Sequential Star Formation in the Filament S242

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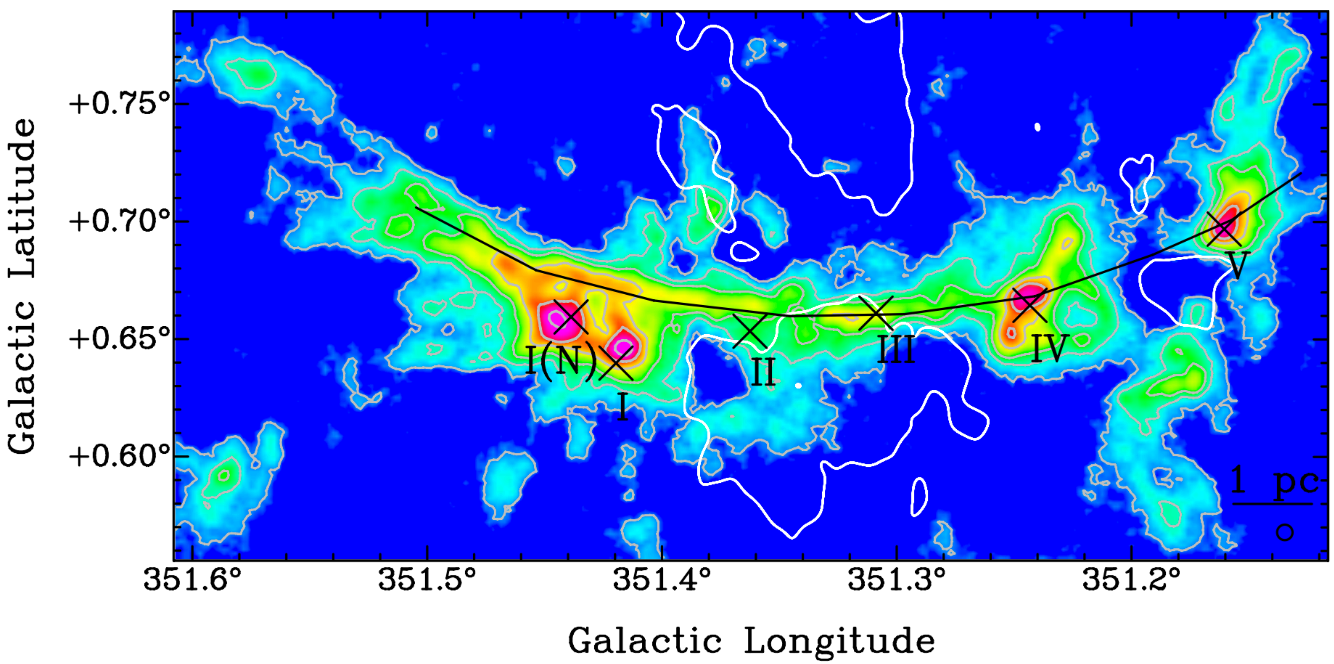
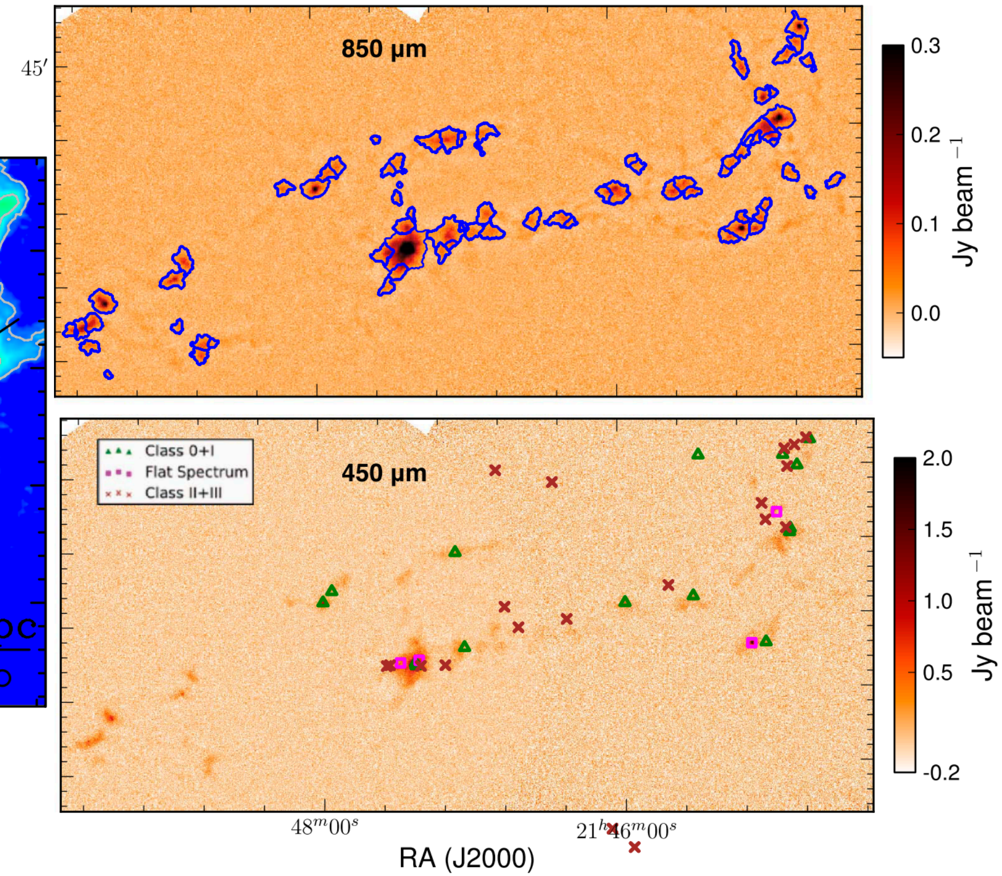
Introduction

