Nobeyama Open-use Highlights III: Study of the jet-ISM interaction based on the ^{12}CO, ^{13}CO, and C^{18}O line observation

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Introduction: Interaction between jet and ISM

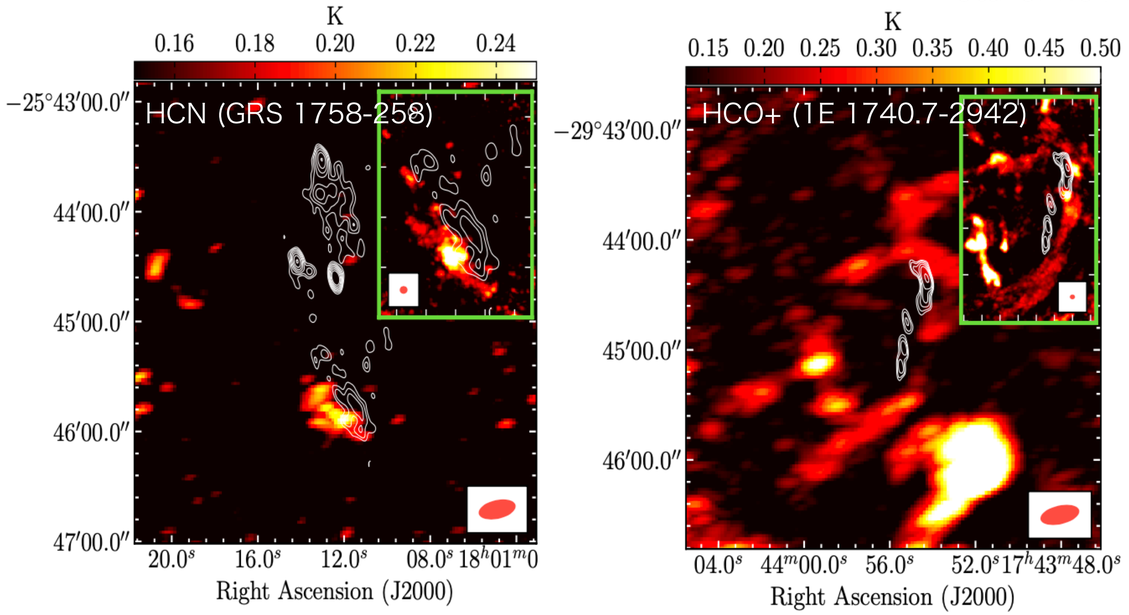
<u>X-ray binary jets:</u>

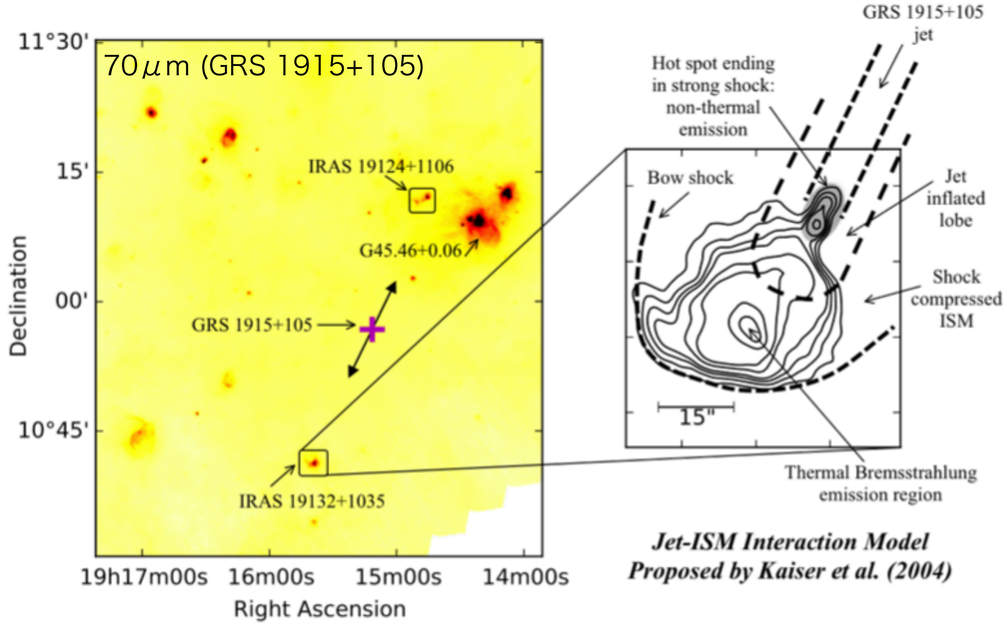
Interaction with surrounding ISM,

→ **alter the chemistry and excitation conditions??**

More observational studies are required to investigate how jets influence to the surrounding environment.

