Towards a better understanding of Giant Molecular Clouds' evolution

I L Λ N C E

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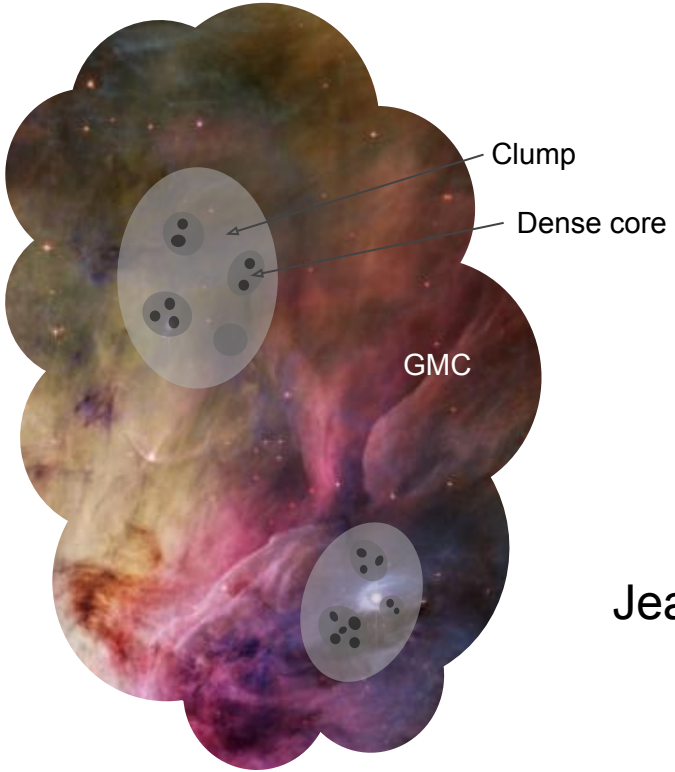
Giant Molecular Cloud (GMC) / 巨大分子雲



Birthplaces of stars

How : by collapse of gas

Virial equilibrium : $2E_{therm}+E_{grav} = 0$

$$E_{therm} = \frac{3Mk_BT}{2\mu m_H} \qquad E_{grav} = \frac{-3GM^2}{5R}$$

Jeans mass : $$M_J = \left(\frac{5k_BT}{G\mu m_H}\right)^{\frac{3}{2}}\left(\frac{3}{4\pi\rho}\right)^{\frac{1}{2}}$$

Fragmentation until ρ high enough to form a star

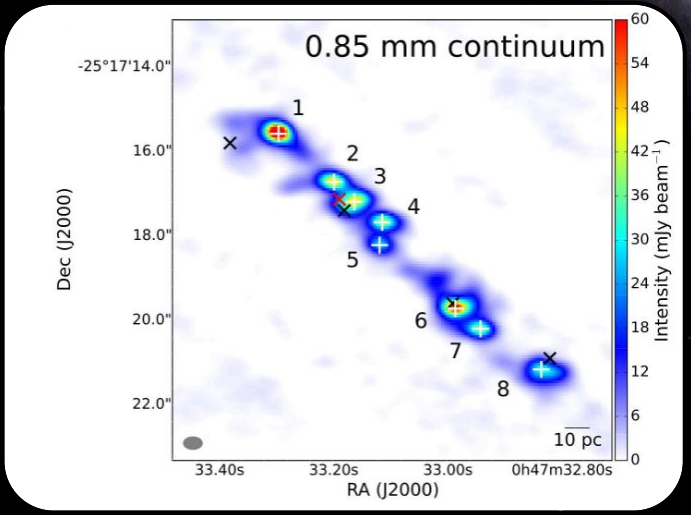
NGC 253

Starburst galaxy

3.5Mpcs

R.A. $00^h43^m33.1^s$
Dec -25°17’18”

Radio observation
https://arxiv.org/pdf/1710.01432 (Ando et al. 2017)



