

ALMA SUMMER PROGRAMS

– Student presentation



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subject：The molecular spectrum in IRDC G28

Outline

- Introduction
- Motivation
- Result
- summary

Introduction- Observation

- ❑ Observation : SMA
- ❑ Date : 2008/9/30
- ❑ Source : IRDC G28.34+0.06
mm1, mm4, & mm9
- ❑ Calibration : 1751+096 & 1911-201
- ❑ Band : LSB 230.3 GHz ~ 232.3 GHz
USB 240.3 GHz ~ 242.3 GHz

Introduction- SMA

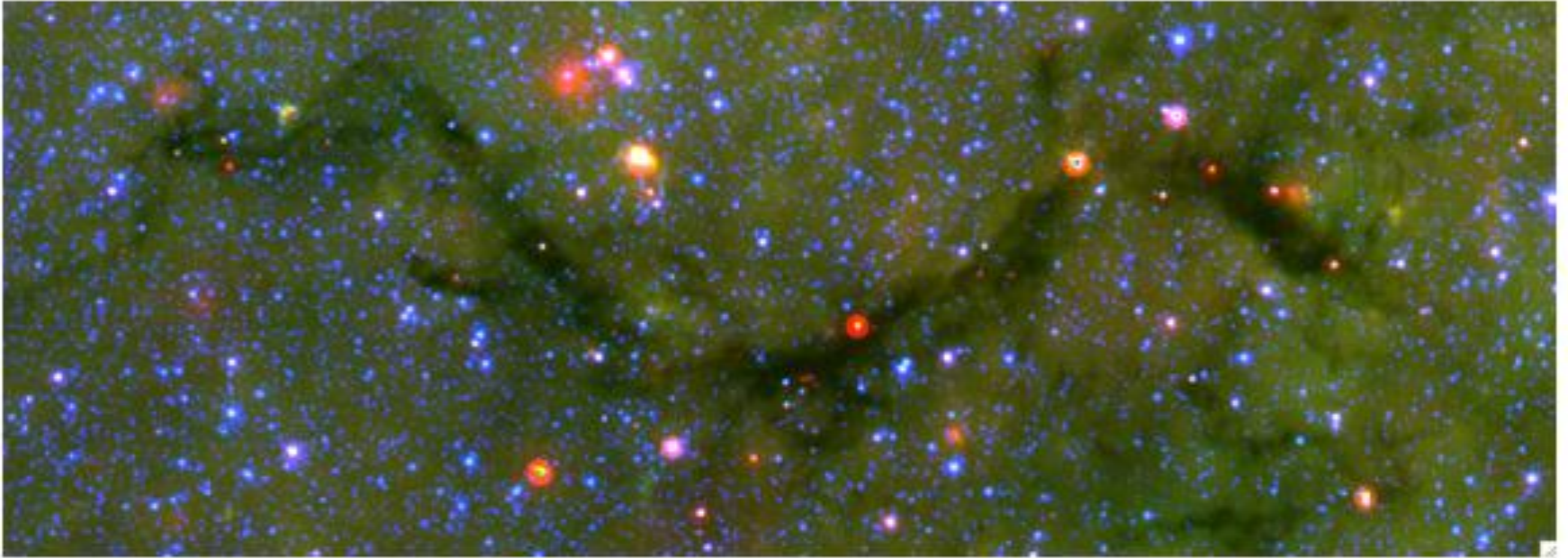
- ❑ SMA = Submillimeter Array
- ❑ Located atop Mauna Kea in Hawaii.
- ❑ $6m \times 8$
- ❑ Operating from 180 GHz to 700 GHz



Introduction- IRDC

- ❑ IRDC = Inferred Dark Clouds
- ❑ first identification is in 1996 by the Infrared Space Observatory(ISO).
- ❑ A dense and cold molecular clouds.
- ❑ Absorb Galactic background inferred emission and emit at longer wavelength.
- ❑ Revealing more than 10000 IRDCs so far.