Tetarenko+17,20





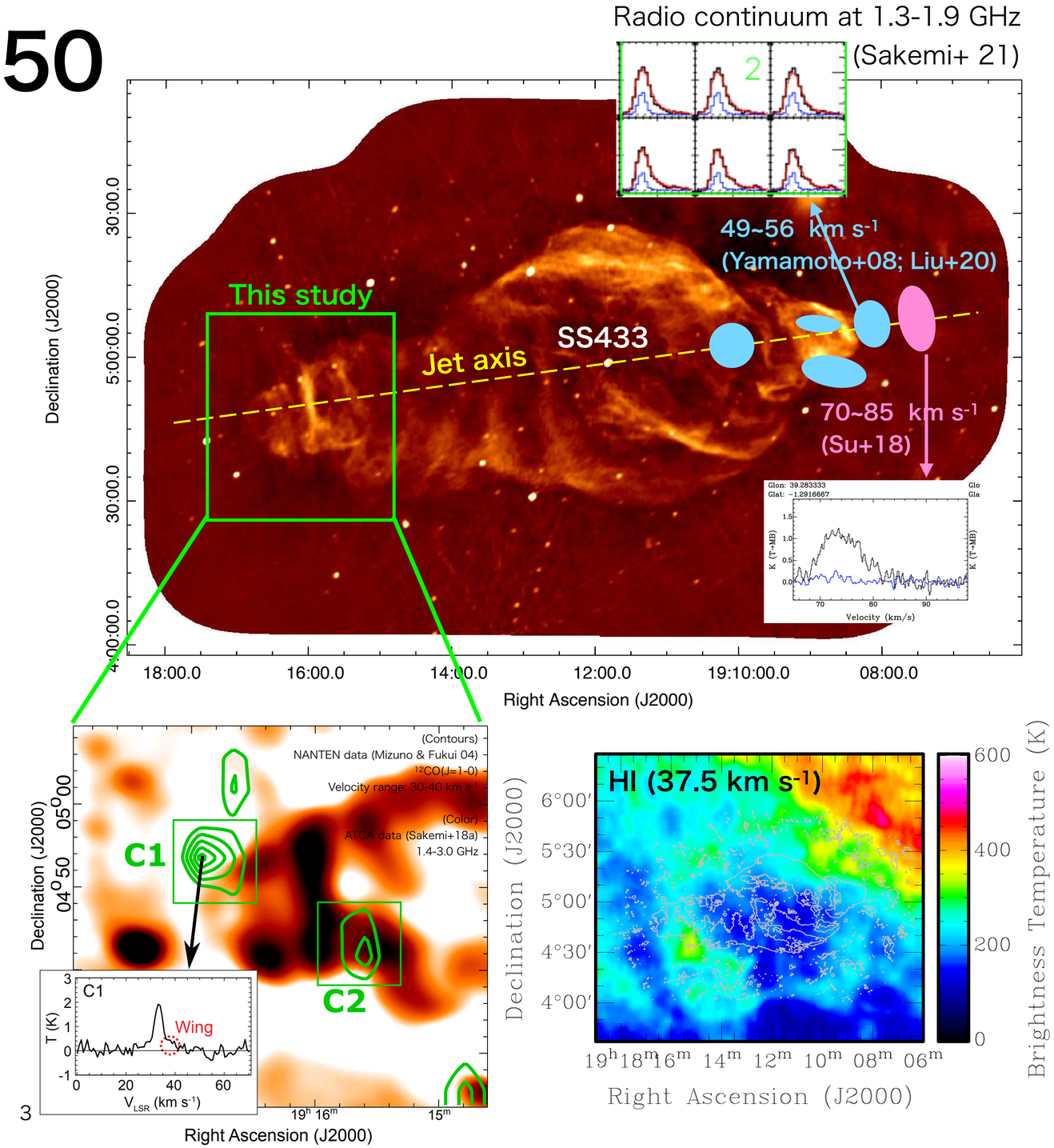
Introduction: SS433/W50

<u>Molecular clouds around W50:</u>

In different velocity ranges
(42-85 km s^{-1})
along **the SS433 jet axis**,

<u>Eastern edge of W50:</u>

Clouds interacting with W50??
Velocity range: 30-40 km s^{-1}
→ Corresponding the velocity range of HI cavity (33-55 km s^{-1}, Sakemi+21)



Purpose / Observations

Molecular clouds interacting with SS433/W50:

