



# Rotation in Massive Star Forming Regions

Pamela Klaassen

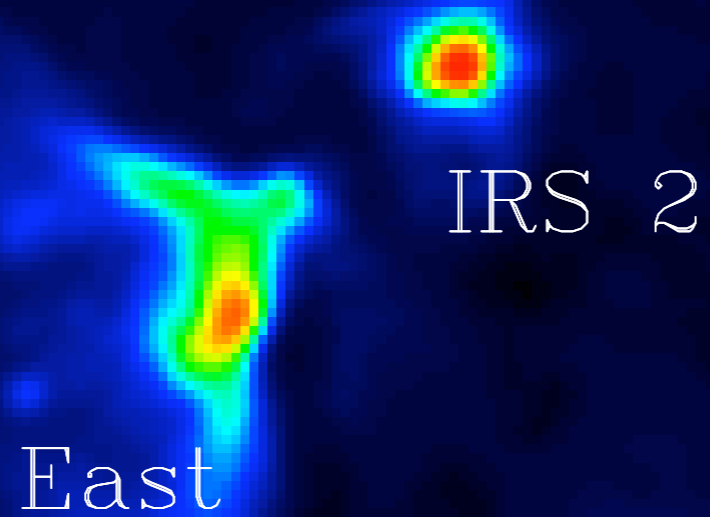


# Outline

- Recent molecular line observations of massive star forming regions have shown evidence for rotation on a number of scales
- I will present evidence for this in W5 I
  - in both early and late stages of MSF

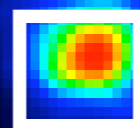
# W51

6 cm continuum



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6 cm continuum



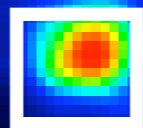
IRS 2

East

# W51

6 cm continuum

East

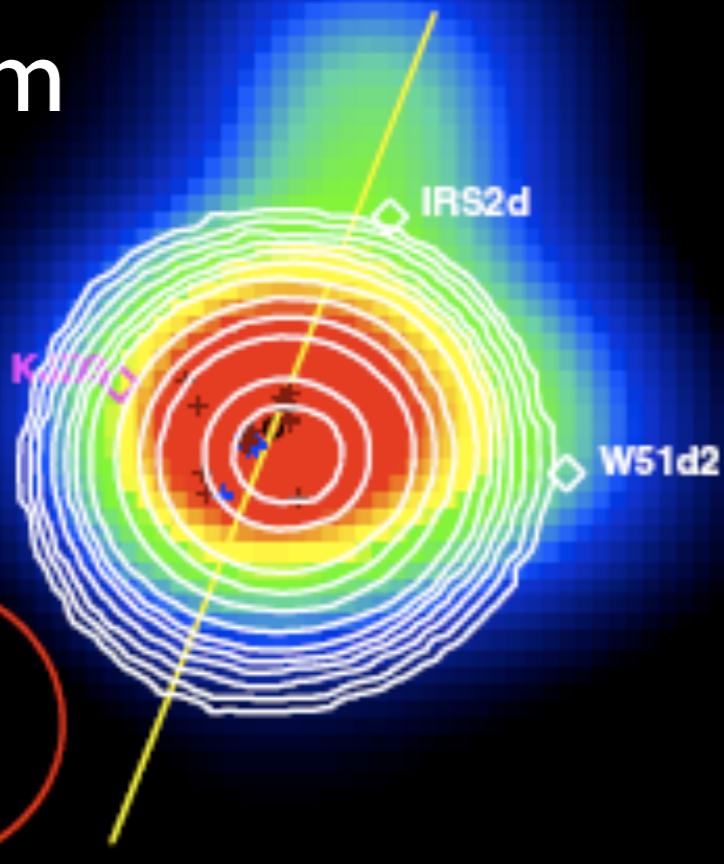


IRAC 8

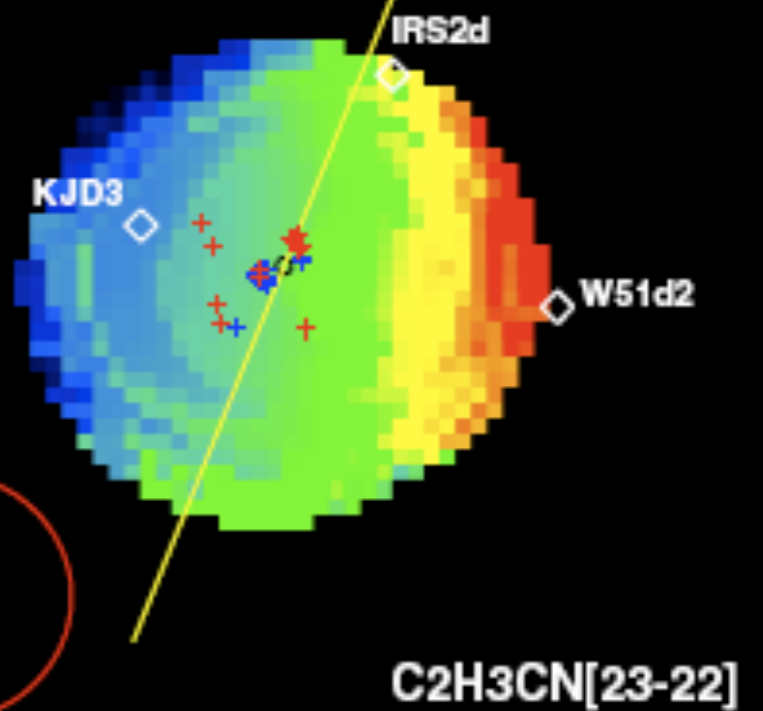


# W51 IRS2

1.3 mm



Velocity Gradient



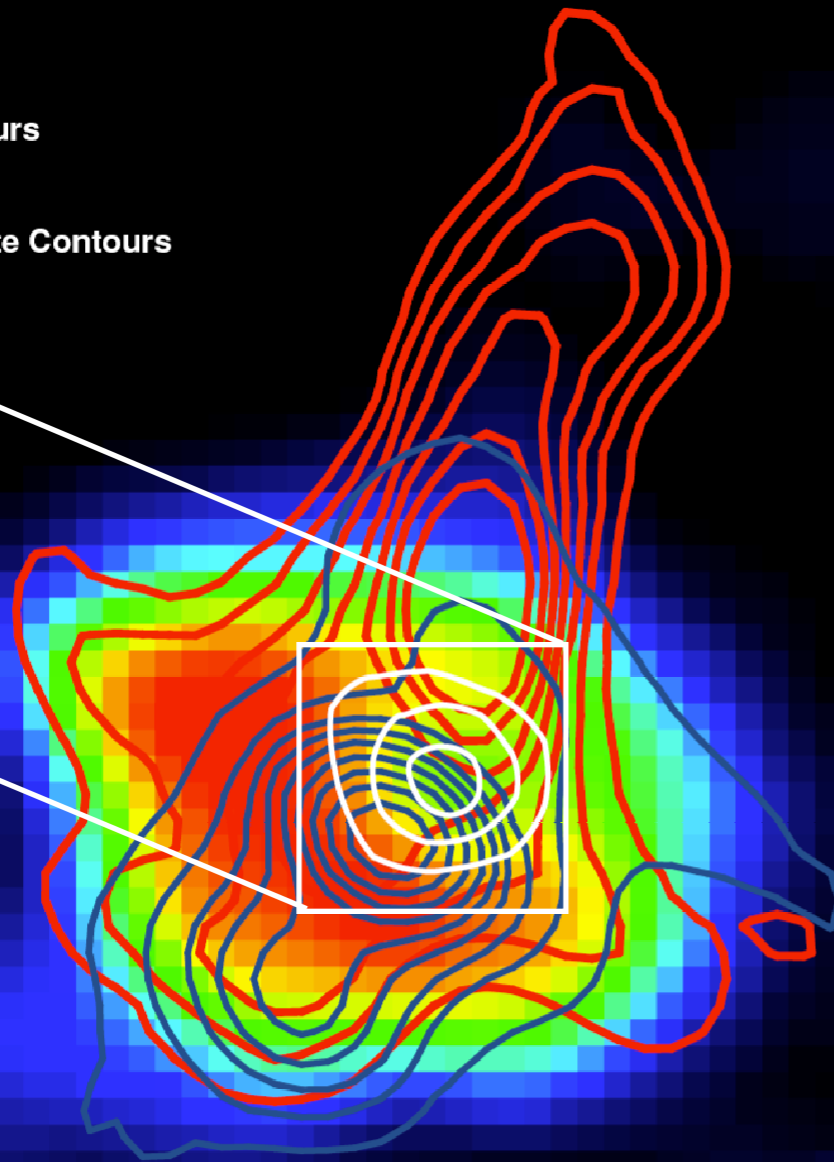
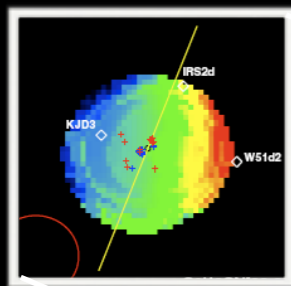
# W51 IRS2

