

## Abstract

Dense pre-stellar molecular clumps have been well studied extensively in the Milky Way; however, little has been done in understanding pre-stellar molecular clumps in external galaxies due to their distance and low-resolution telescopes. This leaves an important gap in understanding how stars form under different galactic environments, with the coming of the Atacama Large Millimeter/submillimeter Array (ALMA) telescope, which offers high resolution, it is now possible to have such studies in the external galaxies. The aim of this work is to deploy high resolution ALMA observations of  $^{12}\text{CO}(2-1)$ ,  $^{13}\text{CO}(2-1)$  and  $\text{C}^{18}\text{O}(2-1)$  data to study clumps in M33 galaxy. This work is expected to provide new insights into, clump properties in low-metallicity environments and improve our understanding of environmental variations of clumps.

## Introduction

A clump is a dense self-gravitating, pocket of gas inside a molecular cloud that is a candidate site for star formation.

## Aim

To study the properties of molecular clumps in M33; Mass, size, density, pressure, velocity dispersion and Luminosity

## Objectives

- Determine Larson's Laws and the XCO factor.
- Map molecular cloud distribution
- Compare clump properties with the Milky Way

## Methodology

ALMA archive data of the south-western region of M33 were processed using CASA. Molecular clumps were identified with Astrodendro and visualized using APLpy.

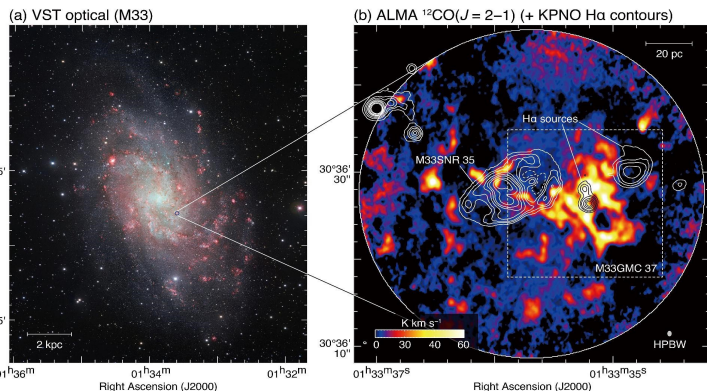


Fig 1: Image of M 33 obtained with the VLT Survey Telescope (VST, credit: ESO).

## Preliminary image

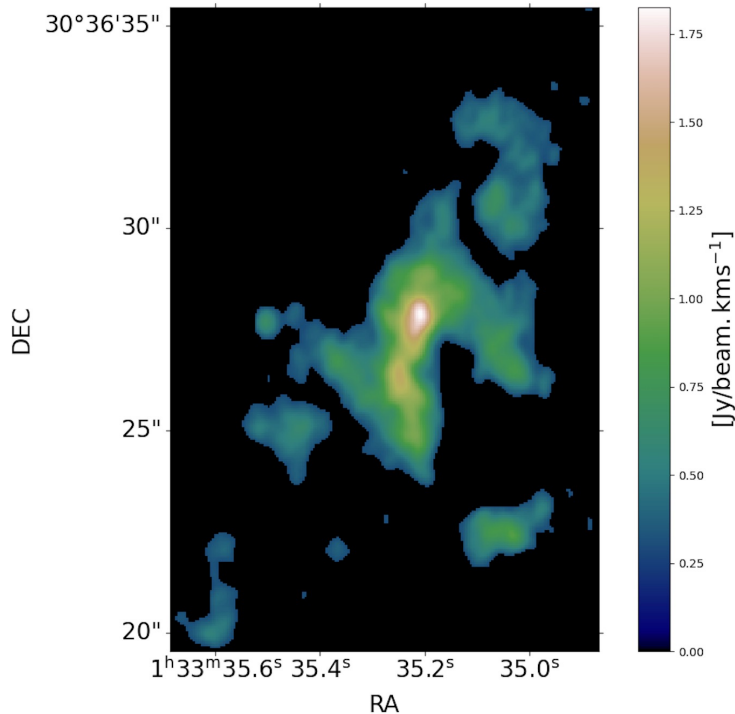


Fig 2: M33GMC 35 image

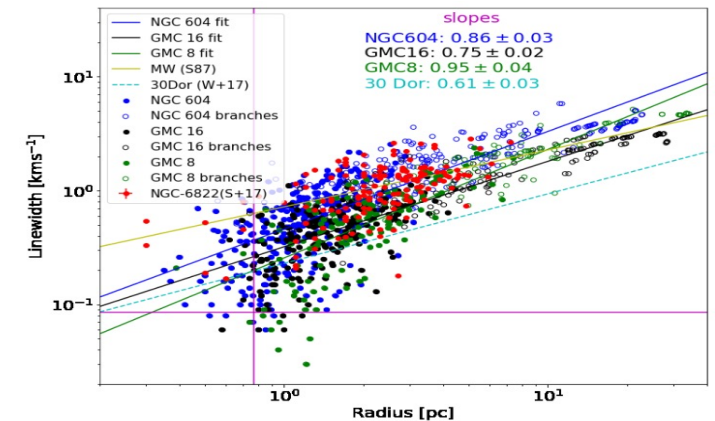


Fig 3: Preliminary Results based on  $^{12}\text{CO}$  only from three GMCs in M33 galaxy, Northern Arm, Phiri et al. In Prep.

## Summary

Using ALMA CO observations, this study maps molecular clumps in the low-metallicity Galaxy M33 to explore how galactic environment and metallicity influence star formation.

## References

- Sano et al., 2020
- Muraoka et al., 2019
- S. P. Phiri et al., 2021.