- Provide distance information (3.0-5.5 kpc)
- Influence of jet to ISM

45 m and ASTE observations to verify interaction

45 m

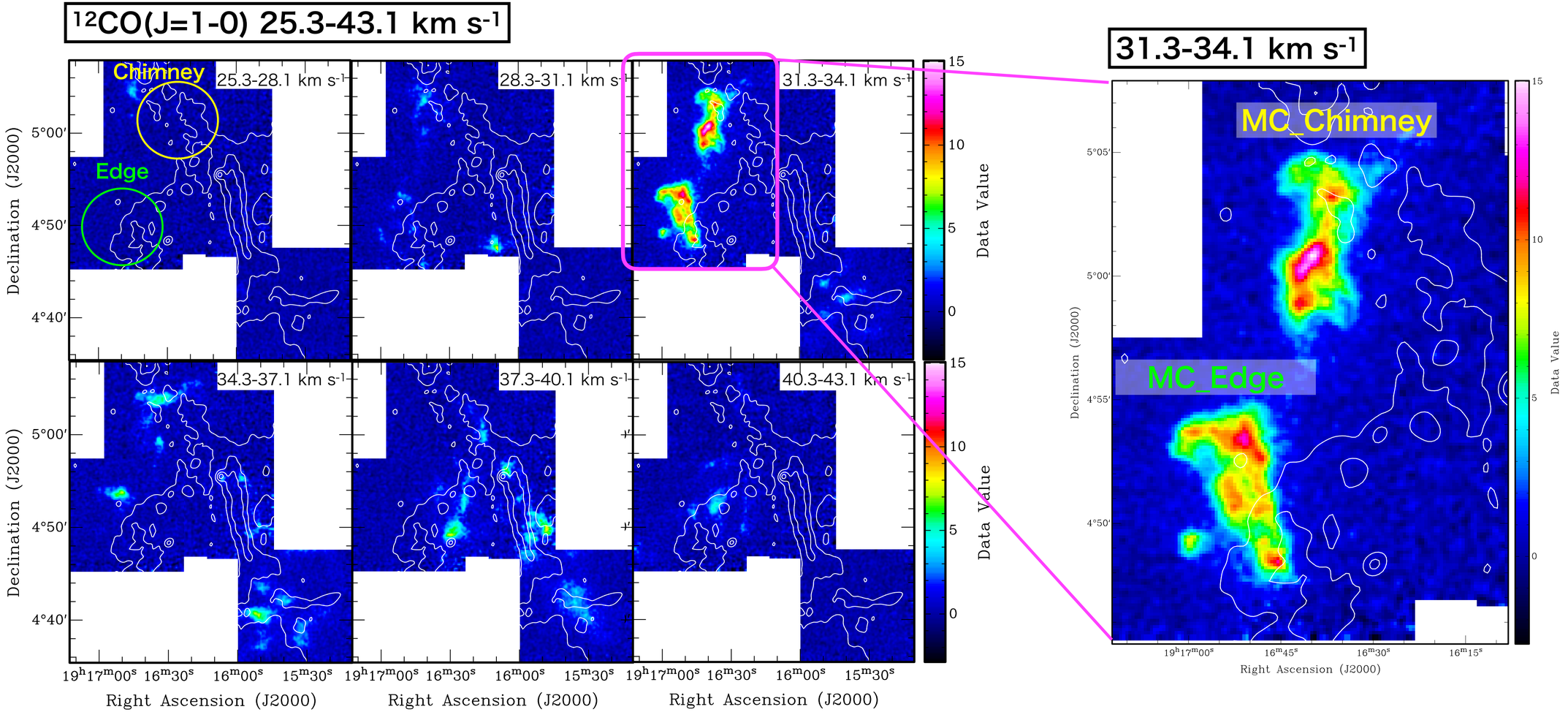
- ^{12}CO(J=1-0), ^{13}CO(J=1-0), (C^{18}O(J=1-0))
- Spatial resolution: 19 asec
- Velocity resolution: 0.2 km s^{-1}
- rms noise: 0.5 (0.2) K at 115 (110) GHz

ASTE

- ^{12}CO(J=3-2)
- Spatial resolution: 28 asec
- Velocity resolution: 0.2 km s^{-1}
- rms noise: 0.1 K at 345 GHz

Results: Molecular clouds at eastern edge of W50

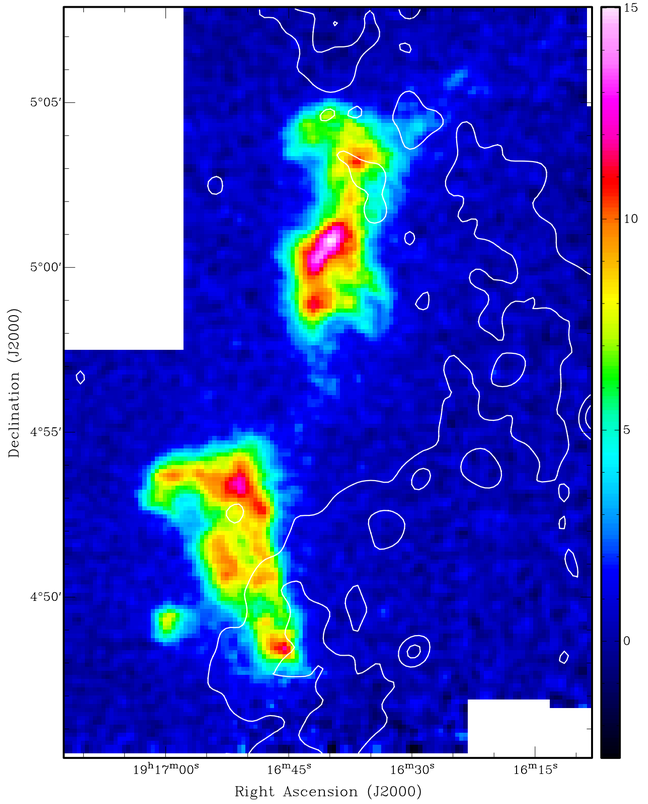
- 25.3-43.1 km s^{-1}
- Clouds in 31.3-34.1 km s^{-1} have intensity gradients



