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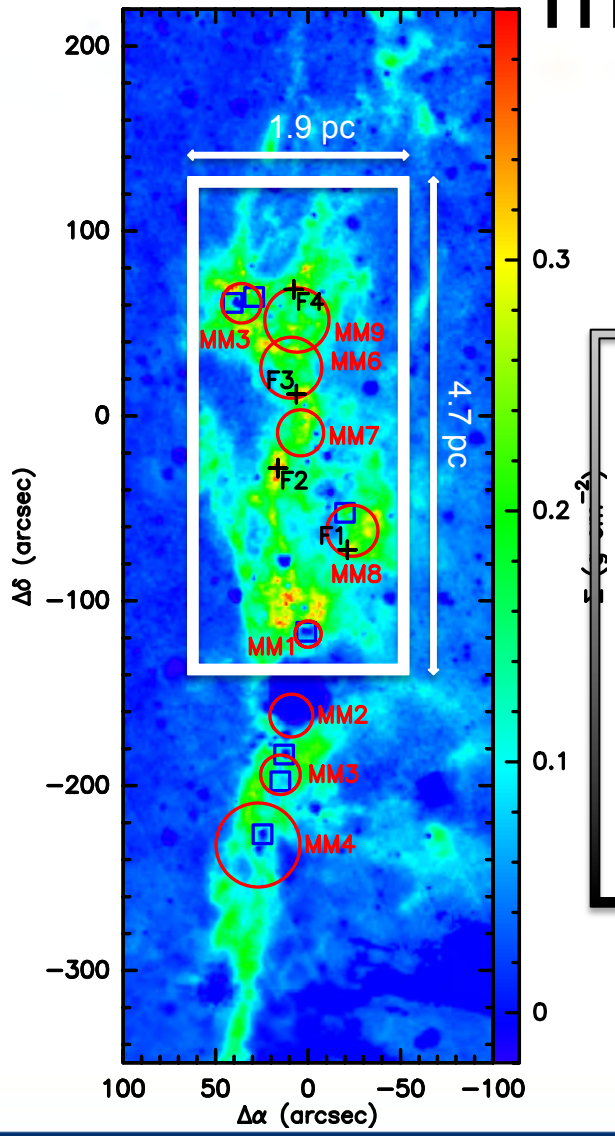
Complex, coherent kinematics in a highly filamentary infrared dark cloud: the case of G034.43+00.24

A . T. Barnes[1,2], J. D. Henshaw[1,2], P. Caselli[3,2], I. Jimenez-Serra[5,4], F. Fontani[6], J. C. Tan[7,8] and A. Pon[3,2]

[1]Astrophysics Research Institute, Liverpool John Moores University, 146 Brownlow Hill, Liverpool L3 5RF, UK
[2]School of Physics and Astronomy, University of Leeds, LS2 9JT, Leeds, UK
[3]Max-Planck-Institut für extraterrestrische Physik, Gießenbachstraße 1,D-85748 85748, Germany
[4]European Southern Observatory, Karl-Schwarzschild-Str. 2, 85748 Garching, Germany
[5]University College London, Department of Physics and Astronomy, 132 Hampstead Road, London NW1 2PS, UK
[6]INAF - Osservatorio Astrofisico di Arcetri, L.go E. Fermi 5, I-50125, Firenze, Italy
[7]Department of Astronomy, University of Florida, Gainesville, FL 32611, USA
[8]Department of Physics, University of Florida, Gainesville, FL 32611, USA

How complex is the gas structure of massive IRDCs?



G034.43+00.24 – one of highest contrast IRDCs, most massive (1700 $M_\odot$) with radius of 10pc

NIR+MIR Mass surface density plot taken from Kainulainen & Tan (2013).

CIRCLES = millimeter continuum cores (Rathborne et al. 2006).

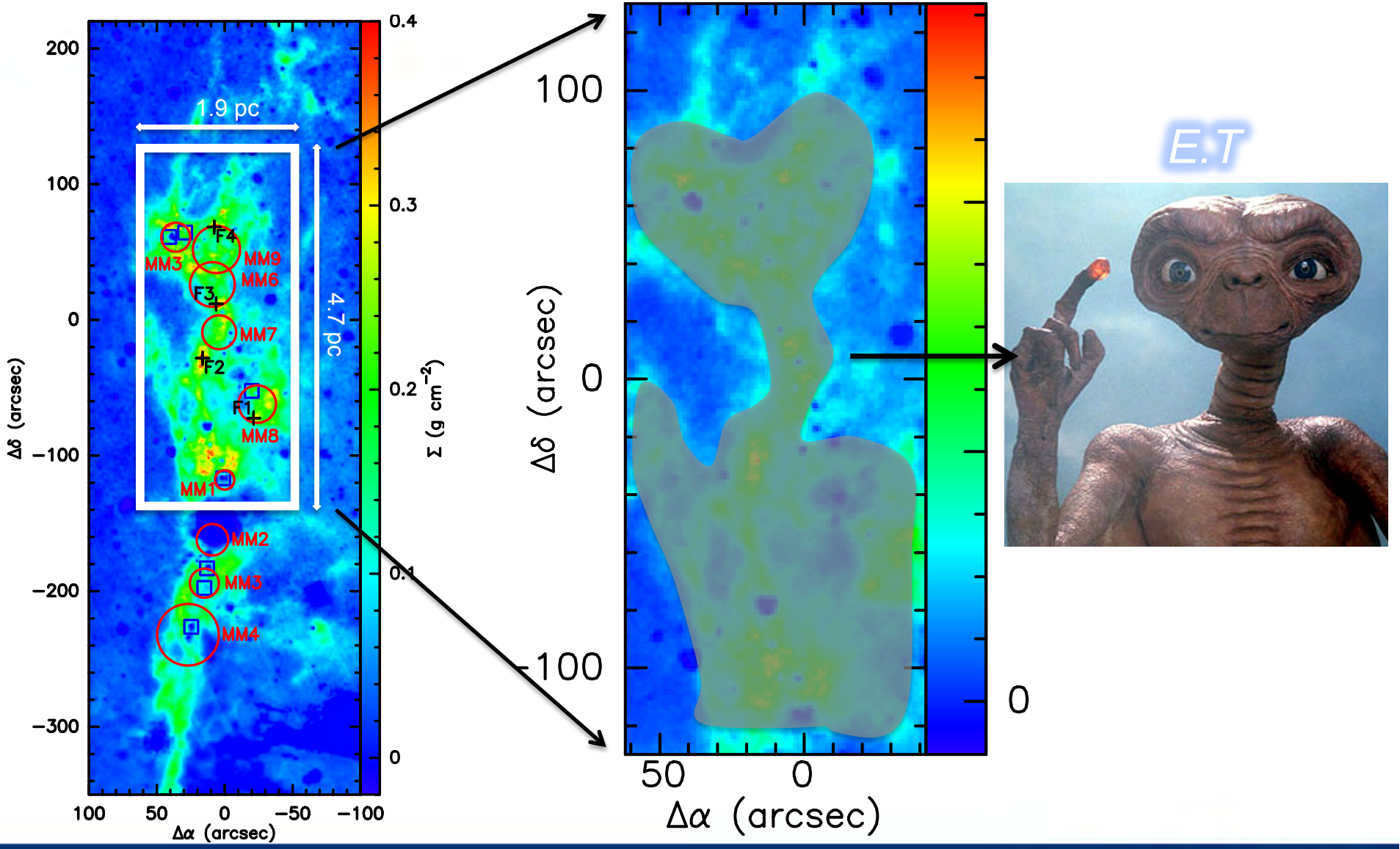
CROSSES = MIR extinction cores F cores (Butler and Tan 2012).

