We have detected the microjet in the T Tauri star RY Tau by optical spectro-imaging observations using the integral field spectrograph OASIS at the CFHT. We have detected the blueshifted jet with an average centroid velocity of ≈-70 km/s, that suggests a weak inclination of the jet axis to the plane of the sky. We have found a jet PA ≈ 294° ± 1° perpendicular to the disc PA inferred from mm CO observations. This PA agrees with the PA of the binary inferred from Hipparcos observations calling into question the binarity of RY Tau.

## Introduction:

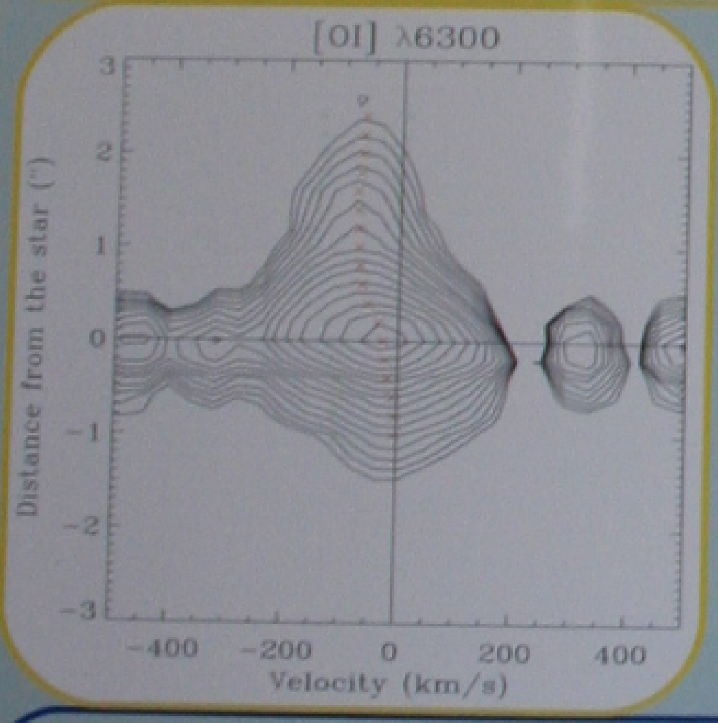
Microjets from T Tauri stars offer a unique opportunity to constrain both the ejection mechanism and the ejection region in young stars. The main goal of this work is to extend the on-going survey of microjets studied in detail (5-6 so far). RY Tau is hotter and more massive, and it has an acretion rate typically an order of magnitude lower than previously studied sources (RW AUR, DG Tau). It is also a suspected close binary star from Hipparcos observations. The variability of the astrometric solution, resulting in a motion of the photocentre, is interpreted with a binary of PA = 304° ± 34° and minimun separation of 3.27 AU[5].

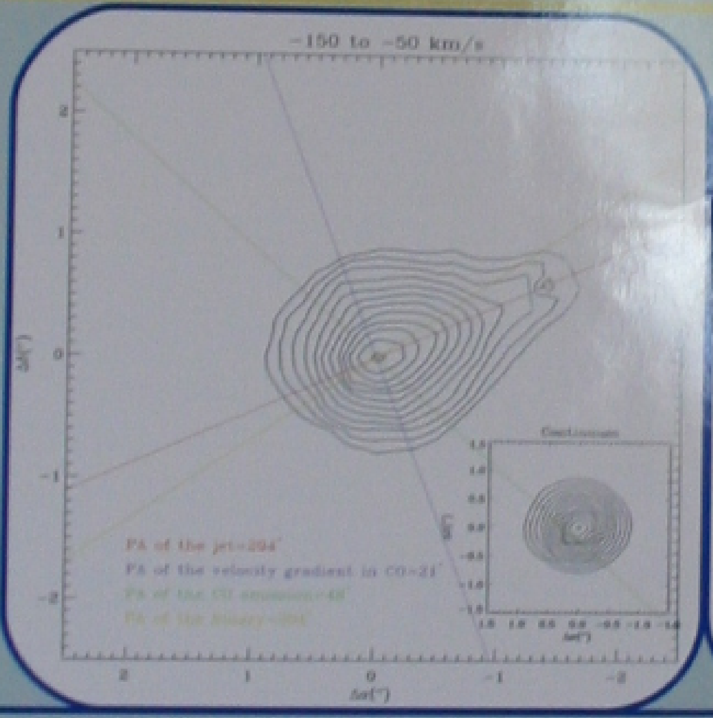
| RY Tau properties | |
|---|---|
| Mass | $\approx 1.4\ M_\odot$ [1] |
| Spectral Type | G1 [2] |
| Accretion Rate | $\approx 10^{-7}\ M_\odot/yr$ [2] |
| Age | $\approx 3\ 10^6$ yr |
| Veiling | ≈0.1 [3],[1] |
| vsini | 55 ± 3 [4] |