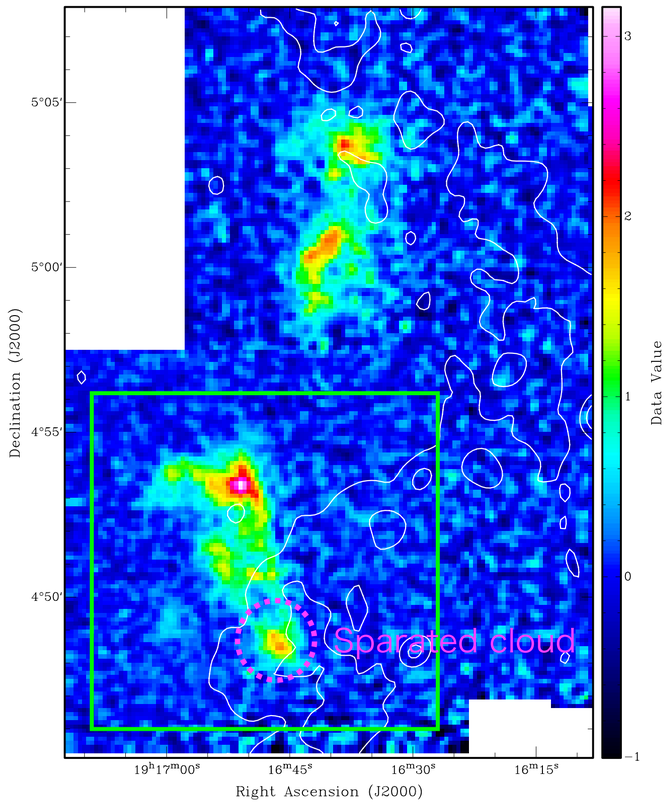
Results: Molecular clouds at eastern edge of W50

- 25.3-43.1 km s^{-1}
- Clouds in 31.3-34.1 km s^{-1} have intensity gradients
- MC_Edge has bright rim

