The Cygnus X main filament: an exceptional star formation site

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Introduction

The Cygnux X region (Fig. 1, left) is the **richest star forming** region in the Galaxy at a distance lower than 3 kpc ([1],[2],[3]). More than 40 massive protostars were detected within the Giant Molecular Cloud Complexes of Cygnus X North and South at a distance of 1.7 kpc, including well-known objects such as **DR21, DR21(OH), W75N, S106**, and **AFGL2591**. The most massive (~35 000 M_{sol} from ^{13}CO 2-1 [1]) feature in Cygnus X is the dense molecular filament we refer to as the **'Cygnus X main filament (CXMF)'** [4], containing DR21 and DR21(OH). It belongs to a network of filaments (Fig. 1, middle) that marks active star formation sites.

Recent imaging in near- and mid-IR with the Spitzer satellite ([5],[7]) revealed that the CXMF is forming numerous stars, and our continuum imaging using MAMBO at the IRAM 30m telescope [6], detected several potential sites of OB star formation apart from DR21 and DR21(OH). Follow-up observations using the PdB interferometer reveals the **multiplicity** of some sources and outflow emission ([8]).

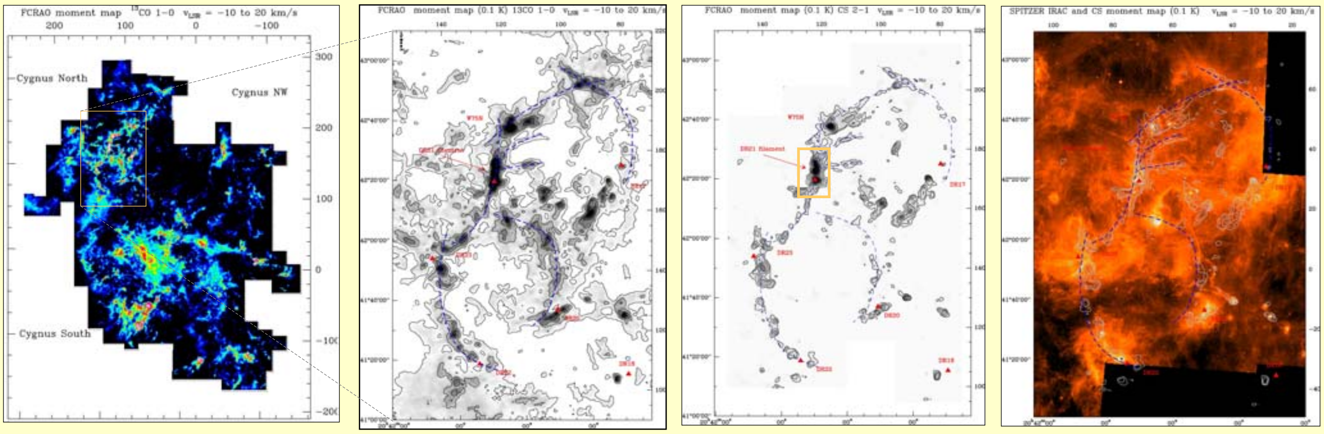

Fig.1: Left: ^{13}CO 1-0 emission of the Cygnus X region (FCRAO 50" resolution, offsets are in arcmin**). Middle:** Zoom into Cygnus X North in ^{13}CO 1-0 and CS 2-1 (the CXMF is indicated by a rectangle), filaments are indicated by blue lines. **Right:** Spitzer IRAC 4.5 micron image [7] with CS 2-1 emission overlaid.

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The CXMF was observed in various **molecular line tracers** using the IRAM 30m telescope (beamsize between 12" and 30"). While in HCO^+ and ^{13}CO (Fig. 2), **DR21** and its **outflow** are most prominent, it is the **hot core** around **DR21(OH)** that emits most strongly in the optically thin $C^{34}S$ and $H^{13}CO^+$ lines (Fig. 3) at a velocity of -3 km/s. Another velocity component (~0 km/s) with cold gas (<10 K determined from N_2H^+) 'falls' on the DR21(OH) core. This is one of the filamentary structures already seen on larger scales. Since N_2H^+ traces cold, dense gas, it is depleted in the hot core region but prominent more south (Fig. 2,3). The northern part of the filament is colder and contains several **protostellar, dense cores** (N_2H^+ and dust continuum peaks) while $C^{34}S$ is depleted. **Active star formation** is also indicated by **outflows** seen in SiO, ^{12}CO, and HCO^+ (not shown here).

The whole CXMF may undergo a **global collapse** because the typical spectral features of **infall** (Fig. 4, self-absorbed optically thick lines with a higher intensity blue component and the absorption dip redshifted with regard to the optically thin line) are observed across large parts of the filament. The total **mass** of the CXMF determined by dust continuum is around **20 000 Msol**, the one of the DR21(OH) core alone is **7000 Msol**, contained in a volume of 1 pc^3 at a **density** of **~6.5 10^5 cm^{-3}** . Only distant objects like, e.g., W43, W49, or W51, host similar clumps. We estimate that for a "normal" IMF, there would be 300 M_{sol} in OB stars (20 to 25 stars) and 80 M_{sol} in O stars (2 to 3 stars) at the end of the star formation process. **No other nearby clump can probe so clearly the OB (and perhaps O) star regime.**

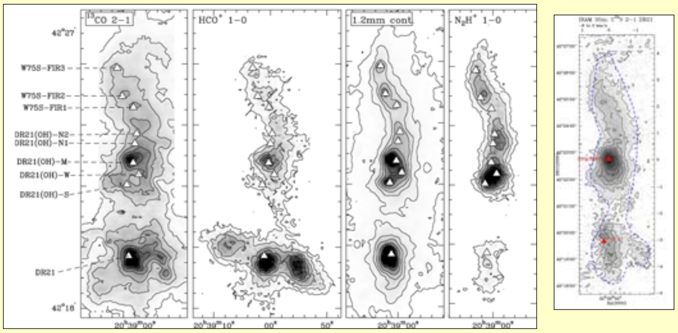

Fig.2: Molecular line maps of the CXMF. Known mm-continuum source ([6],[9]) are indicated. The mass obtained from $C^{34}S$ inside the blue polygon is 24 000 M_{sol} and the average density 6.3 10^4 cm^{-3} ($C^{34}S$ abundances were calibrated using mm-continuum).

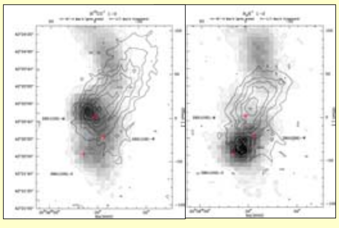

Fig.3: Velocity integrated maps of the -3 and 0 km/s components in $H^{13}CO^+$ (gray scale) and N_2H^+(contours).

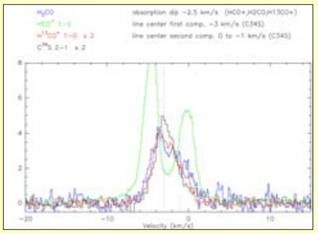

Fig.4: Spectra of different line tracers at the position DR21(OH). Note the self-absorption dip for HCO^+ and H_2CO.

Literature:

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