Star Formation and Filaments

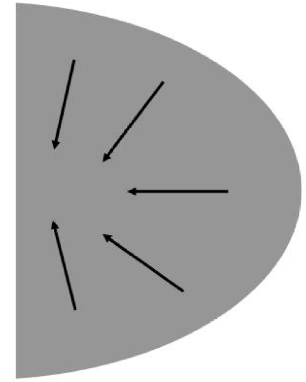


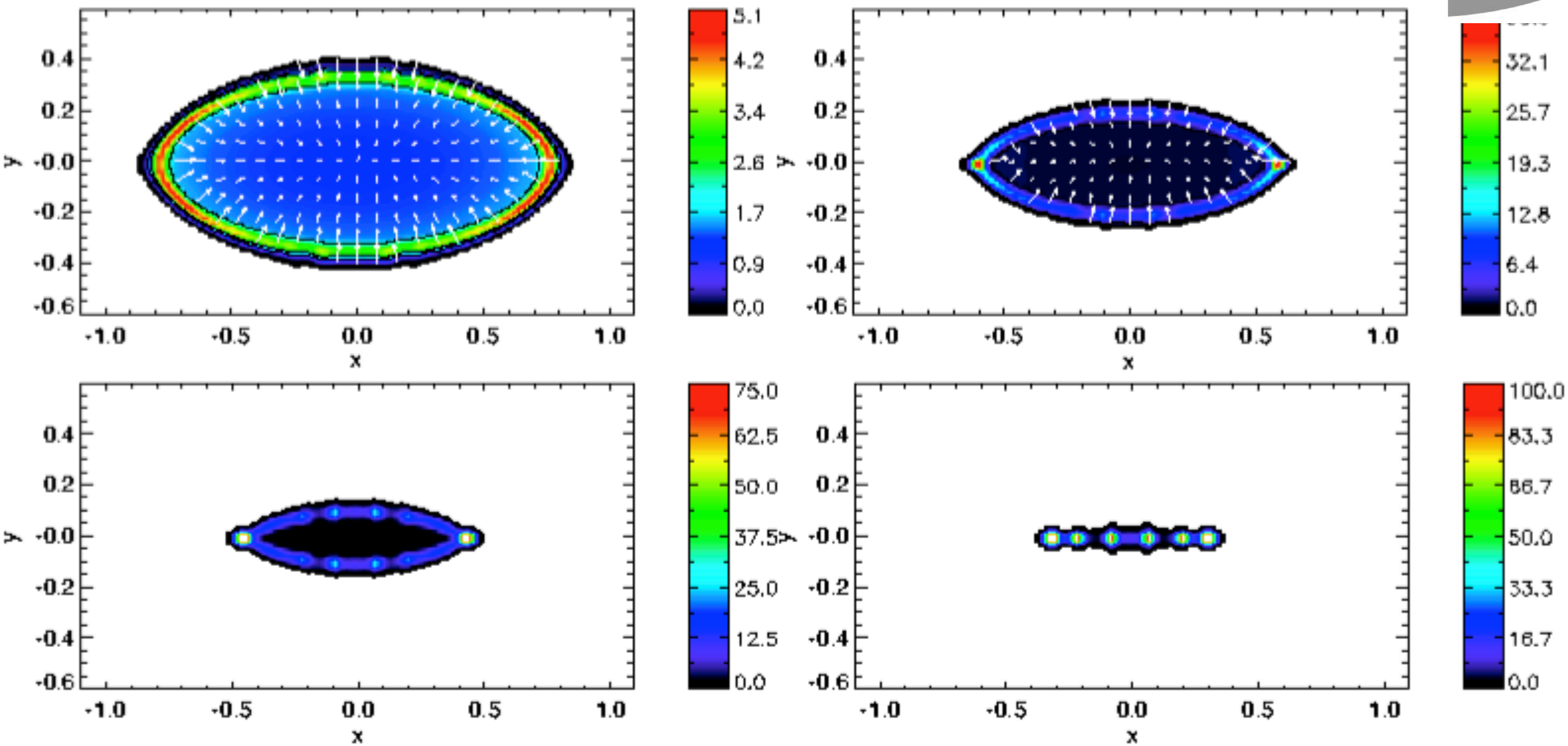
Zernickel et al. 2013, NGC 6334



Johnstone et al. 2017, IC 5146

Gravitational collapse in finite sheets





Burkert et al., 2004

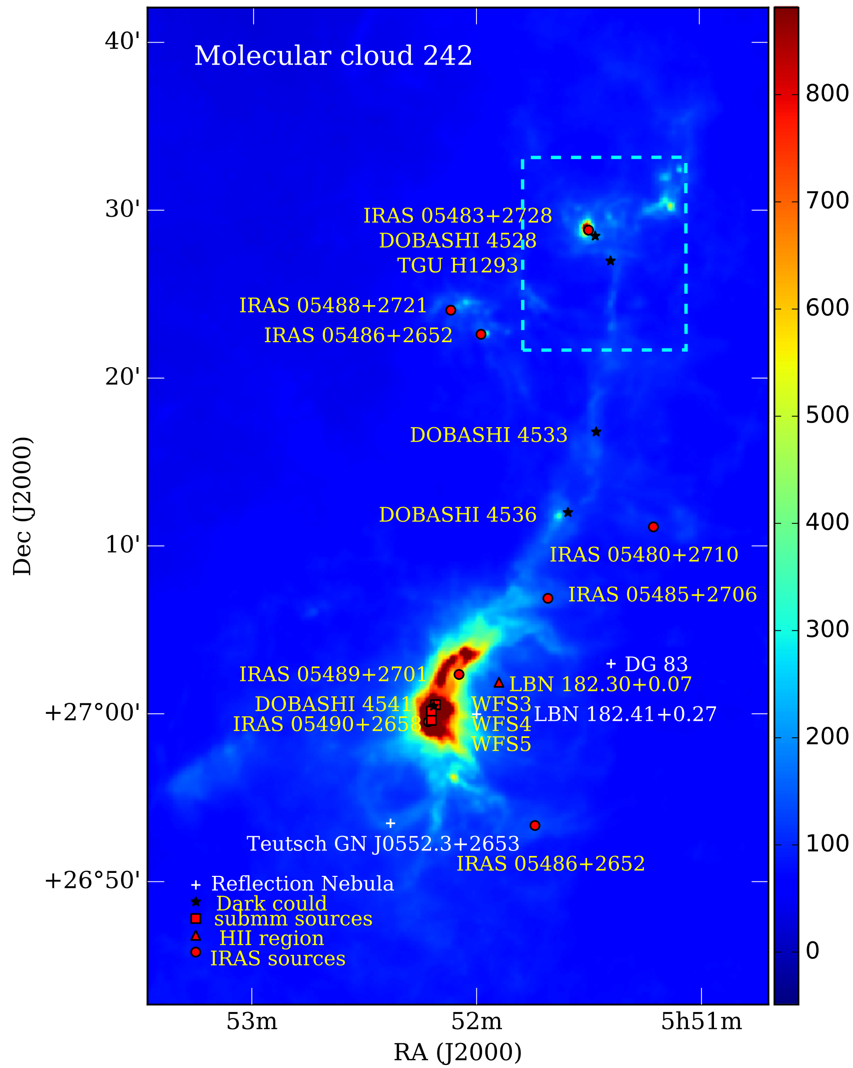
Objects

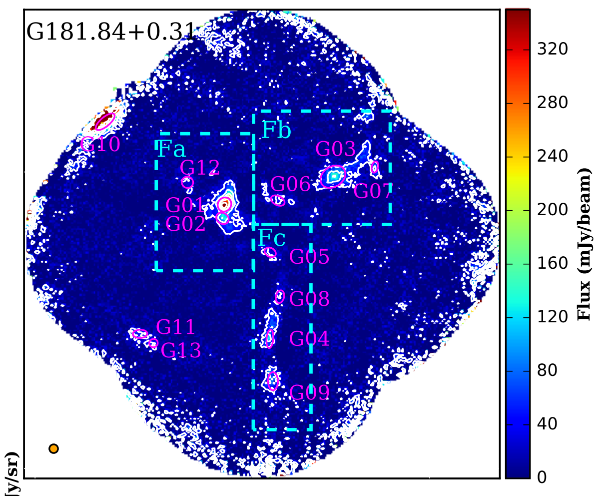
Filament S242

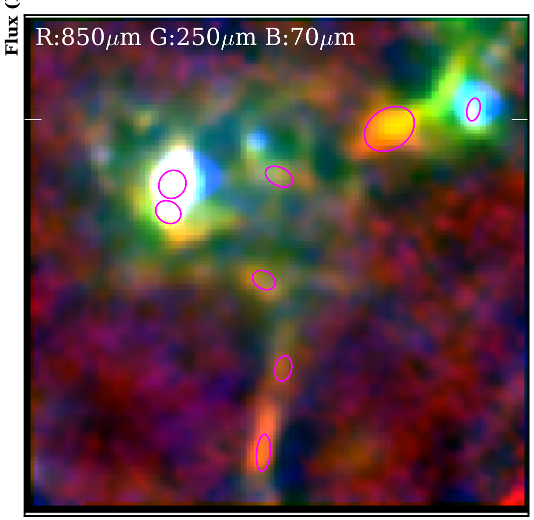
(2 kpc, ~ 30 pc, ~ 10^4 Msun)
End-dominated collapse ?
(S242, Dewangan et al 2017)

PGCC G181.84+0.31

SCUBA-2 (850 μm) continuum
Magenta ellipses:
Compact sources (FellWalker)







DATA

Continuum emission

JCMT: 850 µm (SCOPE, Liu et al.)
Herschel: 70-500 µm
WISE: 3-22 µm
Spitzer: 1-5 µm

