

# Massive young stellar objects in the N66/NGC346 region of the SMC ★

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## ABSTRACT

We present *HK* spectra of three sources located in the N66 region of the Small Magellanic Cloud. The sources display prominent stellar Br $\gamma$  and extended H<sub>2</sub> emission, and exhibit infrared excesses at  $\lambda > 2\mu\text{m}$ . Based on their spectral features, and photometric spectral energy distributions, we suggest that these sources are massive young stellar objects (mYSOs). The findings are interpreted as evidence of on-going high mass star formation in N66.

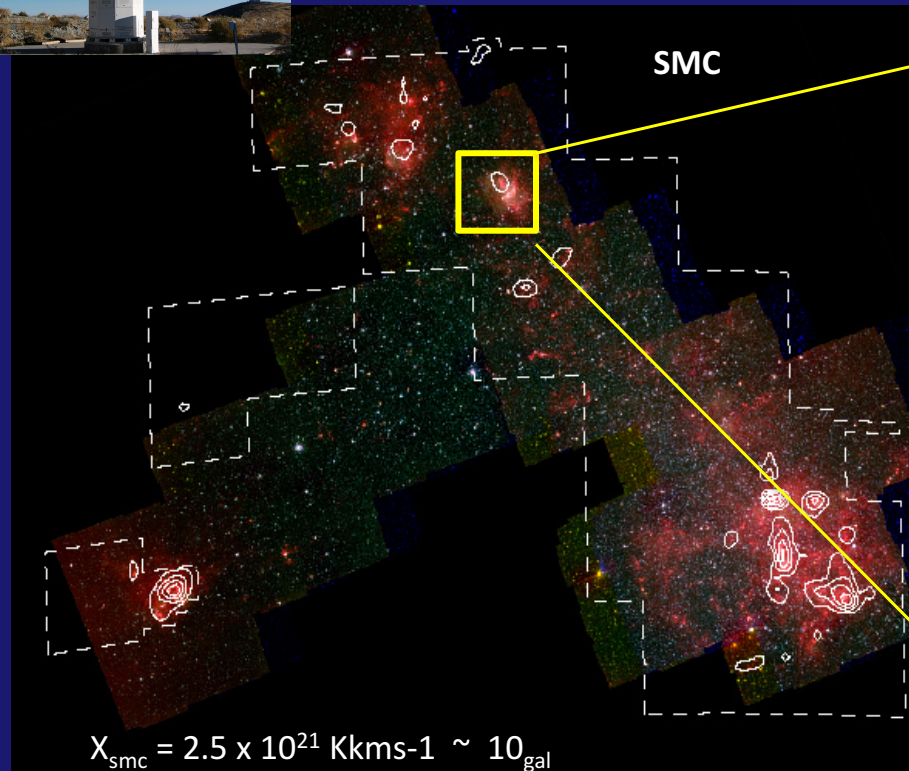
**Key words.** Magellanic Clouds — HII regions — infrared: stars — techniques: spectroscopic — ISM: individual (N66) — stars : pre-main-sequence