IRDC G11.11-0.28



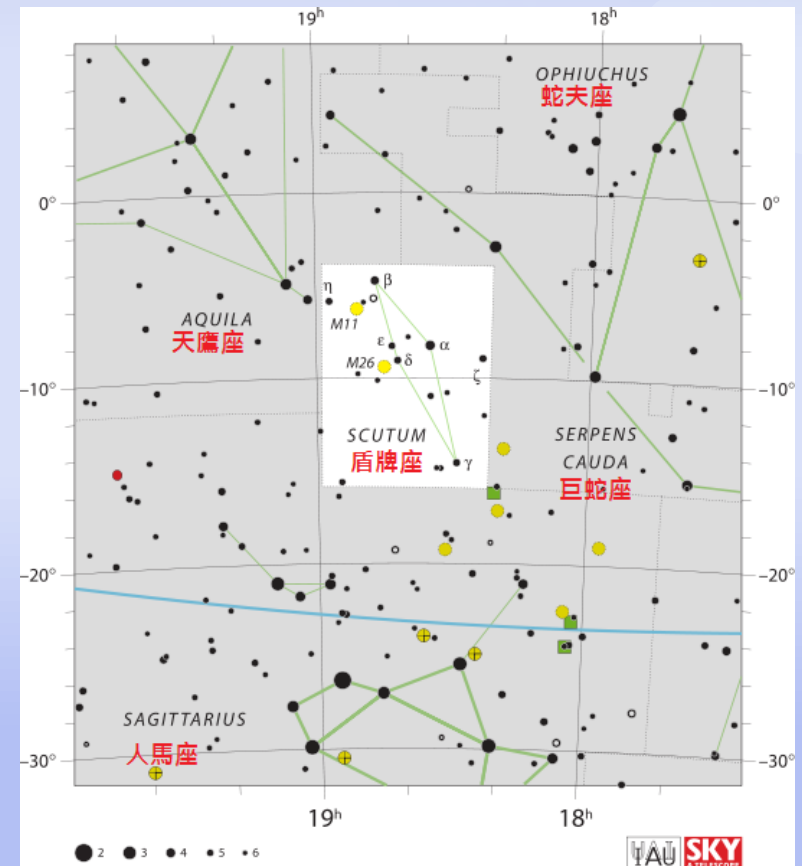
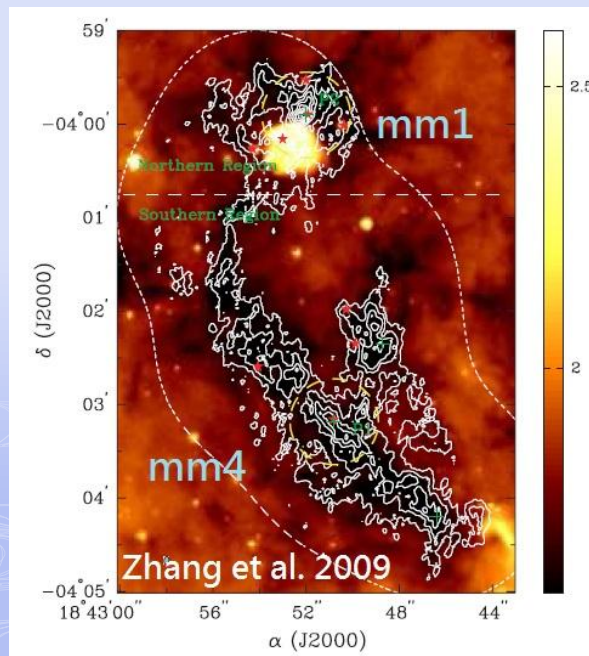
From http://mipsgal.ipac.caltech.edu/p_gallery.html

seen at 3.6, 8.0 and 24 microns (mid-infrared)

Introduction- G28.34+0.06

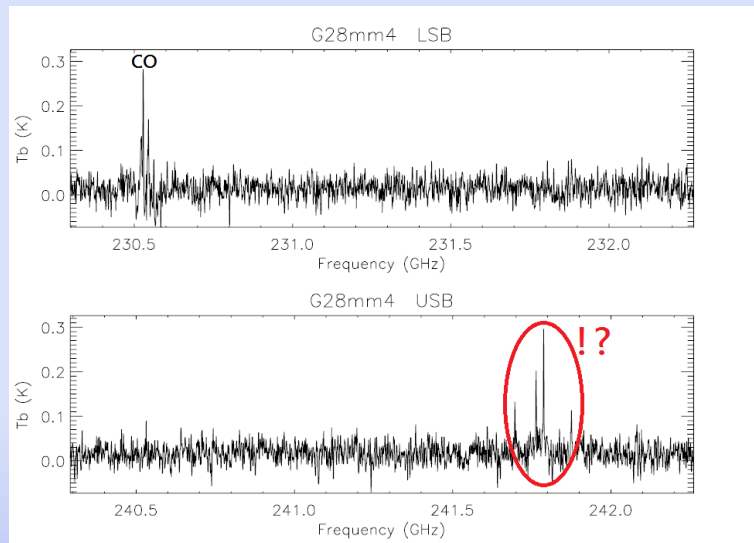
- At $(18^h 42^m 50^s, -4^\circ 03' 15'')_{J2000}$
- At a distance of $\sim 4.8\text{kpc}$
- $v_{LSR} = 79(\text{km/s})$

(Carely et al. 2000;
Simon et al. 2006b;
Rathborne et al. 2006;
pillai et al. 2006;
Wang et al. 2008;
Zhang et al. 2009)