## W51 North

SiO[5-4] – blue/red Contours

SO2 – Colour Scale

7 mm from the disk – White Contours



3500 AU



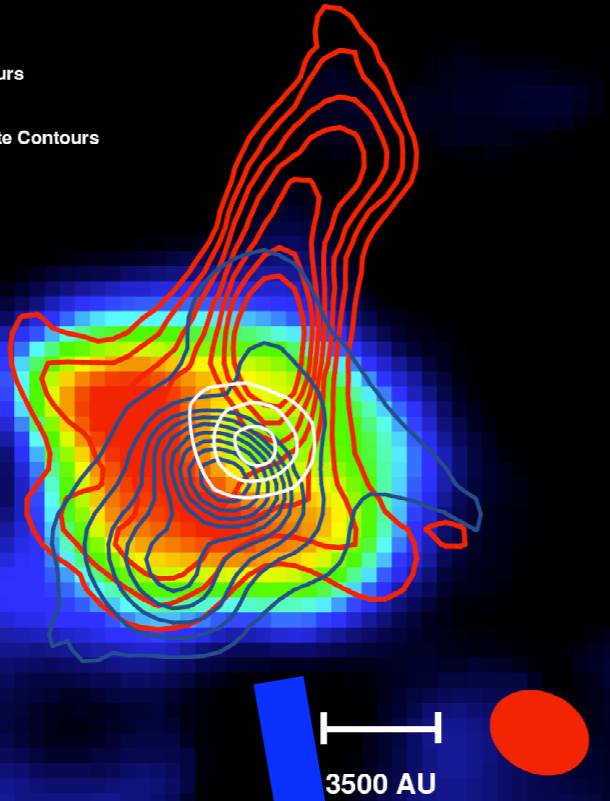
- Rotation in  $C_2H_3CN$  is perpendicular to the outflow
- There is an extra 'ring' of warm gas emission around the 'disk'

# W51 North

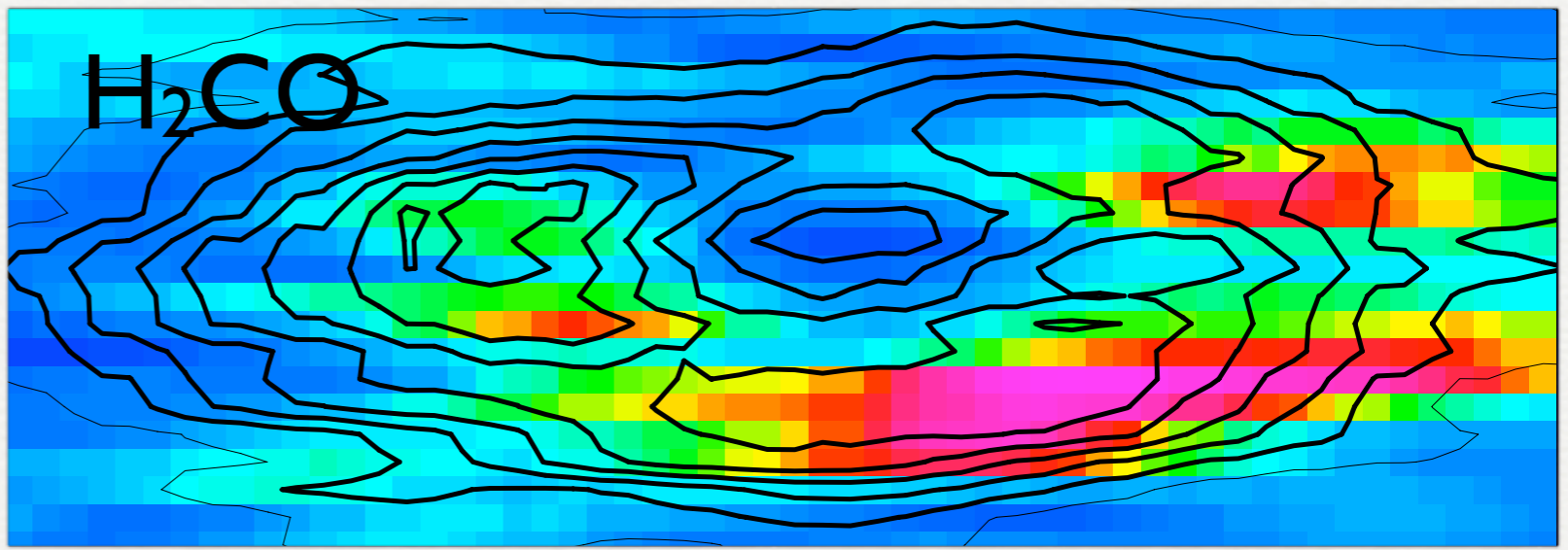
SiO[5-4] - blue/red Contours

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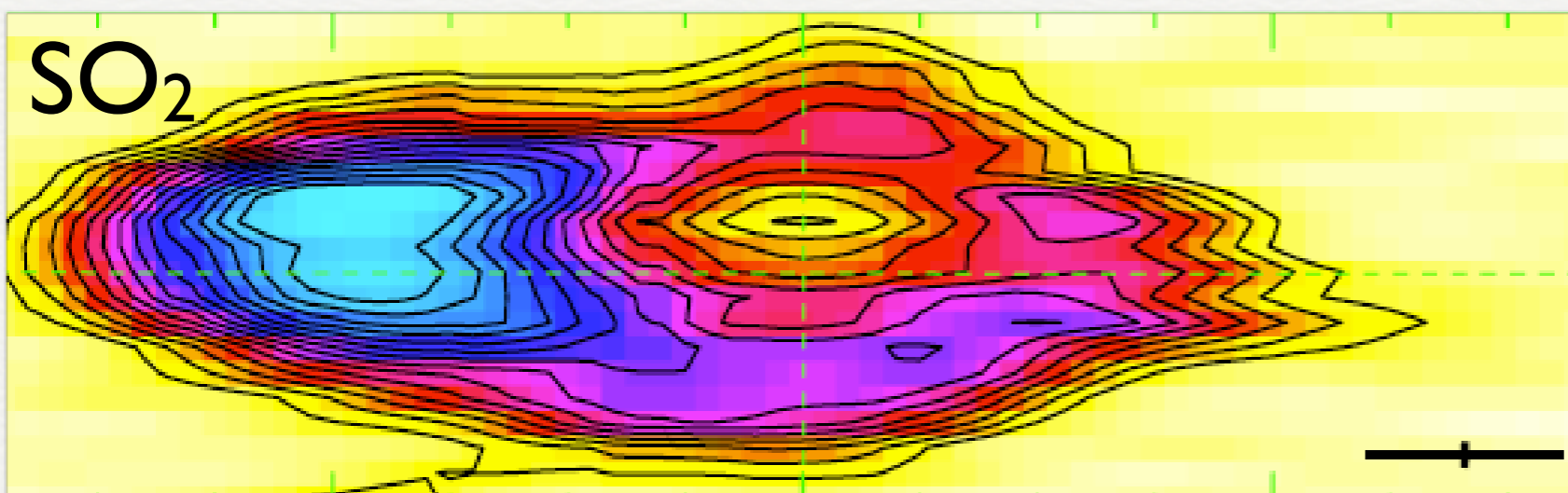


# W51 IRS2



(20 km/s) V  
P (3'')