HOLES = Sources of MIR emission.

SQUARES = Enhanced 4.5 micron emission 'green fuzzies' (Chambers et al. 2009).

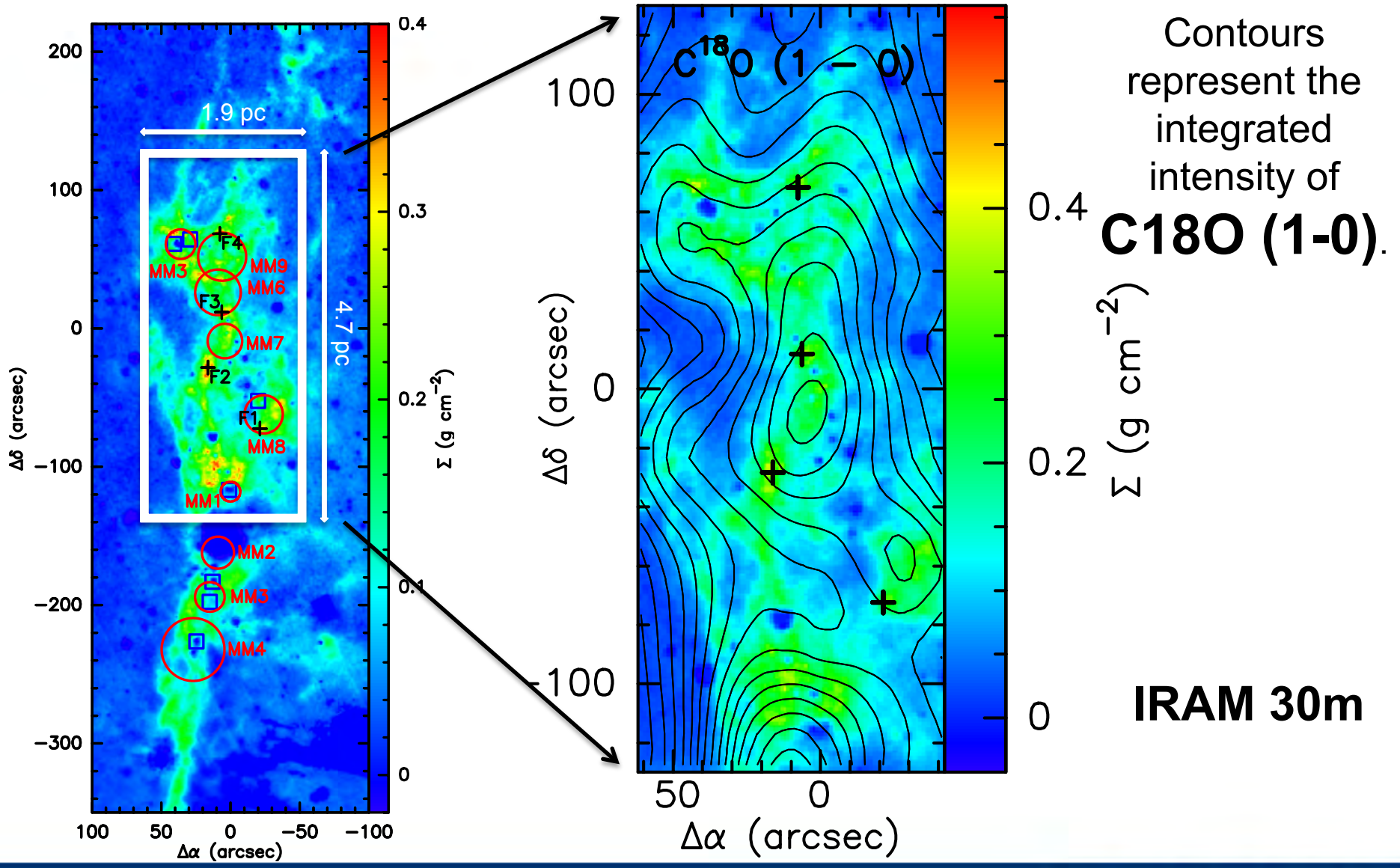
From Rathborne et al. (2006), and Butler & Tan (2009).

