

Molecular Line Surveys of Cygnus X: The ^{13}CO and C^{18}O View

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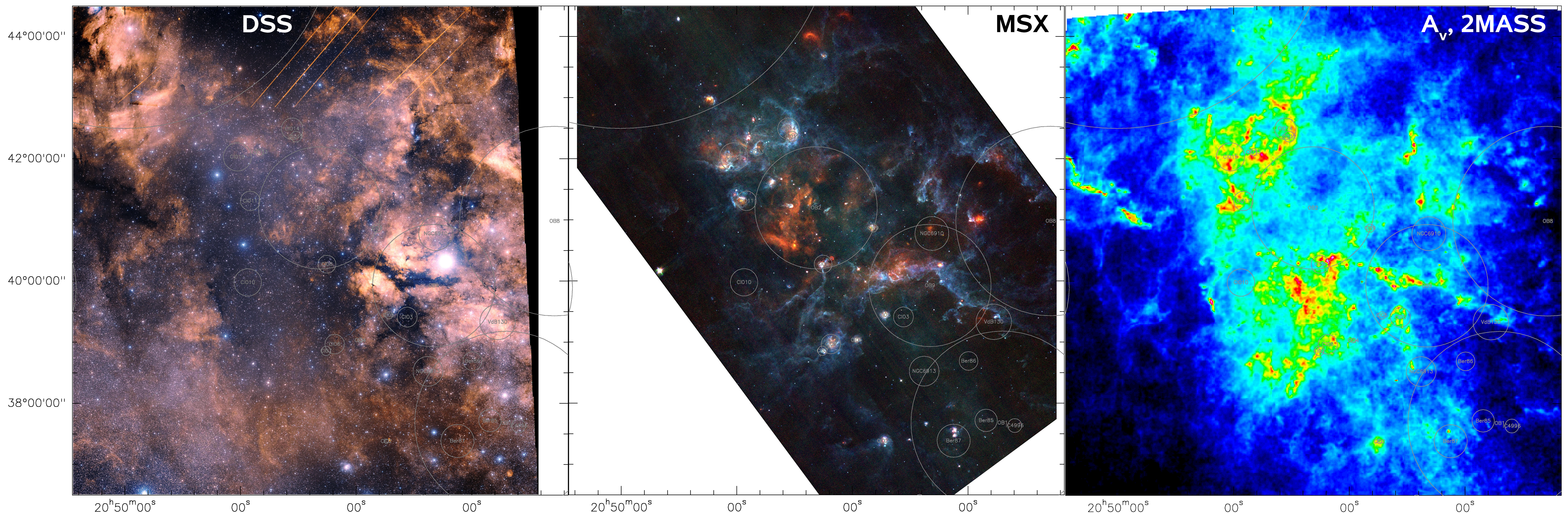
Abstract

The Cygnus X region at less than 2 kpc from the Sun harbors one of the richest giant molecular cloud and high mass star forming complexes in the Milky Way. Here, we present high spectral resolution imaging of the Cygnus X complex in the ^{13}CO and C^{18}O 1–0 transitions. The data have been taken with the SEQUOIA array at the FCRAO 14 m telescope and cover 35 square degrees at 45" resolution. While ^{13}CO traces the large scale distribution of cold and warm gas throughout the region, the high column density filaments and clumps are outlined by C^{18}O emission. We compare the global properties of the different velocity components of the complex together with available other large scale data at optical and infrared wavelengths, their relation to the active centers of star formation, and investigate their structure.

The Cygnus X region

The Cygnus X complex is the richest known massive star forming region within 2 kpc from the Sun including well-known regions like DR21, W75N, S106, and AFGL2591. It displays all signs of active, massive star formation from evolved to deeply embedded at a single distance (Schneider et al. 2006, 2007, see poster by N. Schneider) in a region ~ 200 pc across. The region contains

- hundreds of H II regions, several OB associations (incl. OB2, one of the richest in the Milky Way) with ~ 2600 OB, a number of Wolf-Rayet and OIII stars,
- a very massive molecular cloud complex ($3 \times 10^6 M_{\odot}$),
- a population of 40 high mass protostars detected in the mm-continuum (Motte et al. 2007, A&A in press, poster by S. Bontemps), some of them are OB protostars in their earliest stages of formation.