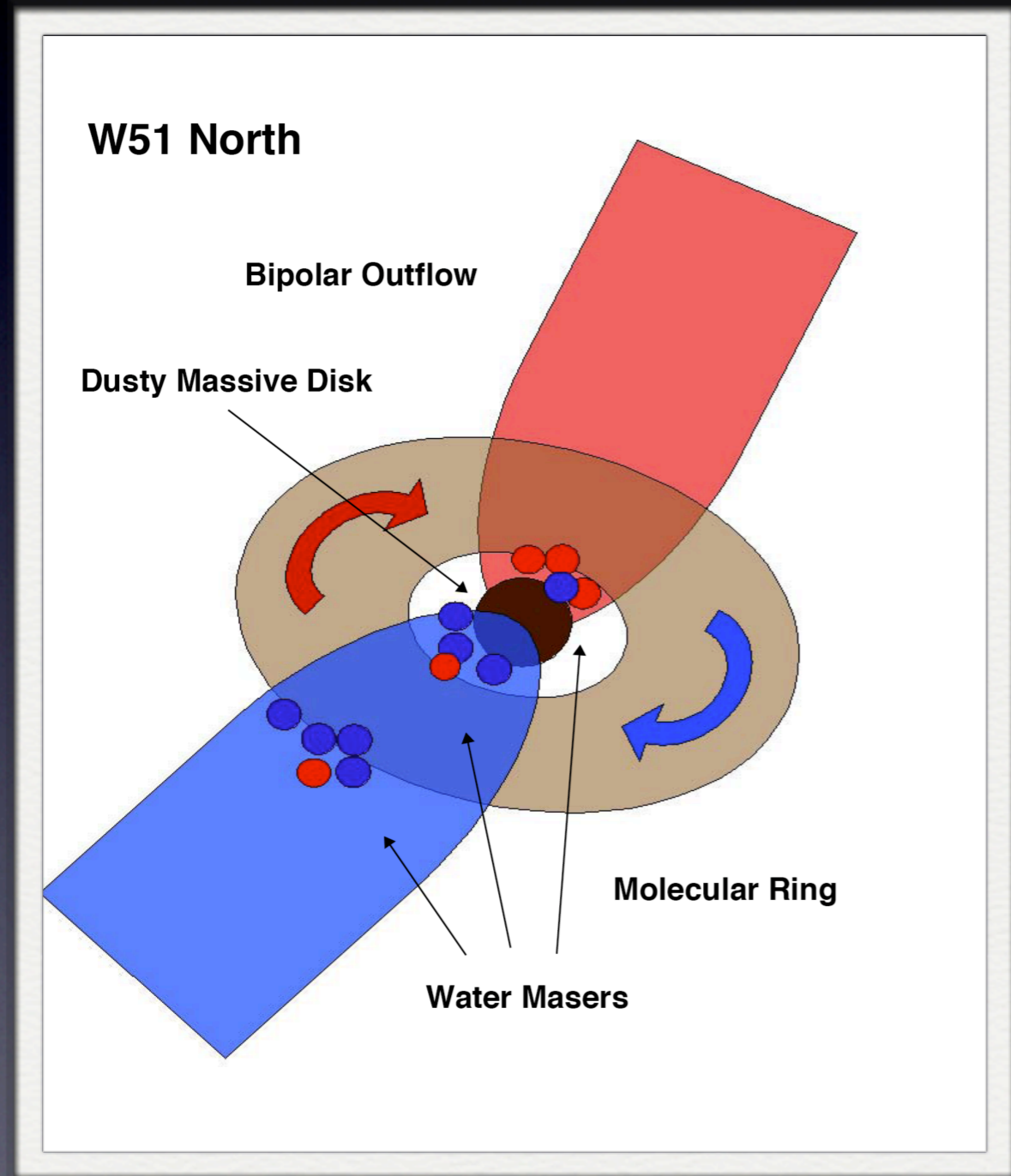
# SO<sub>2</sub>



Different molecules appear on different sides of the continuum source

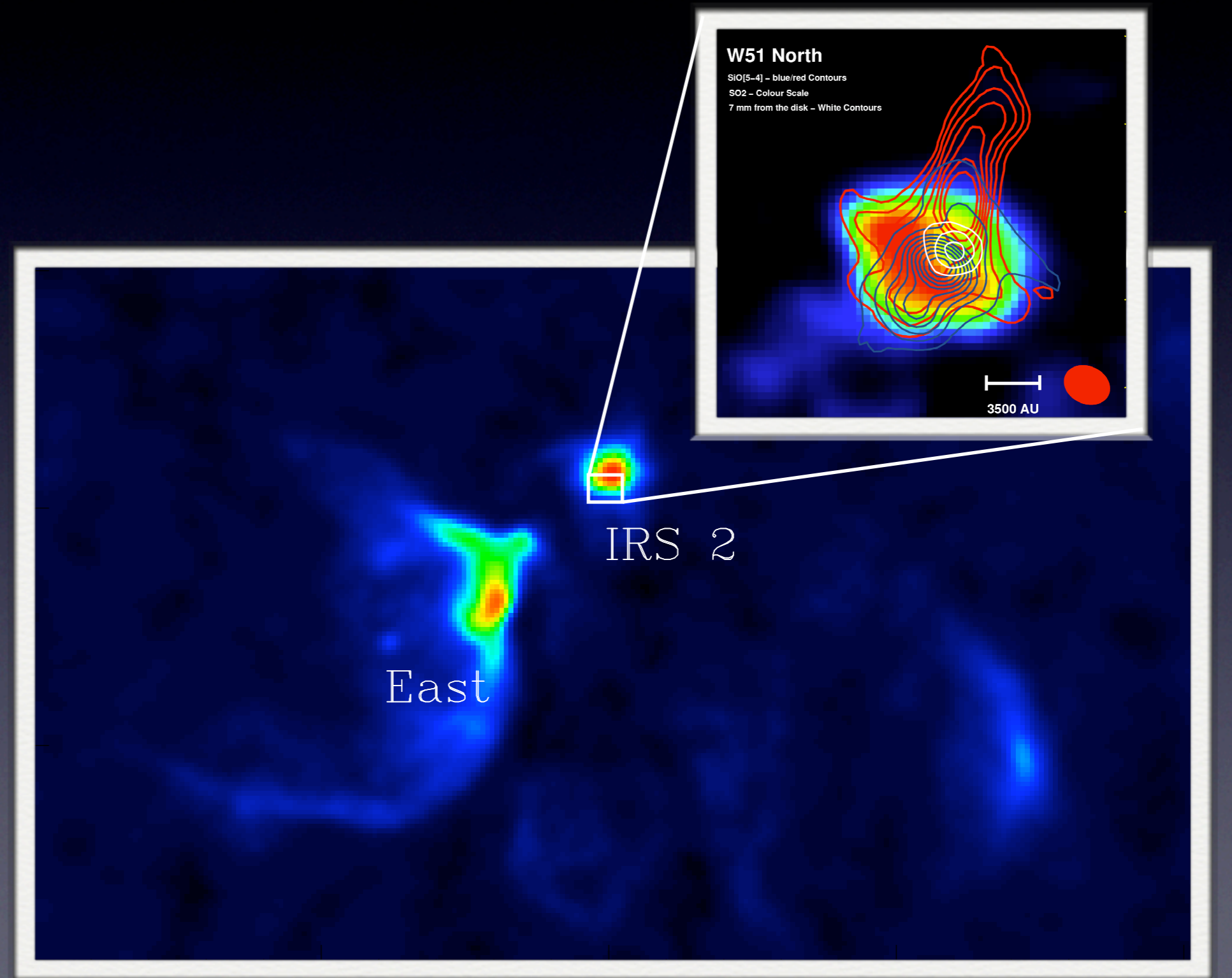


# W51 IRS2

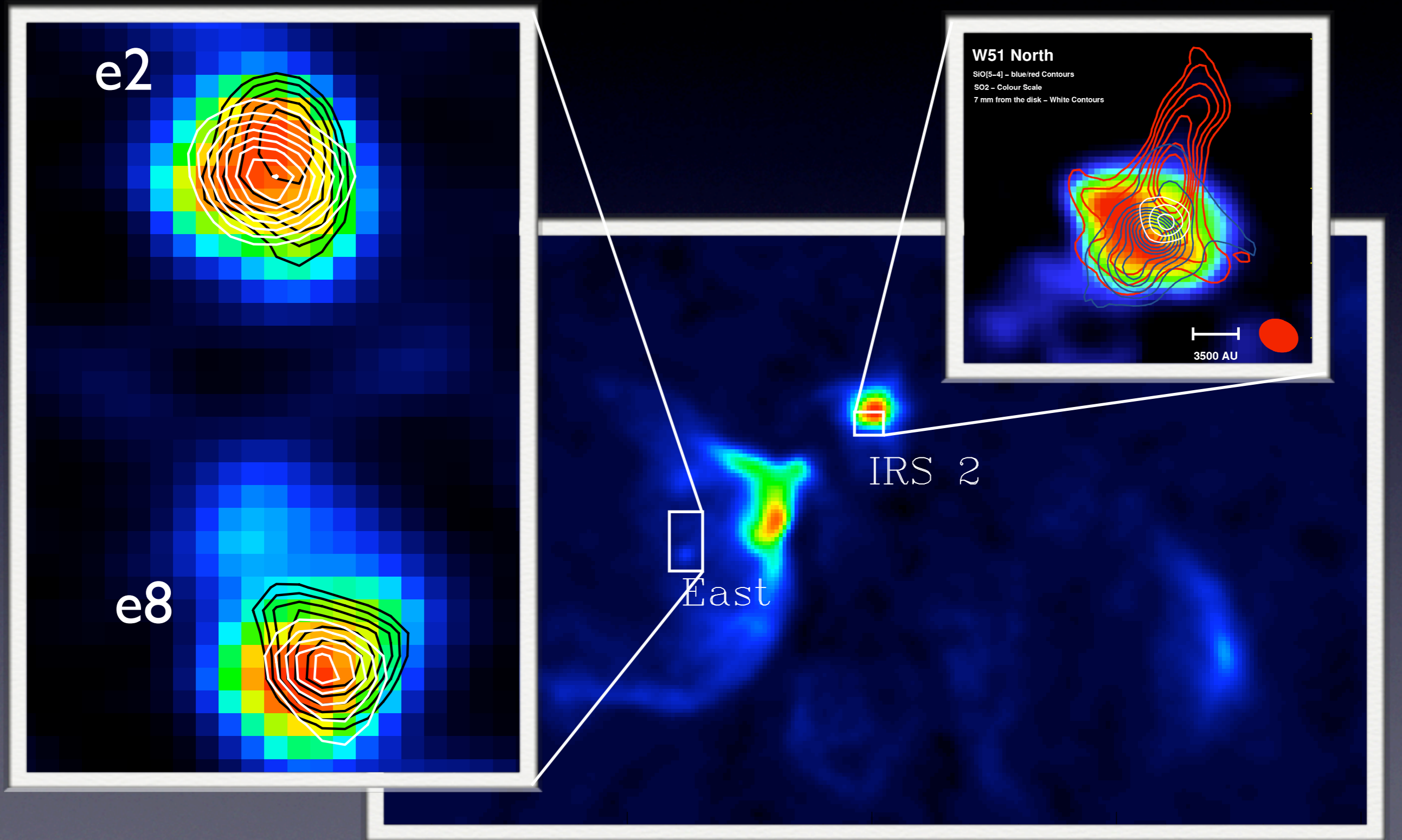


- The rotating and infalling molecular ring may be feeding the inner Keplerian disk.

