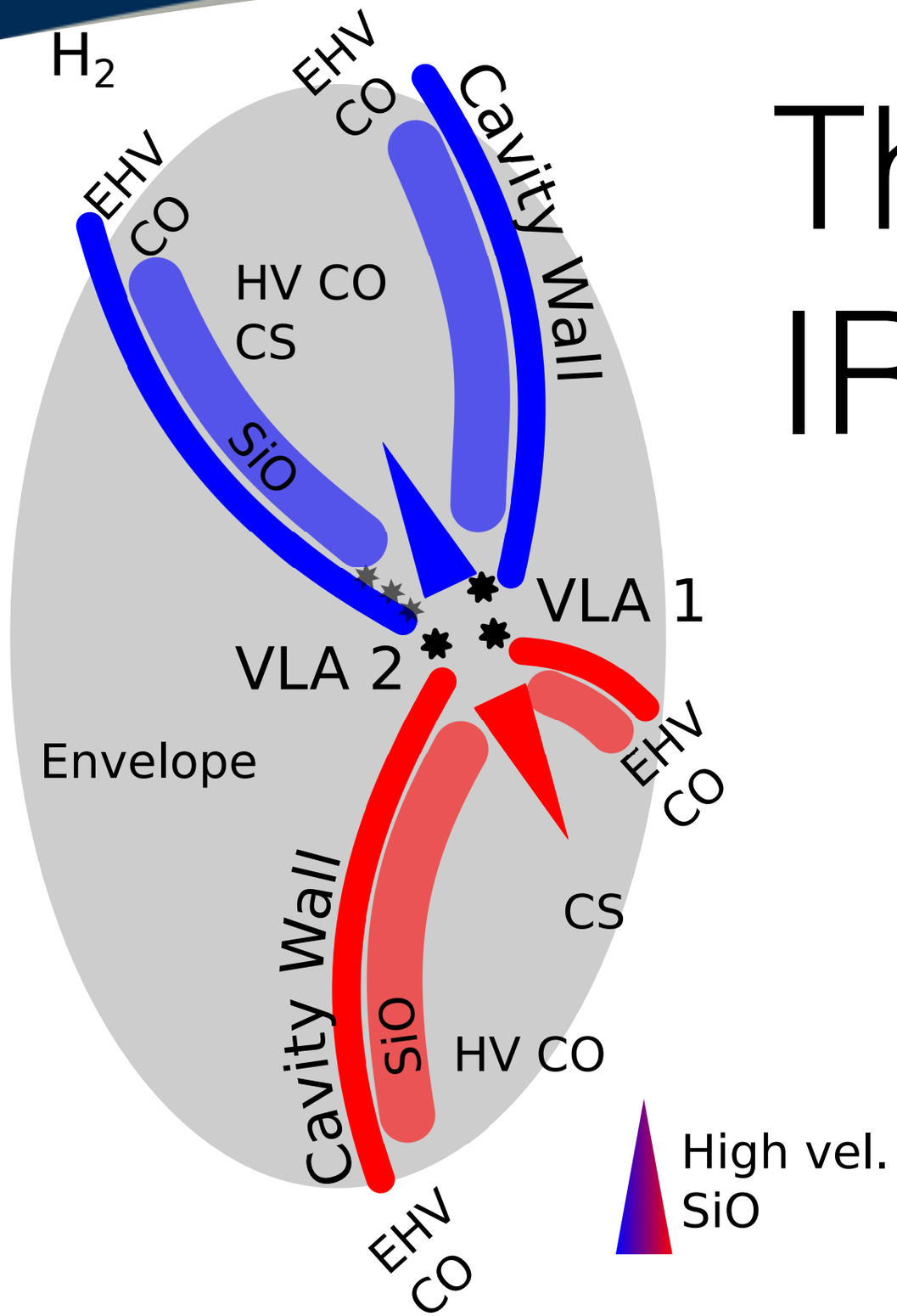
Science & Technology Facilities Council
UK Astronomy Technology Centre



The Outflow from IRAS17233-3606

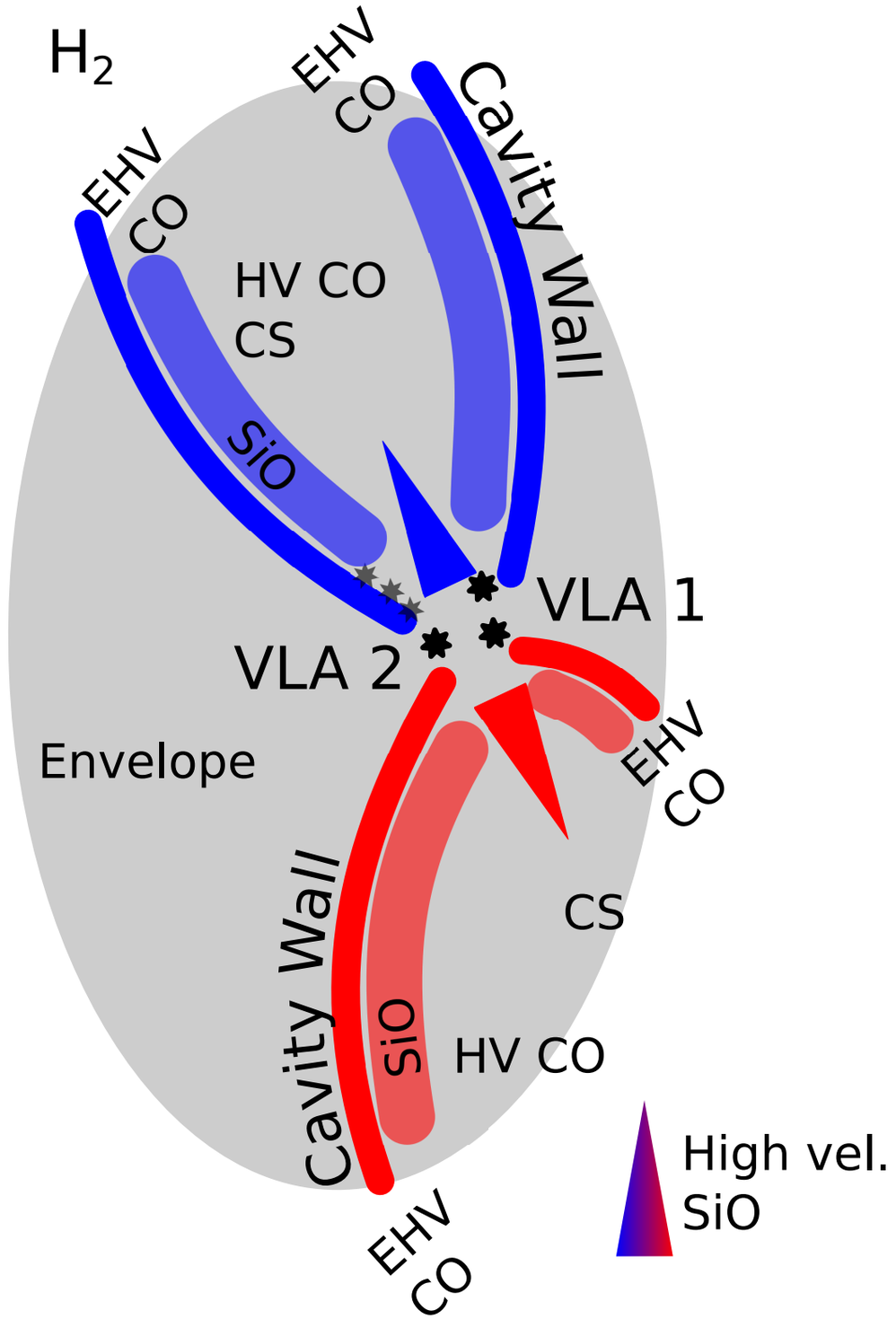
Pamela Klaassen
Katherine Johnston
Luis Zapata
Silvia Leurini

2015 A&A 575A 54

The overall concept

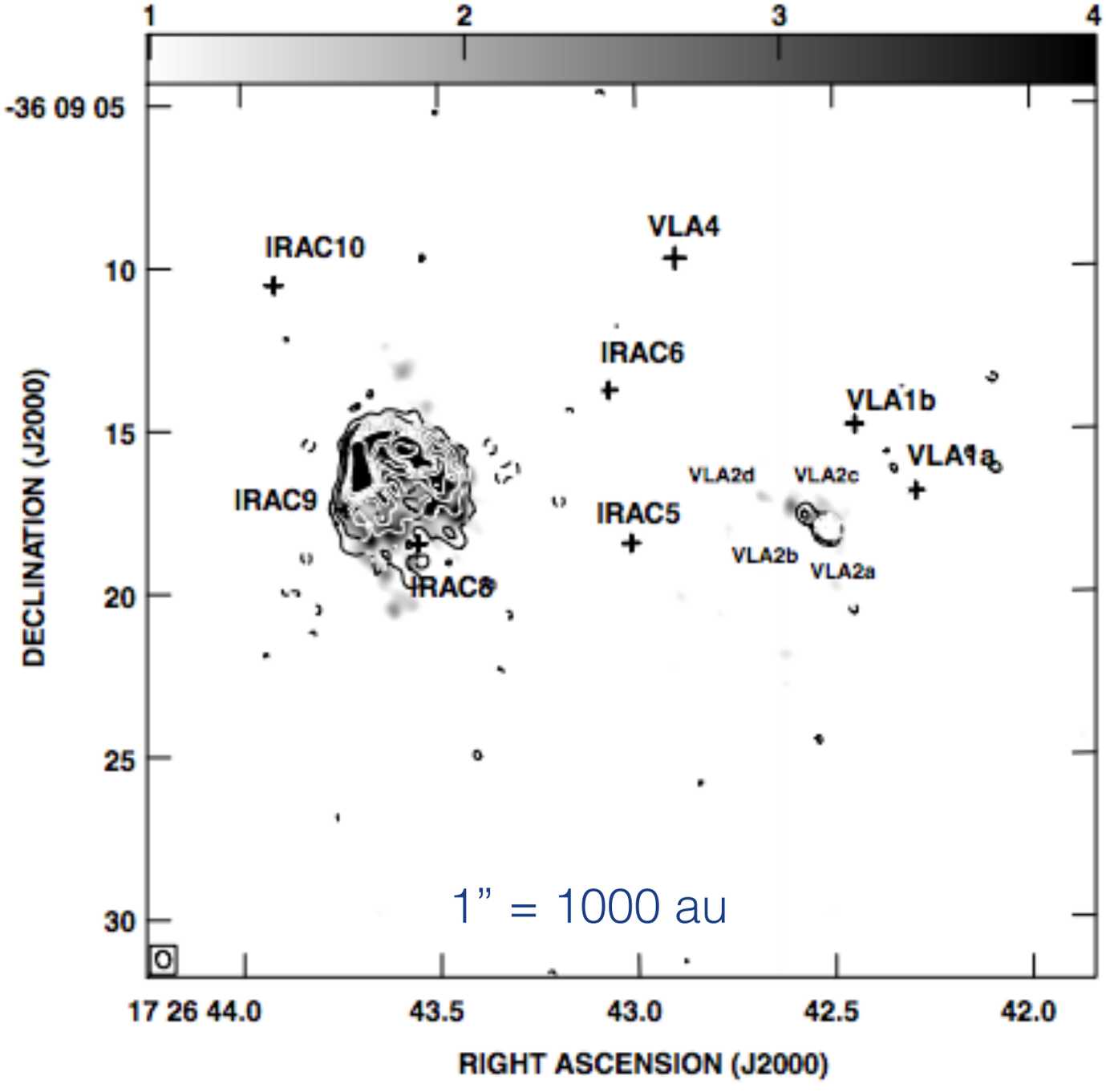
- We're used to the paradigm in which each outflow can *and should* be traced back to each powering source.