Optical observation
Mount Lemmon SkyCenter/University of Arizona

Super Star Clusters (SSC) / 超星団

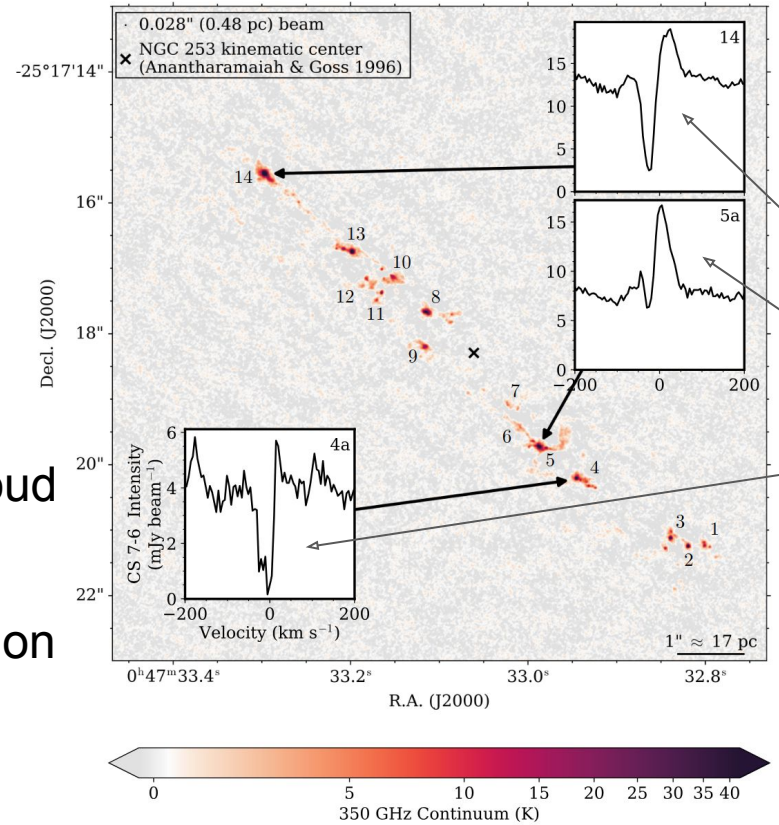
fast outflows

↓

gas depletion in the cloud

↓

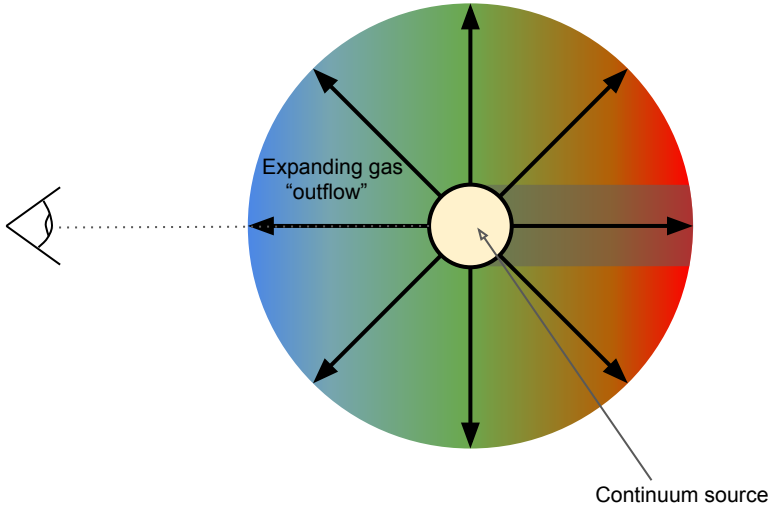
mitigation of star formation

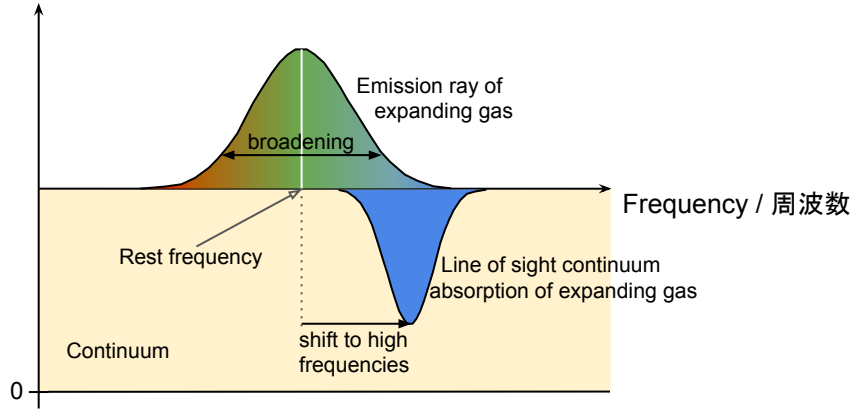


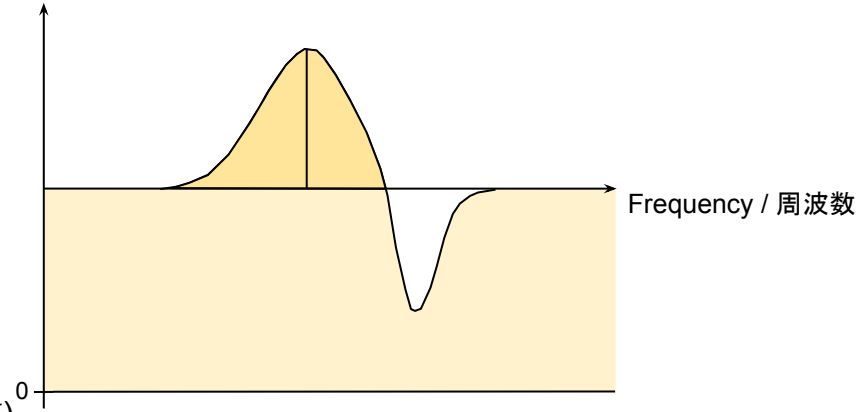
“P-Cygni profile”, signature of outflows

Radio observation https://arxiv.org/pdf/2011.05334 (Levy et al. 2021)