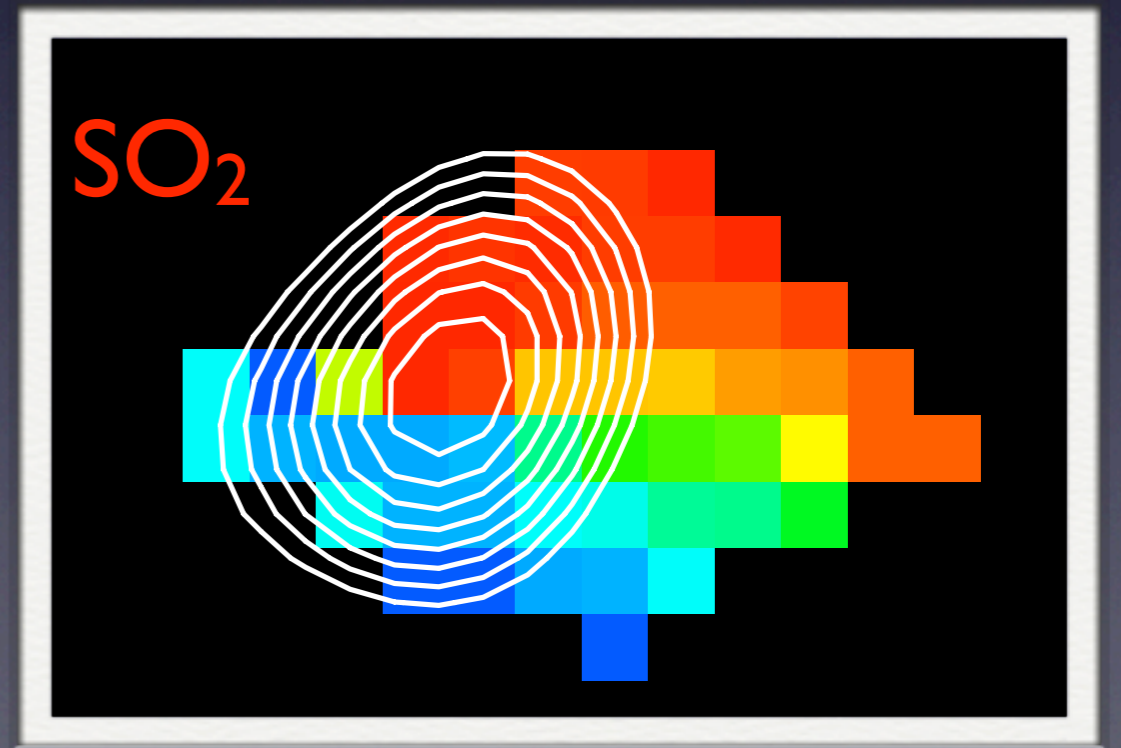
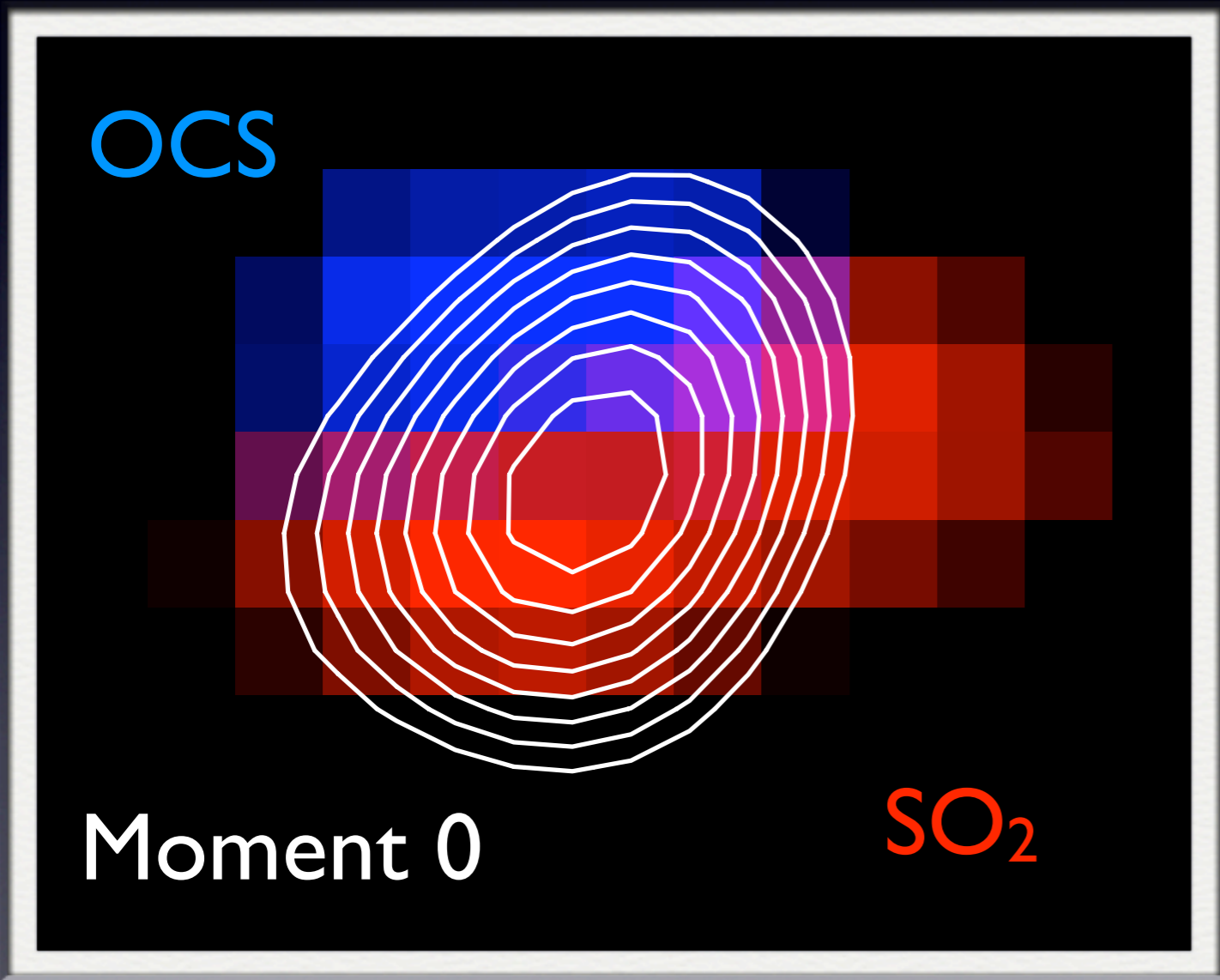
# W51 I - IRS2, e2 and e8



# W51 - IRS2, e2 and e8



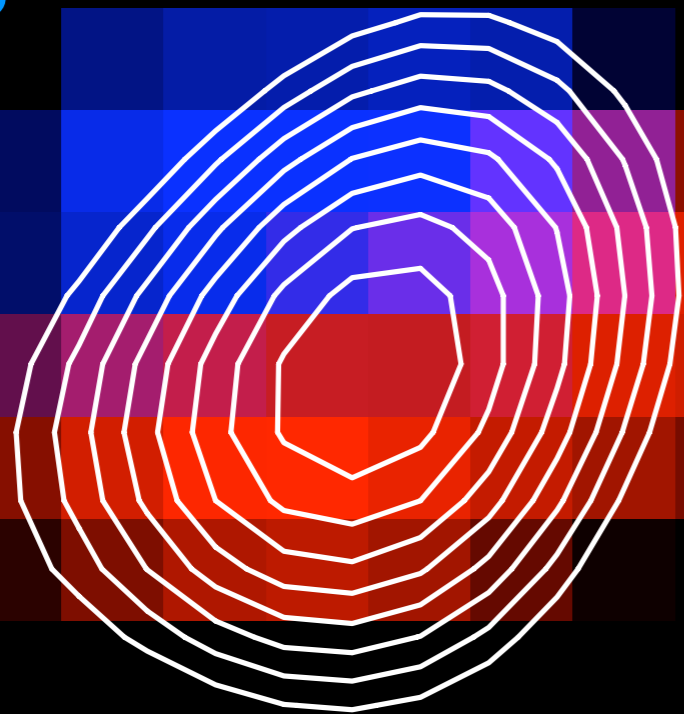
# G10.6-0.4



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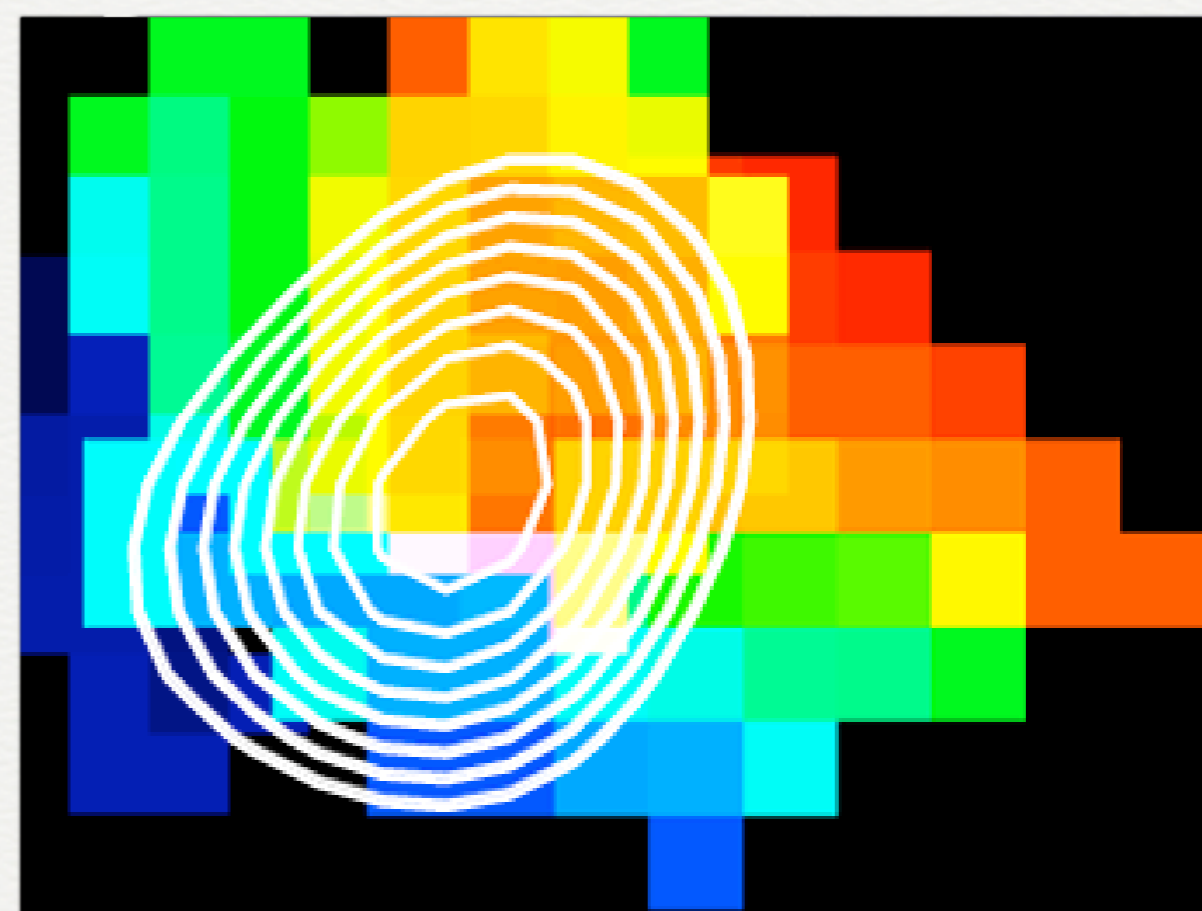
Overlay of OCS and  
SO<sub>2</sub> Moment 1 maps