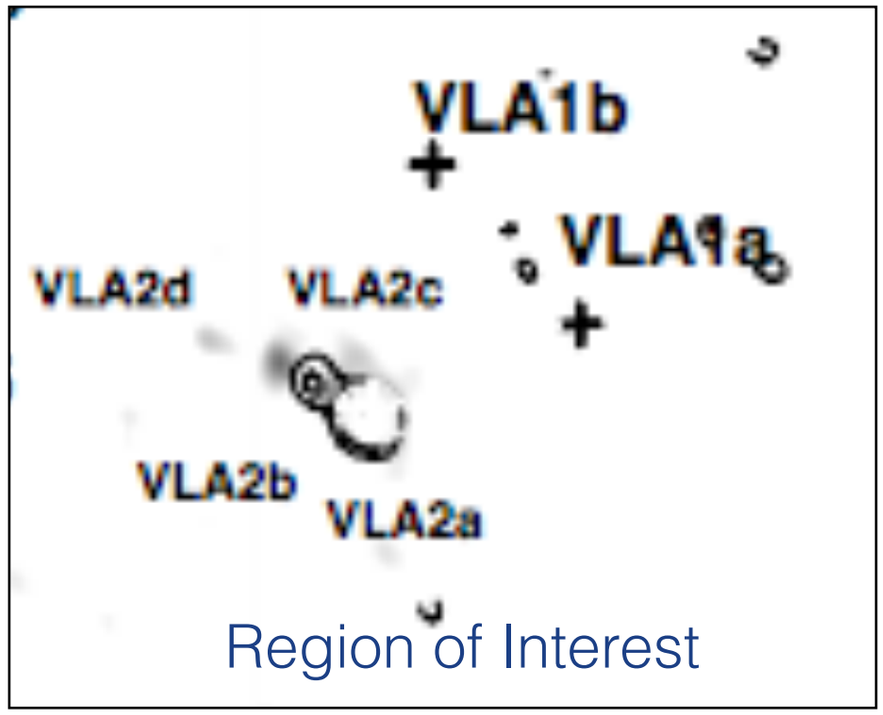
- But what if massive stars are conspiring against us?
  - what if they're coming together (because of their common potential well), and creating one large scale structure between them?



IRAS 17233-3606

Zapata et al. 2008



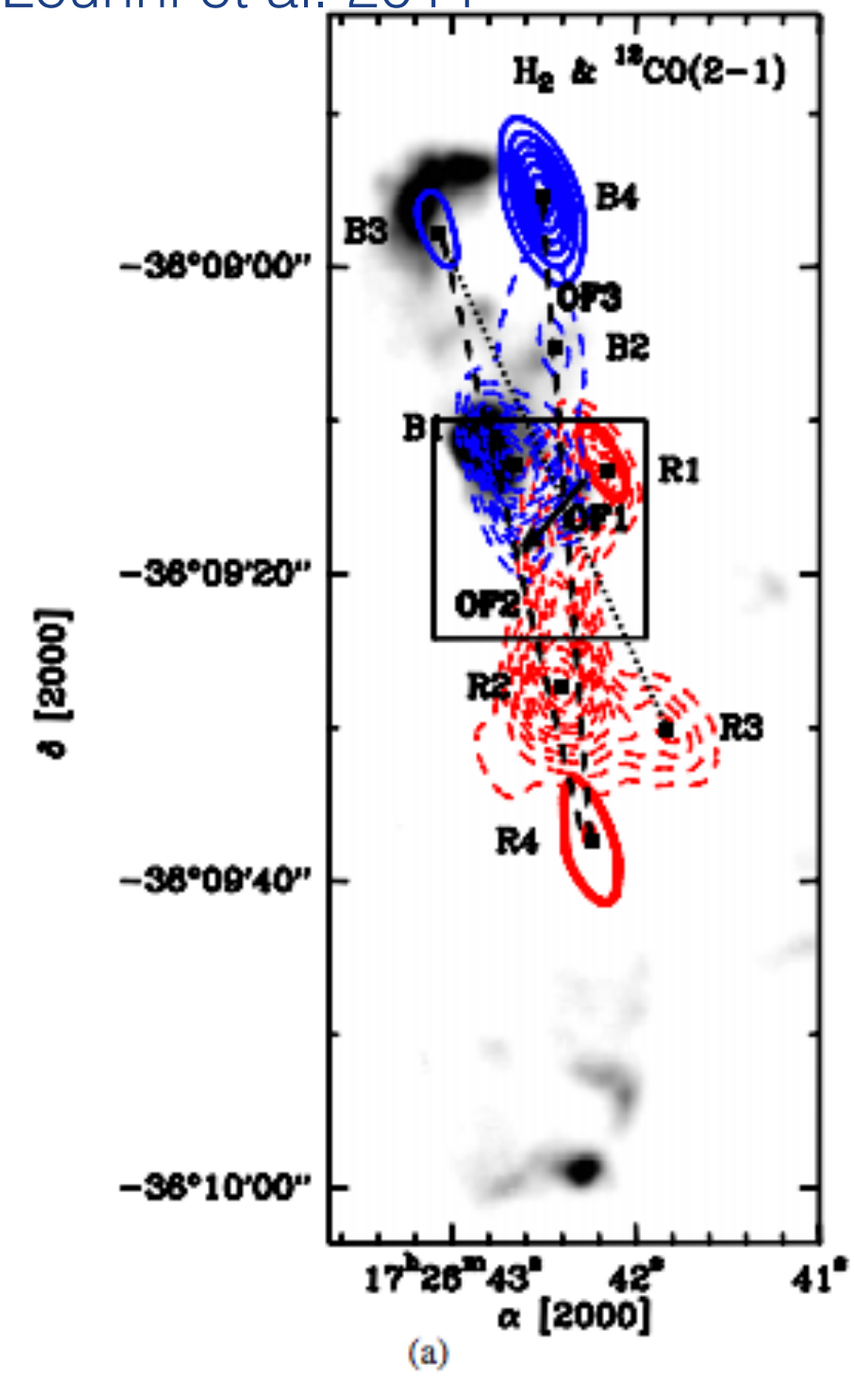


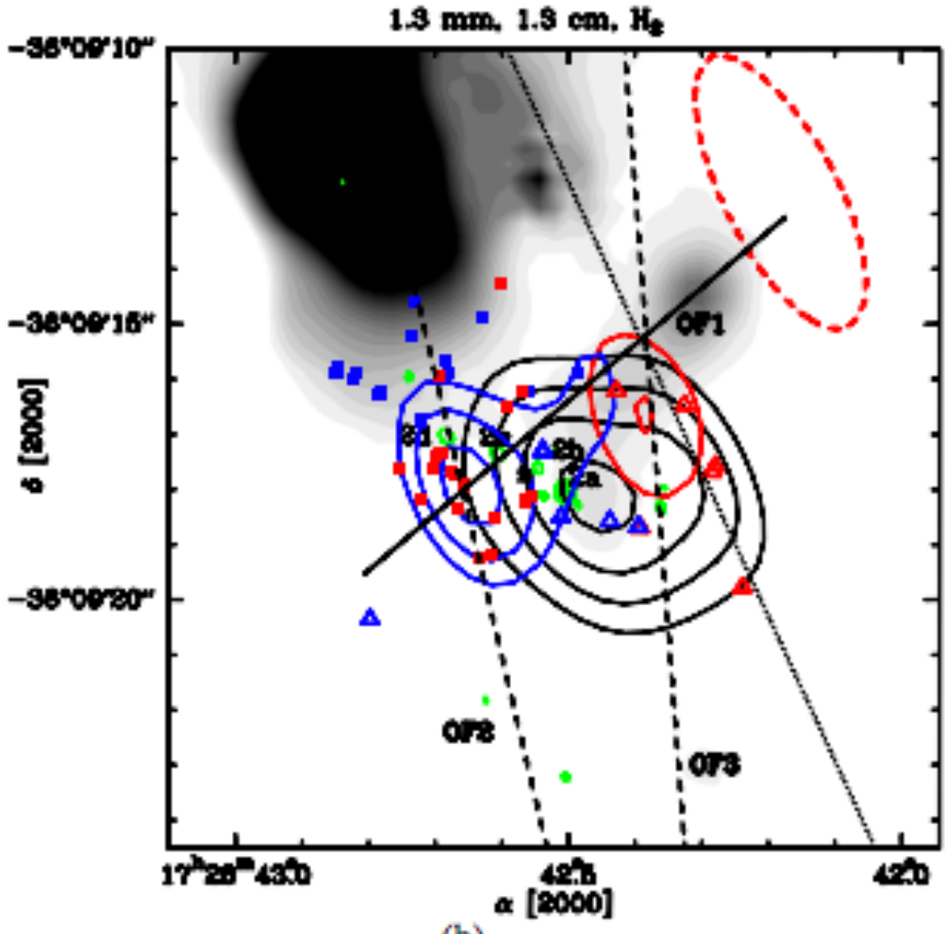
Region of Interest

- $10^{4.2}$ L_sun
- 1 kpc
- Multiple HII regions

IRAS 17233-3606

Leurini et al. 2011

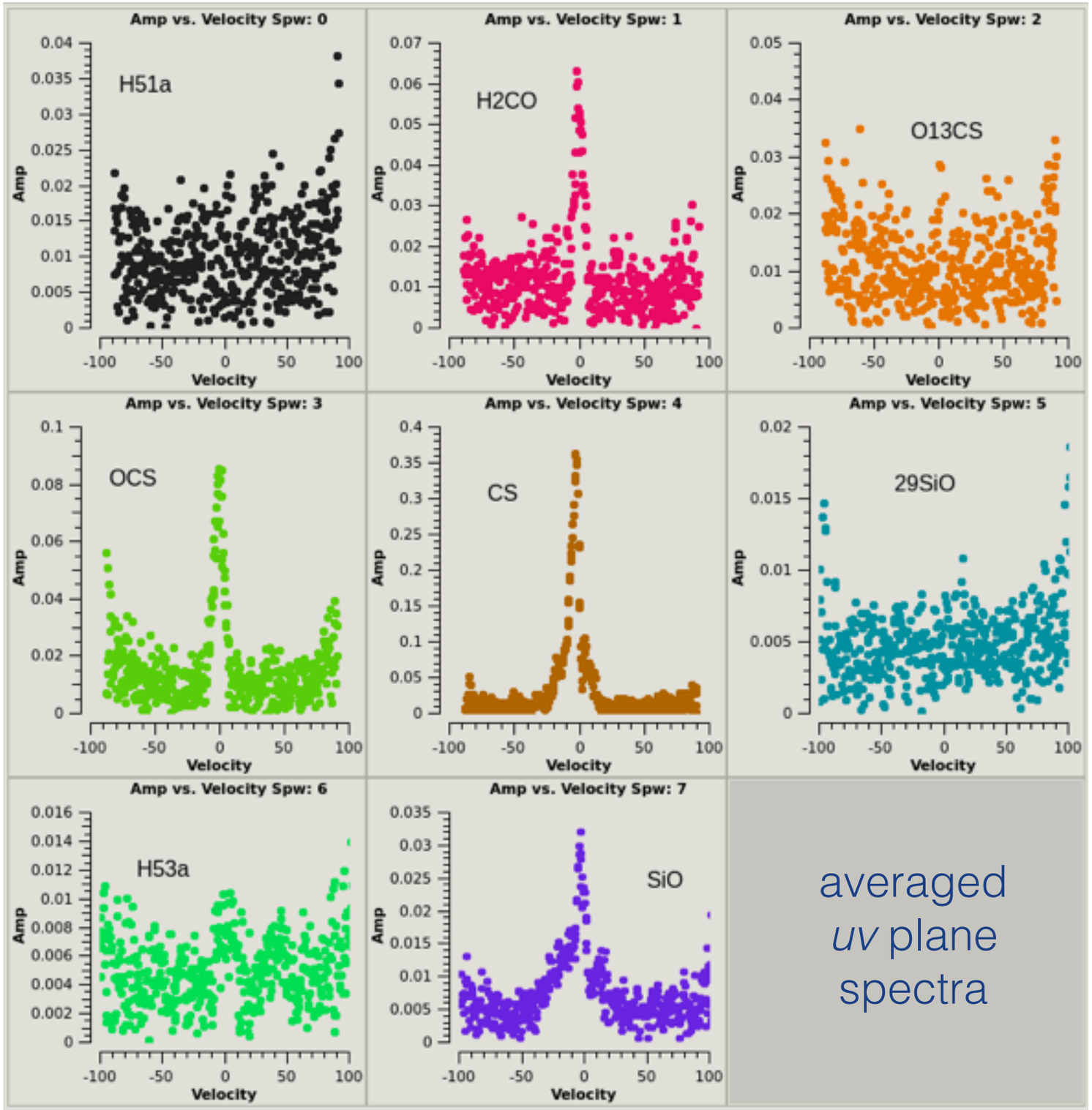




- $10^{4.2}$ L_sun
- 1 kpc
- Multiple HII regions
- Multiple Outflows?