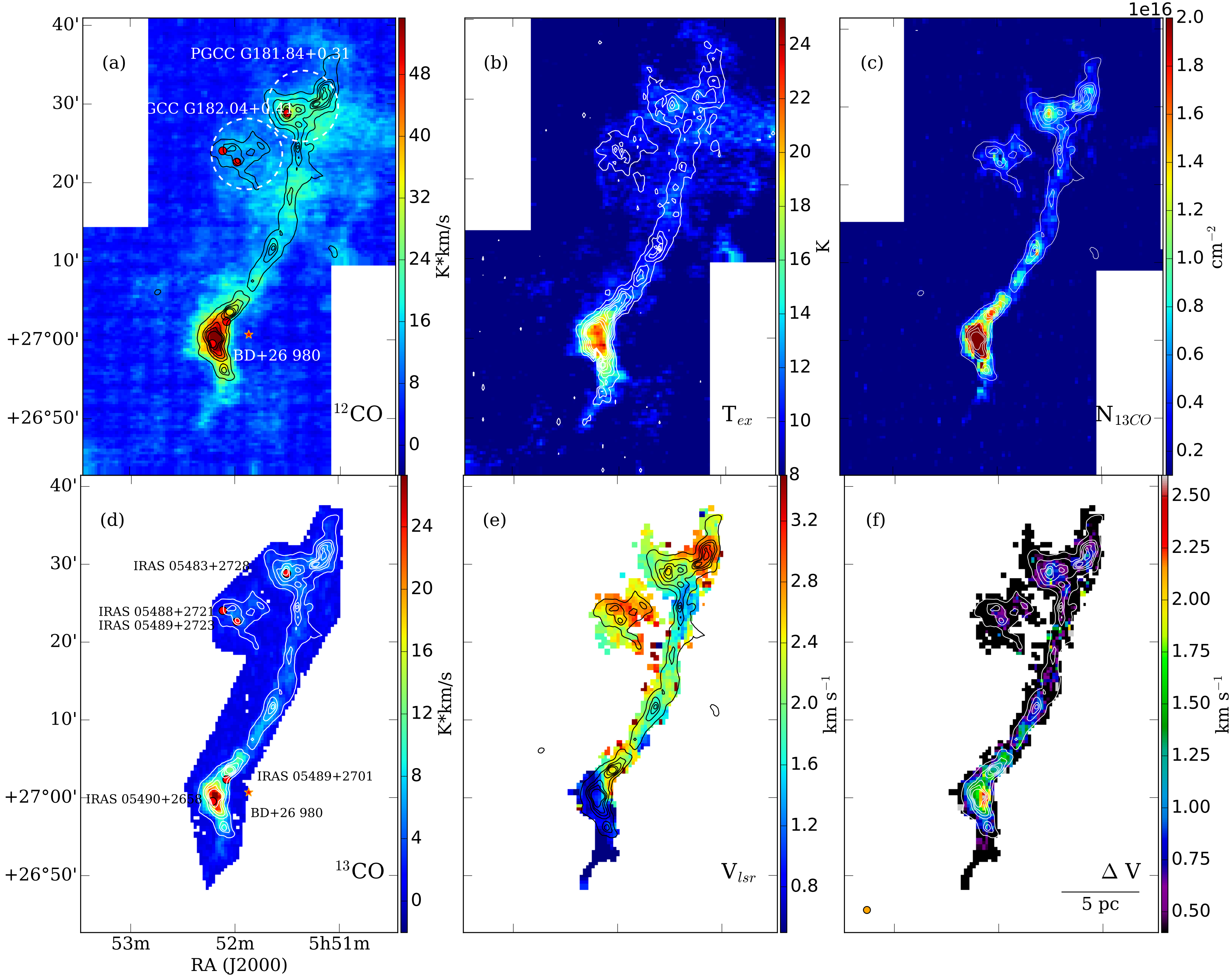
Spectral lines

OTF mapping

$^{12}CO(1\text{-}0)$, $^{13}CO(1\text{-}0)$ (TRAO)
$^{12}CO(3\text{-}2)$, $H^{13}CO+(4\text{-}3)$ (JCMT)
$HCO^{+}(1\text{-}0)$, $N_2H^{+}(1\text{-}0)$ (NRO 45-m telescope)