小マゼラン雲 N66/NGC364という領域のYSOを同定  
この領域では大質量星(15M<sub>o</sub>以上)が少なくとも3つ形成段階である

Introduction: N66とは  
SMCで一番大きいH II領域, 星形成がon-going



## CO in the Small Magellanic Cloud



$$M(\text{H}_2) = 4.6 \times 10^6 \text{ Mo}$$

Mizuno, Rubio et al. 2001

N66



NGC346

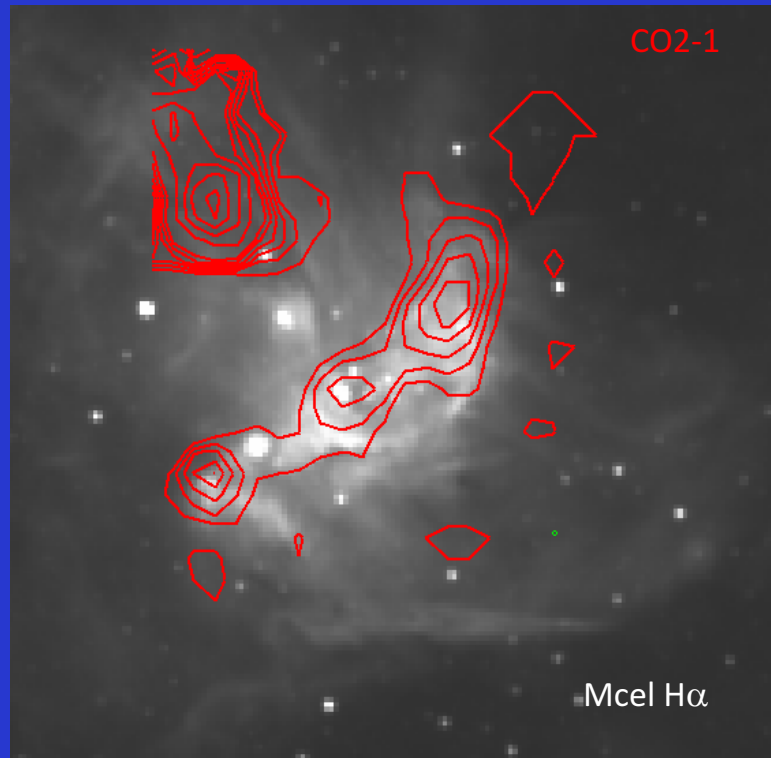
33 O type Stars  
11 Earlier O6

Massey et al. 1989

HST

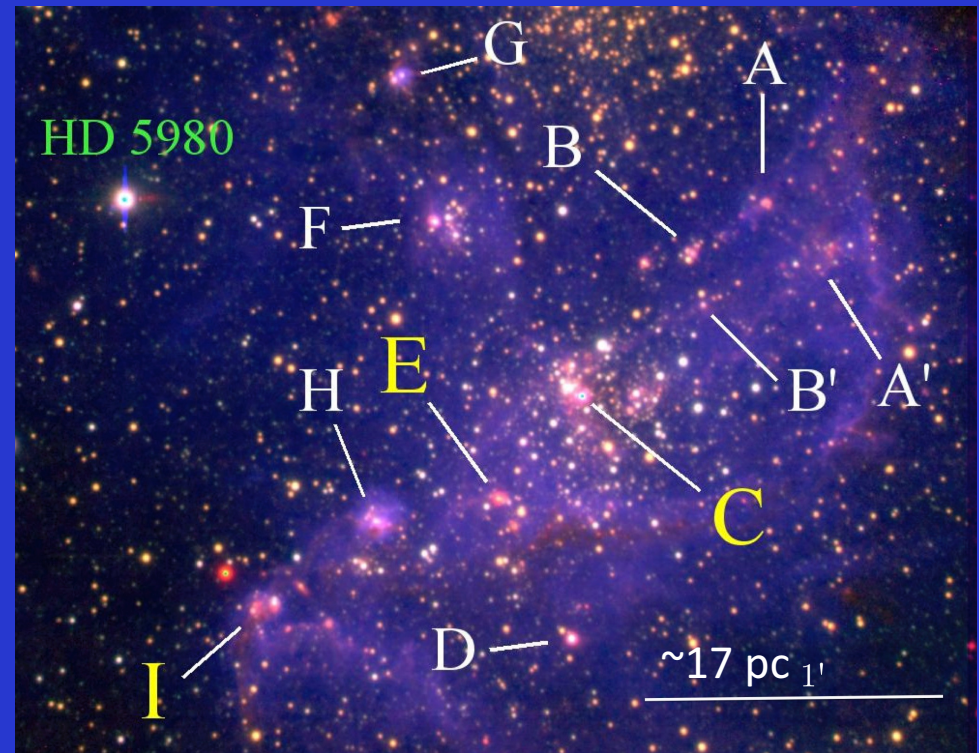
Red: Ks  
Green: J  
Blue: H $\alpha$

# CO in N66



Rubio et al. 2000.