JVLA Observations

- CnD configuration
- 43/48 GHz
- 2.8x1.7” beam
- part of larger sample
  - still working on them!

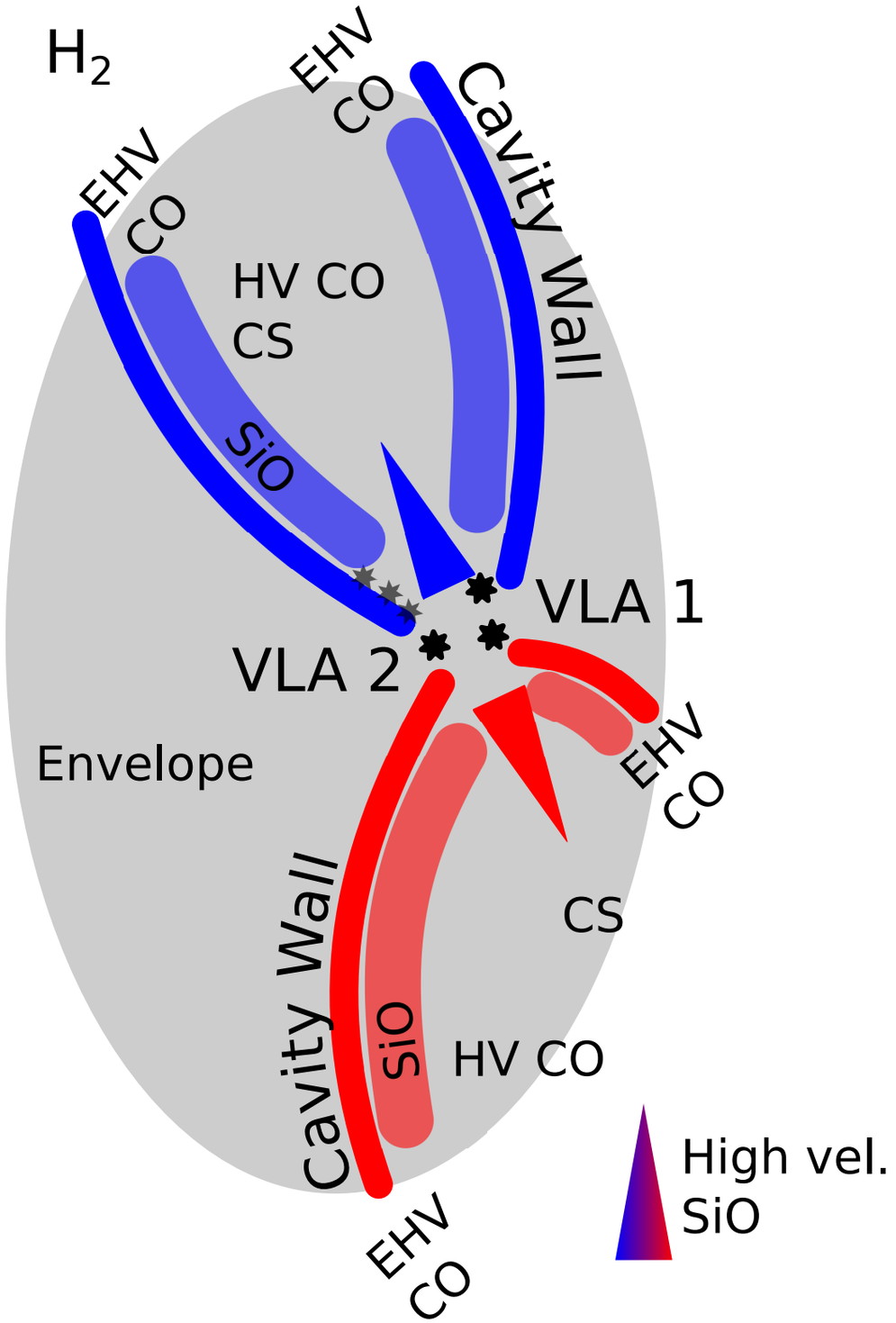


The single outflow

- We're used to the paradigm in which each outflow can *and should* be traced back to each powering source.

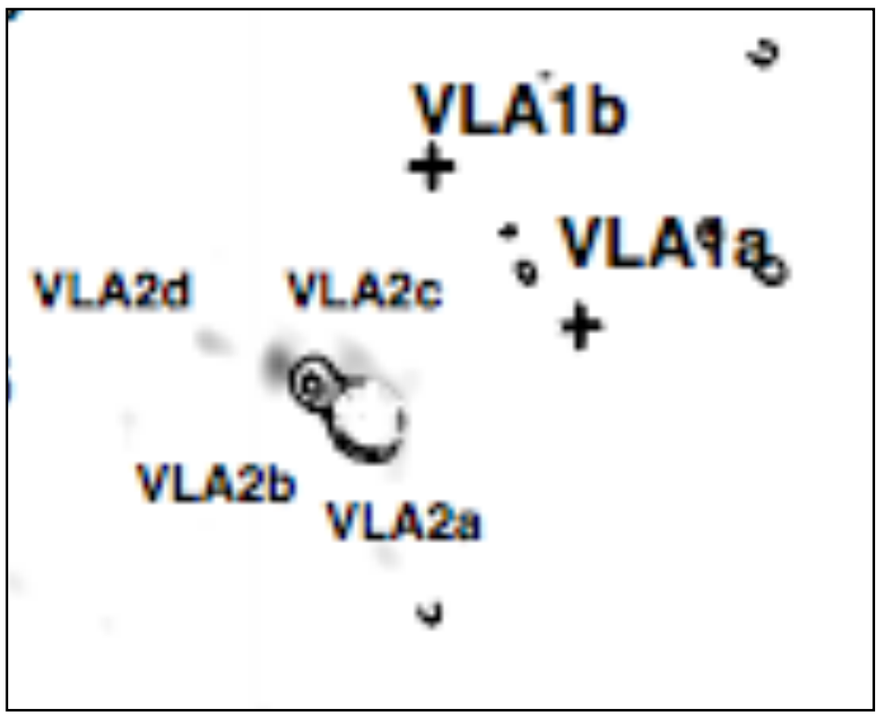
- I'm going to step through the data to show you why I think there's only one outflow, despite the presence of multiple HII regions
  - SiO
  - CS

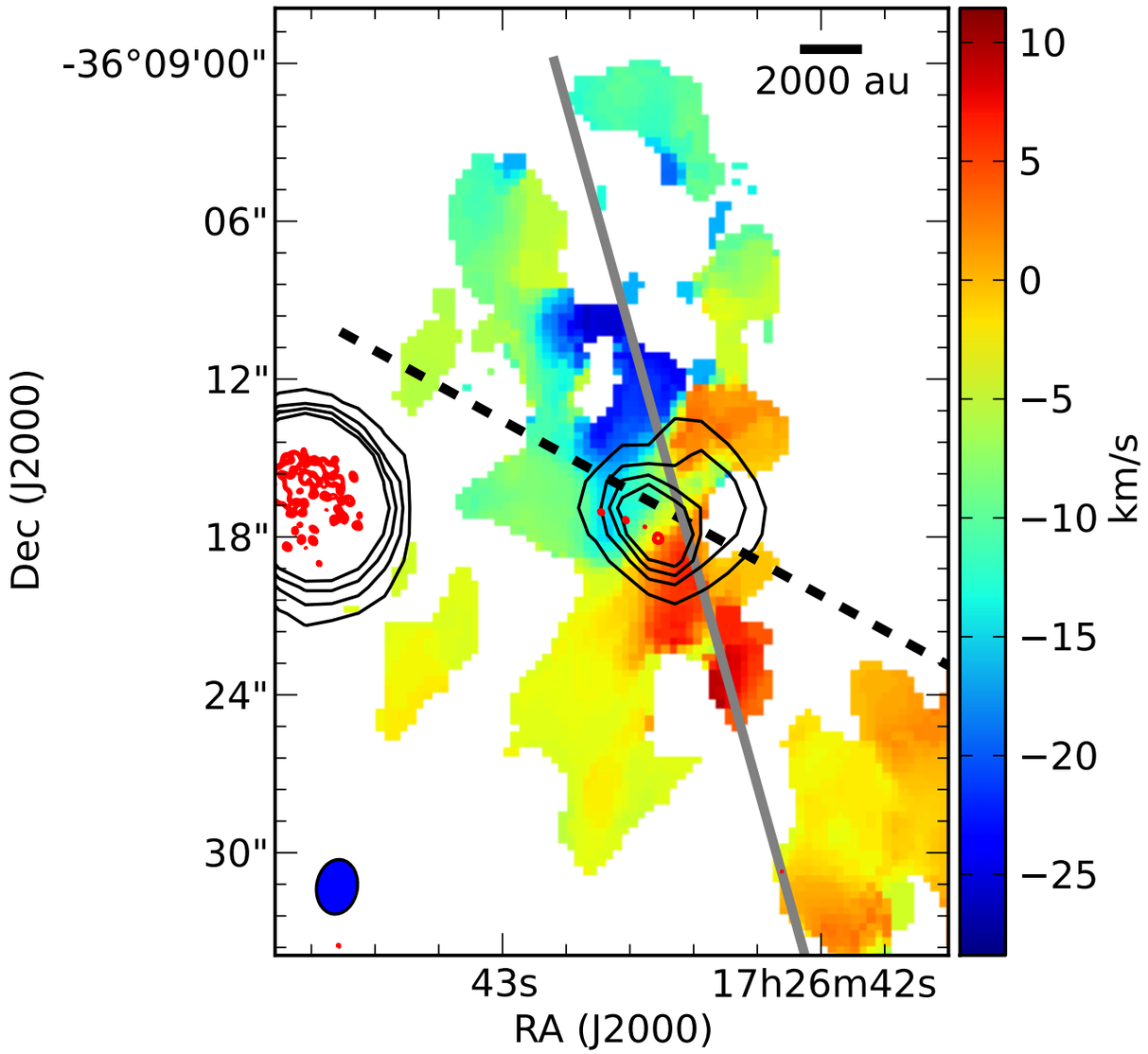
With help from previously published CO



SiO - outflow shocks

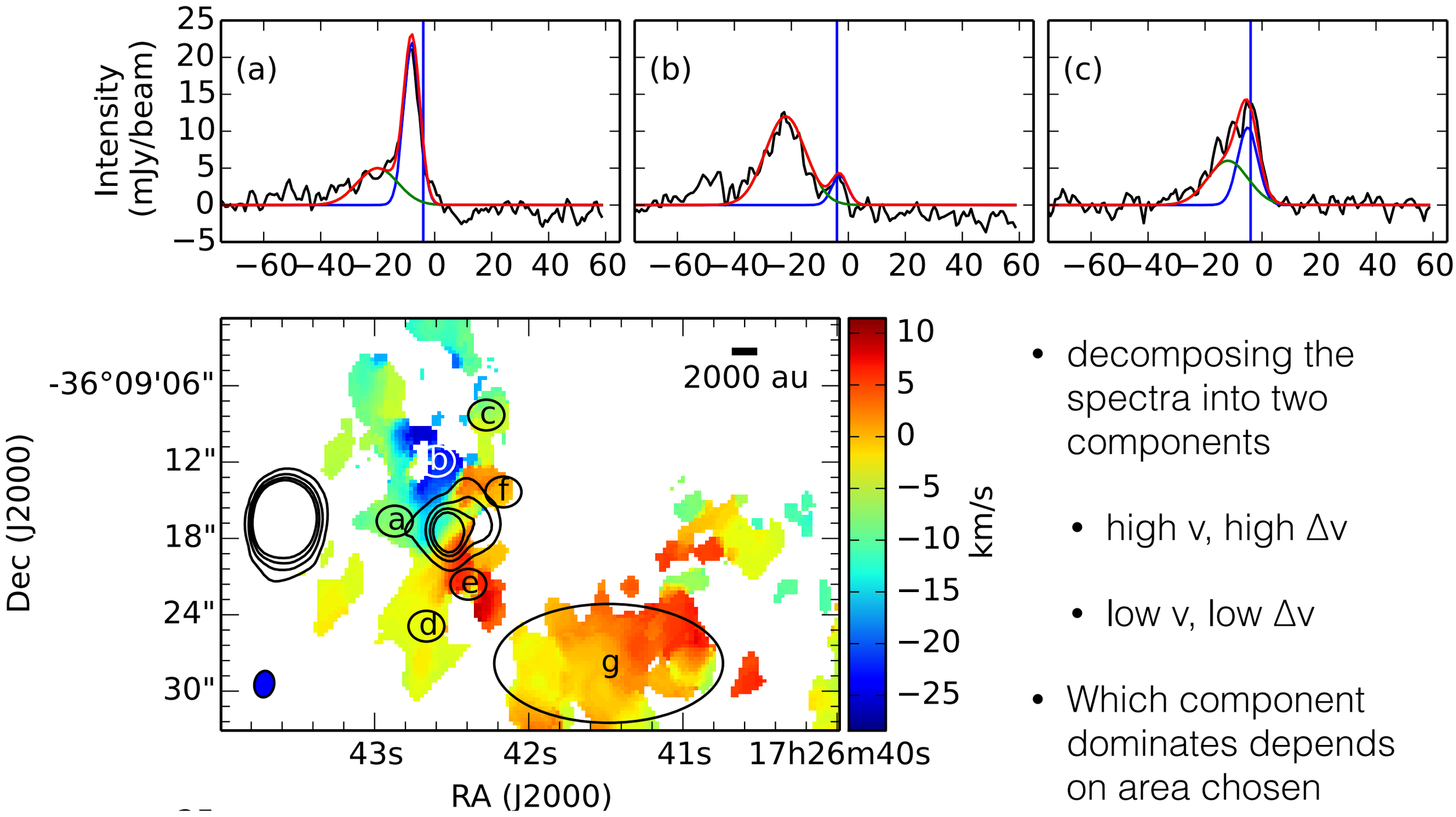
- Blue in the north, red in the south
- Appears to be two distinct velocity components in each region