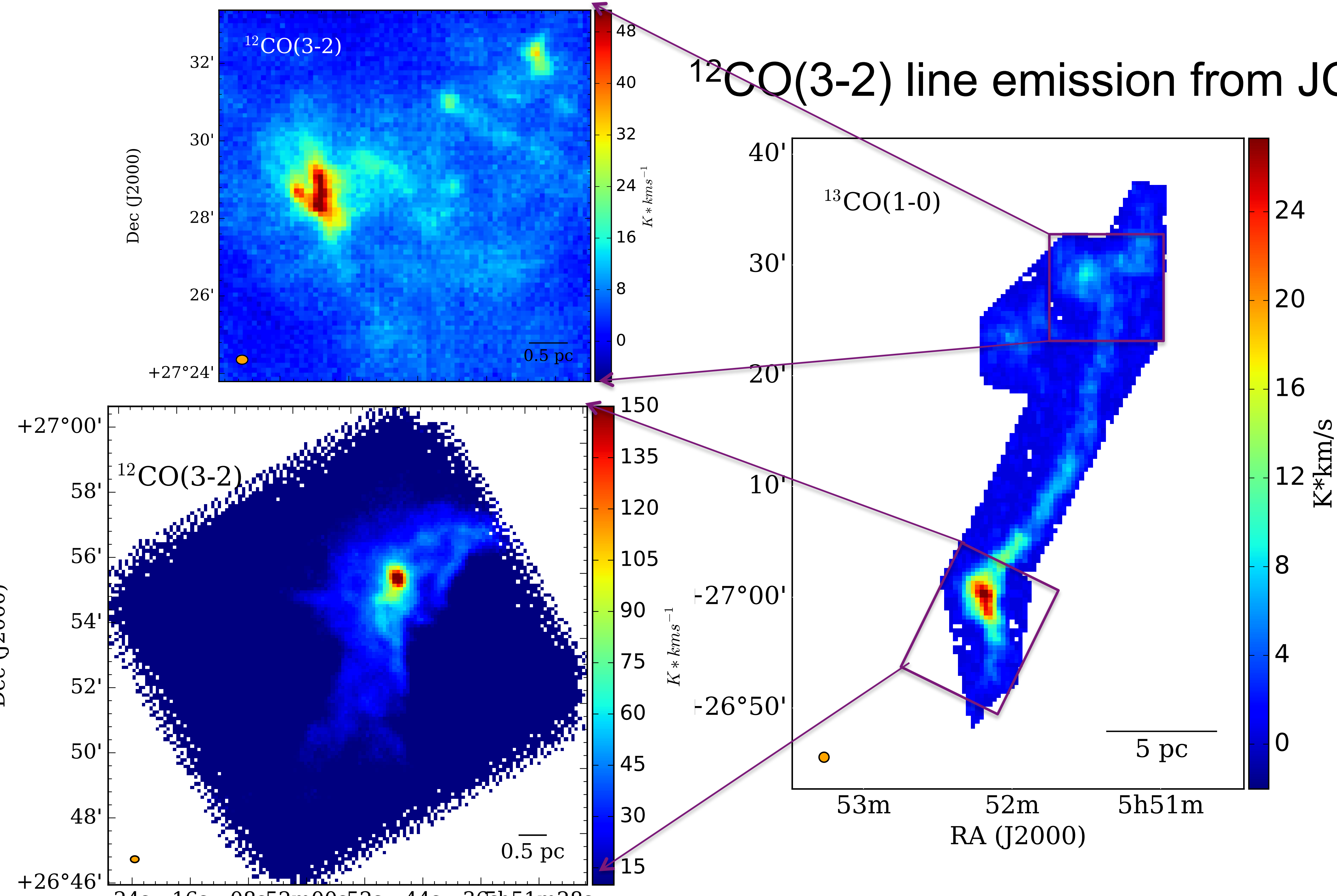
Single point

$H^{13}CO^{+}(1\text{-}0)$, $HCO^{+}(3\text{-}2)$ and $H^{13}CO^{+}(3\text{-}2)$

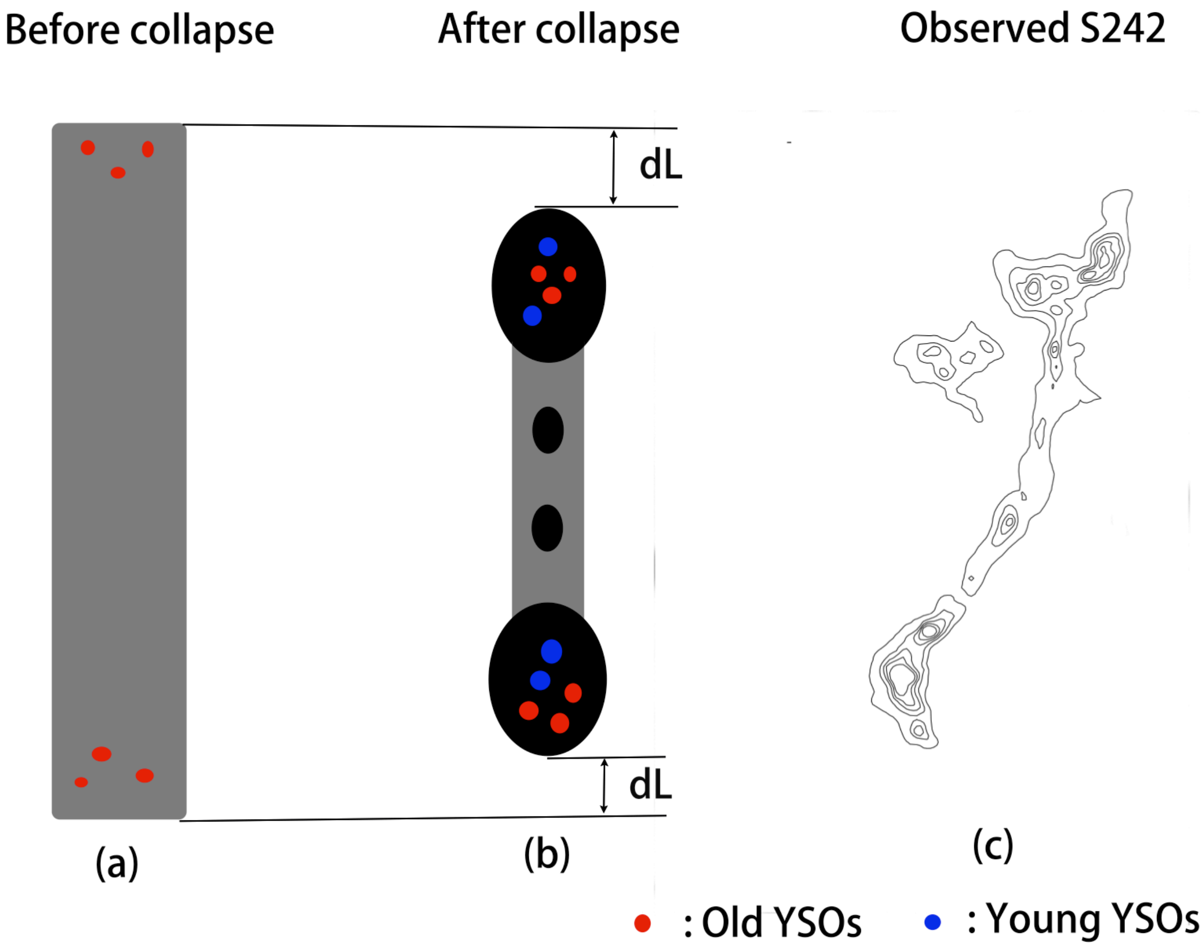


The information of filament S242 from TRAO CO lines

^{12}CO(3-2) line emission from JCMT



The sketch for the edge-collapse process



The collapse timescale:

$$a \simeq \int_d^L \frac{G\Sigma}{r^2} dr \simeq G\Sigma \left(\frac{1}{d} - \frac{1}{L} \right) ,$$

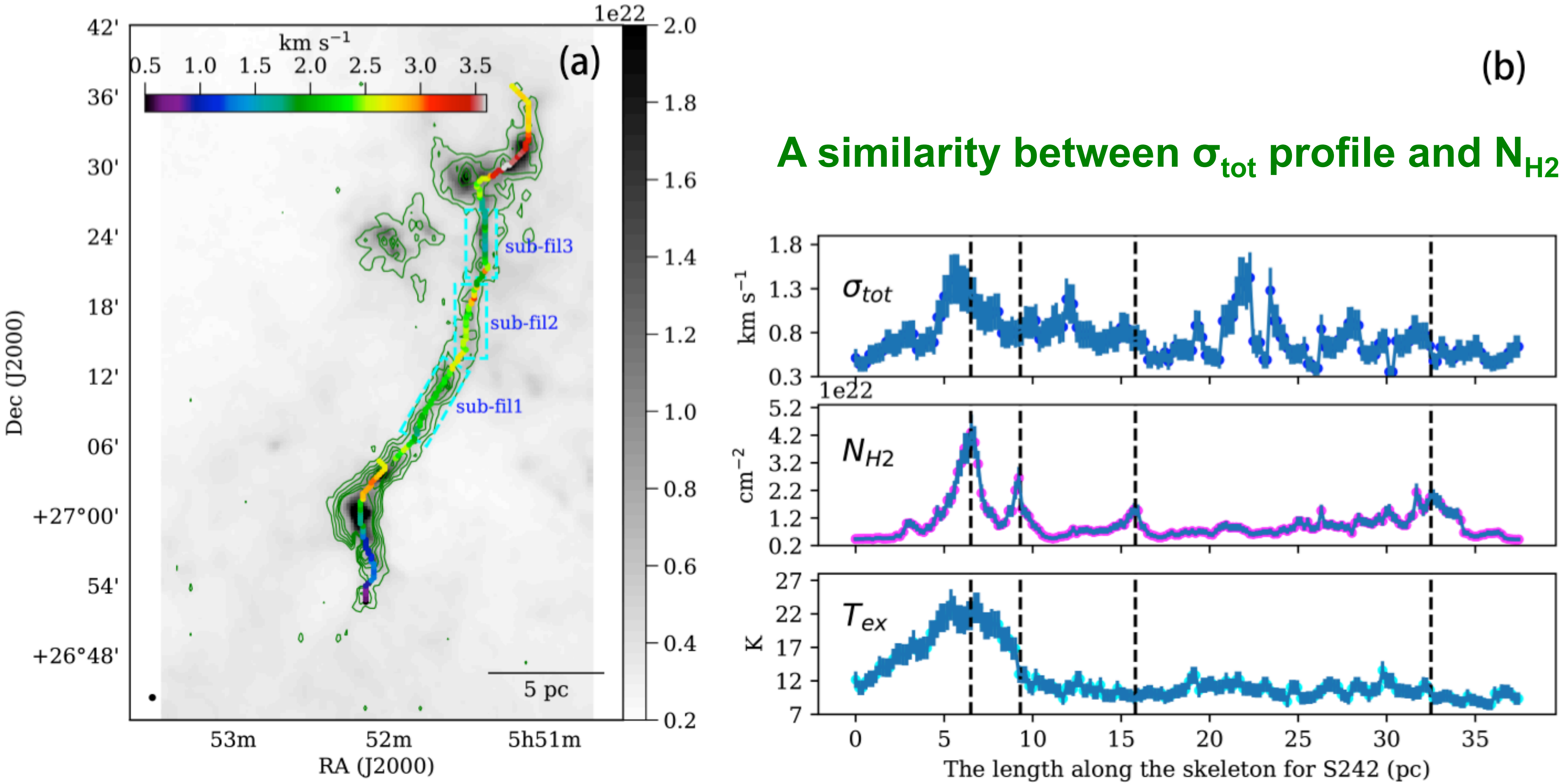
$$\Delta L = L_{\mathrm{before}} - L_{\mathrm{after}} ,$$

we further estimate the collapse time as:

$$t_{\mathrm{col}} \simeq \sqrt{\Delta L / a} \sim$$ **3.6 Myr**

Self-gravity as the cause of increasing velocity dispersion ?