2D structure of G034.43+00.24



Mass surface density plot taken from Kainulainen & Tan (2013)

2D structure of G034.43+00.24

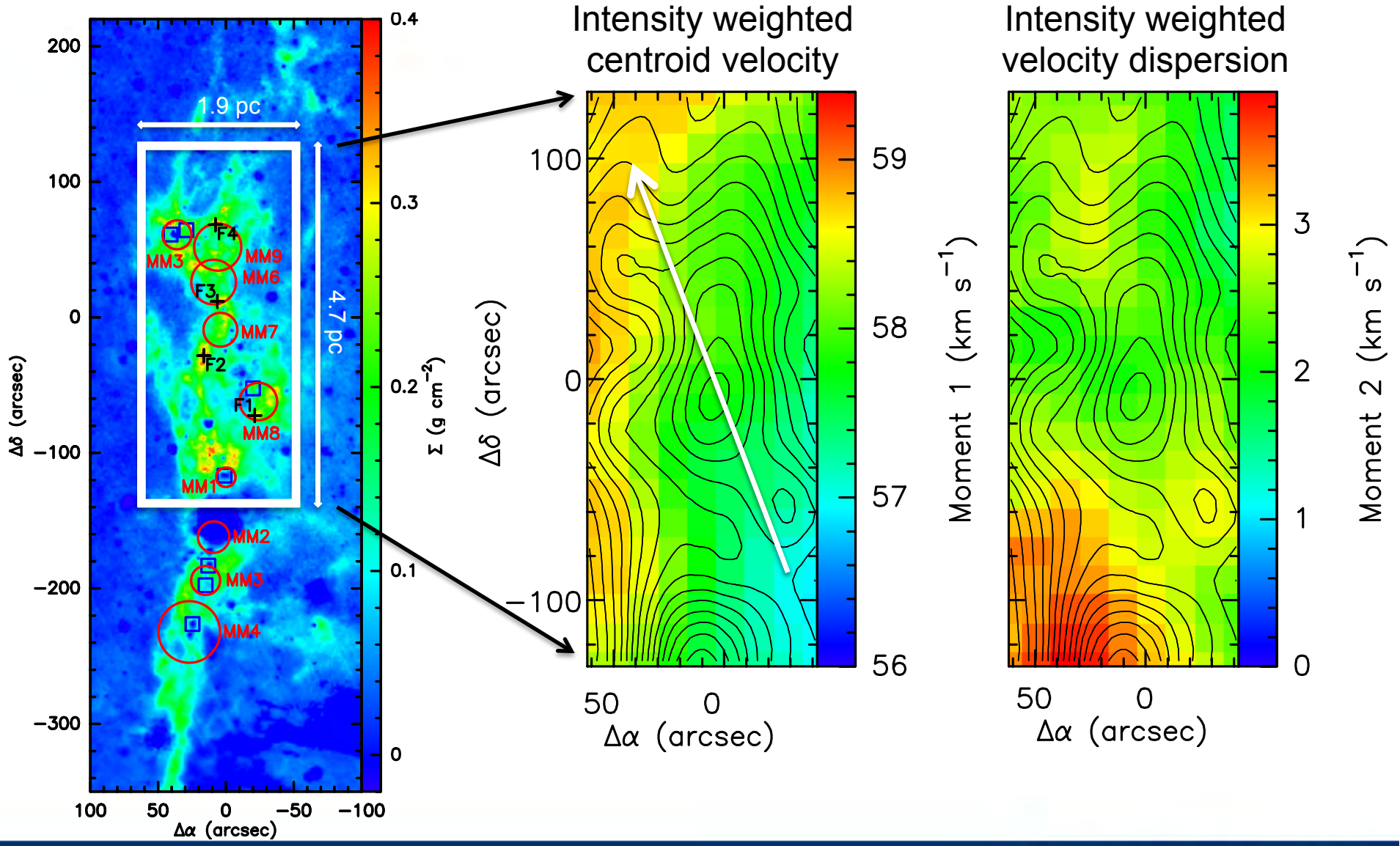


Contours represent the integrated intensity of **C18O (1-0)**.

IRAM 30m

Mass surface density plot taken from Kainulainen & Tan (2013)

Moment analysis of G034.43+00.24



Mass surface density plot taken from Kainulainen & Tan (2013)

Previous summary:

2D analysis is **simple**

But…

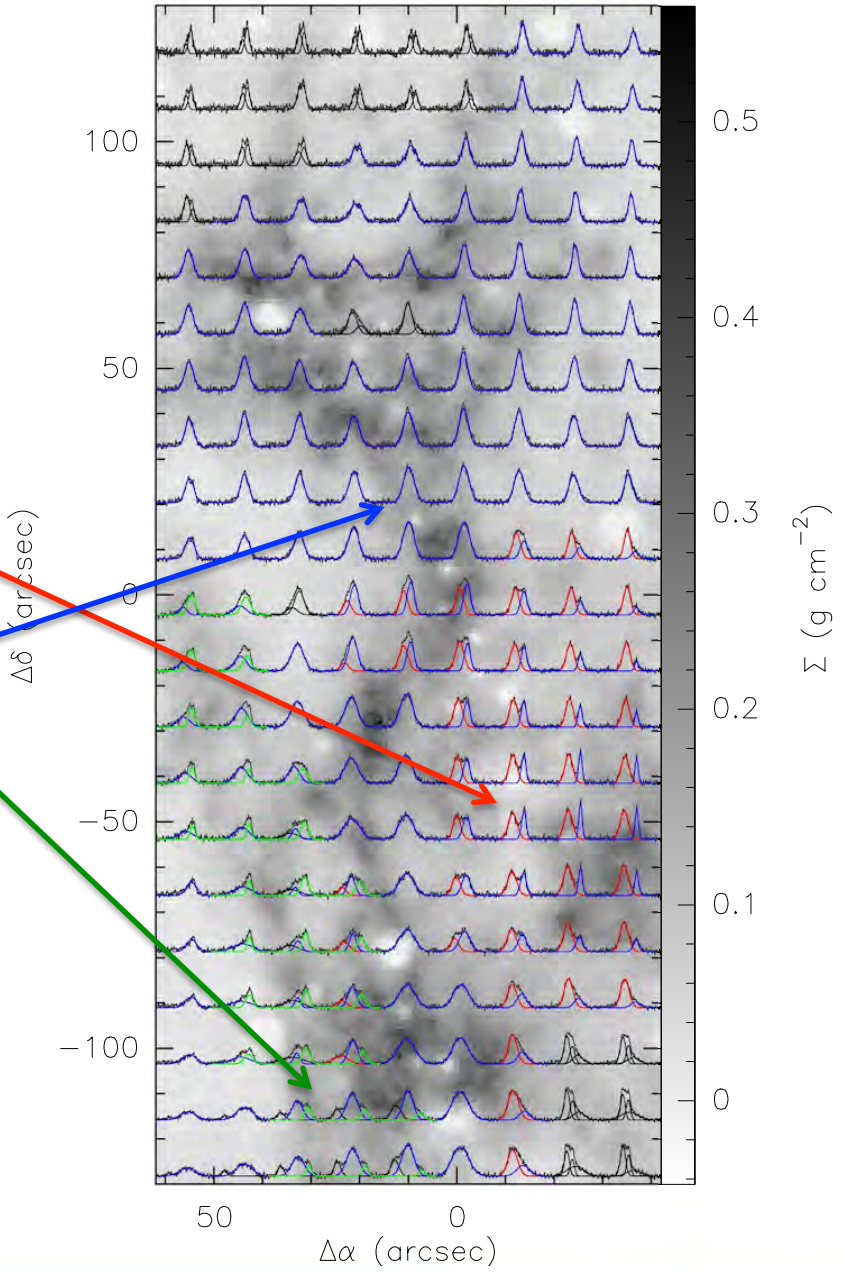
What about the **position-position-velocity** structure?!