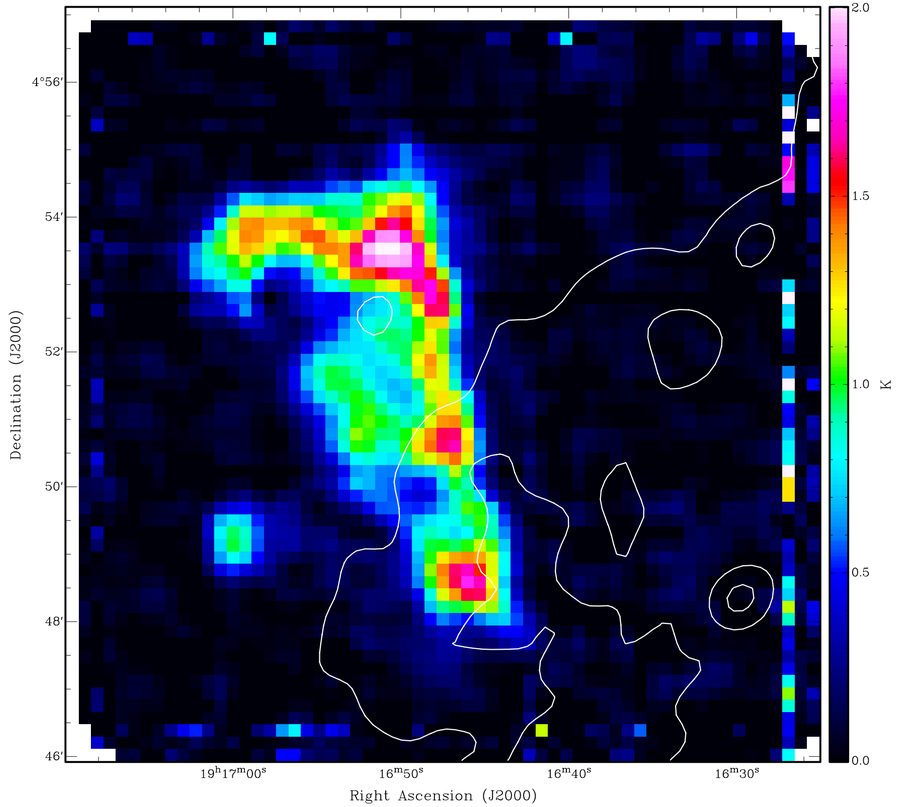
^{12}CO(J=1-0) 31.3-34.1 km s^{-1}



^{13}CO(J=1-0) 31.3-34.1 km s^{-1}



^{12}CO(J=3-2) 31.3-34.1 km s^{-1}