OCS



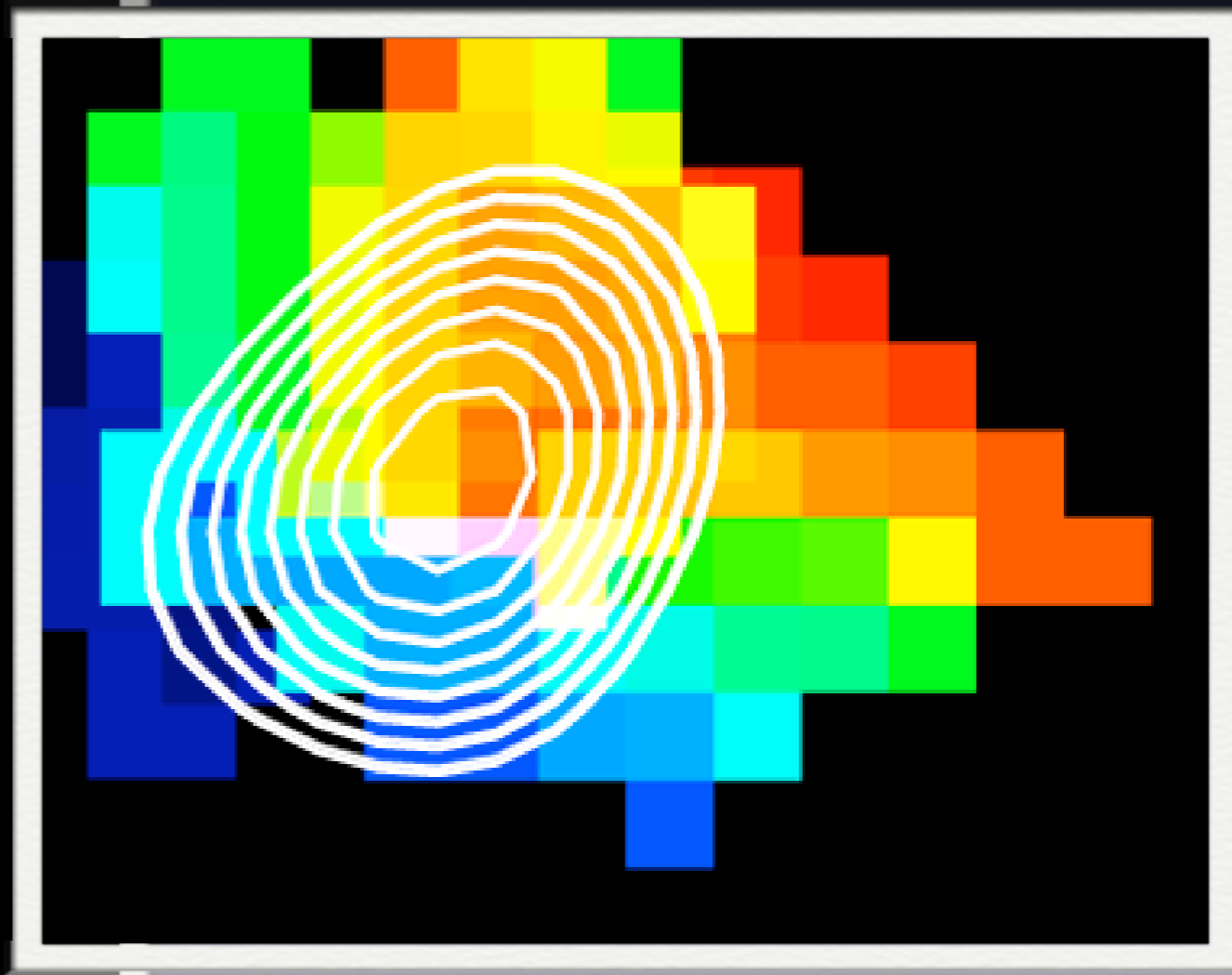
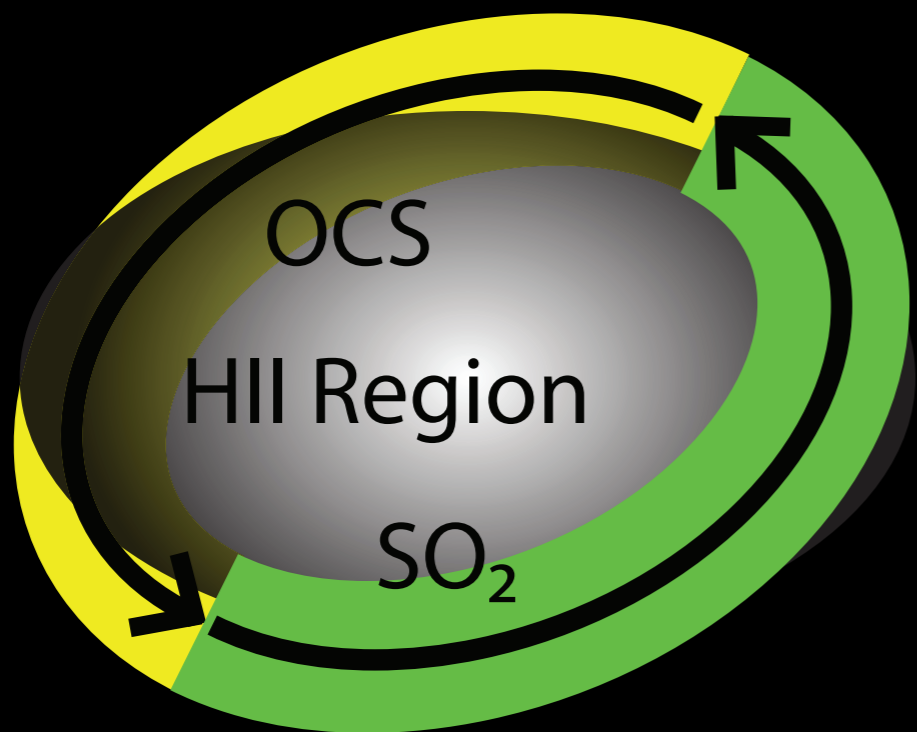
Moment 0