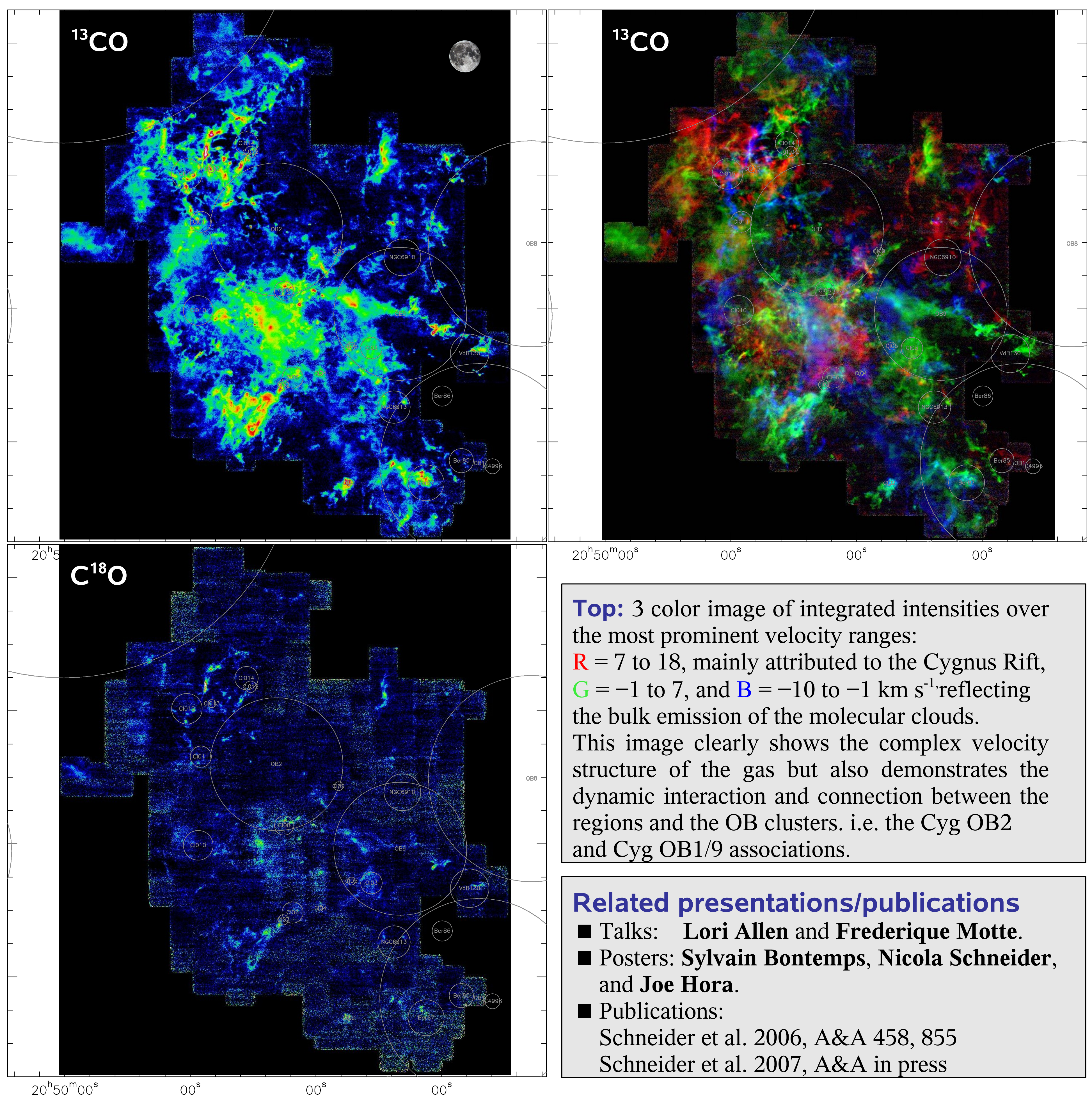


Top row: Due to the extinction of the foreground *Great Cygnus Rift*, the optical image (left, DSSII composite) does not show much details of the Cygnus X molecular cloud complex. The positions and approximate sizes of the most prominent OB clusters are indicated.

The full extent of the star forming gas and dust is only revealed at infrared or radio wavelengths. The middle image shows the 3-color MSX emission (R,G,B = Bands E,CD,A), nicely outlining the extended PAH emission at 8 micron. A map of visual extinction derived from 2MASS colors (S. Bontemps, Schneider et al. 2006) is shown on the right.

Right: The total integrated intensity of ^{13}CO 1-0 as seen with the FCRAO tracing the large scale distribution of the cold and warm molecular gas.

Bottom: Total integrated intensity of C^{18}O 1-0 emphasizing the high column density filaments and clumps.



Top: 3 color image of integrated intensities over the most prominent velocity ranges:

R = 7 to 18, mainly attributed to the Cygnus Rift, **G** = -1 to 7, and **B** = -10 to -1 km s^{-1} reflecting the bulk emission of the molecular clouds.

This image clearly shows the complex velocity structure of the gas but also demonstrates the dynamic interaction and connection between the regions and the OB clusters. i.e. the Cyg OB2 and Cyg OB1/9 associations.

Related presentations/publications

- Talks: **Lori Allen** and **Frederique Motte**.
- Posters: **Sylvain Bontemps**, **Nicola Schneider**, and **Joe Hora**.
- Publications:
Schneider et al. 2006, A&A 458, 855
Schneider et al. 2007, A&A in press