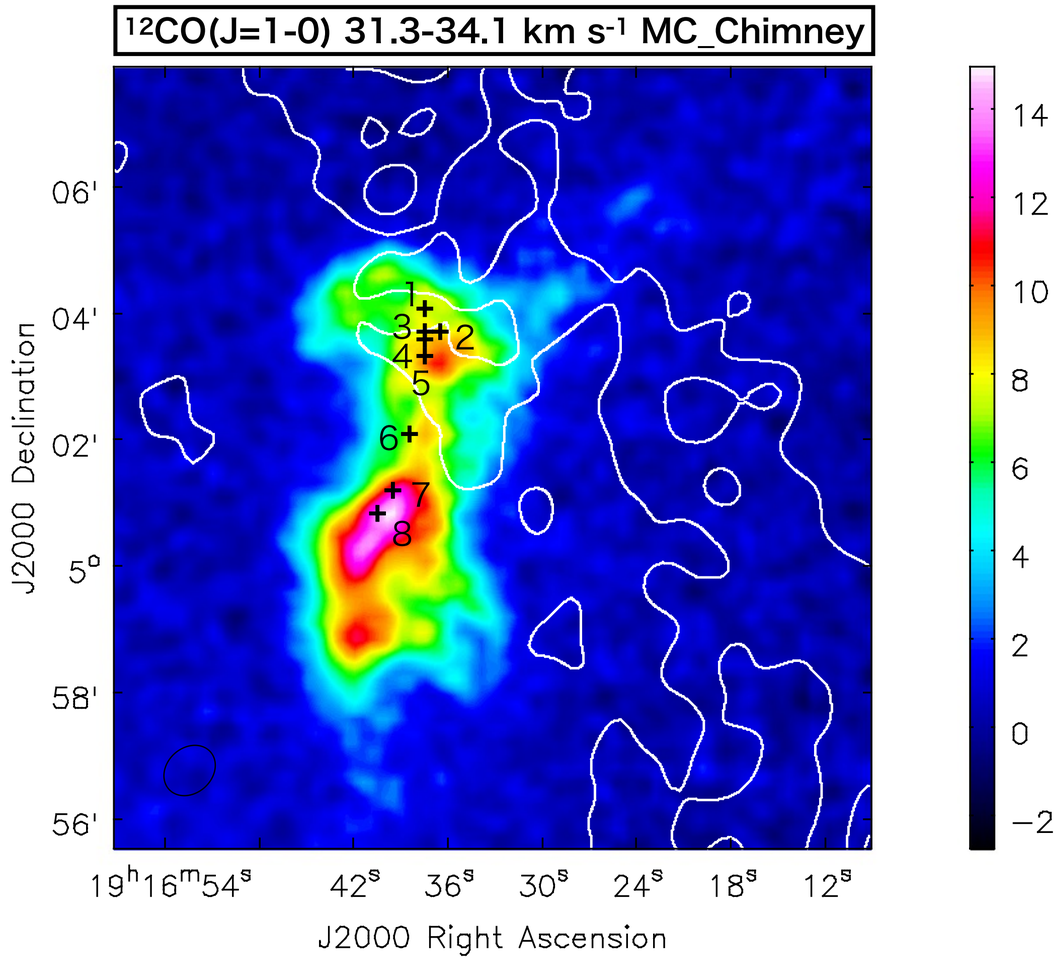


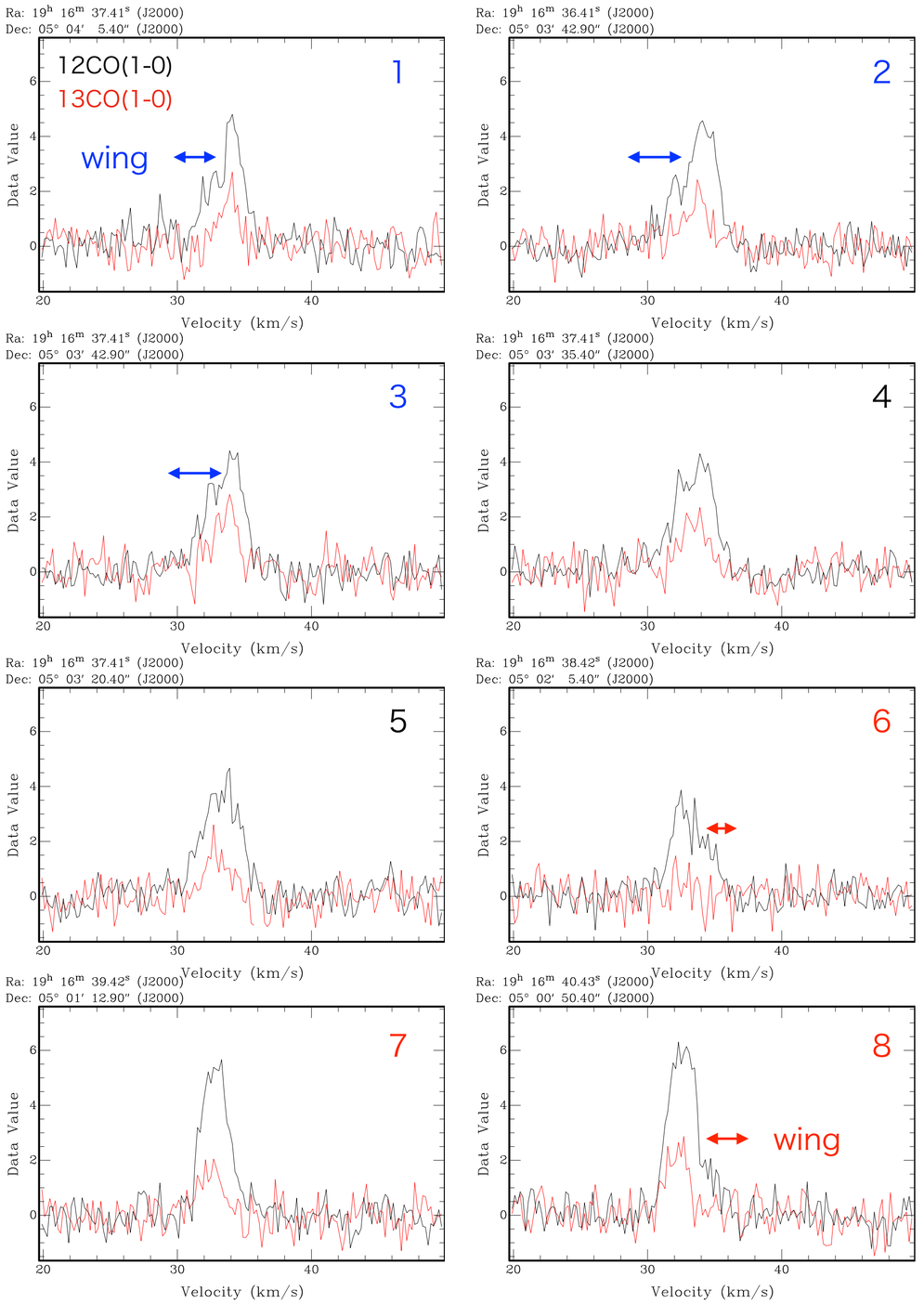
Results: Spectrum (Chimney)

Spectral wing structures: Interaction??