$M \sim 10^3 - 10^4 M_{\odot}$



Labels: Contursi et al 2000

Monicaさんのスライド  
より一部改変



# Discussions & Conclusions

## 星形成シナリオについて

### ○ 3つのYSOは形成段階

- dense clump, CO (2-1)がある
- 年齢は10000~50000 years くらい

### ○ 3つのYSOは同じような年代

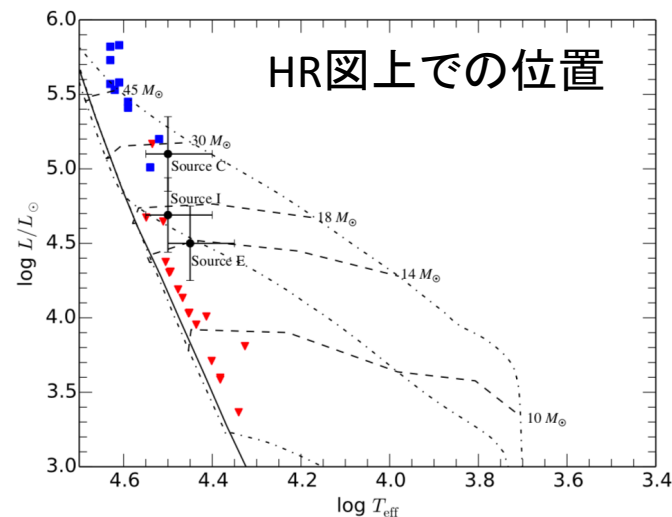
- 中心のSource Cが一番若い

=>これは昔提案していたシナリオと違う  
中心(NGC346)で先に生まれて、barにそって外側に向かって星形成が進行

○統計的に多くないのであんまり確かなことは言えないが、少なくともNGC346の星形成は進行中である

Cluster 自体は4Myr前に形成されたので、星形成がずっと続いていた or 最近のバーストイベントがあった

○ALMAで観測したいな～

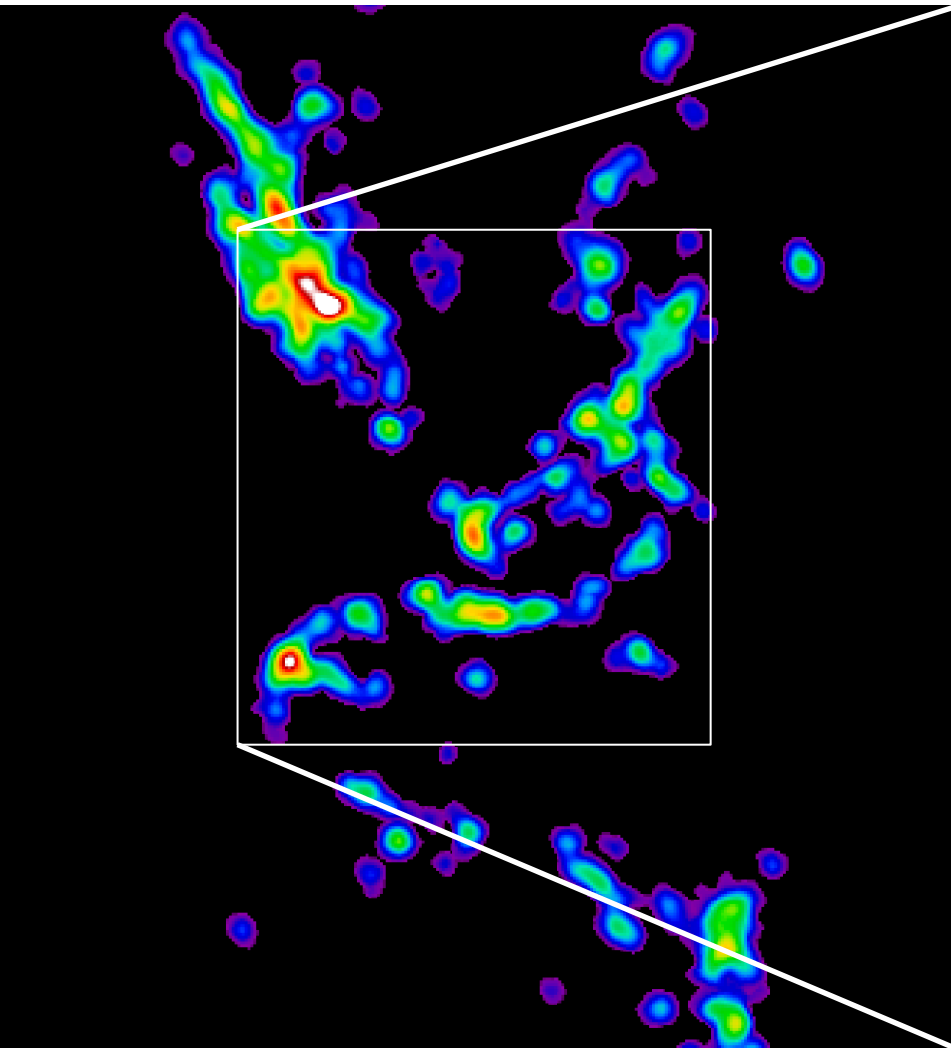


**Fig. 5.** The position of our mYSO candidates (circles) are shown along with known SMC YSOs (Sewilo et al. 2013) as red inverted triangles and galactic YSOs (Wu et al. 2016) as blue squares. The dashed dotted lines are the PMS isochrones of Bressan et al. (2012) at  $1/5Z_{\odot}$  for 0.01, 0.03 and 0.3 Myr right to left respectively, and the dashed line the stellar tracks for 10, 14, 18, 30 and  $45 M_{\odot}$  from bottom up. The solid line is the main-sequence locus.