SO<sub>2</sub>



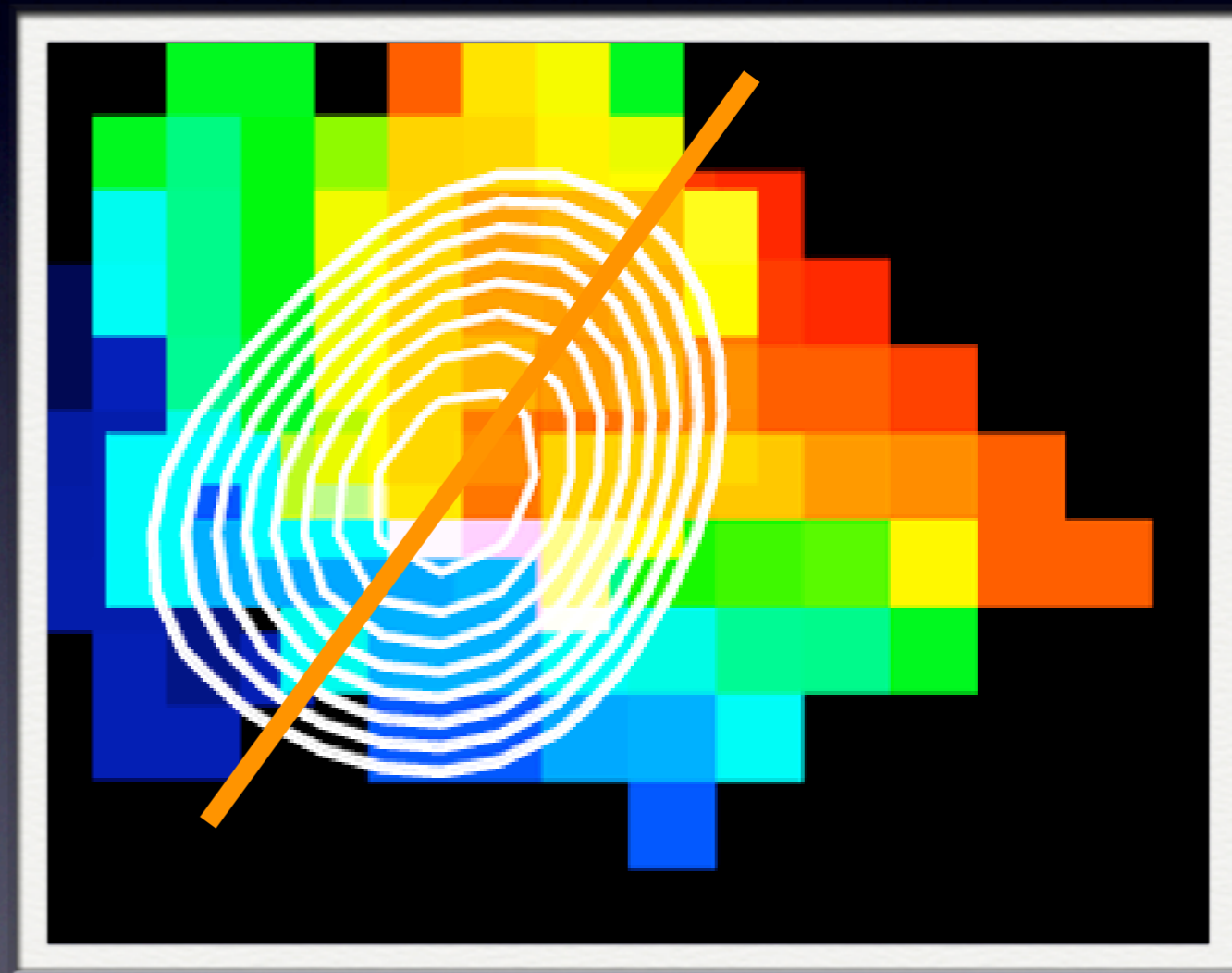
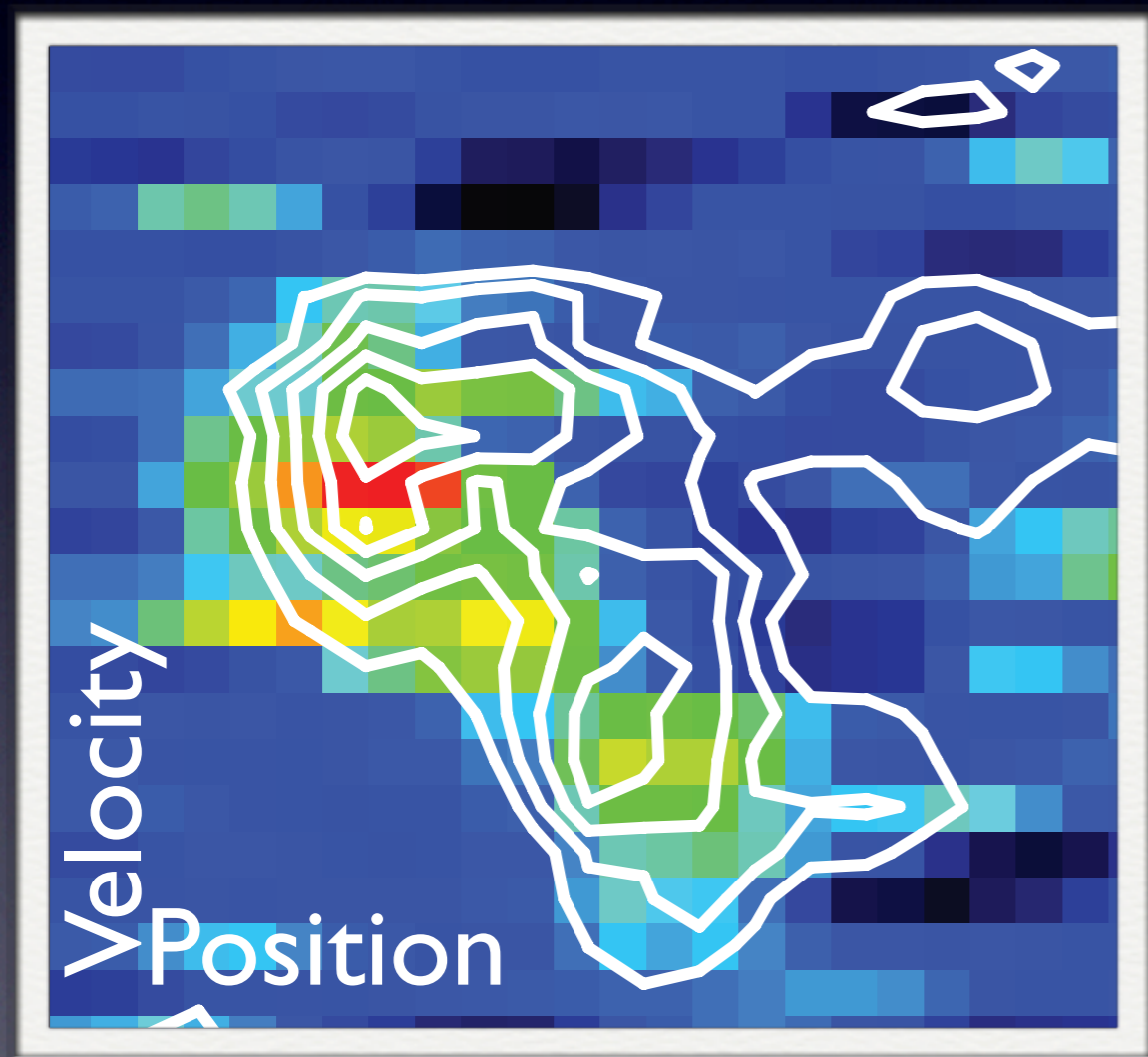
# G10.6-0.4

Overlay of OCS and  
SO<sub>2</sub> Moment 1 maps

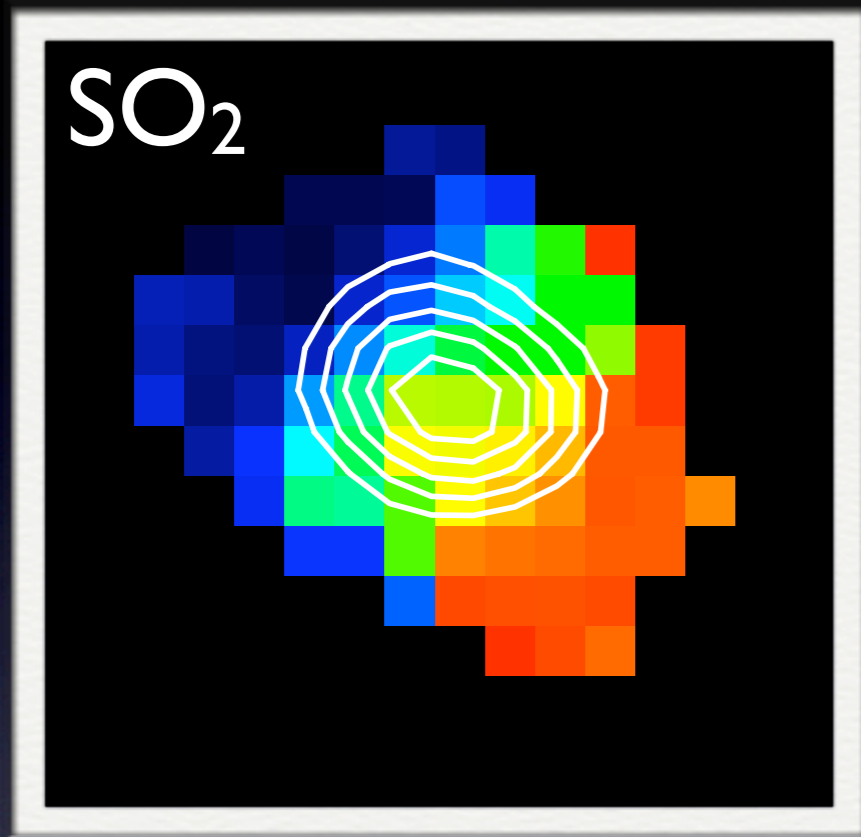


# G10.6-0.4

Overlay of OCS and  
SO<sub>2</sub> Moment 1 maps



# W51 e2 & e8



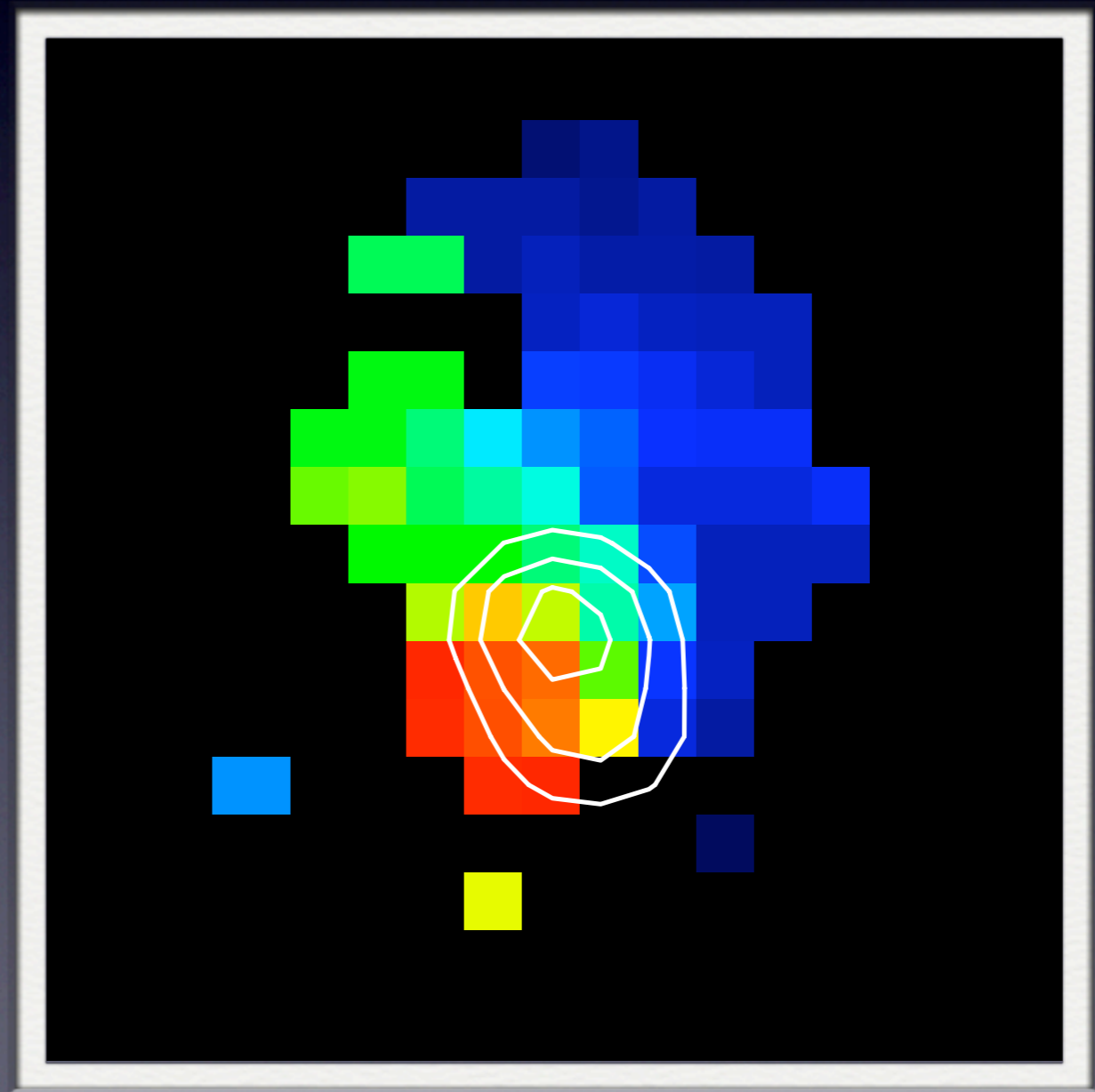
Rotation in the  
molecular (and ionized)  
gas in massive star  
forming regions