SiO first moment map
with 48 GHz contin. contours

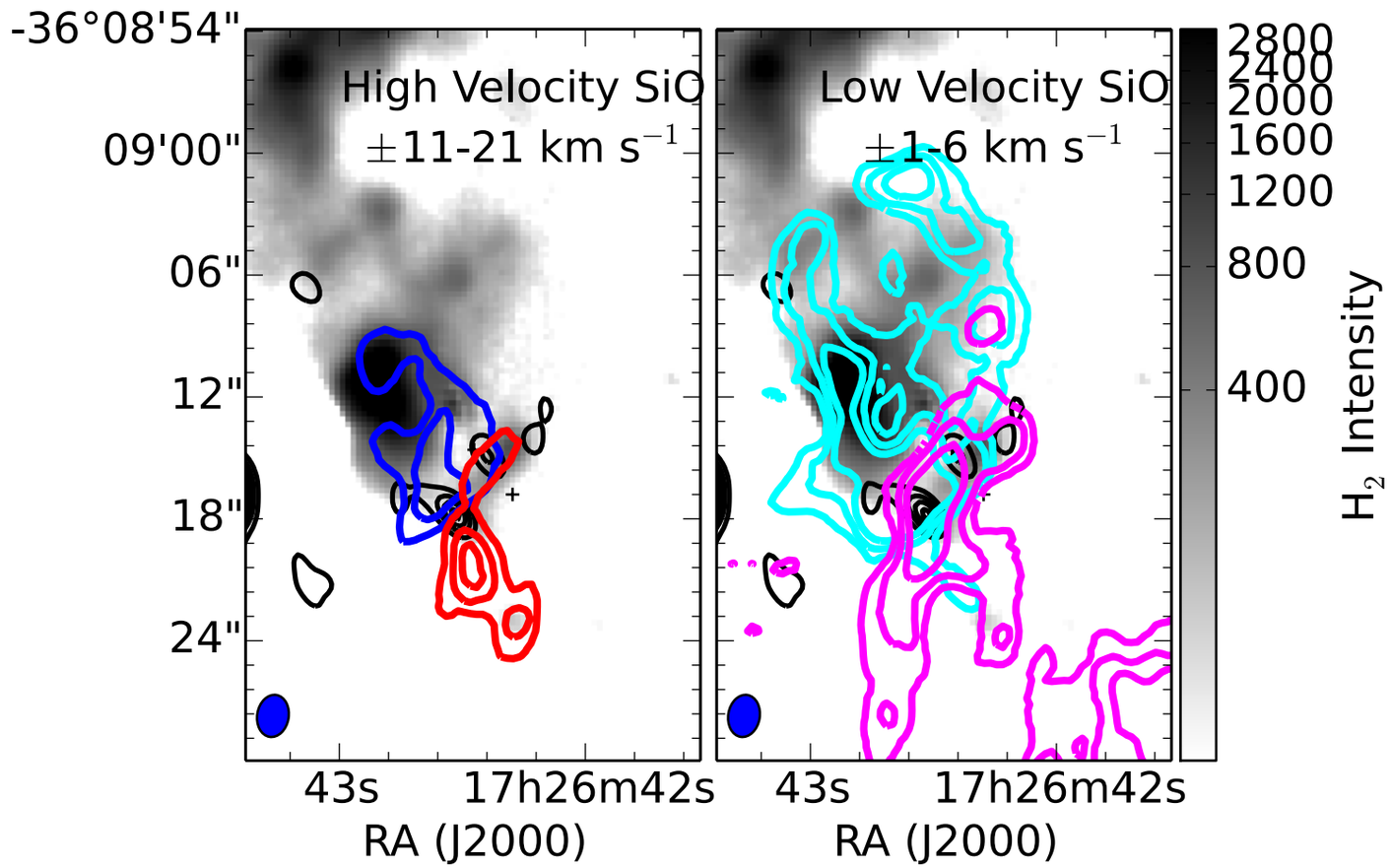
SiO - outflow shocks



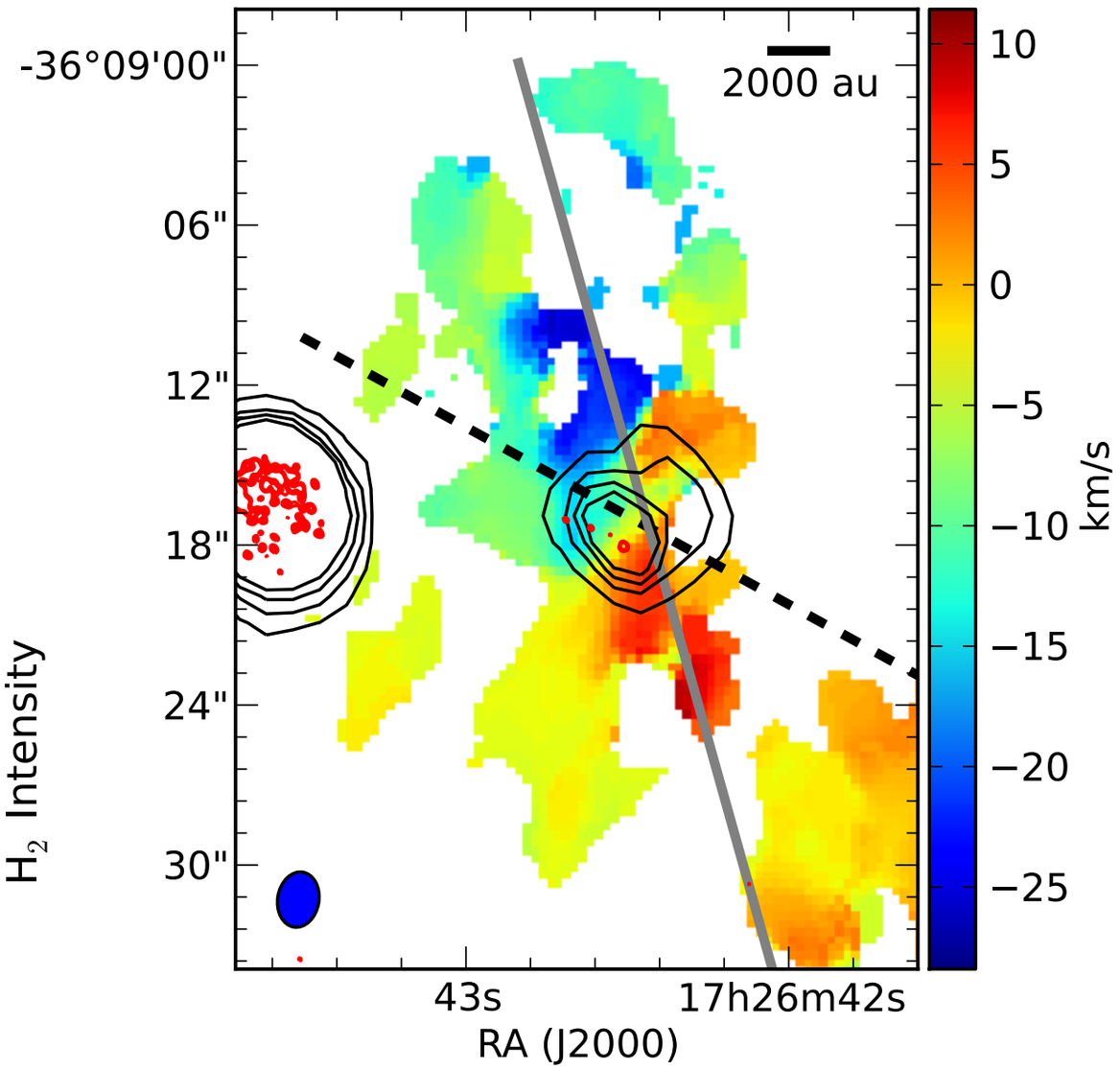
- decomposing the spectra into two components
  - high v, high Δv
  - low v, low Δv
- Which component dominates depends on area chosen

SiO - outflow shocks

- Blue in the north, red in the south
- Appears to be two distinct velocity components in each region