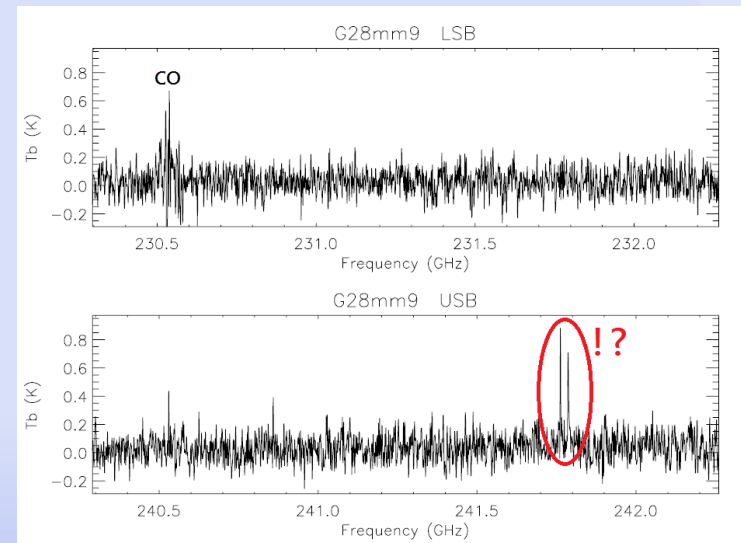


Motivation

- No detection of molecular lines except CO in G28mm4 before. (Zhang et al. 2011)



mm4



mm9

Motivation

- mm1 has a large H ion region (has stars formation process) (Zhang et al. 2009)

+

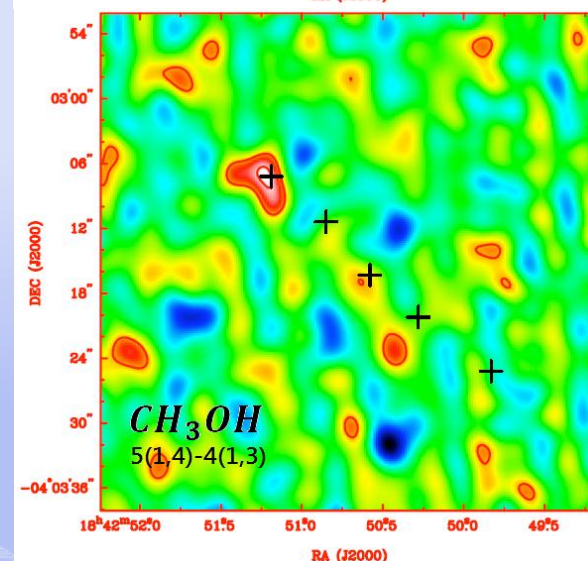
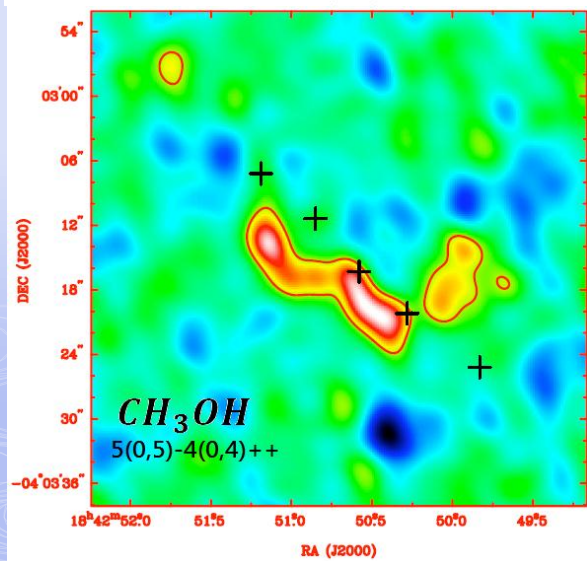
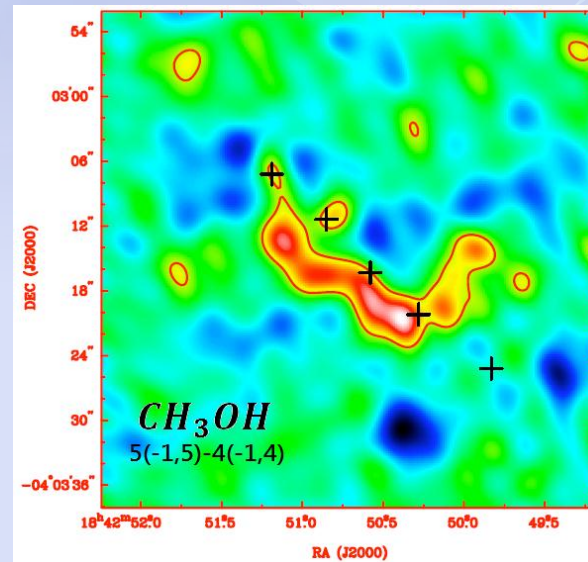
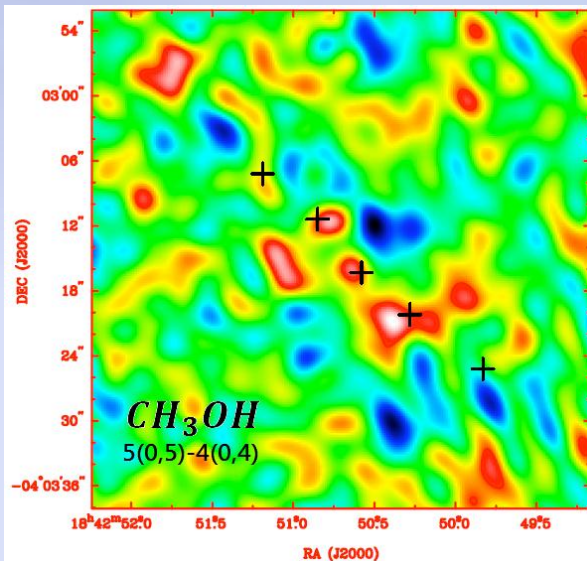
- Age : mm1 > mm4 > mm9 (Chen et al. 2010)