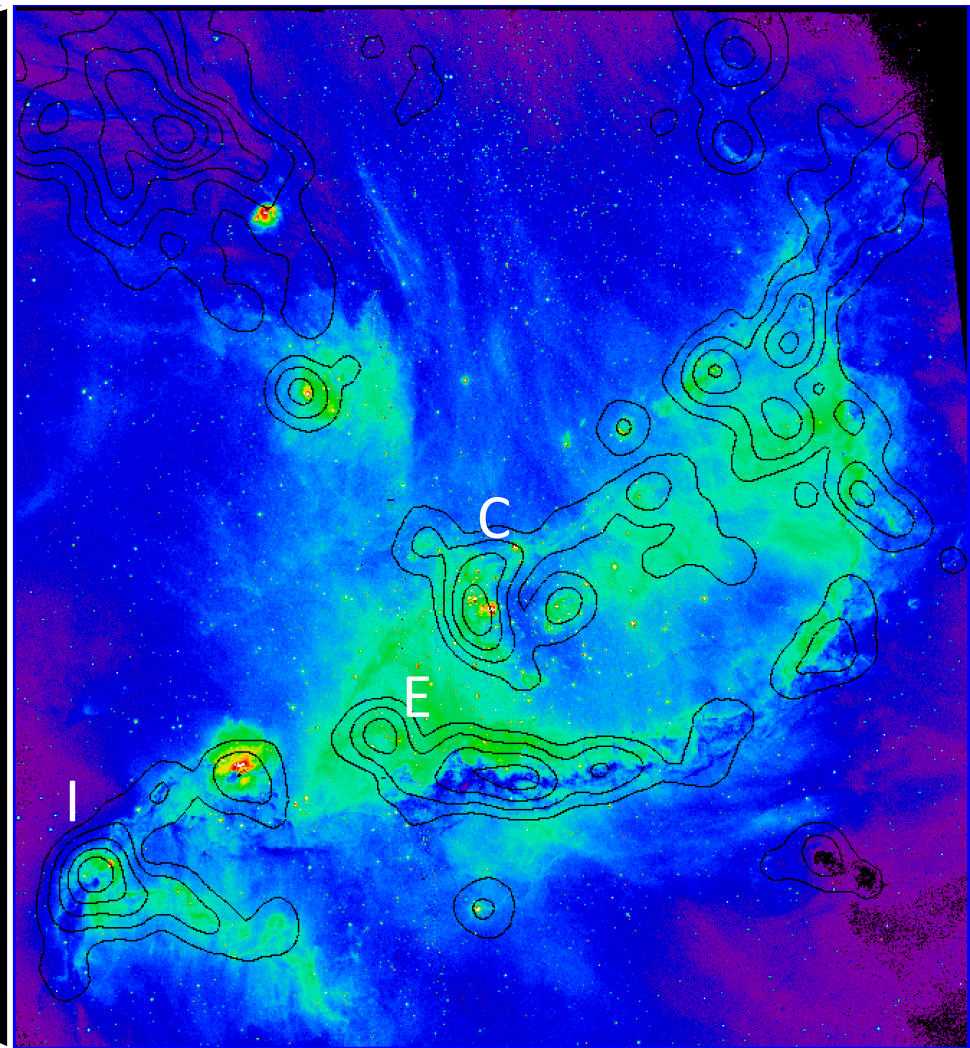
**Table 7.** Stellar parameters of the mYSOs

| Star     | $T_{\text{eff}}$<br>(K) | $\log L_*$<br>( $L_{\odot}$ ) | Mass<br>( $M_{\odot}$ ) | Log Age<br>(yr) |
|----------|-------------------------|-------------------------------|-------------------------|-----------------|
| Source C | $4.5^{+0.1}_{-0.2}$     | $5.1 \pm 0.25$                | $26 \pm 5$              | $4.25 \pm 1.0$  |
| Source E | $4.45^{+0.1}_{-0.2}$    | $4.5 \pm 0.25$                | $15.9 \pm 3.0$          | $4.51 \pm 0.6$  |
| Source I | $4.5^{+0.1}_{-0.2}$     | $4.69 \pm 0.25$               | $19.7 \pm 4.0$          | $4.44 \pm 1.0$  |

# おまけ: ALMA (ACA) でみた N66/NGC364



CO (2-1) ACA



CO contour: on HST,658nm