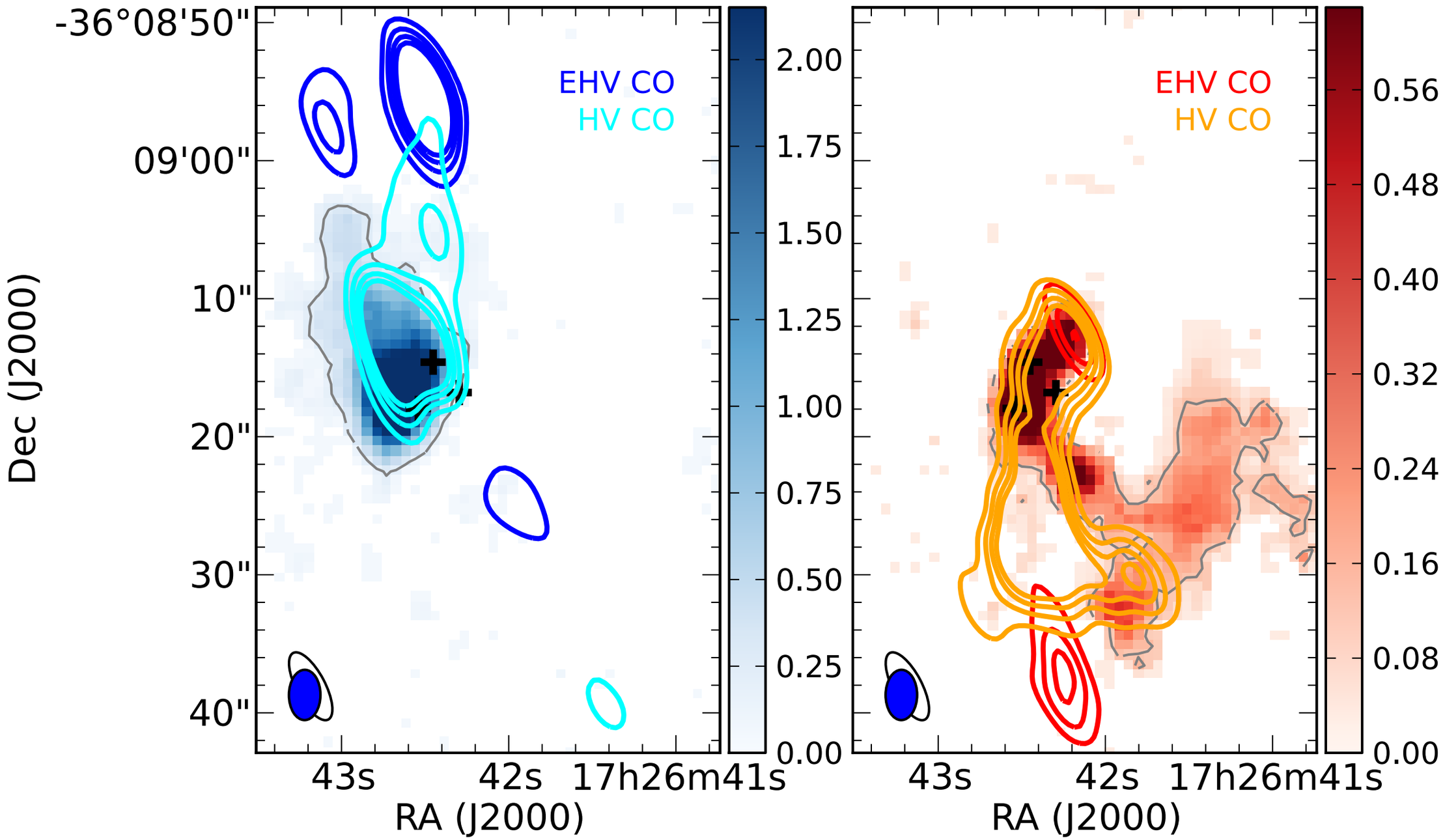


15GHz contin. contours



SiO first moment map
with 48 GHz contin. contours

The entrained outflow



Leurini+ 2011

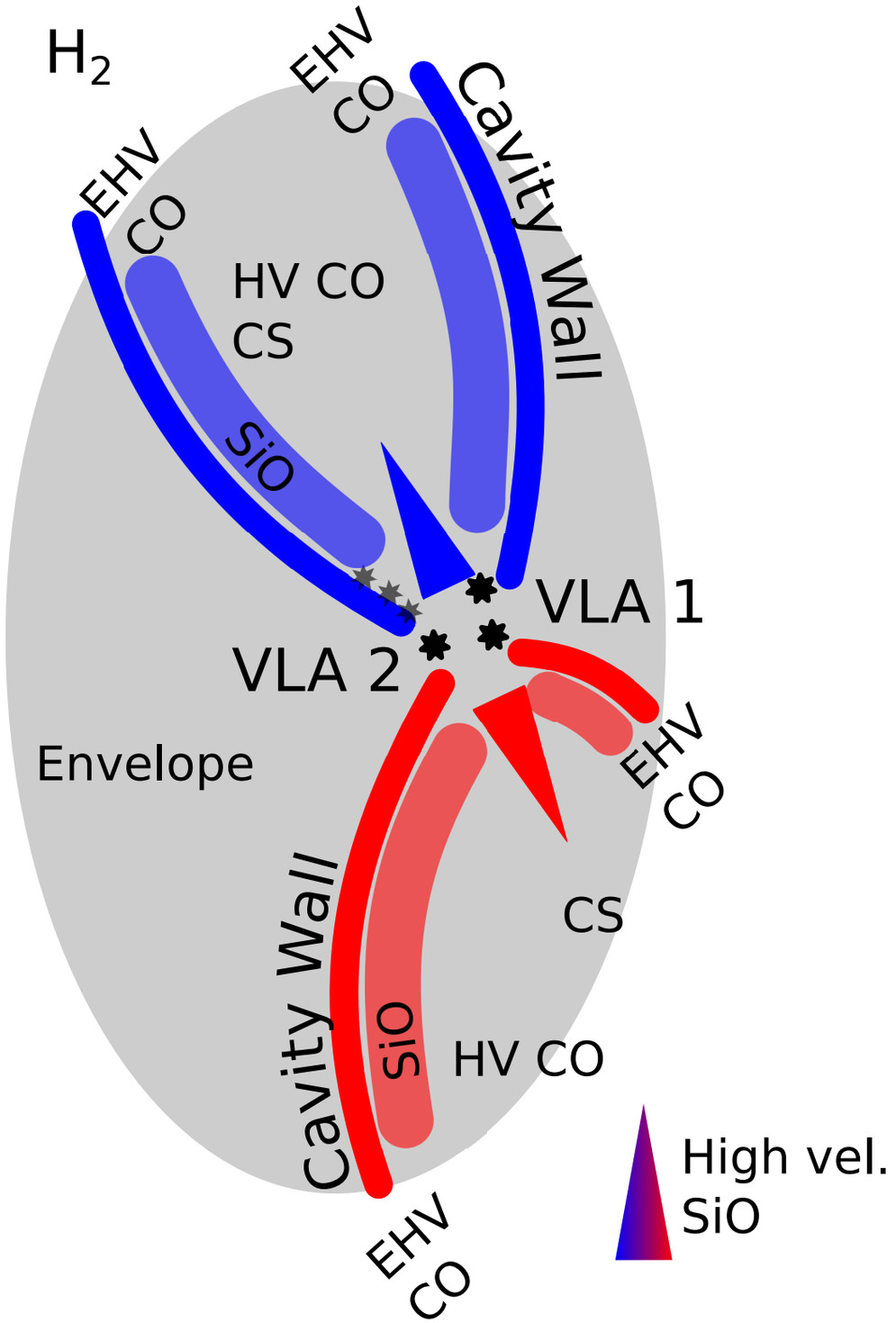
Colour scales: high velocity CS emission

The single outflow

- We're used to the paradigm in which each outflow can *and should* be traced back to each powering source.

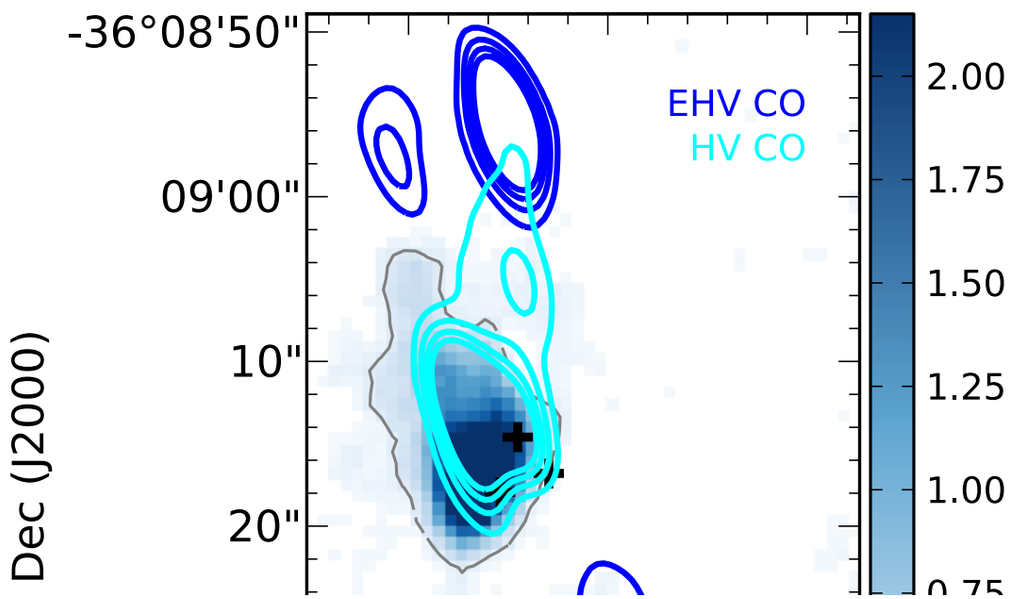
- I'm going to step through the data to show you why I think there's only one outflow, despite the presence of multiple HII regions
  - SiO
  - CS

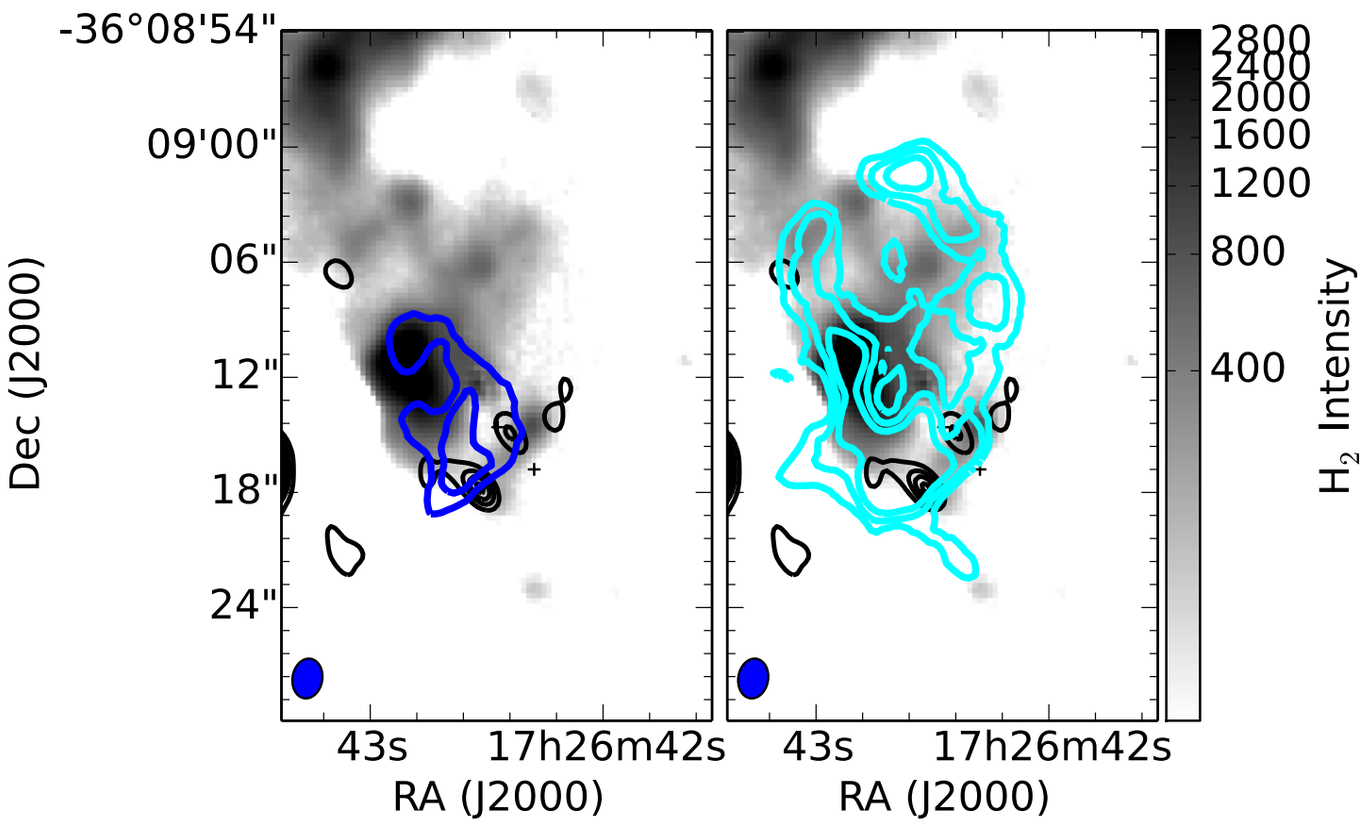
With help from previously published CO

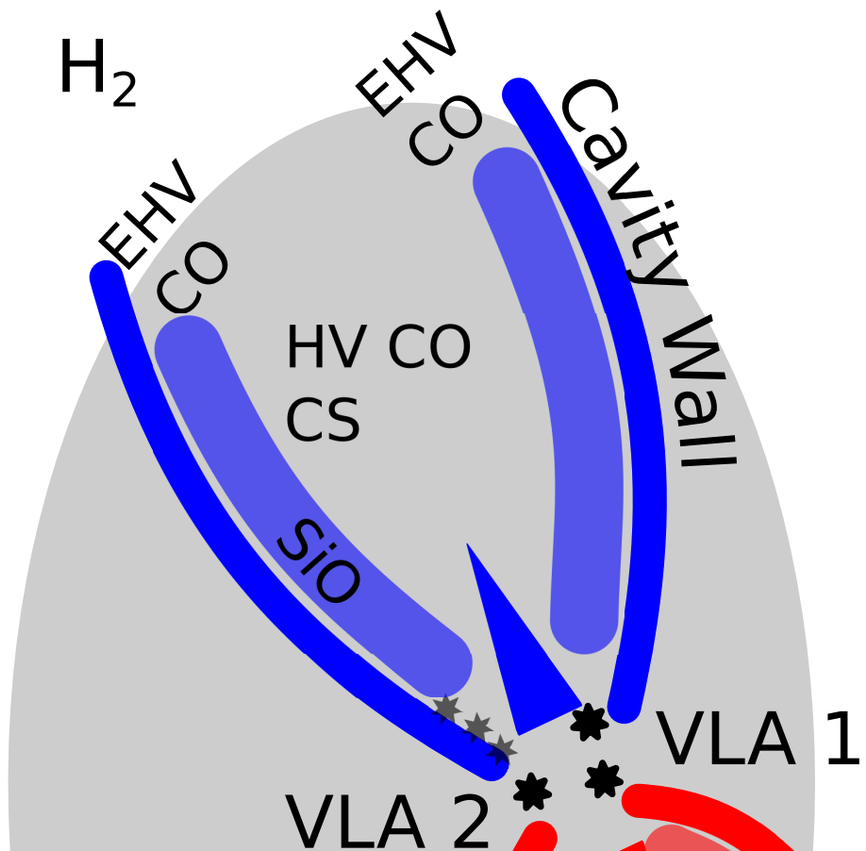


Starting Simple: Blue

- HV SiO ‘jet’ in the centre
- CS & CO fill the cavity
- LV SiO lines edge of wall
- EHV CO has made it out of the envelope
  - Where A_v drops, and H_2 is detectable