↓

- Initial condition of stars formation

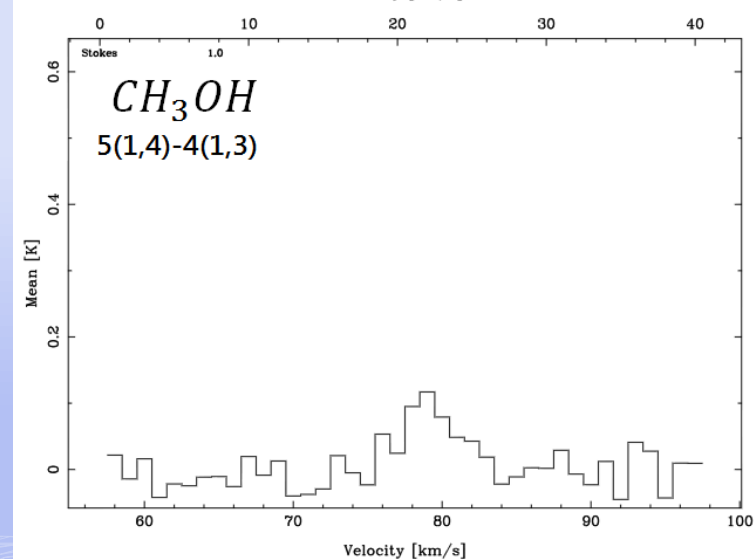
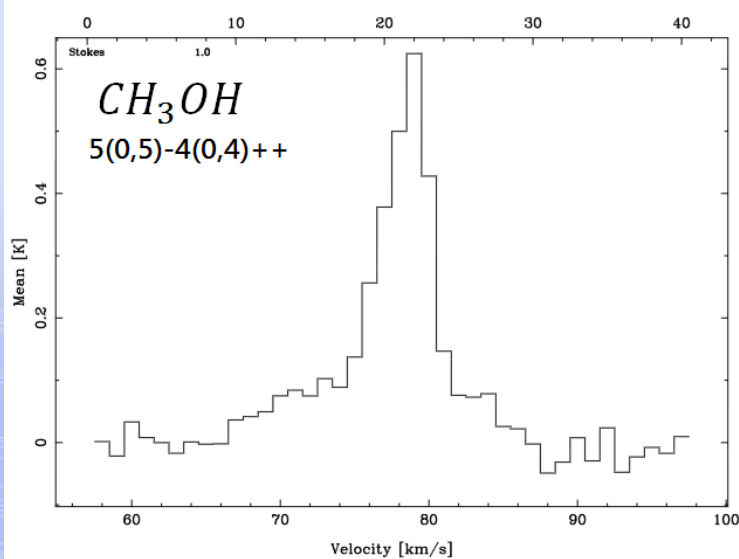
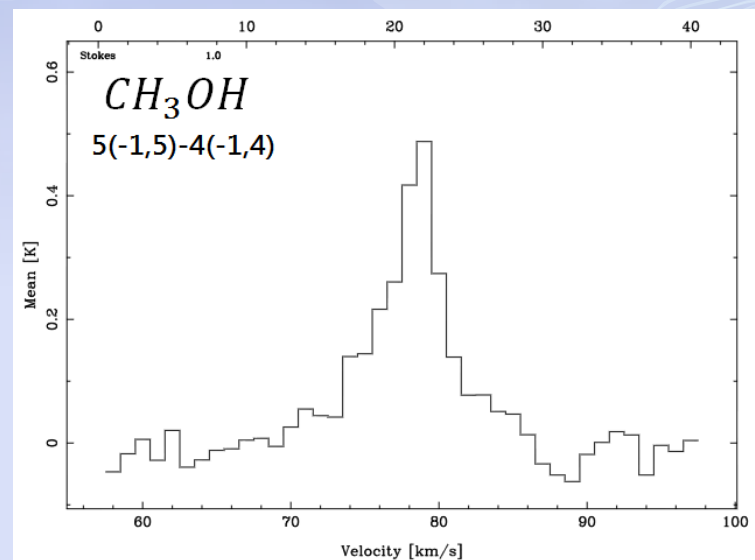
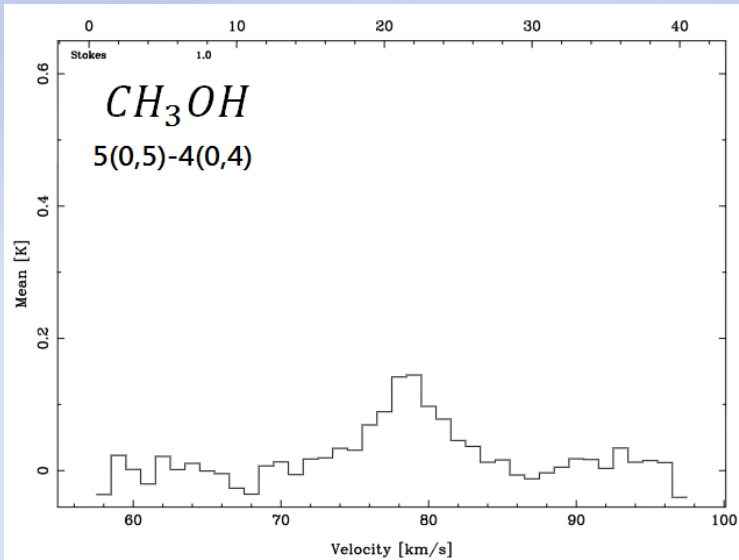
Result-mm4