P-Cygni profile, signature of outflows

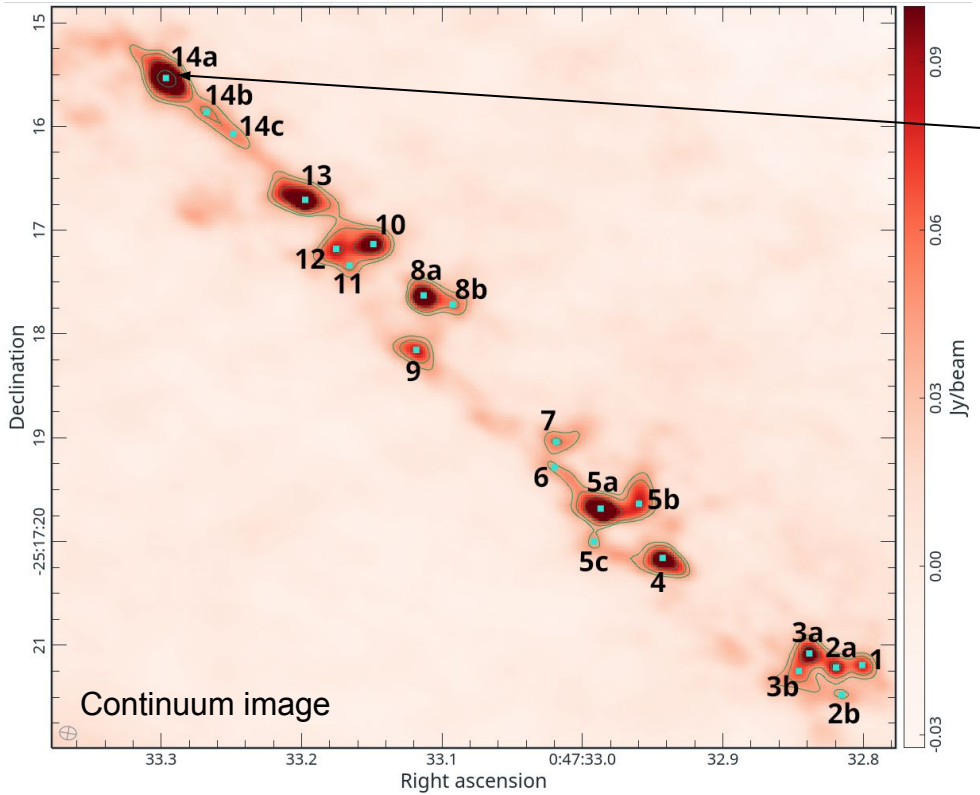




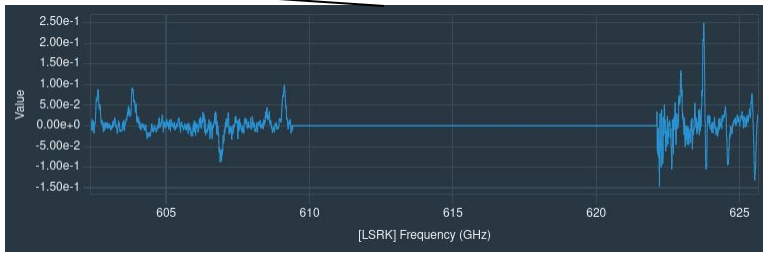


another good sign : presence of species such as ionized water (H_2O^+)