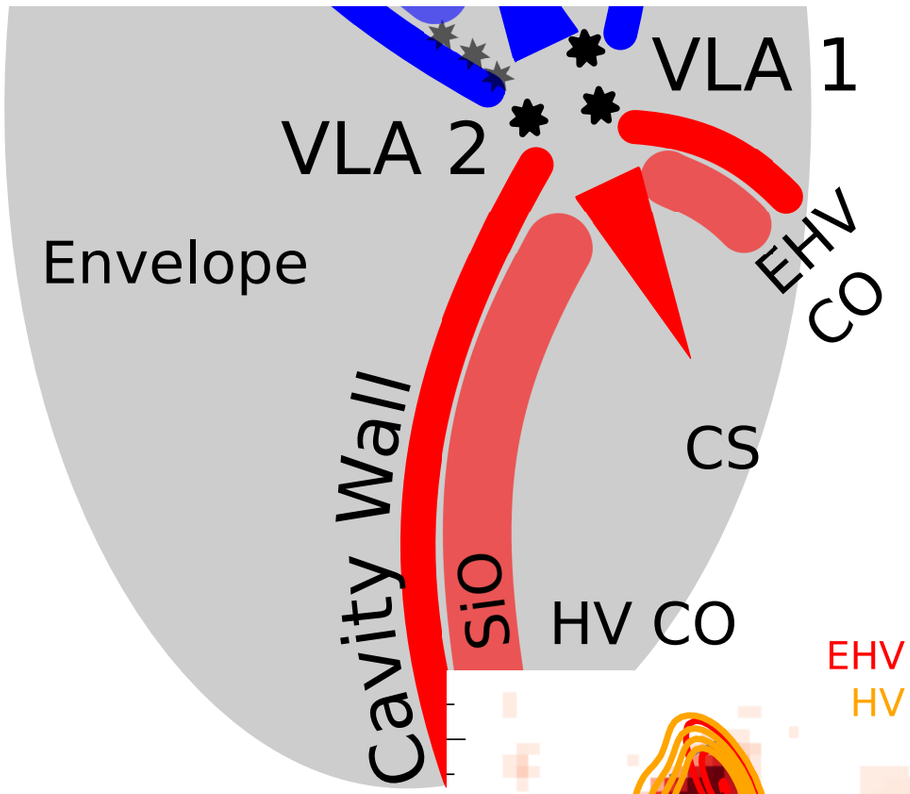


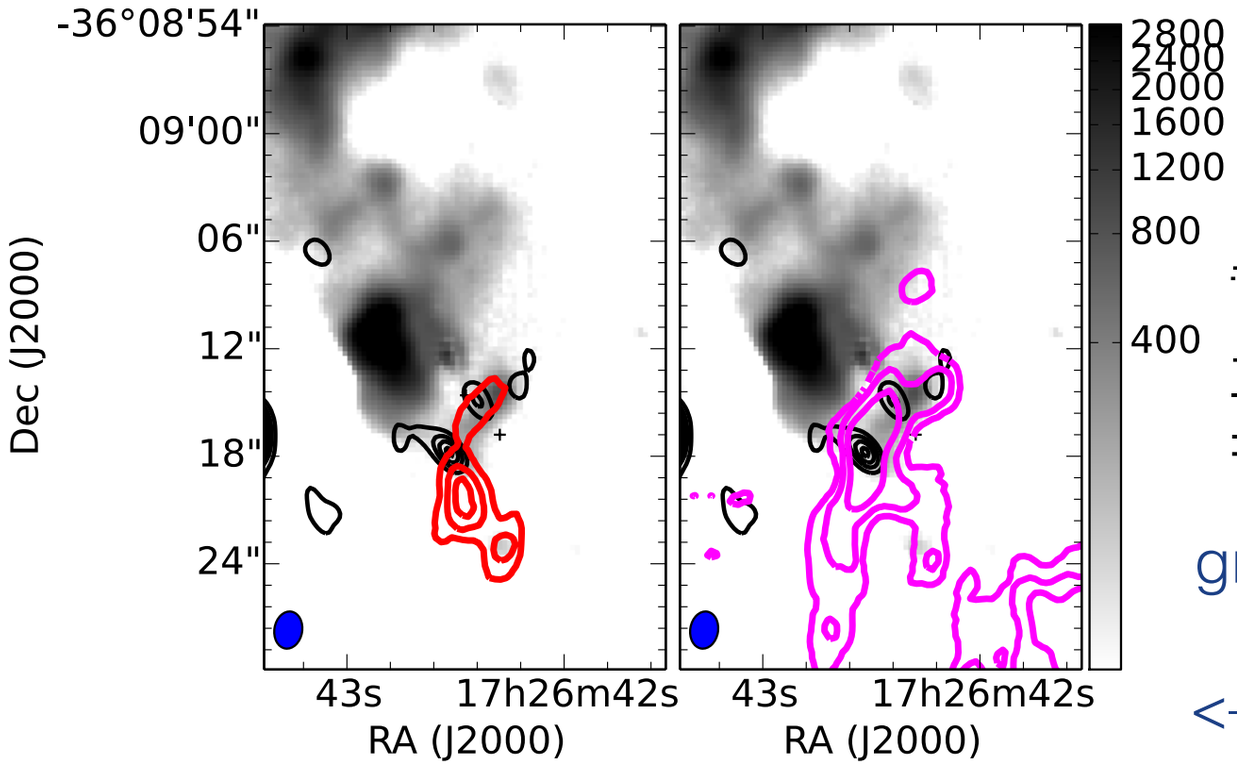




Accepting that, what's the red lobe doing?

- It's doing the same thing, but has been able to escape the envelope 'earlier'
- Shortening the 'right' side

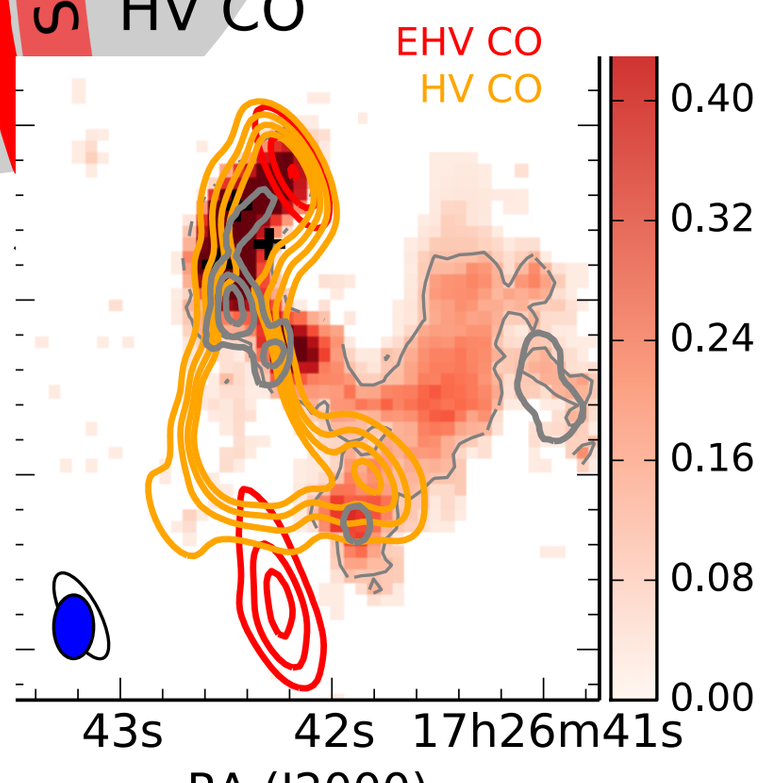




grey contours ->

=

<— red contours

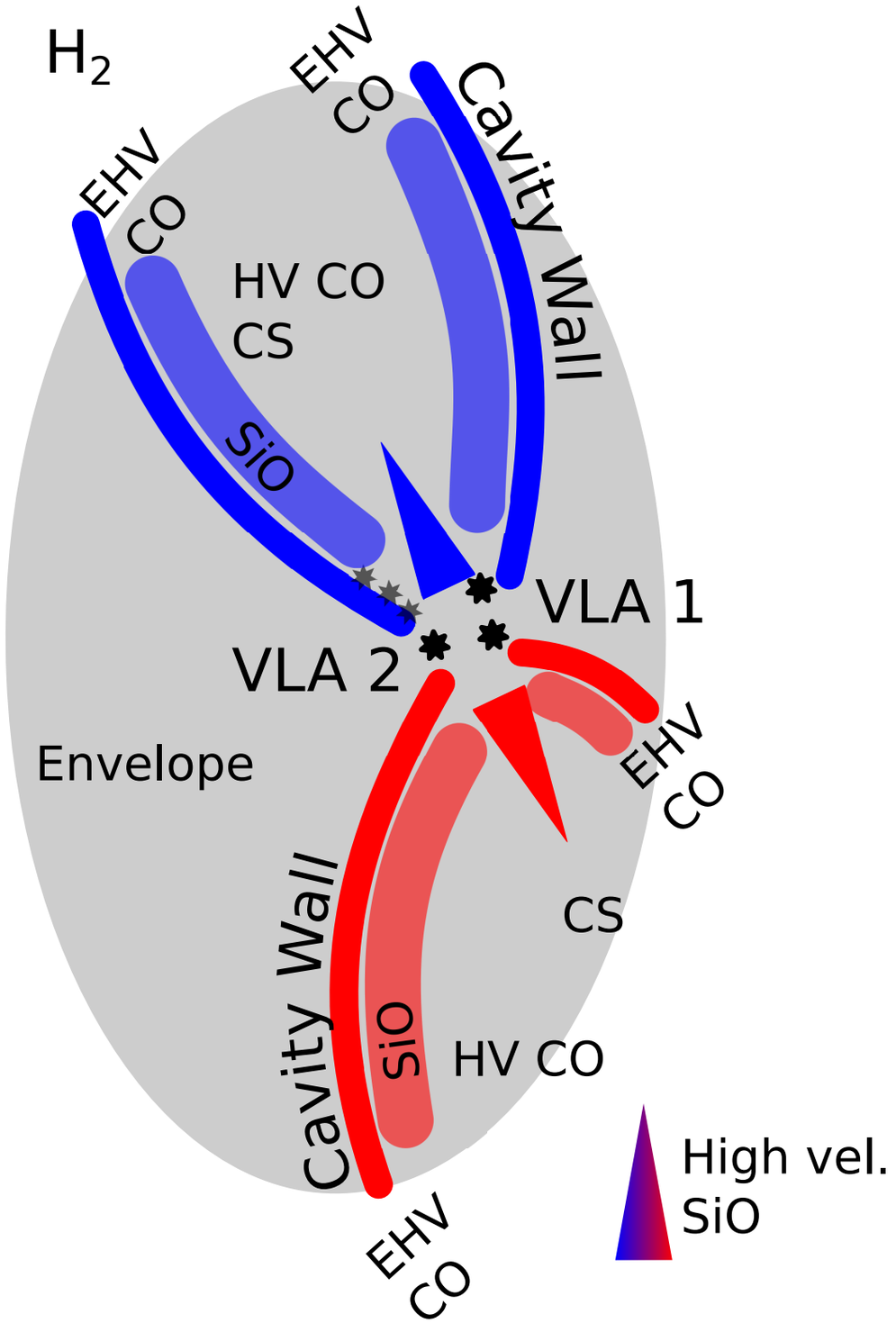


The single outflow

- We're used to the paradigm in which each outflow can *and should* be traced back to each powering source.