4 methanol lines



Result-mm4

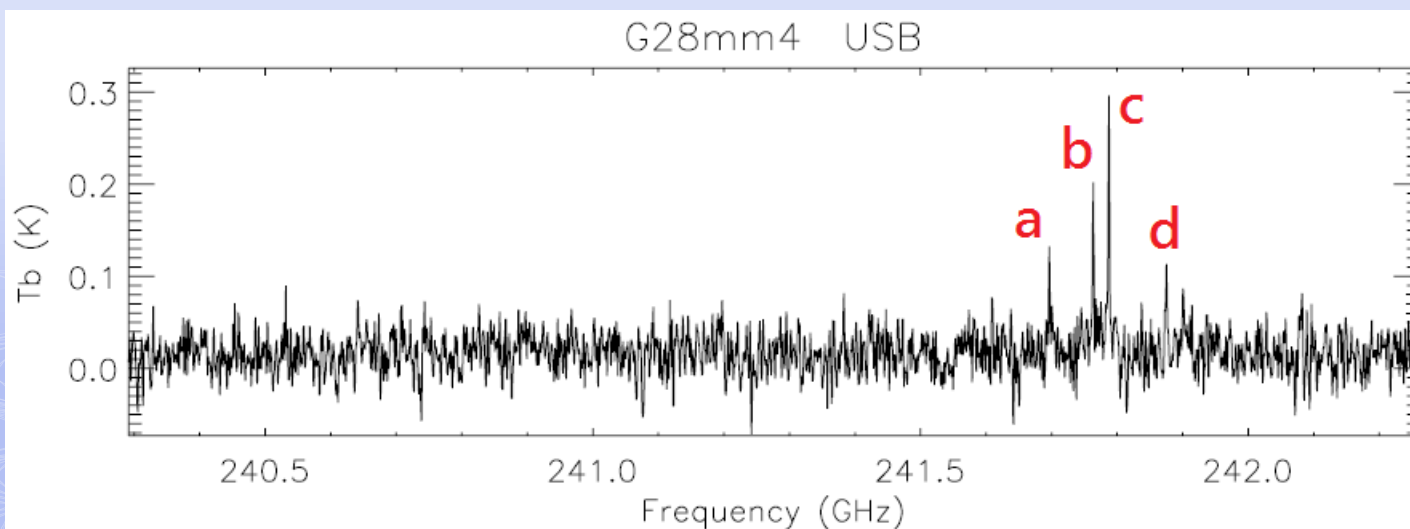
4 methanol lines



Result-mm4

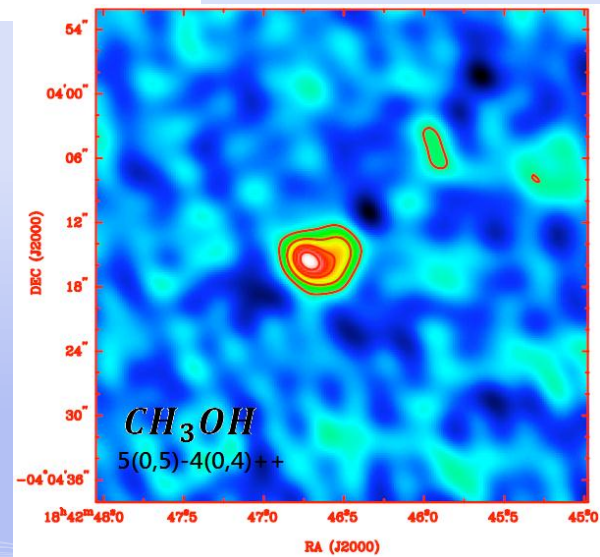
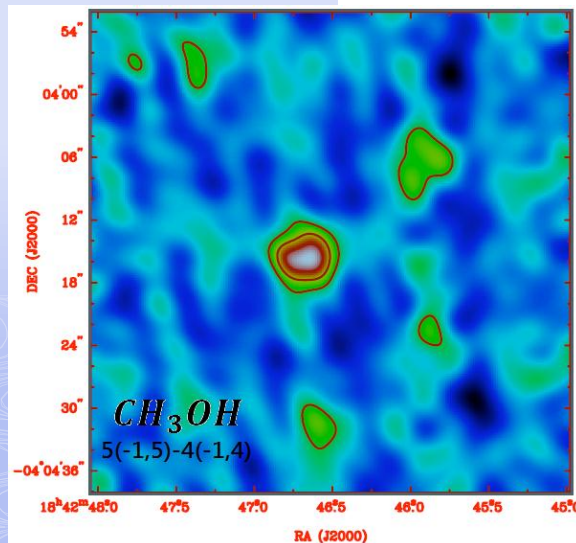
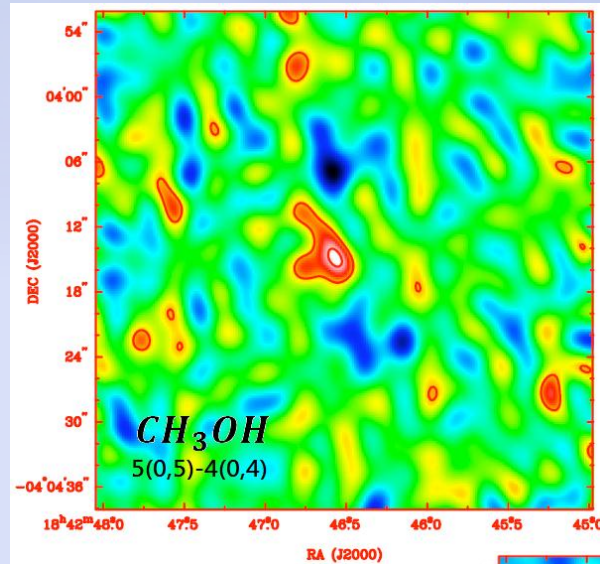
Table of 4 methanol lines