North → blue shift

South → red shift



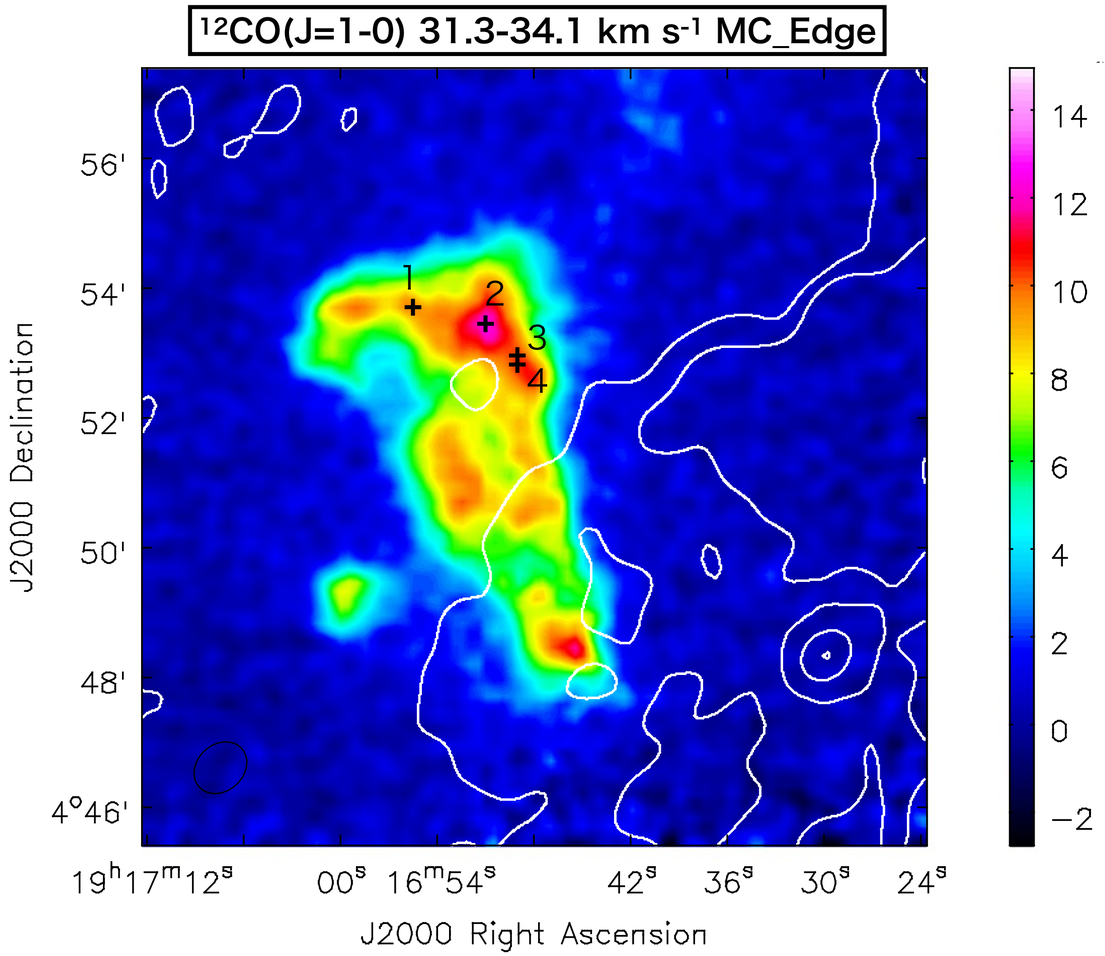


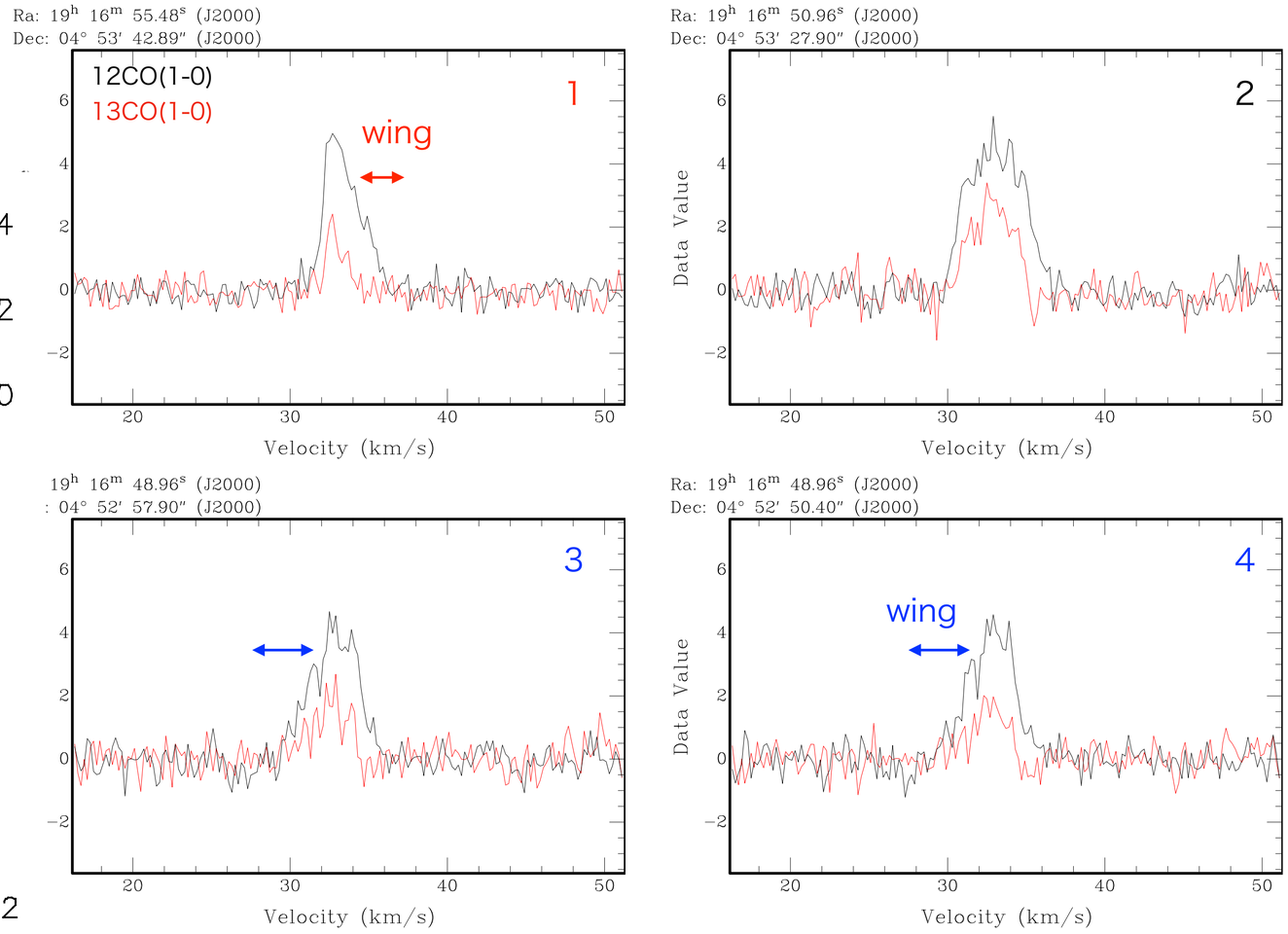
Results: Spectrum (Edge)

Spectral wing structures: Interaction??