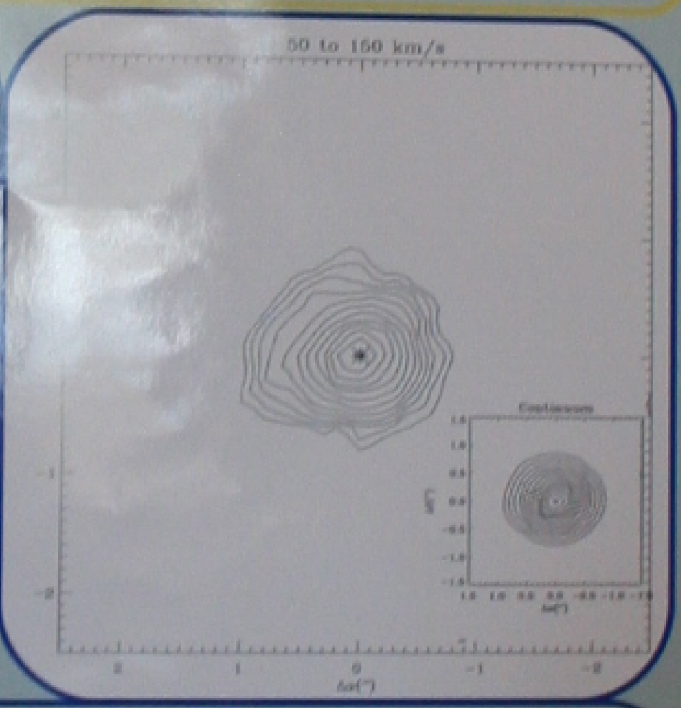
## Observations:

Observations of RY Tau were made on 15 January 2002 using the integral field spectrograph OASIS at CFHT. The configuration used provides a high spectral resolution with a resolving power of ≈3000 and covers a spectral range from 6209Å to 6549Å. We have studied the [OI]λ6300Å line with a spatial sampling of 0."16. After OA correction the spatial resolution is 0."4 (FWHM). The continuum subtraction was carried out using a photospheric spectrum of a similar spectral type star in the regions near the star (d < 1") and a simple linear fit in the rest.

LEFT: Position-velocity map along the jet in [OI] λ6300Å, integrated over a 1" wide "slit" and sampled every 0."2. Centroid velocities (red crosses) and FWHM (blue crosses) derived from gaussian fits are also plotted. We clearly detect a jet in the blue side with an average centroid radial velocity of ≈-70 km/s. Close to the star ( d ≤ 0.5") the wings of the line (v ≥ 250 km/s) are affected by continuum subtraction residuals.




MIDDLE: Continuum-subtracted map of the microjet in the velocity range [-150,-50] km/s in [OI] λ6300Å. Contours start at 2% of the maximum and increase by factors of √2. We represent several important orientations found in the literature. The PA of the jet (in red) is 294°±1° and is practically perpendicular to the orientations of the disc found by [6] using measures of the velocitiy gradient in CO (blue). They also find a direction of elongation of the CO emission of 48° ± 5° (green) but they point out that this value is highly uncertain because of resolution effects. We also show the binary PA found by Hipparcos (yellow).
RIGHT: Continuum-subtracted map in the velocity range [50,150] km/s. The PSF is displayed at the right-down corner. We do not detect emission of the jet in the red side.

## Results Summary:

We carried out the optical spectro-imaging analysis of RY Tau in the [OI] λ6300Å line. We have detected the blue emission of the microjet but not the red one. We have found a low jet radial velocity (≈-70 km/s) that suggests a weak jet inclination to the plane of the sky. Both [3] and [7] also found a HVC of -70\-80 km/s and a strong LVC of -4 km/s [7] that strongly contributes to the PV map close to the star. Finally, the PA of the jet we have found is in agreement with broad band deep HST images obtained by [8], who detect an emission knot at PA ≈ 290° and d ≈ 4". Our PA is also in good agreement with the mean disk velocity gradient of the CO emission shown by [6]. Moreover, the PA of the binary given by Hipparcos (304 °± 34°) agrees with our jet PA (294°± 1°) calling into question the binarity of RY Tau. Further observations with better spatial resolution are needed to clarify this issue.

## References:

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Vanessa Agra-Amboage wishes to acknowledge support through the Marie Curie Research Training Network JETSET (Jet Simulations, Experiments and Theory) under contract MRTN-CT-2004-005592.