G28mm4	Resolved QNs	Rest frequency (GHz)	$S_{ij}\mu^2_x$	$E_U(K)$
CH_3OH a	5(0,5)-4(0,4)	241.70017	4.04030	47.93438
CH_3OH b	5(-1,5)-4(-1,4)	241.76725	3.88220	40.39125
CH_3OH c	5(0,5)-4(0,4)++	241.79137	4.04270	34.81718
CH_3OH d	5(1,4)-4(1,3)	241.87907	3.97970	55.87058



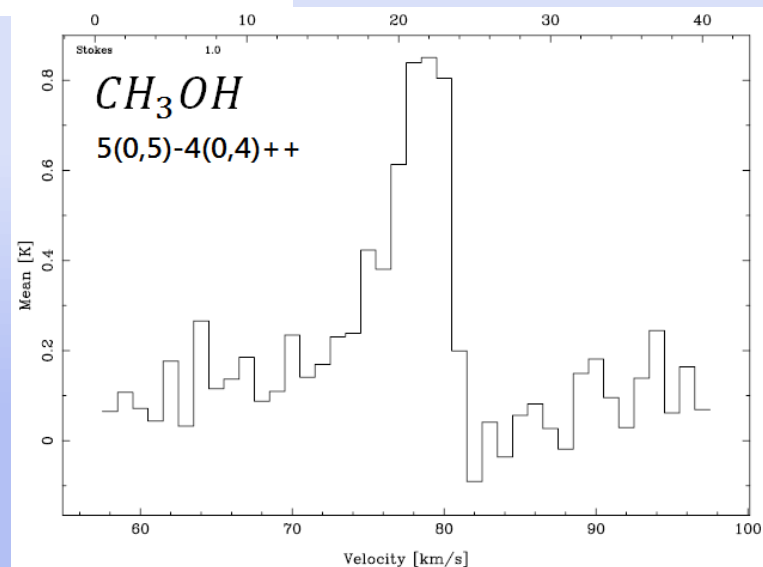
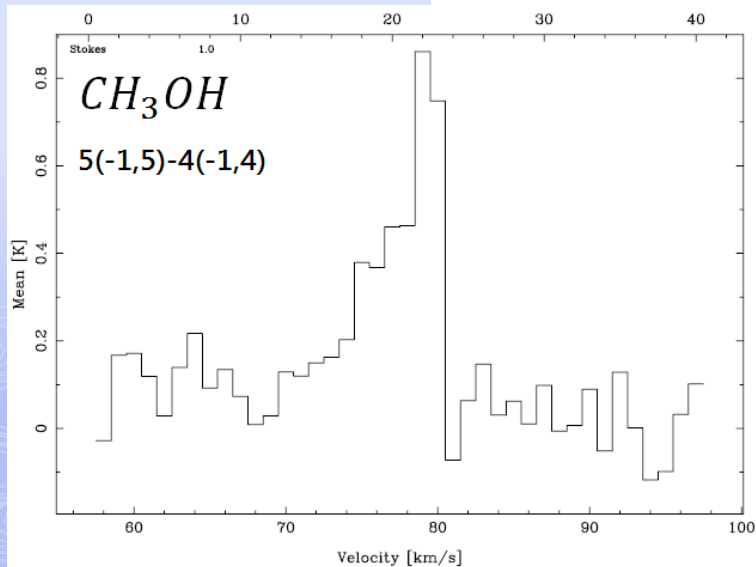
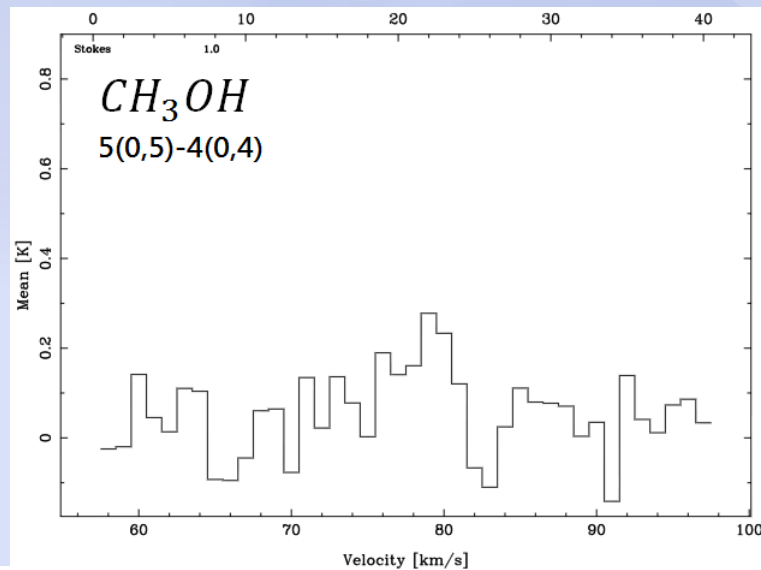
Result-mm9