Spectra - G034.43+00.24

Velocity component 1

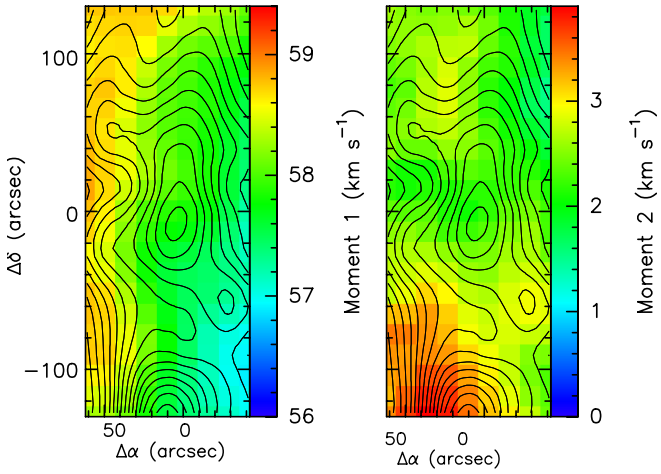
Velocity component 2

Velocity component 3



Fitting = Henshaw et al. (2013, Linking = Henshaw et al (2014)

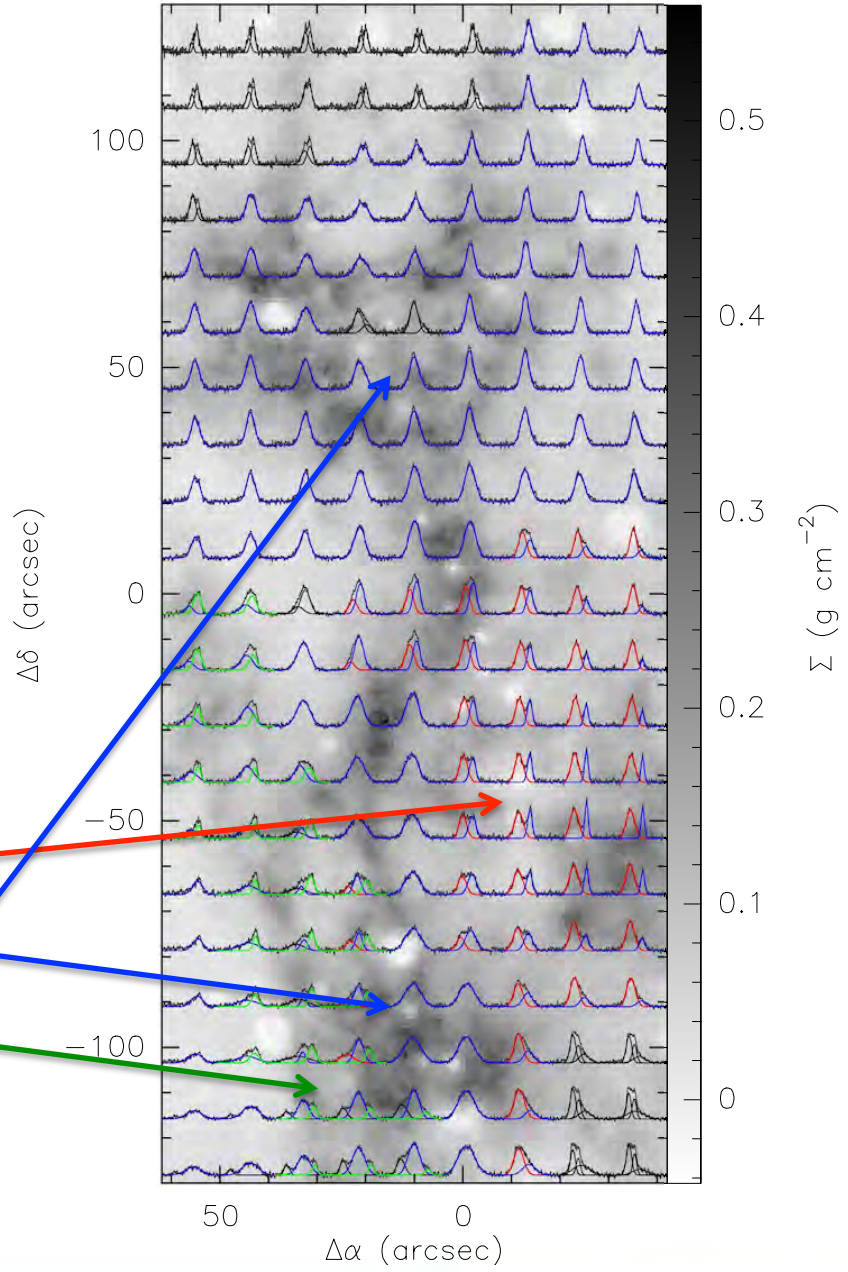