A similarity between σ_{tot} profile and N_{H2}

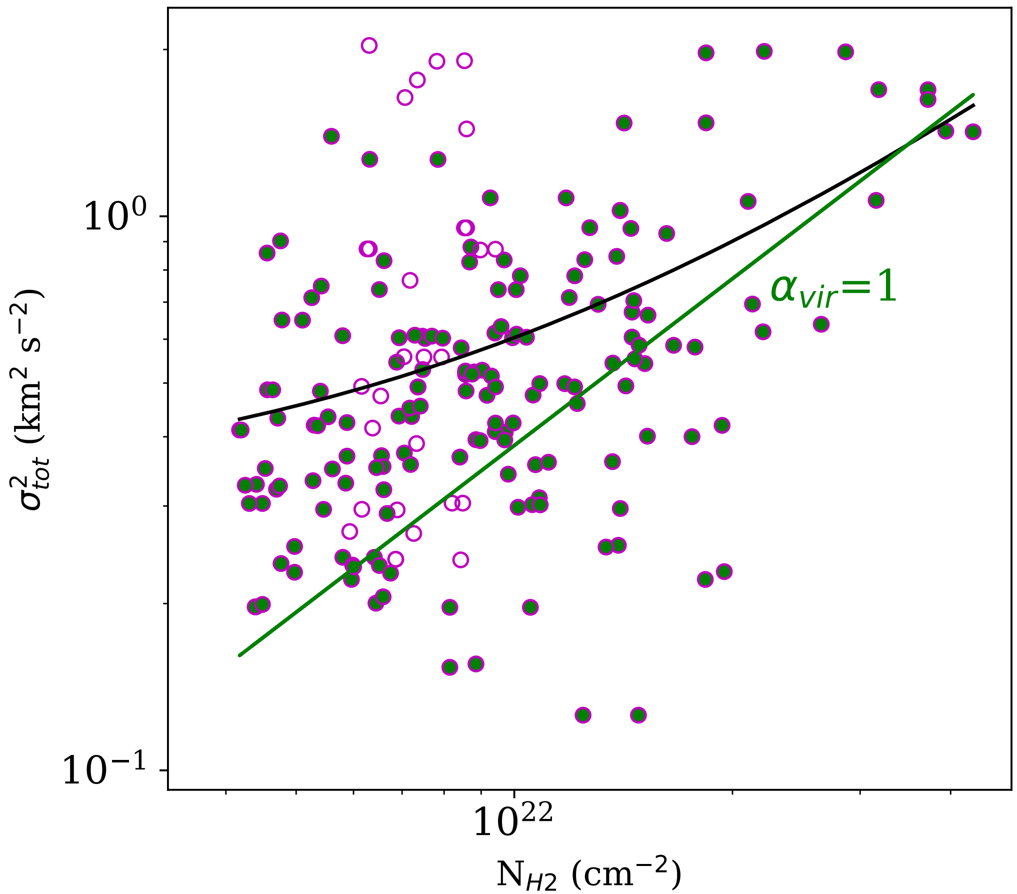


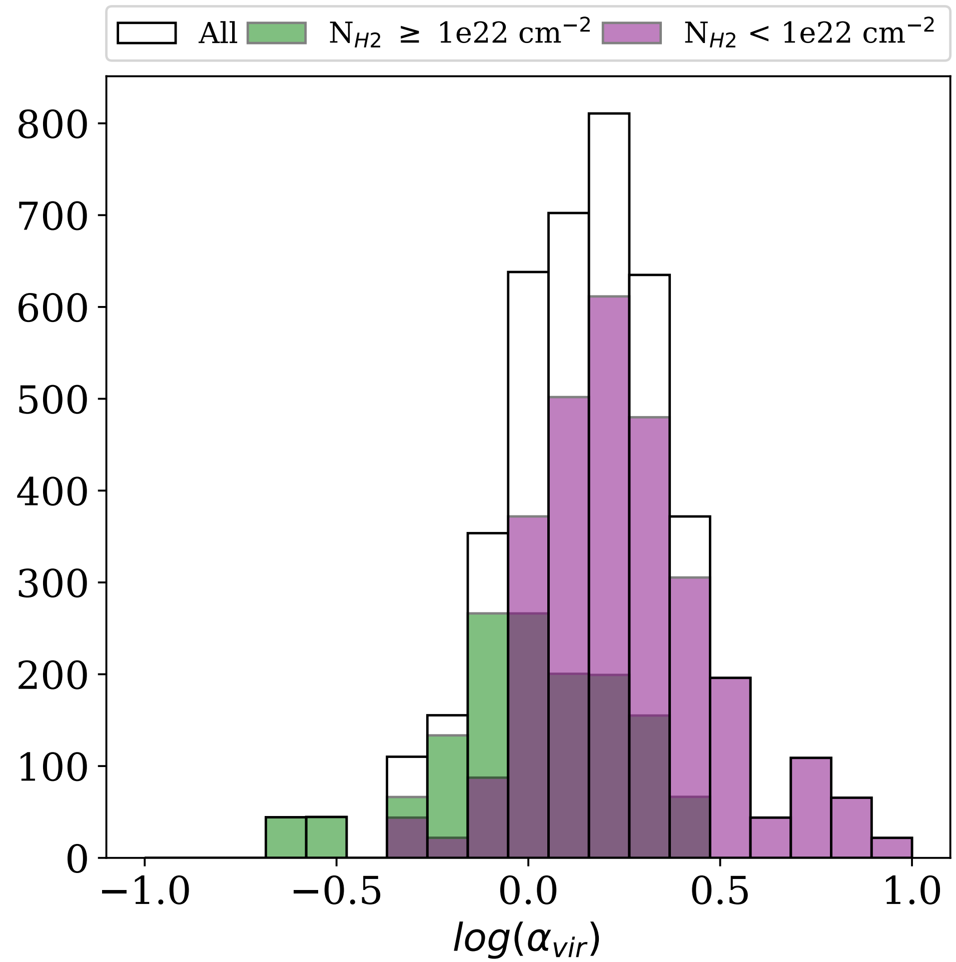
Gravitational stability in filament S242

$$v_{\rm dyn} \simeq \sqrt{\frac{Gm}{r}} \simeq \sqrt{G\Sigma}\,,$$

Self-gravity accounts for a higher fraction of velocity dispersion in regions with high surface mass