3 methanol lines



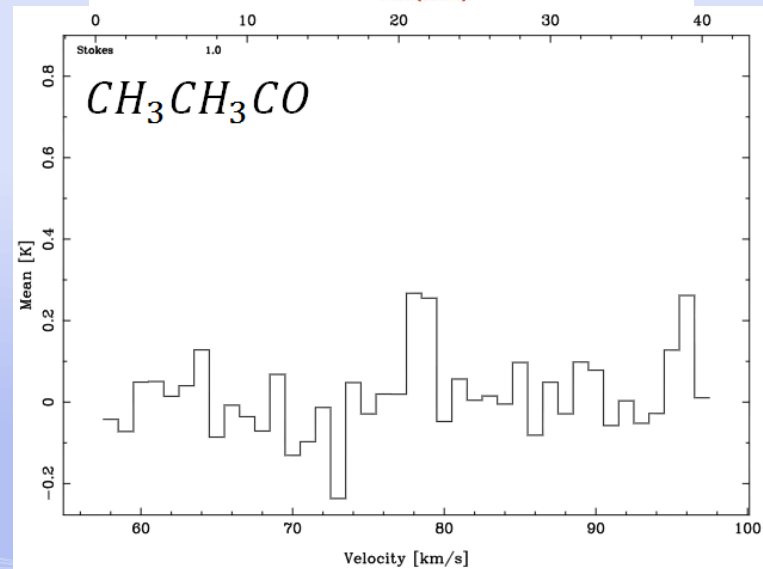
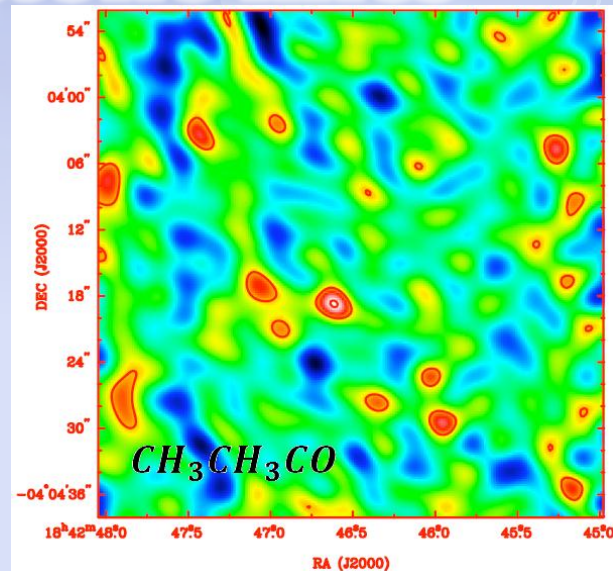
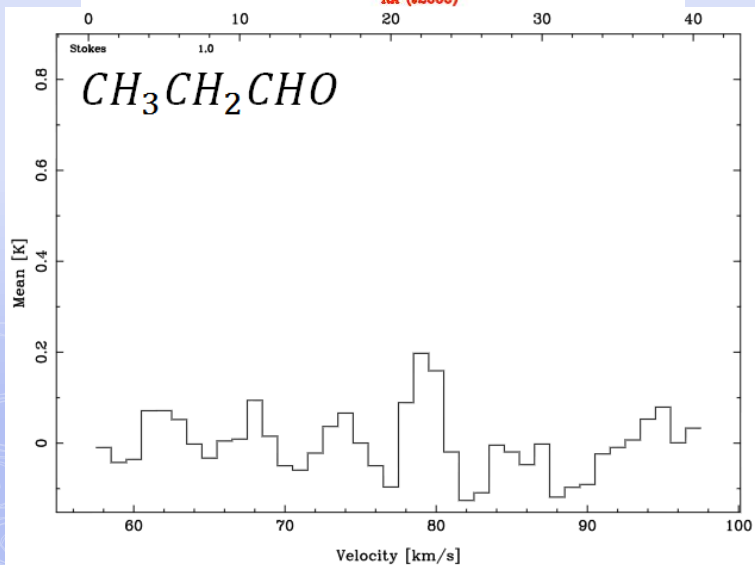
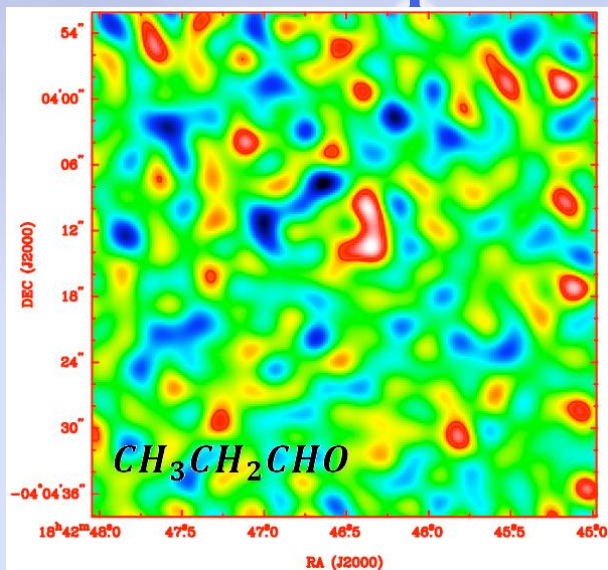
Result-mm9

