The Relationship Between Super Star Clusters and Molecular Gas

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Why do you care about Super Star Clusters?

A very very old SSC...

(M80, image credit: Hubble Heritage)
(Naïve?) Hypothesis:

Molecular line strengths/ratios should evolve along this sequence.
An example of a pre-super star cluster molecular cloud
Properties of pre-SSC cloud

1) $R_{\text{half light}} \leq 24$ pc
2) $M \sim 10^7 M_\odot$
3) (< 60 O7V stars)
4) $T = 25^{+10}_{-2}$ K
5) $P/k_B > 10^8$ K cm$^{-3}$
What about other molecular tracers?

ALMA Cycle 1, Schirm+ (2016)
What about other molecular tracers?

Cycle 4 Follow-up:
P.I. Wilson – 0.’06, dusty cores
P.I. Johnson – 0.’1, multiple lines

ALMA Cycle 1, Schirm+ (2016)
How do the line ratios change with evolution?
Revisiting an Old Friend:
Natal Super Star Clusters in He2-10

(Radio Emission)

ALMA Observations
Team: Johnson, Brogan, Wilner, Chen, Reines, Testi, Vanzi

Johnson+ in prep
Revisiting an Old Friend: Molecular line emission from He2-10

(Johnson+ in prep)
Revisiting an Old Friend: Molecular line emission from He2-10

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What would cause this trend?

HCO+ photo-enhancement

CO photo-destruction
ALMA then...

International Advisory Committee
~2006
ALMA then… and now.
Most of us are *nouveau riche*

We

If I have seen further it is by standing on the shoulders of Giants.

(Isaac Newton)

“(NSF) in July, 1990, called for an array of 40 antennas of 8-meter diameter, with four receiver bands covering the atmospheric windows from 30–350 GHz, configurable in four arrays of size 70–3000 m.”

(text from Paul A. Vanden Bout)
1) Starting to constrain physical conditions related to SSC formation

1) Appears to be evolution in molecular line observations

2) Clearly a larger sample and more lines would be helpful 😊
Summary

1) Starting to constrain physical conditions related to SSC formation

2) Appears to be evolution in molecular line observations

2) Clearly a larger sample and more lines would be helpful 😊
ALMA Cycle 0 CO(3-2) Observations
Team: Brad Whitmore (PI), Crystal Brogan, Adam Leroy, Aaron Evans, John Hibbard, Kartik Sheth

CO3-2 moment 0 outline
(Whitmore et al. 2014)

Velocity cube
Principle Component Analysis

Different species not well correlated.

Similarity between HCO+ and CCH

Similarity between HCN and HNC

Johnson+ in prep
Where are the He2-10 Clouds?