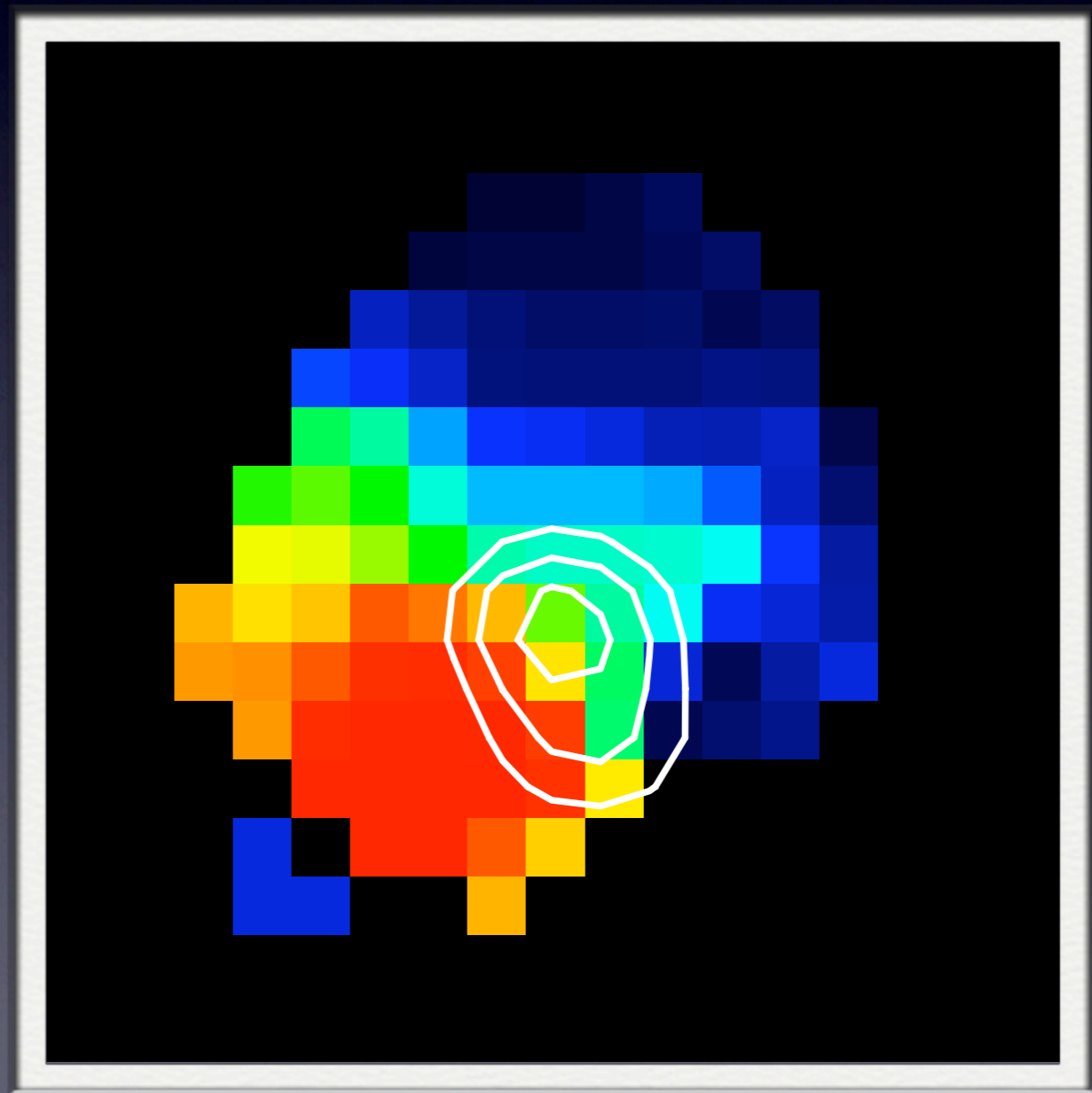
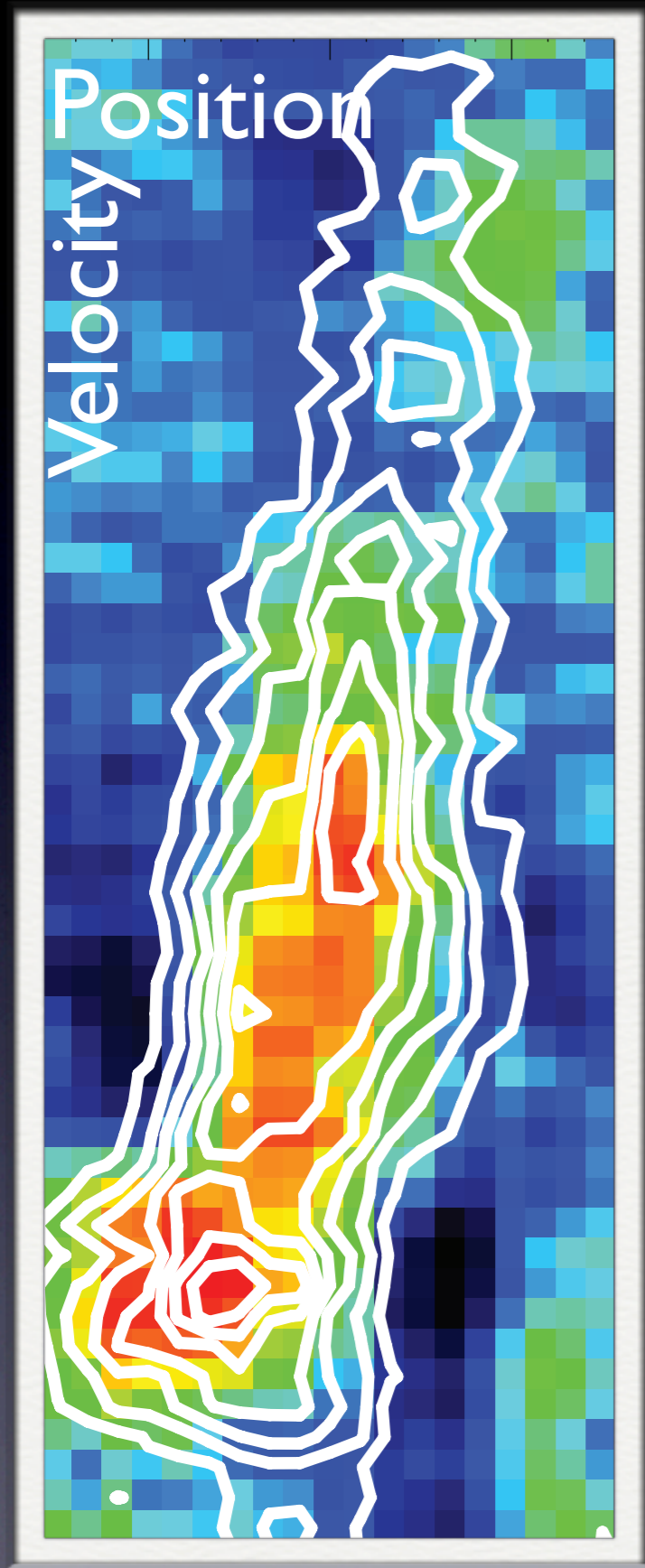
# W51e8