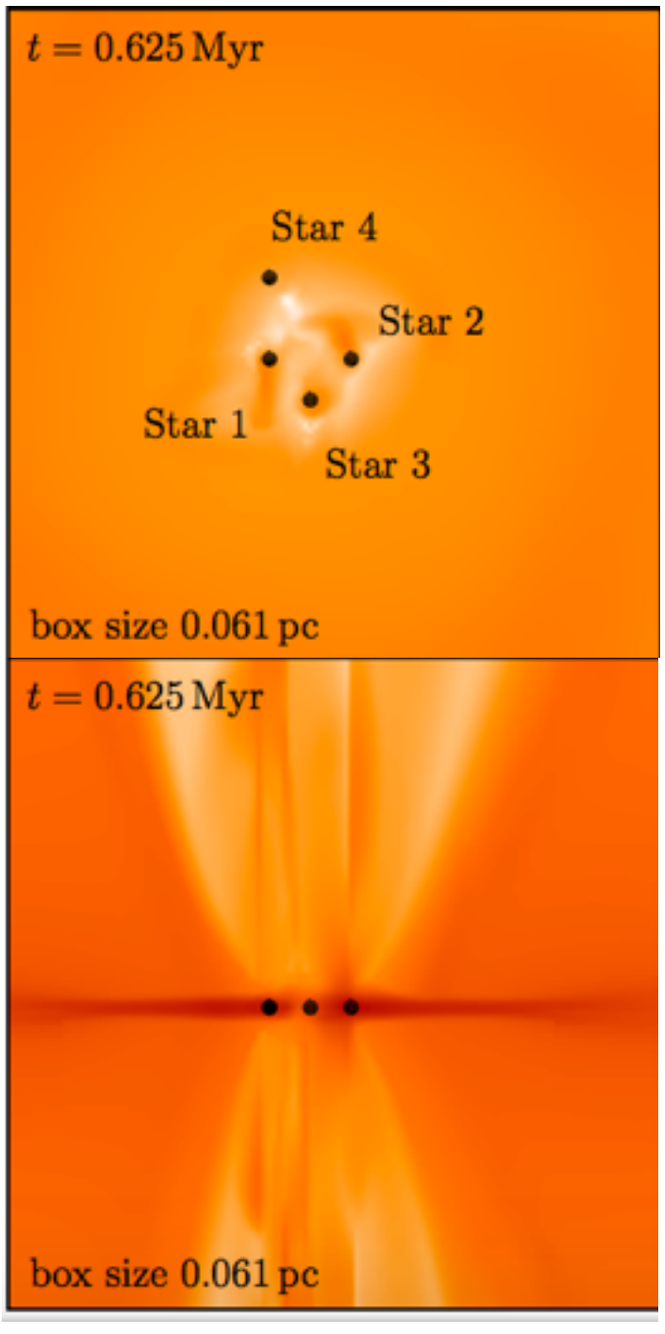
- I'm going to step through the data to show you why I think there's only one outflow, despite the presence of multiple HII regions
  - SiO
  - CS

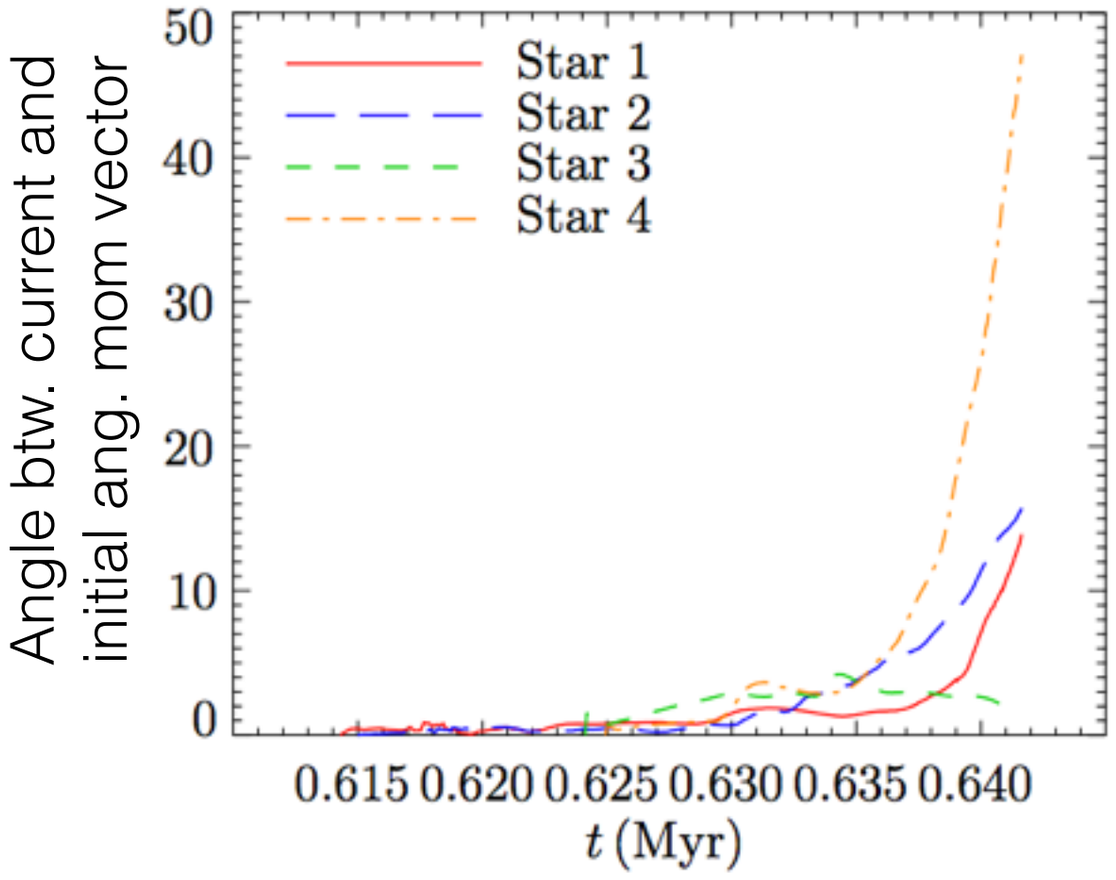
With help from previously published CO



Comparing to Models

Peters et al. 2014b

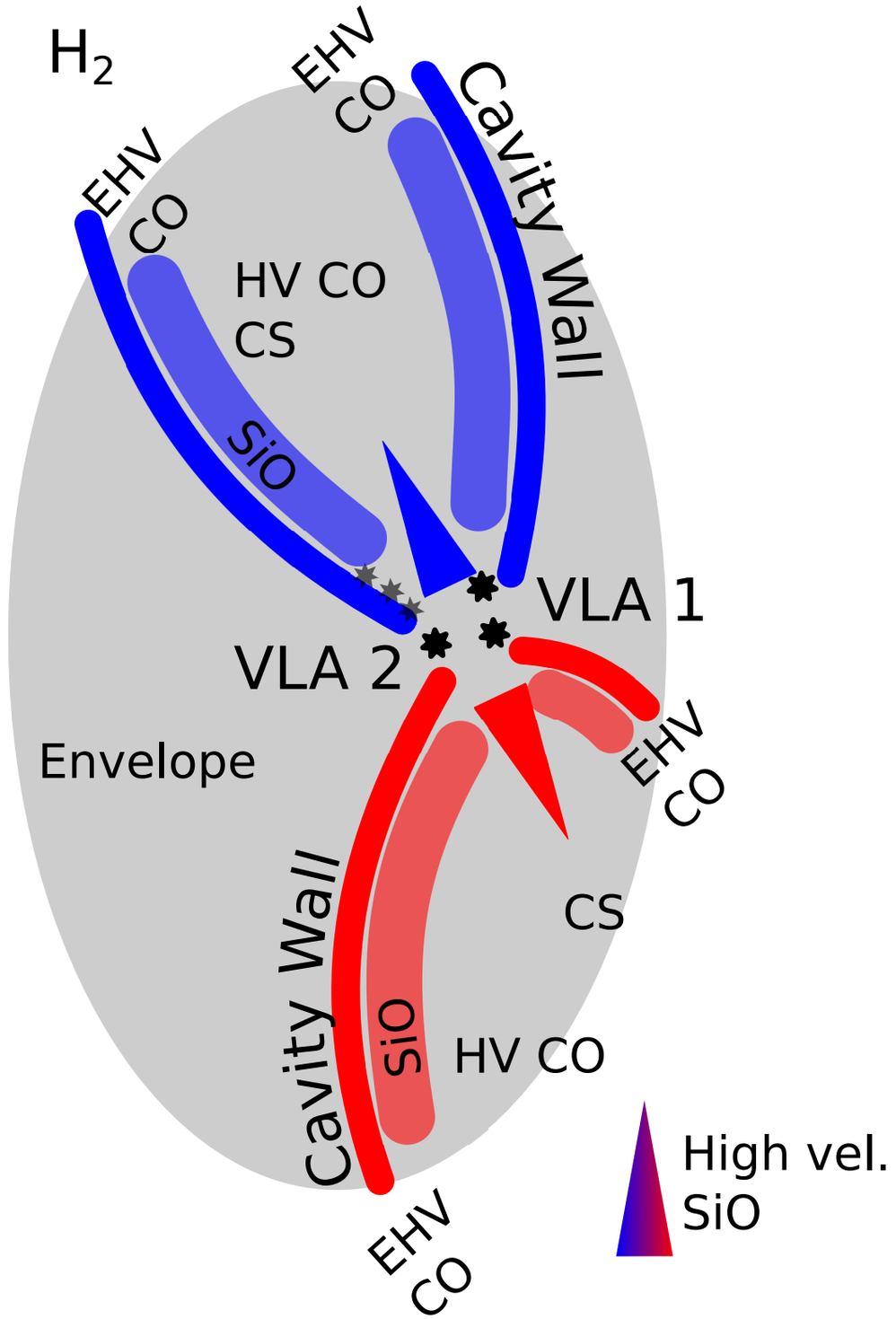




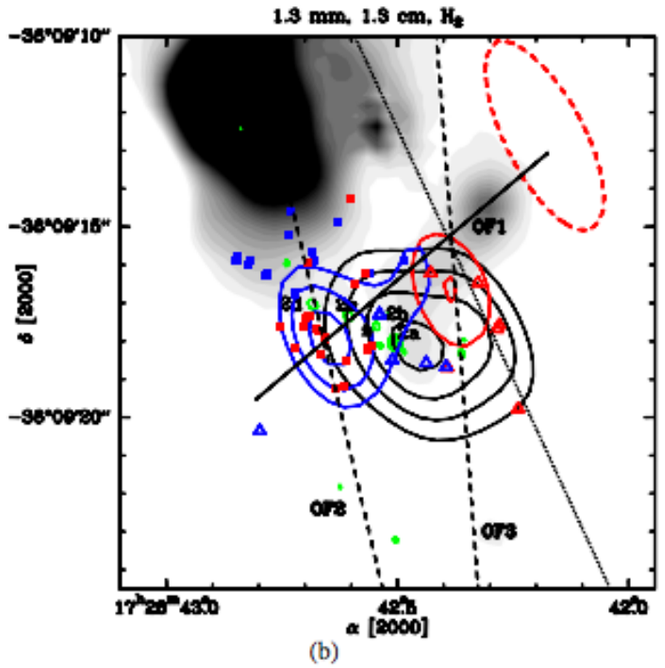
- multiple stars forming from a single accretion flow
- coupled outflow & radiative feedback
- outflows tend to preferentially align themselves

