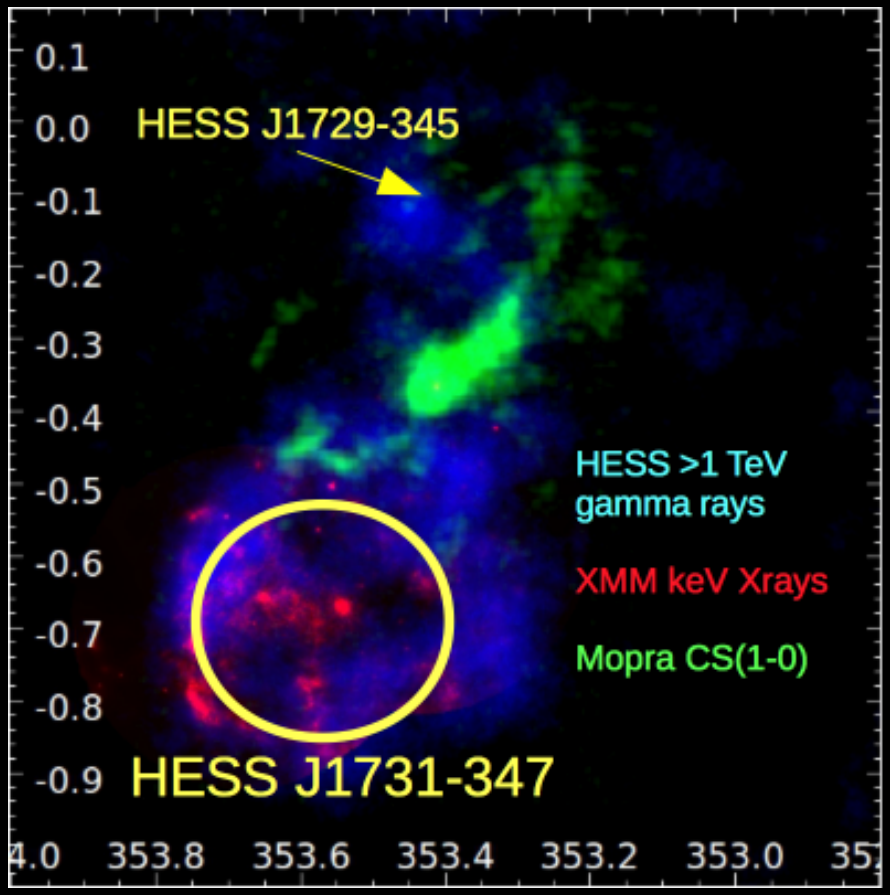
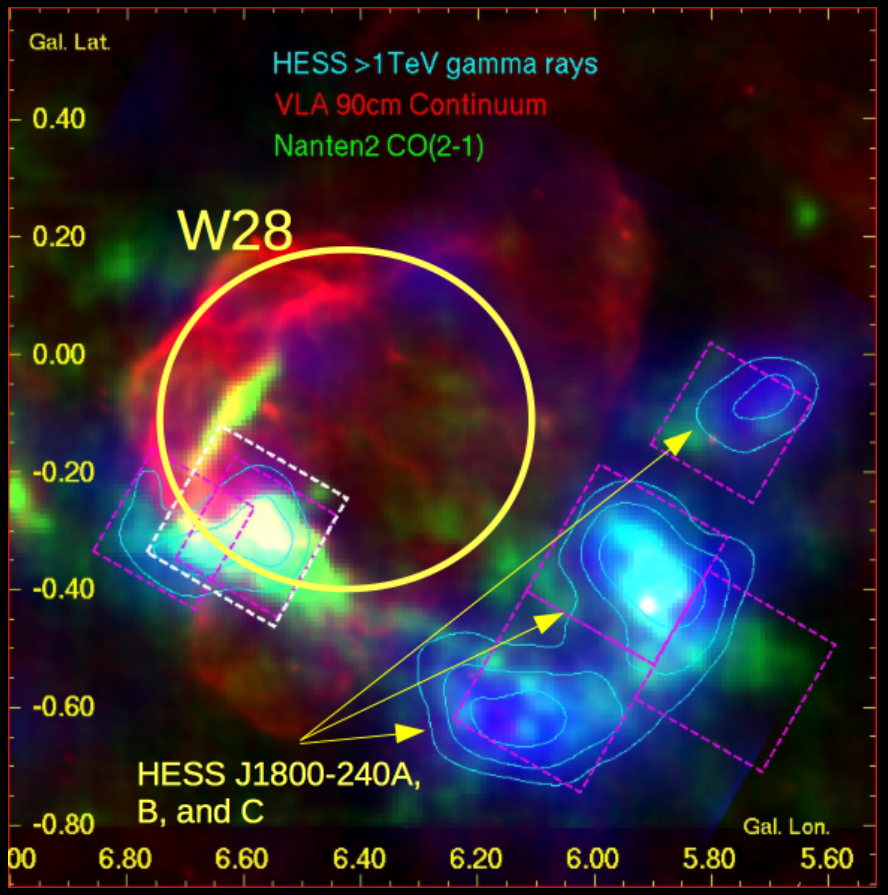
# Gas towards SNRs