Spectra - G034.43+00.24



Velocity component 1

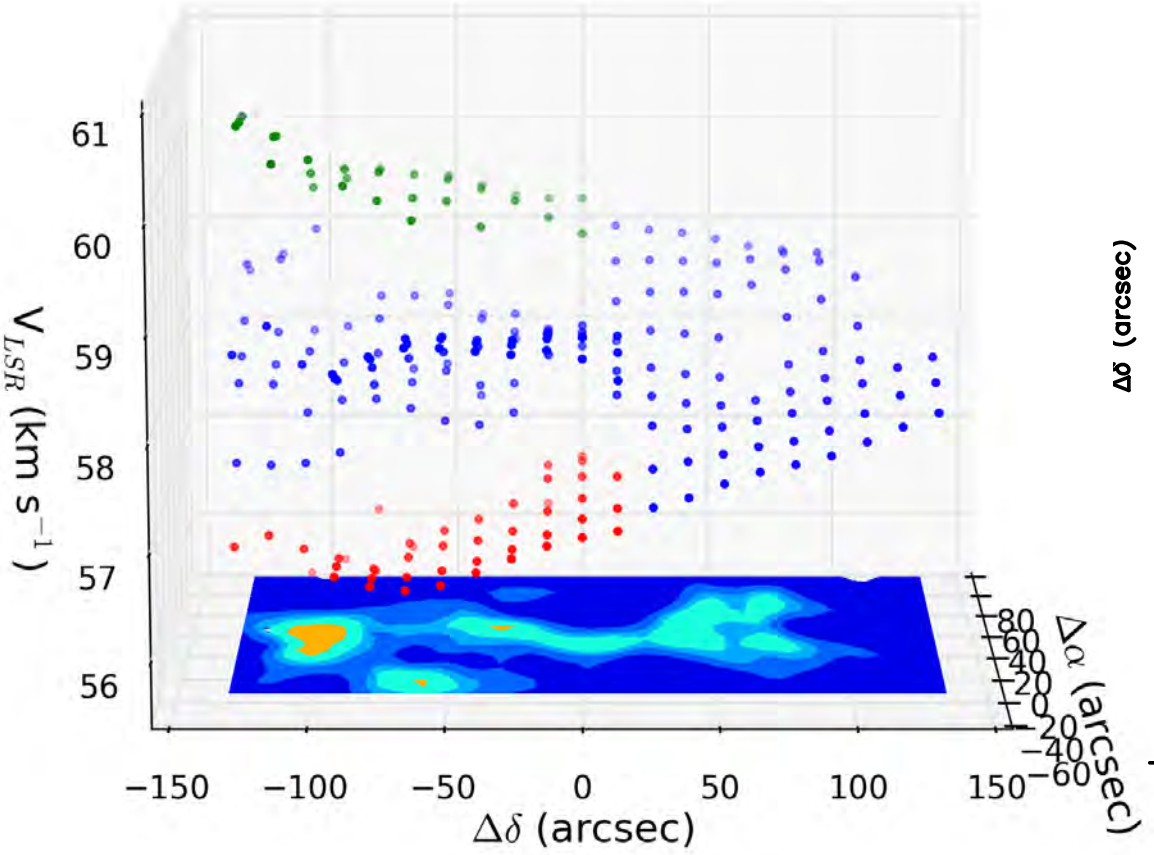
Velocity component 2

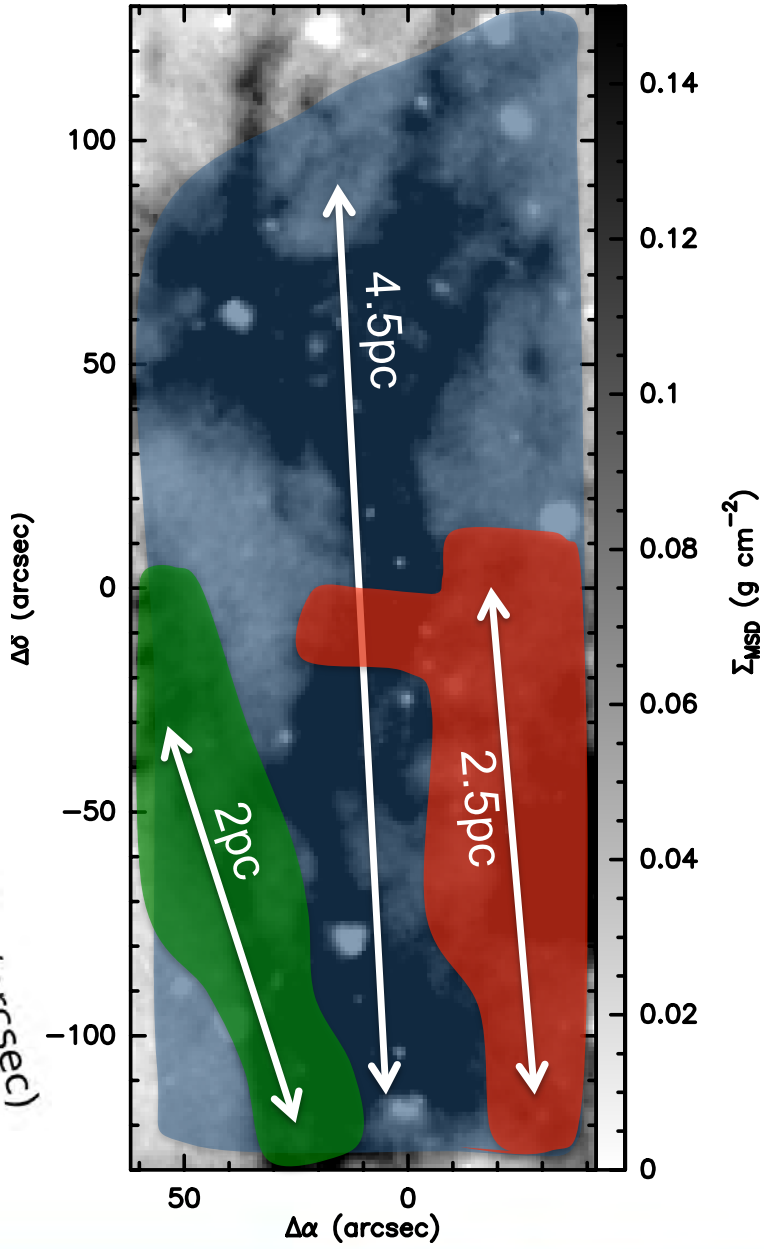
Velocity component 3



Fitting = Henshaw et al. (2013, Linking = Henshaw et al (2014)