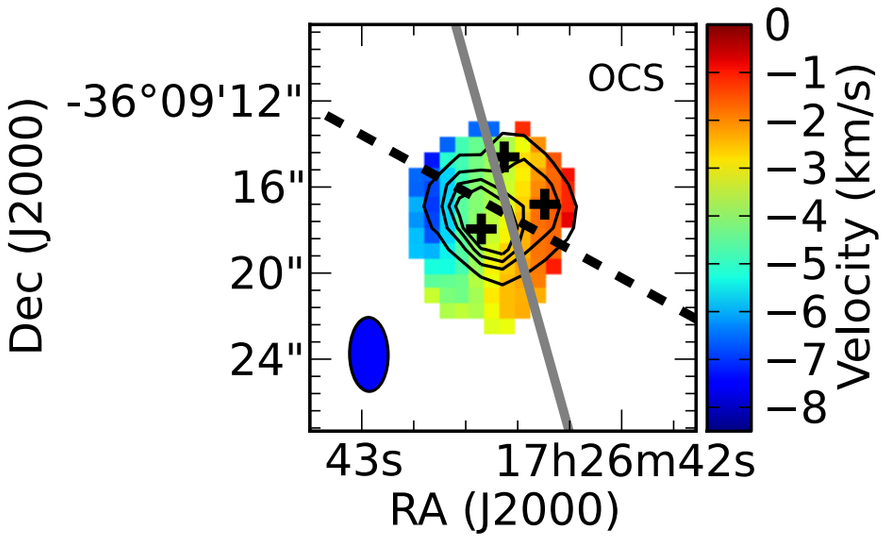
Conclusions

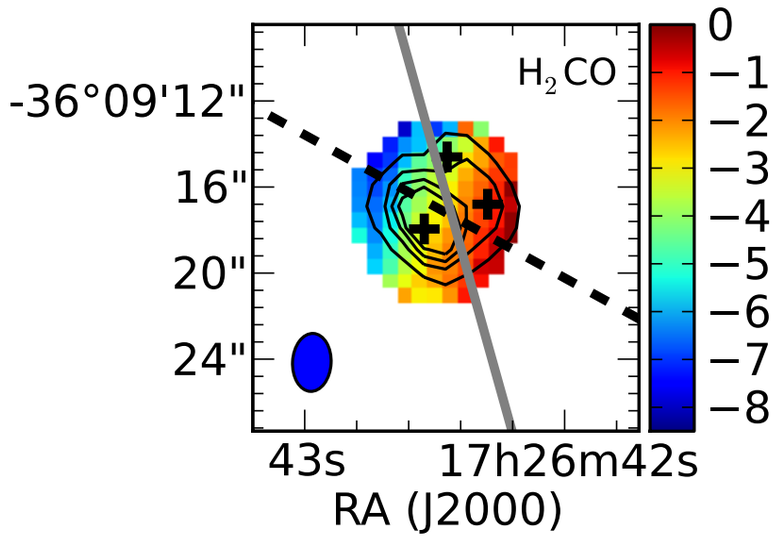
- clusters of HM stars likely influence each other
- their outflows may align
  - causing only 1 large structure to be seen
  - the individual contributions can't even be distinguished in models



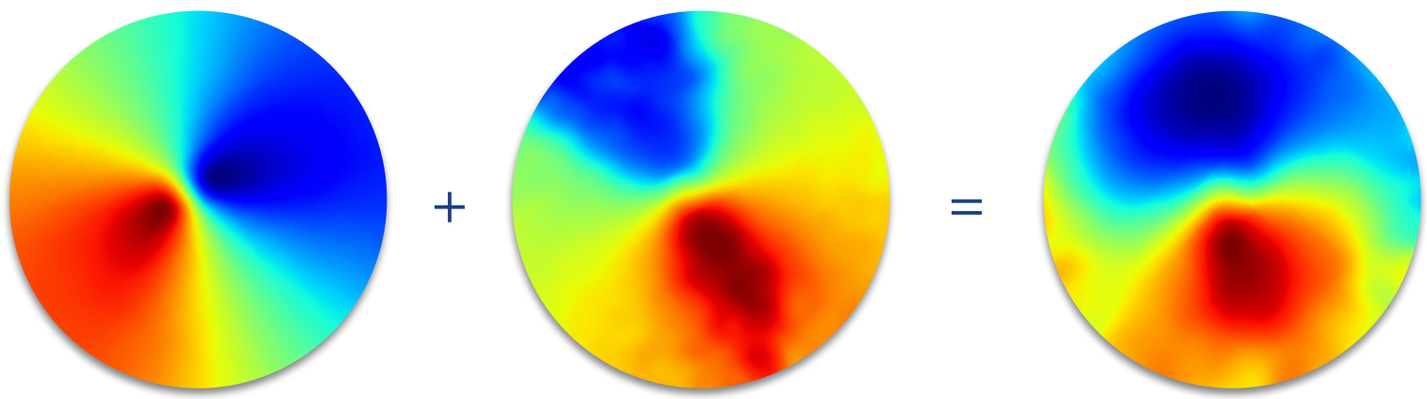
The ‘Third’ Outflow

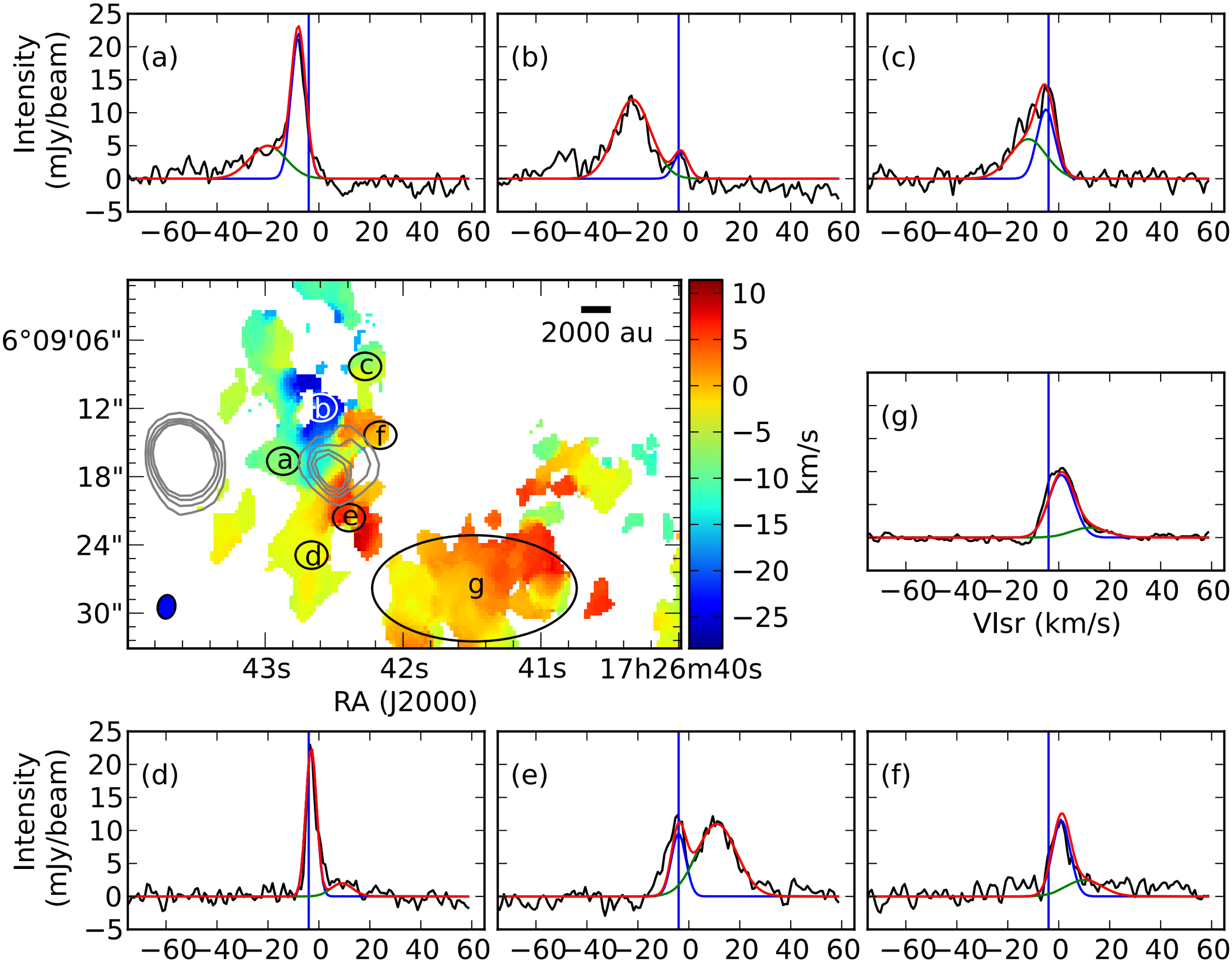






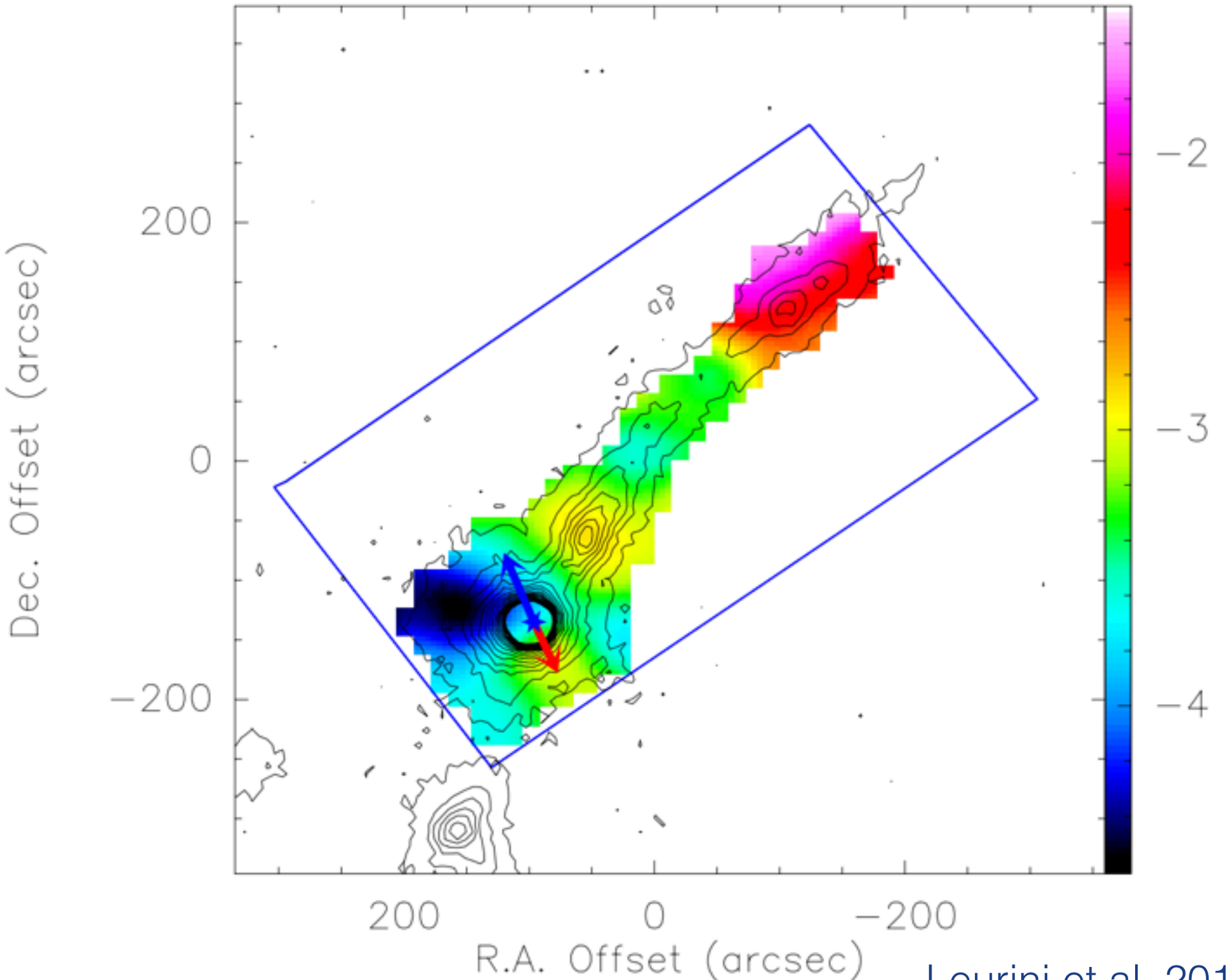
- ~perpendicular to primary outflow direction
- due to a combination of outflow & rotating core motions




(a)
(b)
(c)
Intensity (mJy/beam)
25
20
15
10
5
0
−5
−60 −40 −20 0 20 40 60
2000 au
-36°09'06"
12"
18"
24"
30"
Dec (J2000)
43s
42s
41s
17h26m40s
RA (J2000)
a
b
c
d
e
f
g
10
5
0
−5
−10
−15
−20
−25
km/s
(g)
VIsr (km/s)
(d)
(e)
(f)

Larger Scale Structure

- N_2H^+
- MOPRA observations
- outflow indicated near bottom of IRDC



Leurini et al. 2011