$$\alpha_{\rm vir} \simeq \frac{\sigma_{\rm tot}^2}{v_{\rm dyn}^2}\,.$$



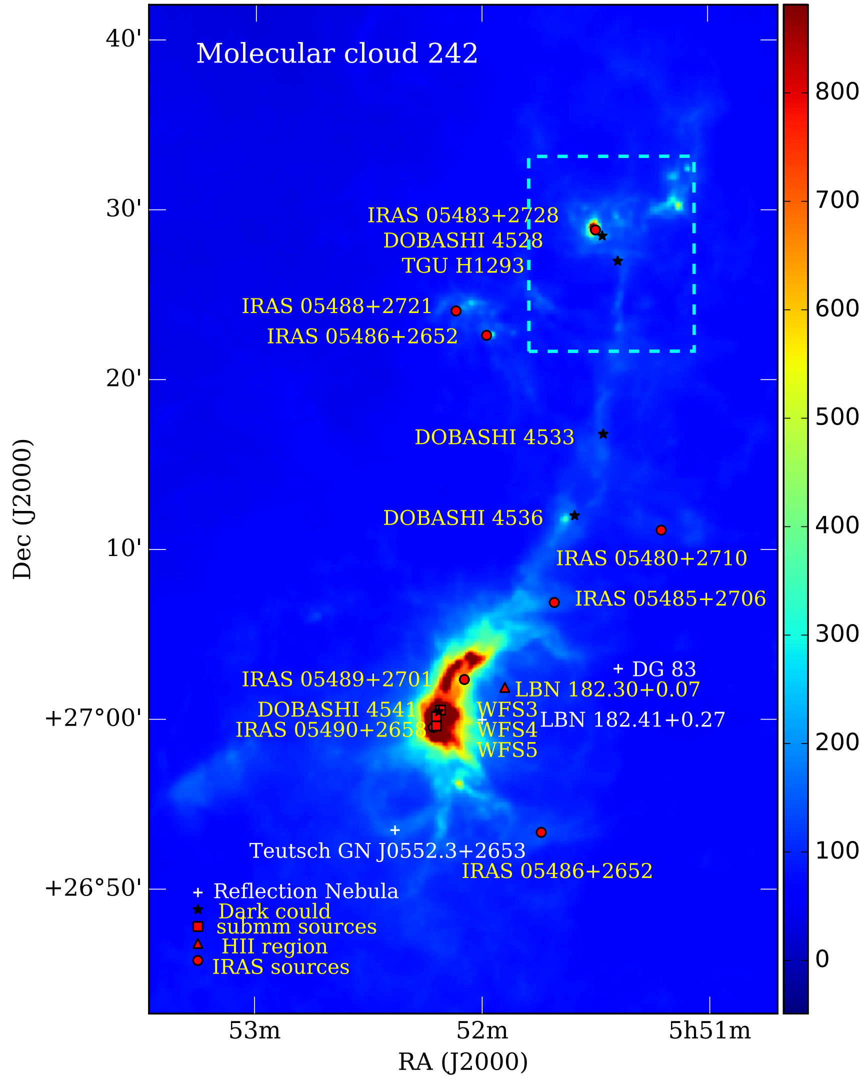


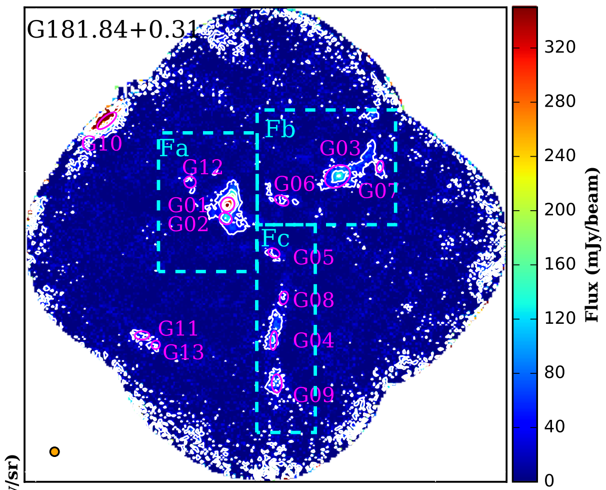
How do the star formation in end-clumps effected by edge- collapse?

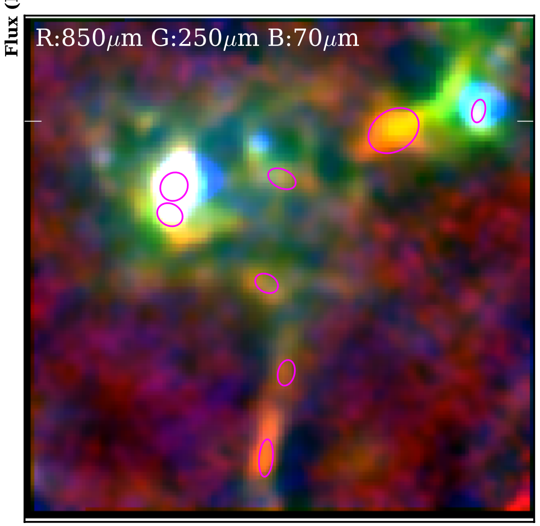
Star formation on the northern PGCC G181.84+0.31
(Yuan et al., MNRAS, 2019)

Magenta ellipses:
Compact sources from SCUBA-2 850 μm (FellWalker):
G01-G09

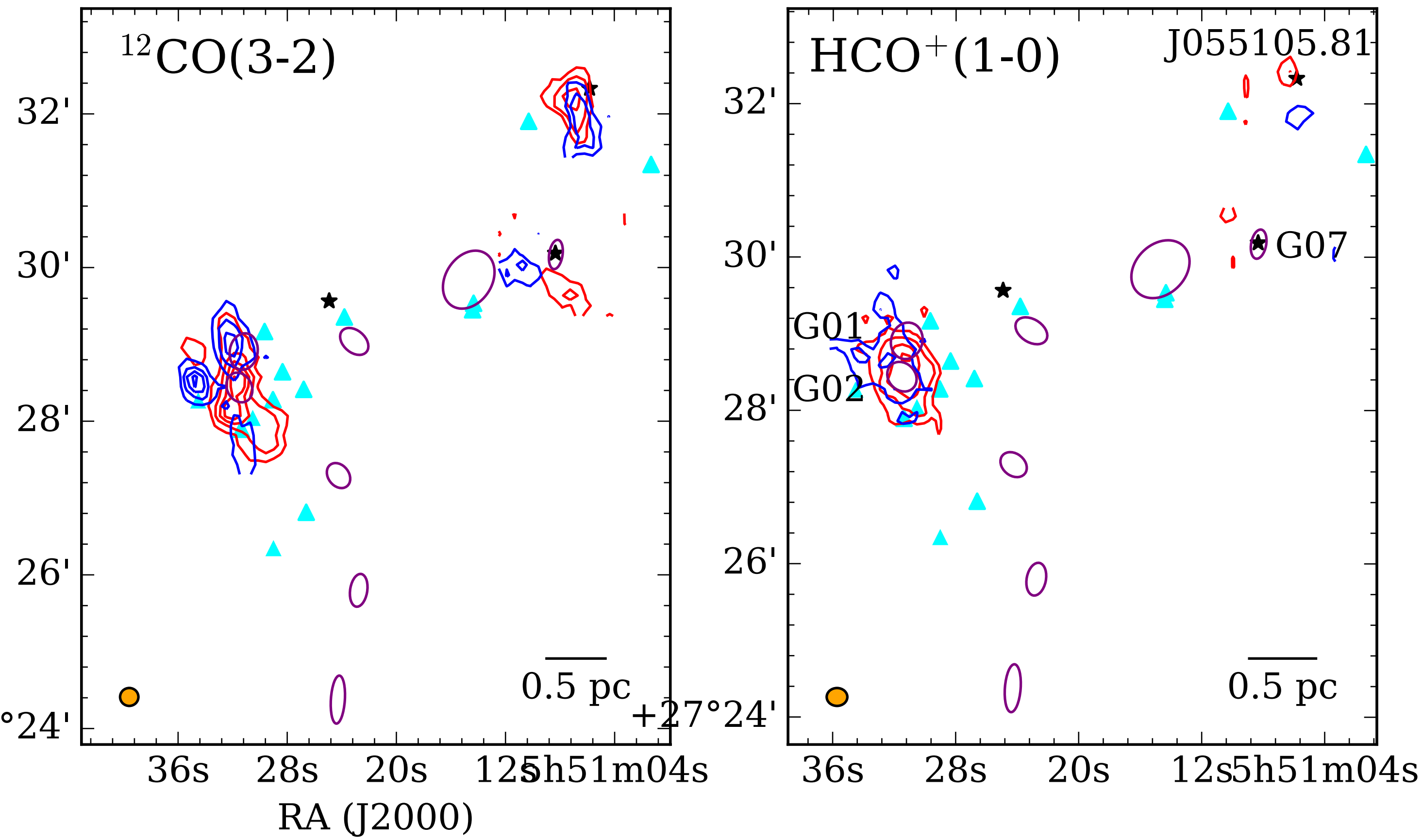
Protostars: G01, G02, G07
Pre-stellar candidates: others
(**70 μm emission**)