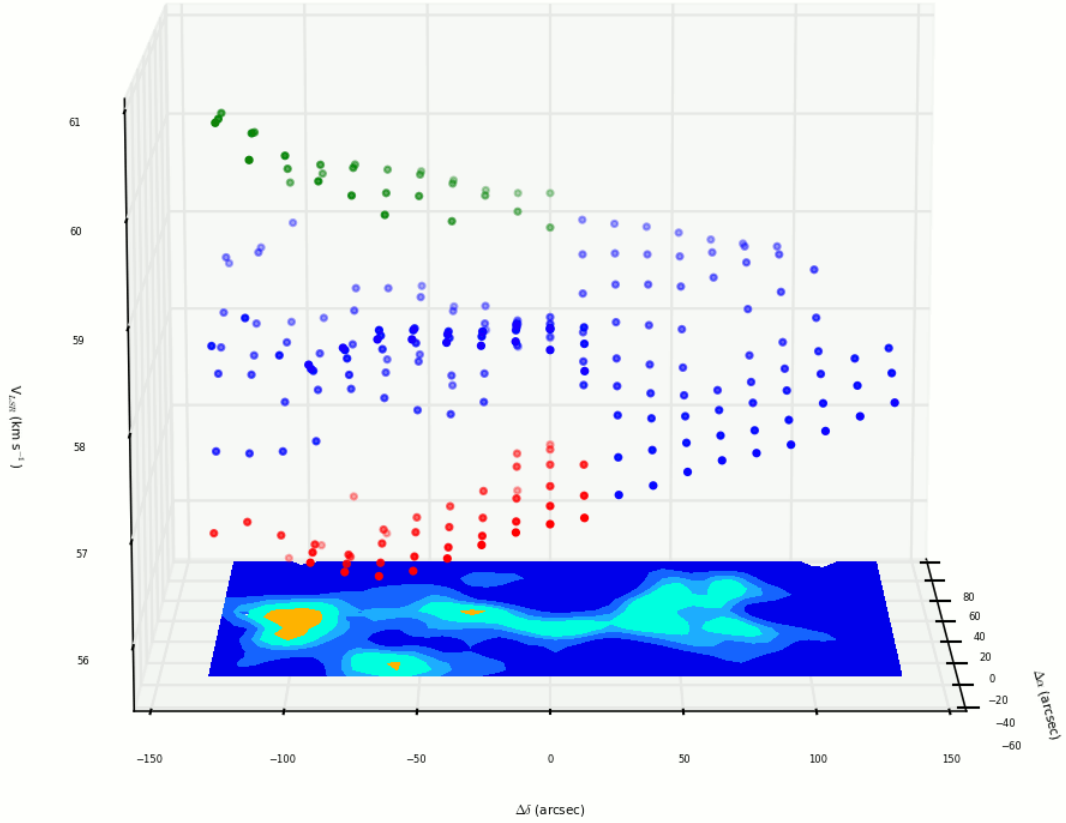
Position-Position-Velocity

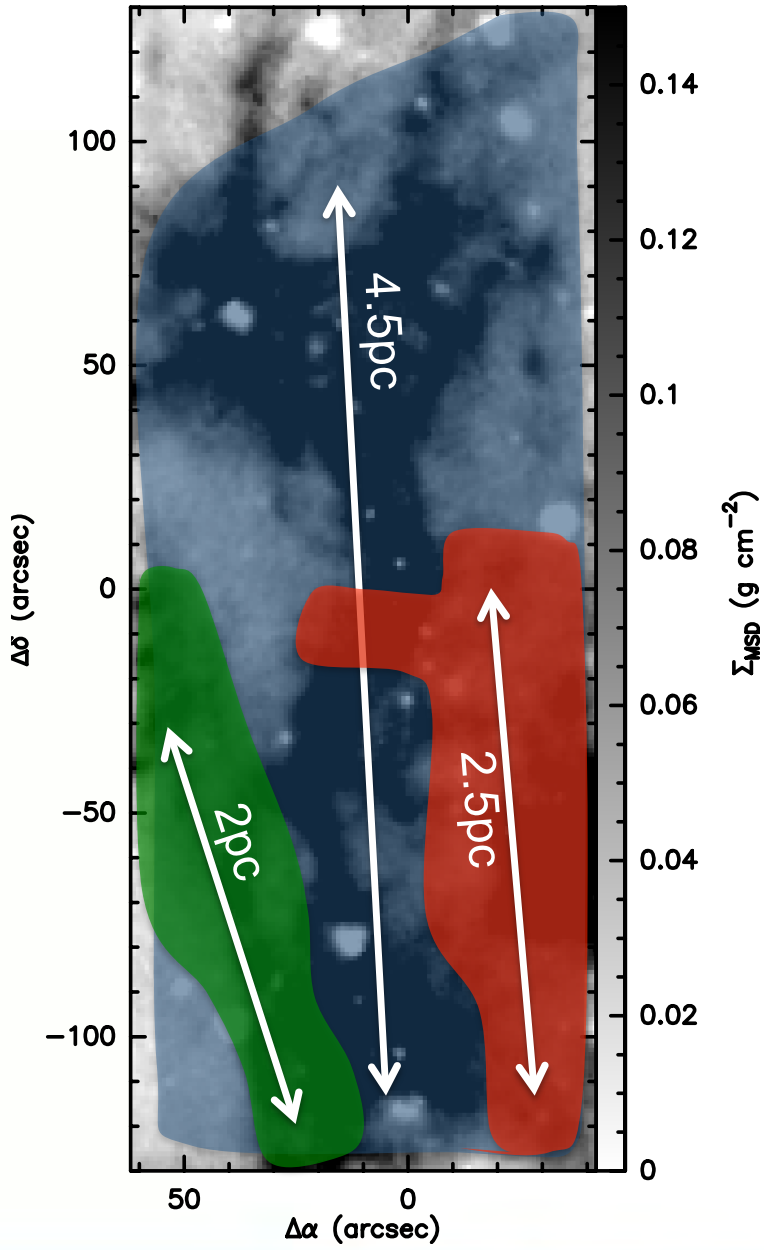




Mass surface density plot taken from Kainulainen & Tan (2013)