A **very** young HII region



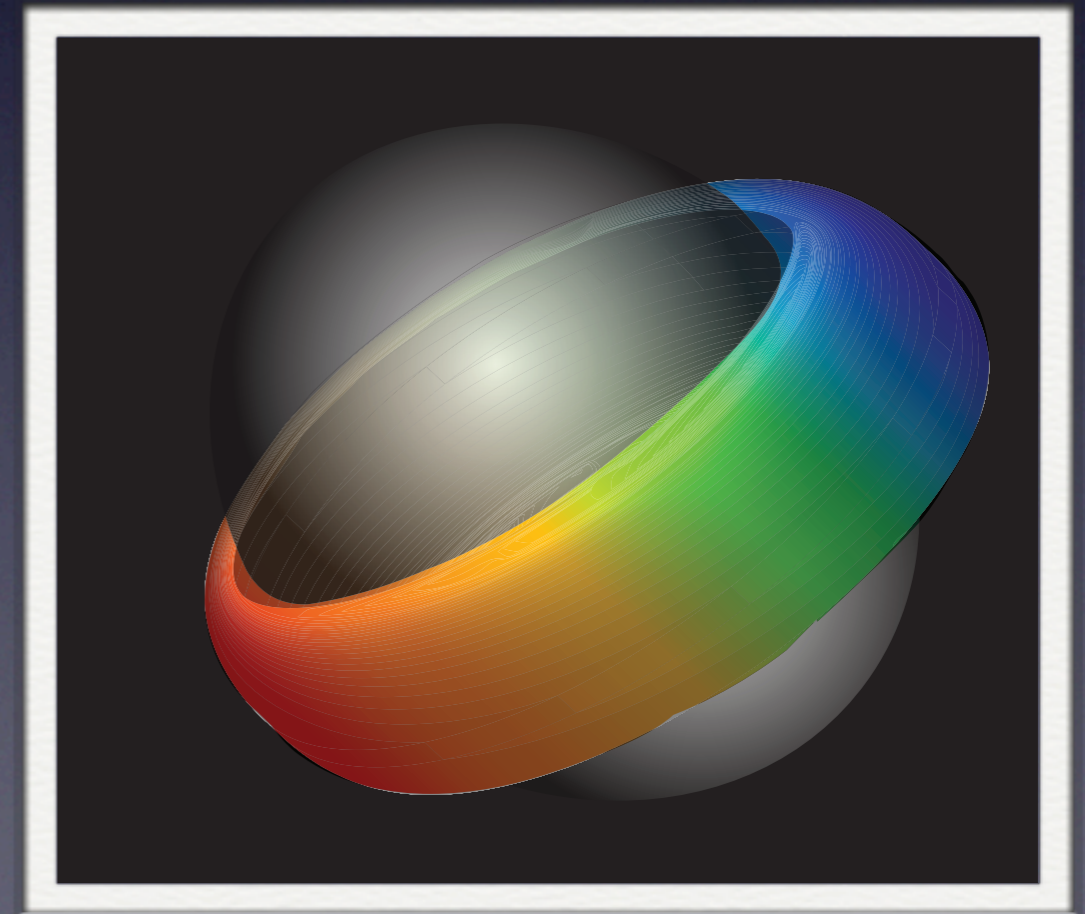
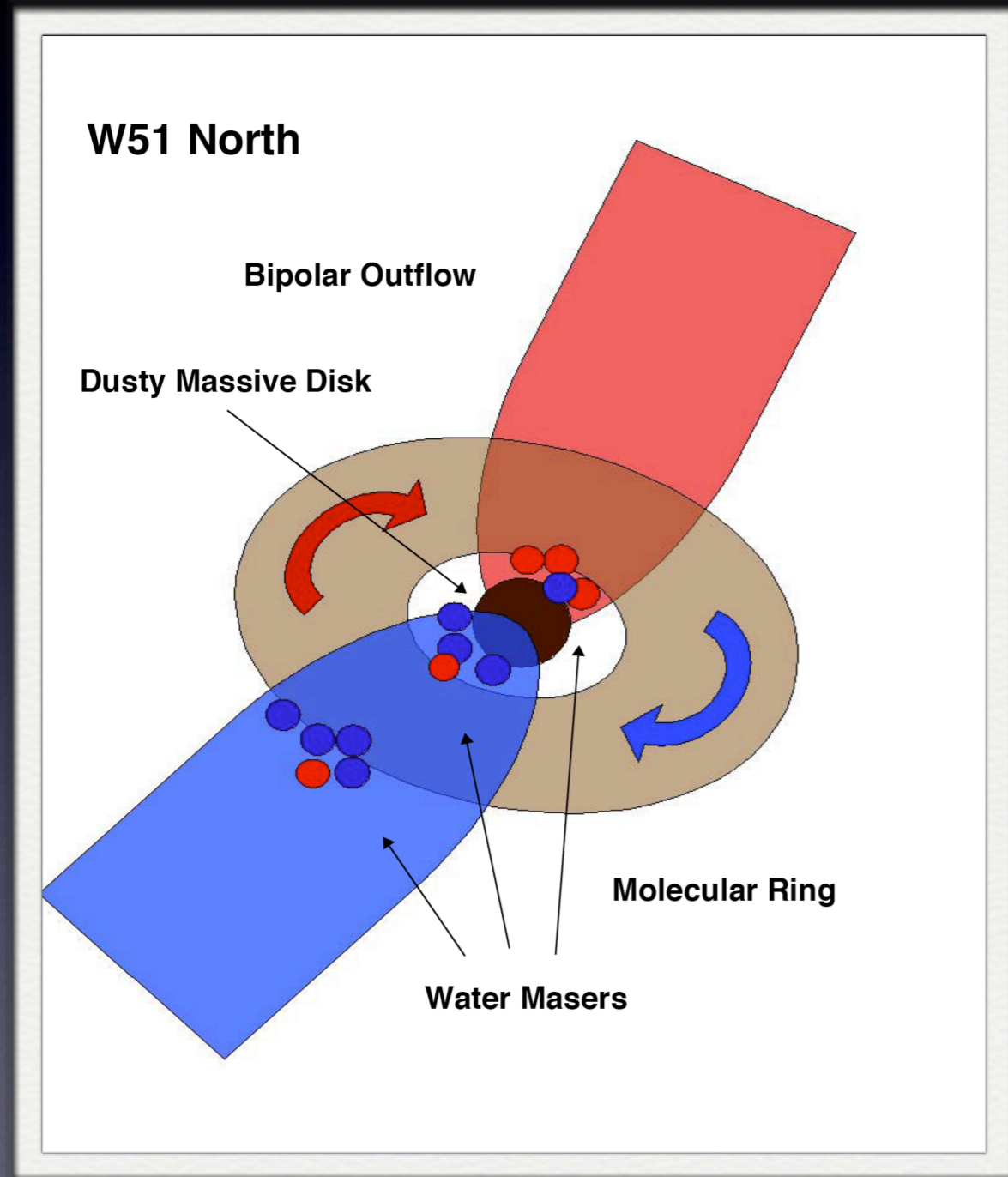
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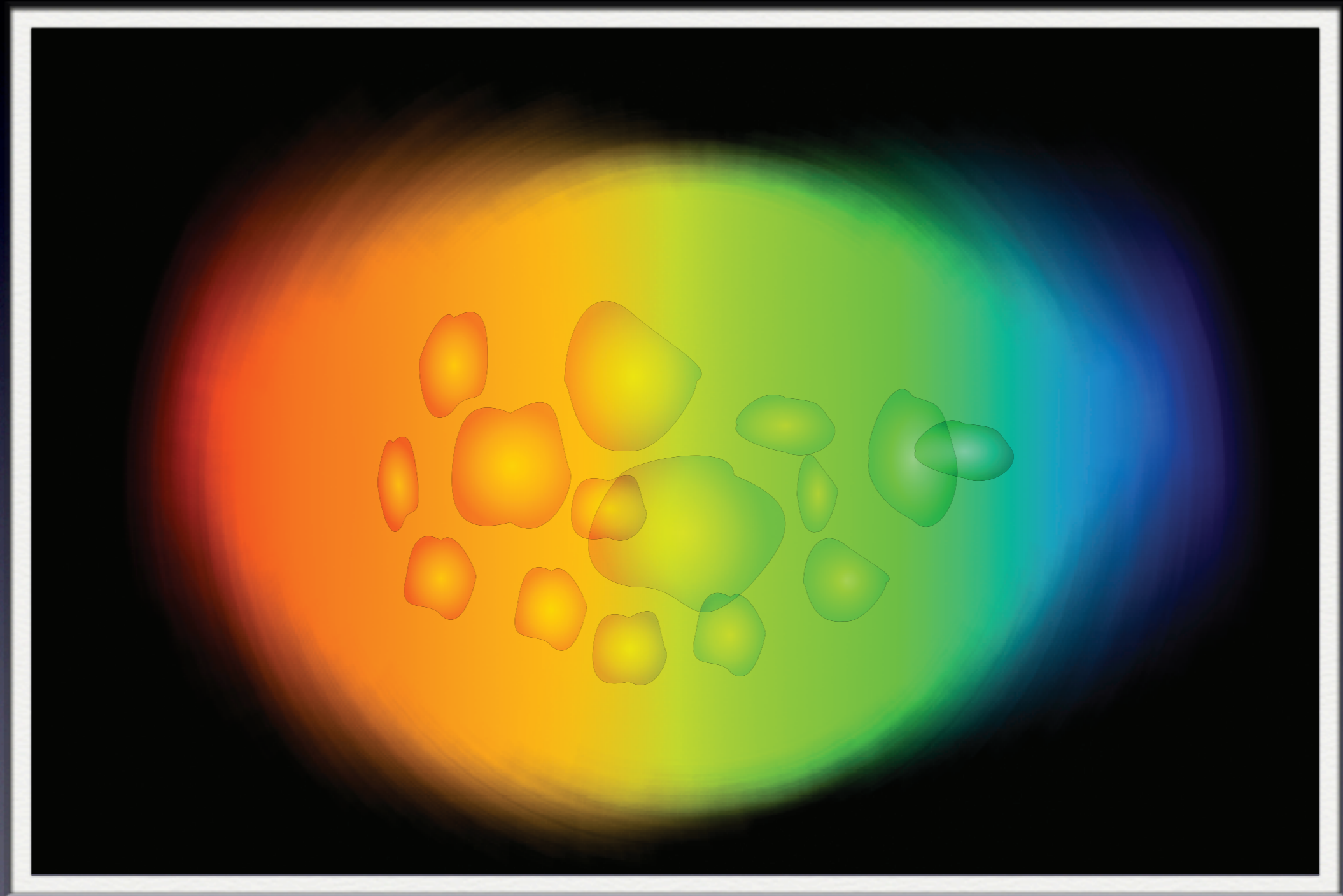


# Molecular Rings

- What are they?
- Do they exist for the whole protostellar lifetime?
- Why can we only see one side in each molecule?



# Predictions for ALMA





# Very Young HII Region