North-East → red shift

South-West → blue shift





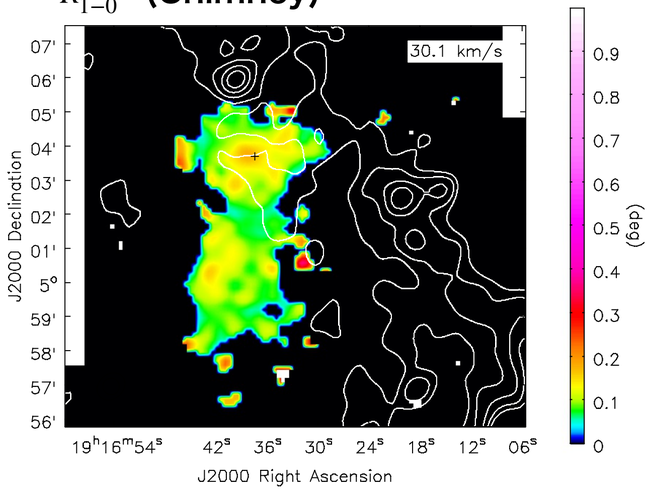
Discussion: Intensity ratio / LVG analysis

Clouds have **spectral wing** and **intensity gradients**. → interaction??

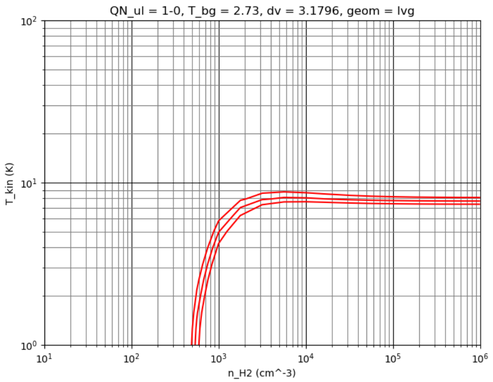
However, No temperature or density excess.

→ Clouds collided with W50 (terminal region of SS433 jet) in the past, and they have been cooled.

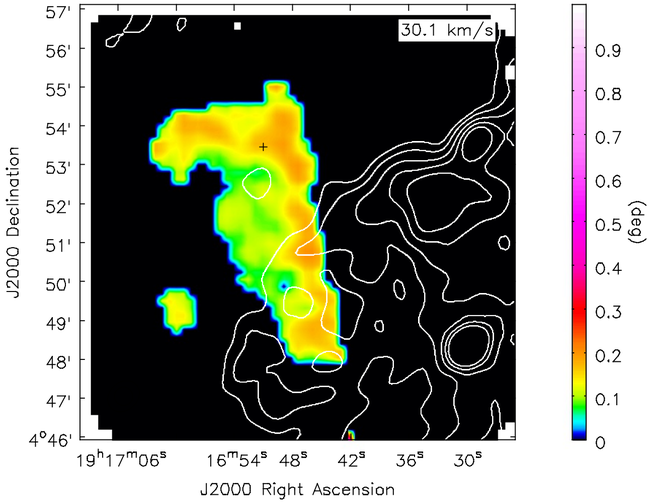
$R_{1-0}^{13/12}$ **(Chimney)**



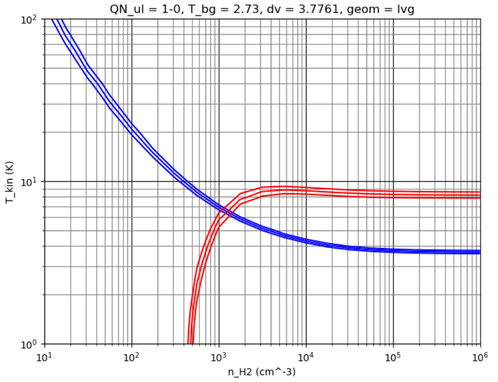
Temperature: < 9K
Density: 500 cm^{-3} <



$R_{3-2/1-0}^{12}$ **(Edge)**



Temperature: 6~7 K
Density: 1000~1400 cm^{-3}



Summary

- We observed molecular clouds at the eastern edge of W50,
- Identified the clouds having the spectral wing (blue and red shifts),
- Intensity gradients towards W50,
- No temperature or density excess,
- The clouds collided with W50 and were cooled??
- We require additional observation to verify the interaction and constrain the distance of SS433/W50.