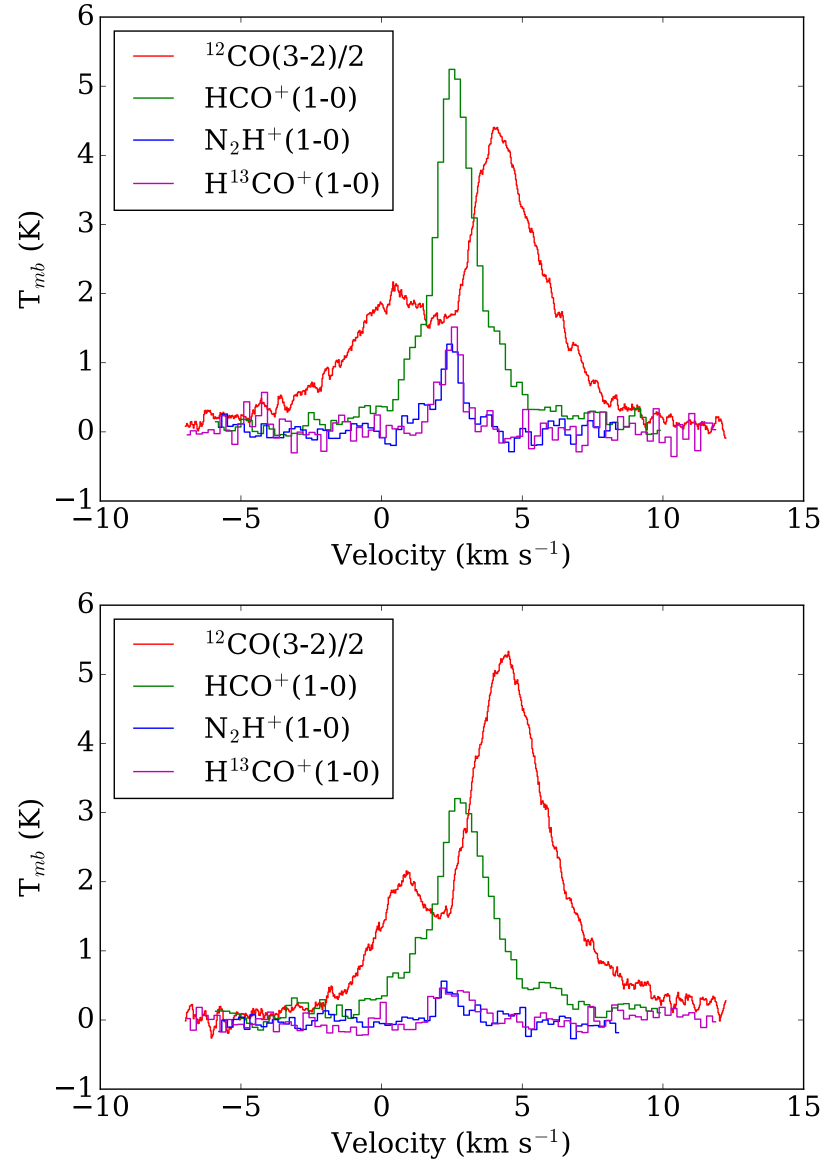




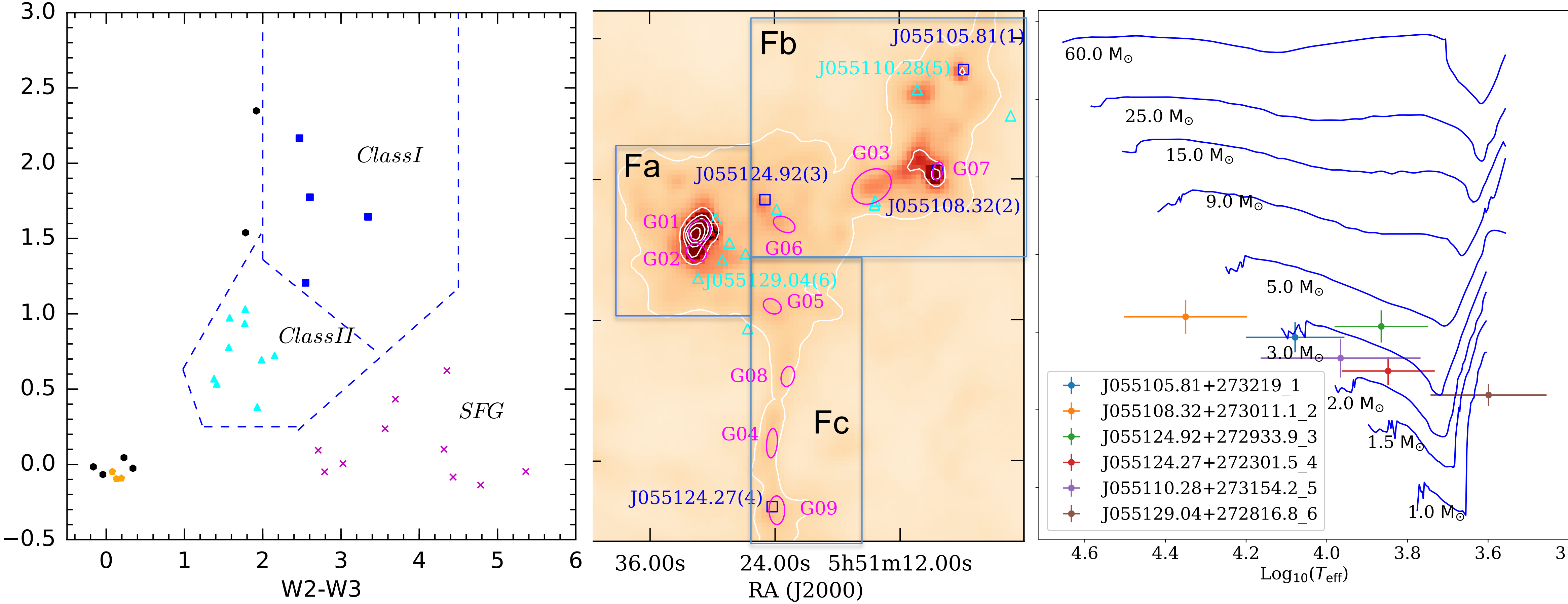


Potential outflow activities in protostars (G01, G02, J055105)





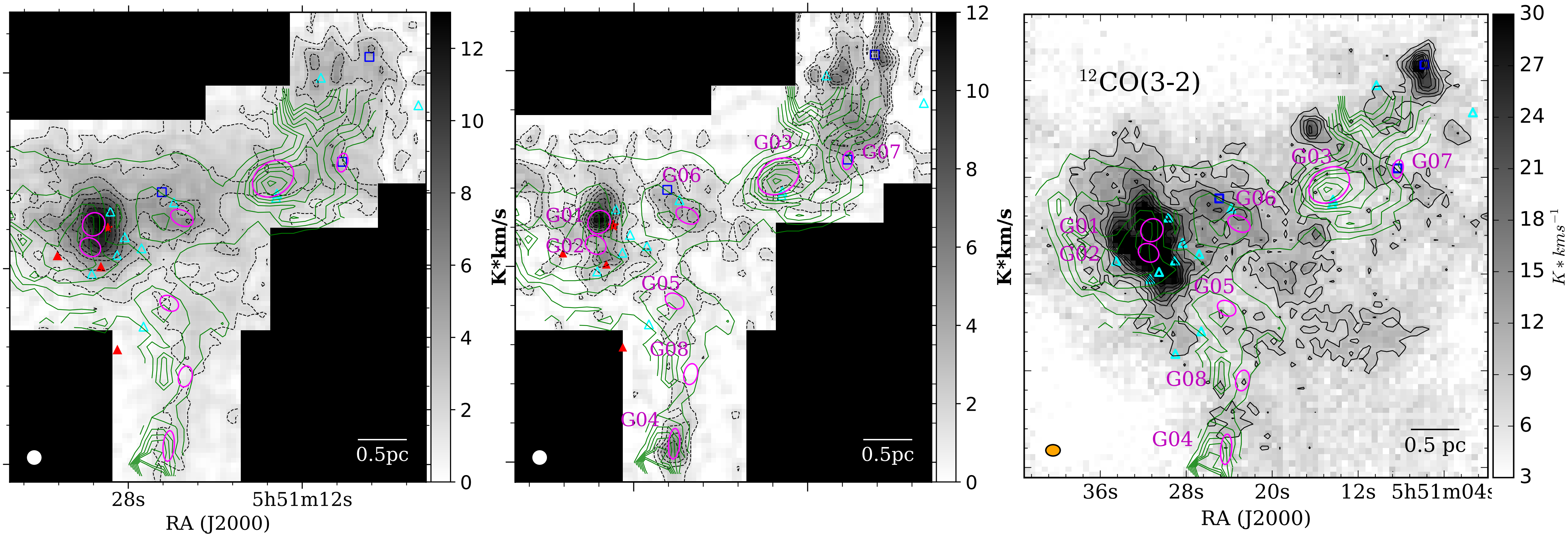
YSOs identification, distribution, evolution