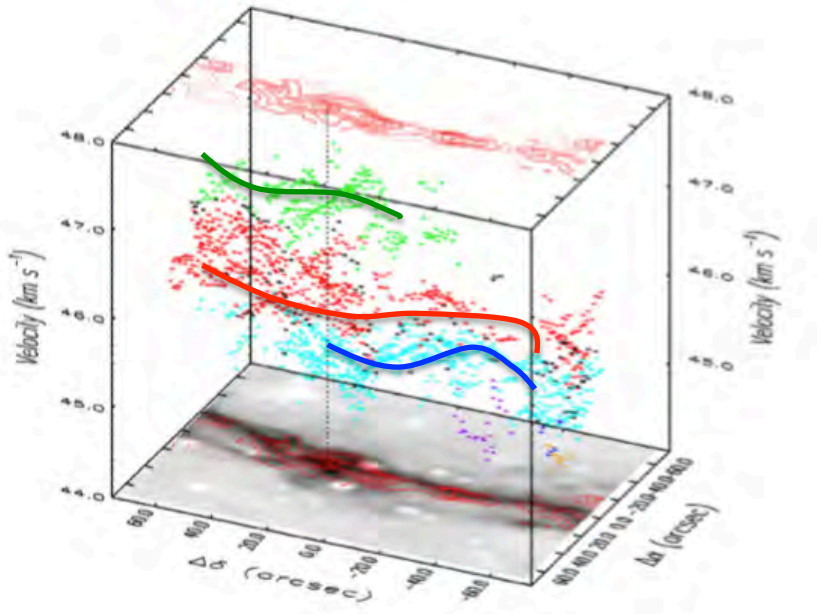
Position-Position-Velocity



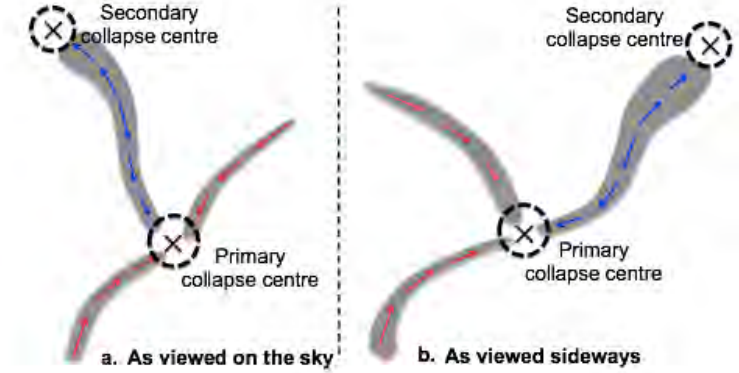


Mass surface density plot taken from Kainulainen & Tan (2013)

G035 - Henshaw et al. (2014)



SDC13 – Peretto et al. (2013) & (2014)



Complex velocity morphology

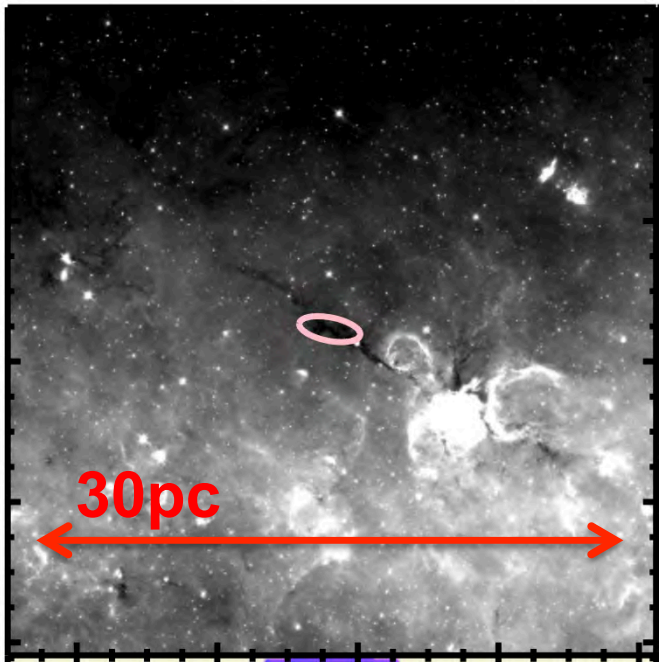
e.g.
L1495/B213 Taurus region – Tafalla & Hacar (2014)
G19.30+0.07 – Devine et al. (2011)
IRDC 18310-4 - Beuther et al. (2013)
4 IRDCs - Beuther et al. (2014)
Cygnus-X – Csengeri et al. (2011)
DR21 – Csengeri et al. (2011)
41 IRDCs – Ragan et al. (2006)

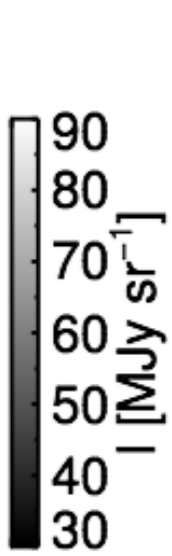
Simulations – Smith et al. (2013)
Butler, Tan & van Loo (2014)
Moeckel & Burkert (2014)
Gomez & Vazquez-Semadeni (2014)

Still no in-depth statistical analysis of the kinematics.

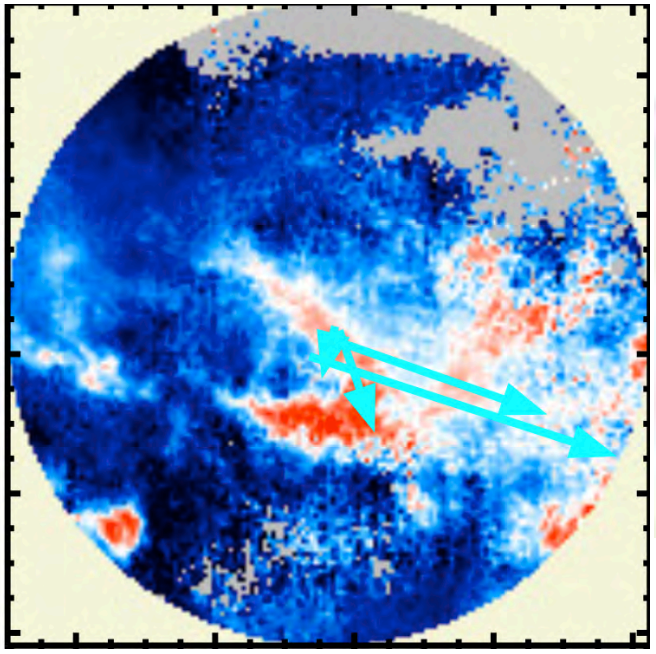
Complex velocity morphology from GMC

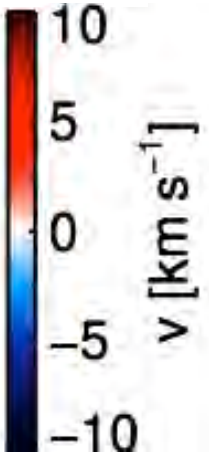
GMC surrounding G034 - Hernandez & Tan (2015)





8micron GLIMPSE





Intensity weighted
centroid velocity

Conclusions

Extinction mapping and moment analysis **SIMPLE**

Spectral analysis **COMPLEX**

Identified 3 coherent, extended velocity components.