3 methanol lines



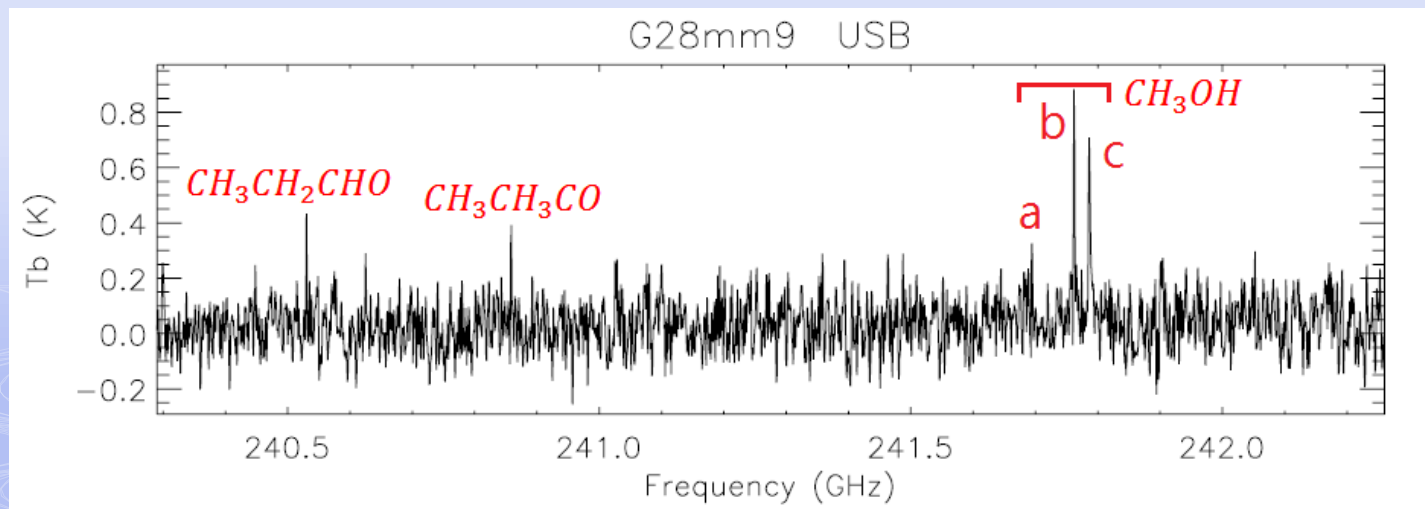
Result-mm9

Propanal & Acetone lines



Result-mm9 table of all lines

G28mm4	Resolved QNs	Rest frequency (GHz)	$S_{ij}\mu_x^2$	$E_U(K)$
CH_3OH a	5(0,5)-4(0,4)	241.70017	4.04030	47.93438
CH_3OH b	5(-1,5)-4(-1,4)	241.76725	3.88220	40.39125
CH_3OH c	5(0,5)-4(0,4)++	241.79137	4.04270	34.81718
CH_3CH_2CHO	13(3,10)-12(2,11)	240.53468	3.36637	52.27388
CH_3CH_3CO	11(6,5)-10(5,6)	240.86123	7.14264	52.98879



Summary

- ❑ 4 methanol lines in IRDC G28mm4
- ❑ 3 methanol + propanal +acetone lines in IRDC G28mm9
- ❑ Different methanol lines in different clumps in mm4 may means different states of them.

The background is a light blue gradient. In the top right corner, there are white, concentric, wavy lines that resemble ripples on water. In the bottom left corner, there are faint, light blue, concentric, wavy lines.

Thank you~