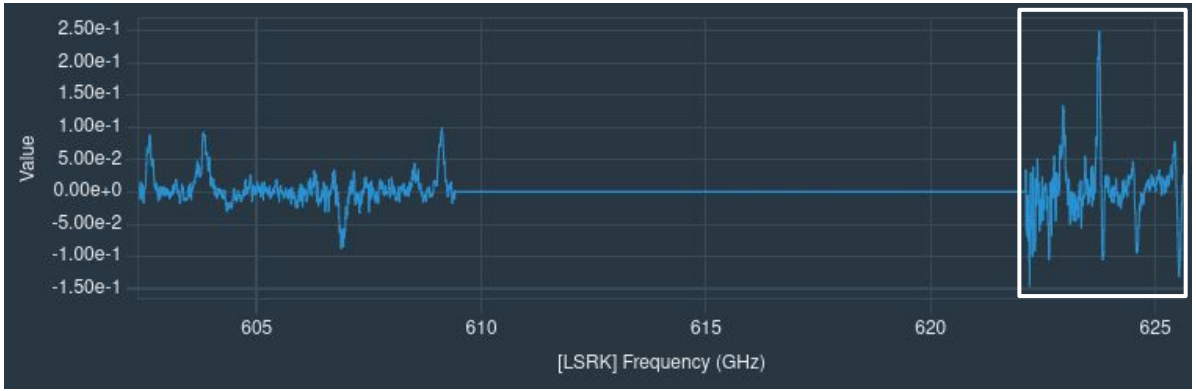
First Results 1/2

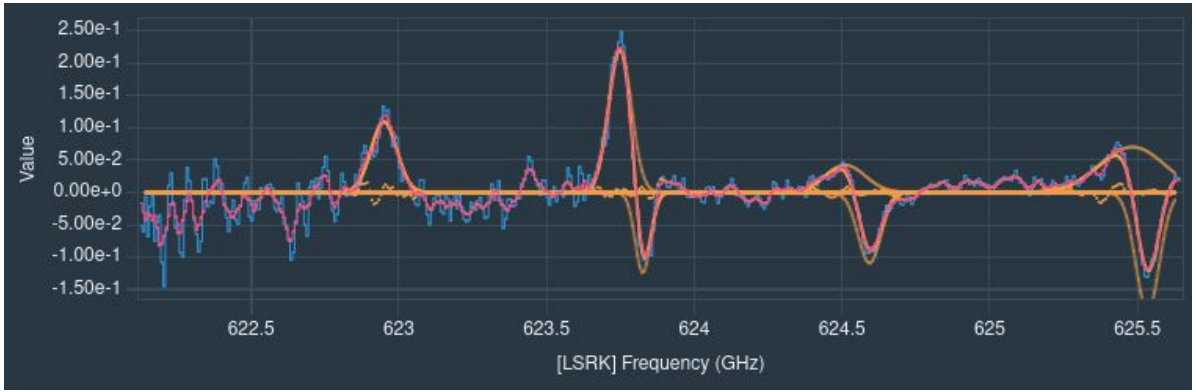


ALMA Band 9 (Radio observation)
602.38~609.40 GHz + 622.12~625.64GHz



First Results 2/2





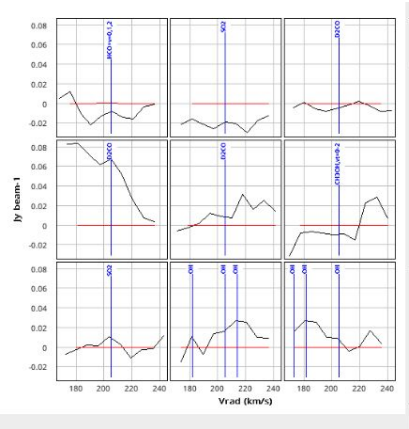