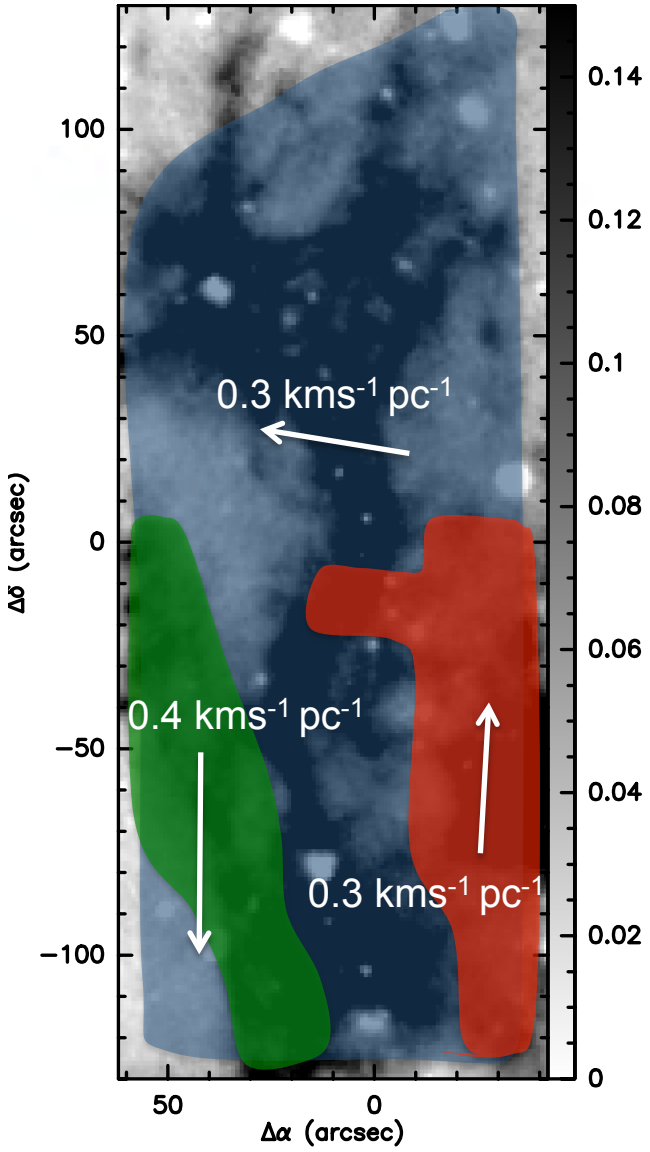
More in Barnes et al. (in prep)

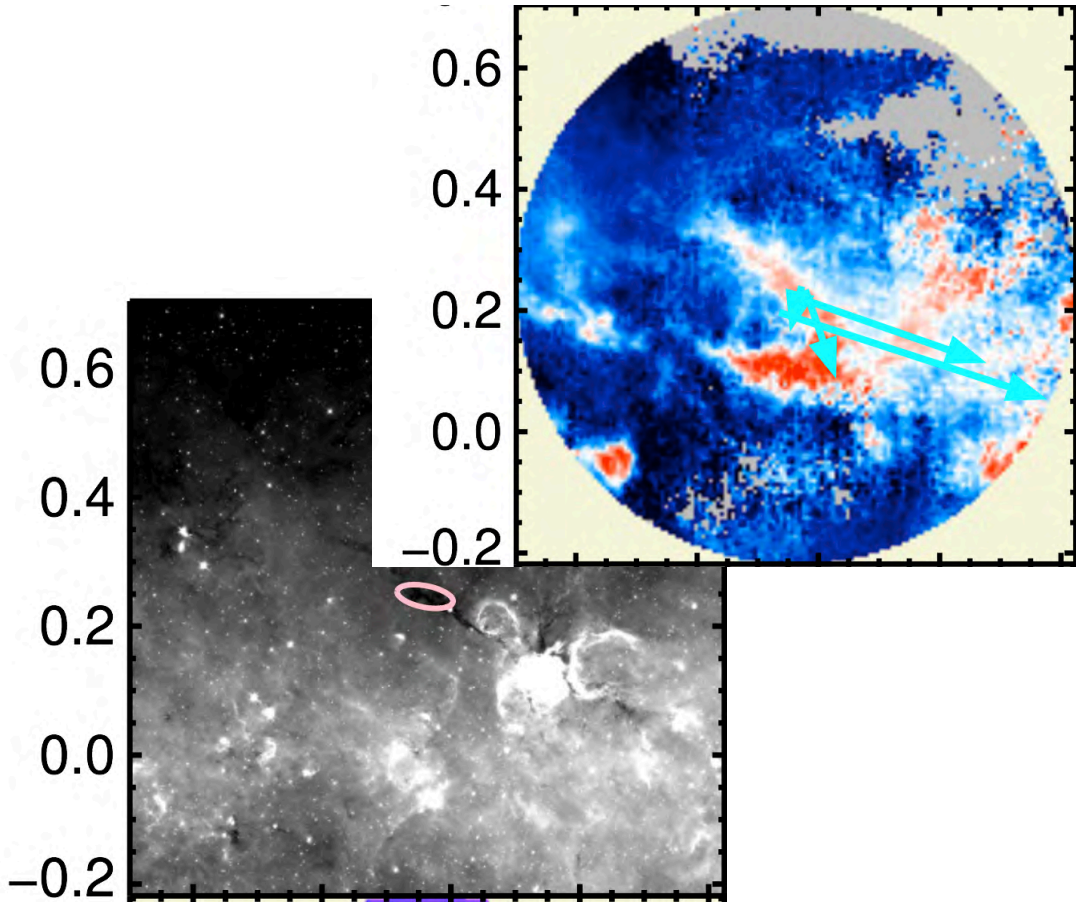
Future plans

Conduct a statistical analysis of **8** other IRDCs to see if this level of complexity is inherent to the general IRDC population.

Complex velocity morphology

GMC surrounding G034 - Hernandez & Tan (2015)





Mass surface density plot taken from Kainulainen & Tan (2013)