Sequential star formation in Fa，Fb and Fc sub-structures in G181

Spectral-line emission in G181

(Nobeyama 45-m telescope and JCMT)



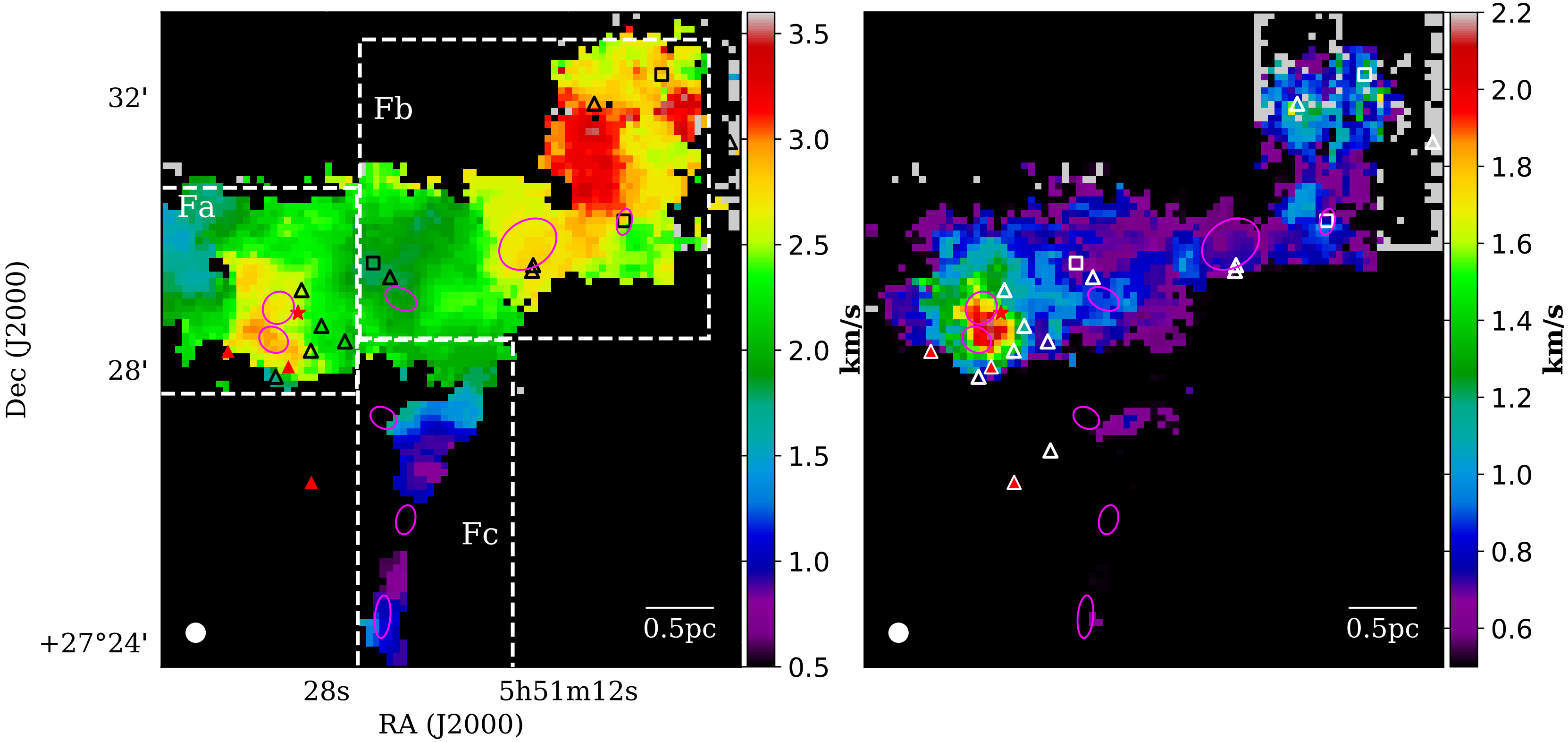
HCO^+(1-0)

N_2H^+(1-0)

CO (3-2)

Kinematical states in G181:

The distribution of Centroid velocity and Velocity dispersion.



Velocity gradients:

~ 1.0 km $s^{-1}pc^{-1}$

The gas flow caused by edge-collapse ?

Mach number:

1.9 (Fa), 1.5 (Fb), 0.8 (Fc)

Supersonic: the result of gravitational collapse ?

Summary

1 The filament S242 may be formed through the collapse of a single, elongated entity, where, an effect known as “gravitational focusing”, drives the ends of the filament to collapse.

2 The increasing turbulent motion in the edge-collapse of S242 may be mainly gravitationally generated.

3 We find the signatures of sequential star formation activities in G181.84, that might be due to the fact that the global collapse of the S242 is driven by an edge effect.

Follow-up discussion:

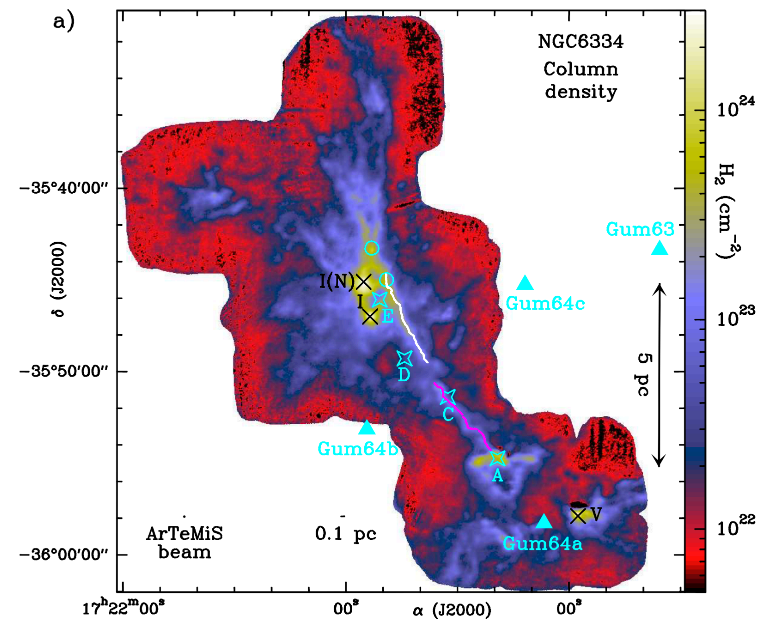
What kind of clouds do the edge-effect usually act a role in?

Maybe clouds morphologies, the higher density,
global gravitational collapse.

The role of edge-effect in the star formation of clouds?

The subsequent fragmentation, star cluster formation,
massive star formation, the effect on CMF and IMF?

The original of supersonic motion in molecular cloud?



High-mass star formation
regions: N6334
(André, et al., 2016)