TODO List

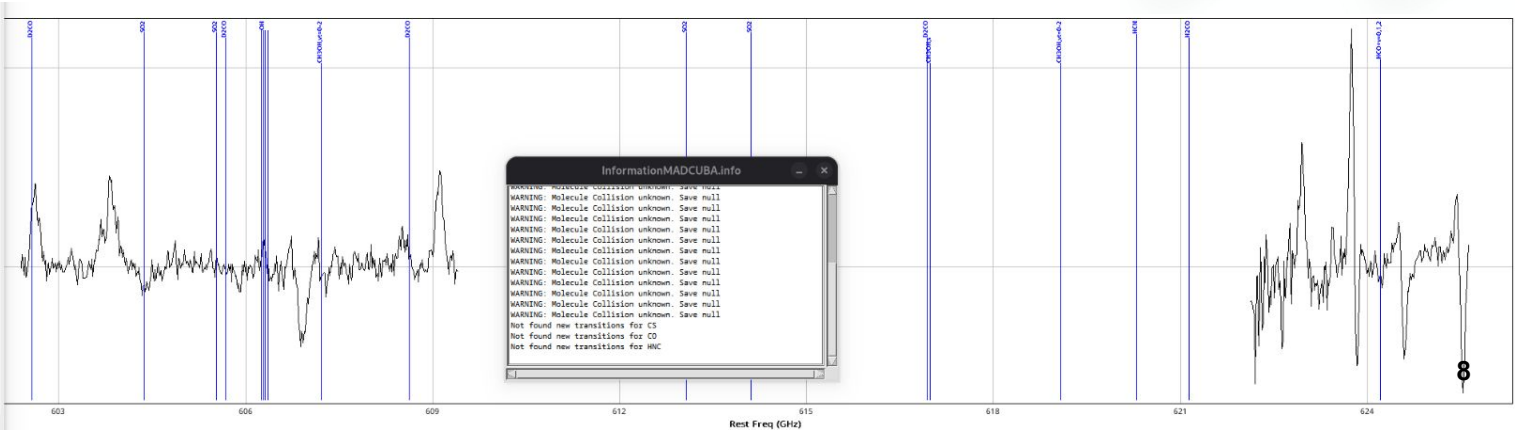
- Line identification (currently)
- Find less clean P-Cygni profile if any
- Explain declination offset with Levy et al. 2021
- Better understanding of those outflows
- Write a paper

