1. Intro: Star Formation Suppression in bars

- In the bars of typical barred galaxies, although the dark lane implies the presence of dust and molecular clouds, there is no (massive) star formation.
- The cause for the star formation suppression in bars has not been clear.

**NGC1300 is an ideal laboratory**

- NGC 1300 is a nearby (20.7 Mpc) prototype strongly barred galaxy and is a very suitable laboratory because star formation activity is clearly suppressed in the bar.
- The mechanism of the suppression is expected to be clearly seen in such bars.

What prevents star formation in bar regions?

Physical mechanisms which could suppress star formation in bars fall into the following three scenarios recently:

1. **Gravitationally unbound molecular clouds in bar regions** (e.g., Sorai et al. 2012, Nishio et al. 2013).
2. **Fast cloud-cloud collisions (CCCs) in bar regions** (e.g., Takahira et al. 2014).
3. **A large amount of diffuse molecular gases in bar regions** (e.g., Yajima et al. 2019).

**Purpose of our study**

- Examining these scenarios from both observational and theoretical studies and unveiling which scenario is the most dominant process.

---

2. \(^{12}\)CO(1-0) Observations with ALMA

**FM + 19, in prep**

- FoV = 54.4’ × 3.2 kpc × 2 points
- 12m Array only
- beamsize = 0.44” × 0.30” ~ 44 × 30 pc
- \(\theta_{\text{maj}}\) = 2 kpc
- \(\theta_{\text{min}}\) = 0.51 mJy/beam (0.37 K) at 5 km/s bin

**GMC identification**

- 3-D clump finding algorithm “CPROPS” (Rosolowsky & Leroy 2006).
- CPROPS parameters are the same as those used in the previous GMC study on M51 (Colombo et al. 2014).
- Peak-to-noise ratio > 4.0
- 236 GMCs were detected.
- Bar: 34, Arm: 119, Bar End: 49
- Mass completeness limit is \(2 \times 10^{4} \text{M}_{\odot}\)

**GMC properties in Bar and Arm are similar.**

Based on the K-S test,

The \(\alpha\) and R do not exhibit environmental variation.

\(M_{\text{crit}}\) in Bar-end is larger than those in Arm and Bar.

**Key Result 1**

- There are no significant regional differences in \(\alpha_{\text{vir}}\) (p-value > 0.05)
- A systematic difference in \(\alpha_{\text{vir}}\) cannot explain the lack of massive SF in the strong bar of NGC 1300.

---

3. Hydrodynamical simulation of NGC 1300

**Fujimoto, FM + 19, submitted**

- Adaptive mesh refinement (AMR) hydrodynamics code enzo (Bryan+14)
- Fixed potential model which is taken from observational results of NGC1300.
- No star formation or stellar feedback.

**Key Result 2**

- No significant environmental dependence in the \(\alpha_{\text{vir}}\)
  - Lack of massive SF cannot be explained by a systematic difference in \(\alpha_{\text{vir}}\) of clouds.

**Key Result 3**

- \(f_{\text{rec}}\) in Bar is lower than those in the Arm and Bar-end.
- A positive correlation between SFE and \(f_{\text{rec}}\)
  - A large amount of diffuse (extended) molecular gases exists in the bar and it would make the SFE very low.

---

4. Diffuse molecular gases in bars FM + 19, in prep

- Due to the lack of ACA data, our ALMA data has no sensitivity on a large-scale structure.
- The recovery fraction of the CO(1-0) flux, \(f_{\text{rec}}\), is a measure of the amount of diffuse molecular gas.

\[
\text{Measurment of the total flux} \rightarrow \begin{align*}
\text{Bary} \rightarrow \text{Arm} \rightarrow \text{Bar-end} \\
\text{CO(1-0)} \rightarrow 4.4 \text{M}_{\odot} \text{K/km/s pc}^{-1}
\end{align*}
\]

**Key Result 3**

- \(f_{\text{rec}}\) map
- \(f_{\text{rec}}\) in Bar is lower than those in the Arm and Bar-end.
- A positive correlation between SFE and \(f_{\text{rec}}\)
- A large amount of diffuse (extended) molecular gases exists in the bar and it would make the SFE very low.

---

5. Summary

- In observation and simulation, there are no significant regional differences in \(\alpha_{\text{vir}}\) of GMCs in the strongly barred galaxy NGC1300.
- A systematic difference in \(\alpha_{\text{vir}}\) cannot explain the lack of massive SF.
- Bar clouds collide with others faster than those in the other regions.
- Lack of massive SF is due to the fast CCCs, which are inefficient in forming massive stars.
- We find a positive correlation between SFE and recovery fraction \(f_{\text{rec}}\)
- A large amount of diffuse (extended) molecular gases exists in the bar and it would make the SFE very low.