splatalogue
database for astronomical spectroscopy

#	Species	Chemical Name	Ordered Frequency (GHz) (rest frame, redshifted)
1	CH_3OH v_t = 0-2	Methanol	603.193542, 603.193542
2	CH_3OH v_t = 0-2	Methanol	603.194265, 603.194265
3	CH_3OH v_t = 0-2	Methanol	603.268906, 603.268906
4	CH_3OH v_t = 0-2	Methanol	603.269562, 603.269562
5	CH_3OH v_t = 0-2	Methanol	603.344616, 603.344616
6	CH_3OH v_t = 0-2	Methanol	603.468776, 603.468776
7	CH_3OH v_t = 0-2	Methanol	603.468855, 603.468855
8	CH_3OH v_t = 0-2	Methanol	603.731963, 603.731963
9	CH_3OH v_t = 0-2	Methanol	603.751021, 603.751021
10	CH_3OH v_t = 0-2	Methanol	603.877318, 603.877318
11	CH_3OH v_t = 0-2	Methanol	604.194257, 604.194257
12	CH_3OH v_t = 0-2	Methanol	604.237818, 604.237818
13	CH_3OH v_t = 0-2	Methanol	604.319054, 604.319054
14	SO_2 v = 0	Sulfur dioxide	604.367435, 604.367435
15	SO_2 v = 0	Sulfur dioxide	604.4065334, 604.4065334
16	CH_3OH v_t = 0-2	Methanol	604.508623, 604.508623

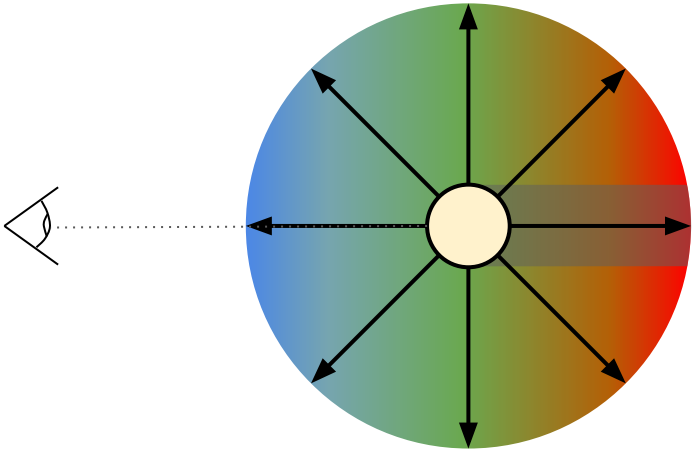
ionized water (H_2O^+)
604.68 GHz
607.23 GHz



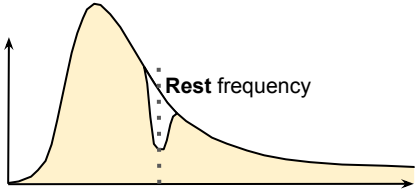



Thank you !

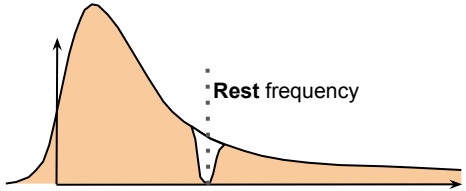
P-Cygni profile, signature of outflows (blueshifted absorption)



case of **motionless** gas

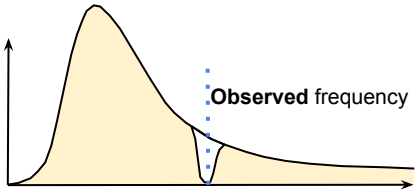


From **gas'** point of view



- Continuum is redshifted as the source is moving away
- Absorption frequency is intrinsic characteristic of the gas

From **observer's** point of view



- Continuum source is not moving
- Absorption seems blueshifted