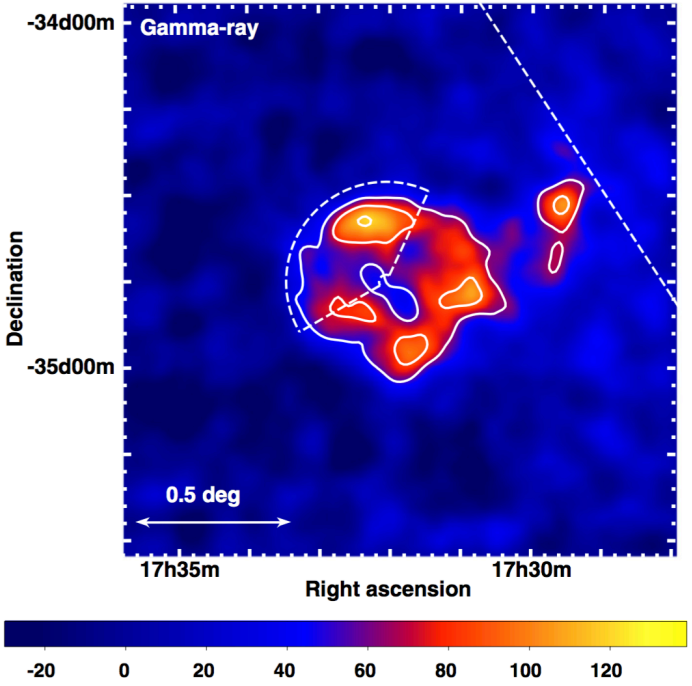
Nigel Maxted
CTA-Oz, Western Sydney,
April 2017

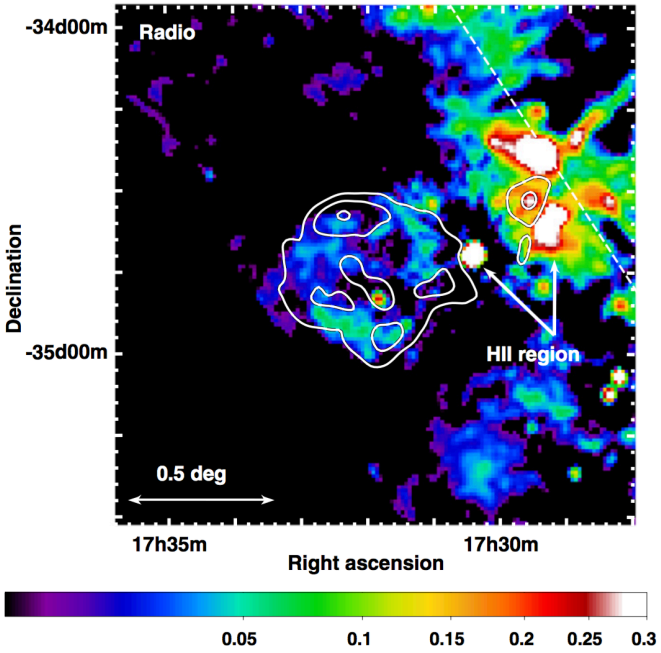
1) Young SNR, HESS J1731-347
2) Old SNR, W28

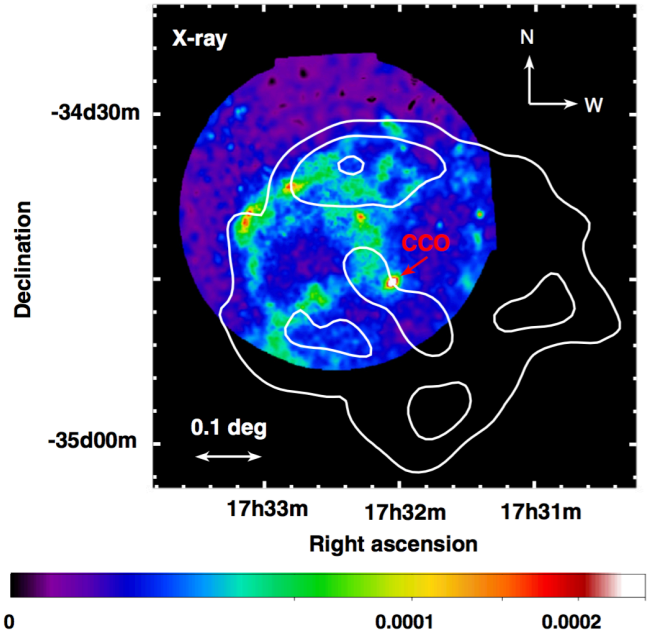


# Probing The Local Environment of the Supernova Remnant HESS J1731−347 with CO and CS Observations




Abramowski et al 2011

# Scutum Vs Expanding Arms

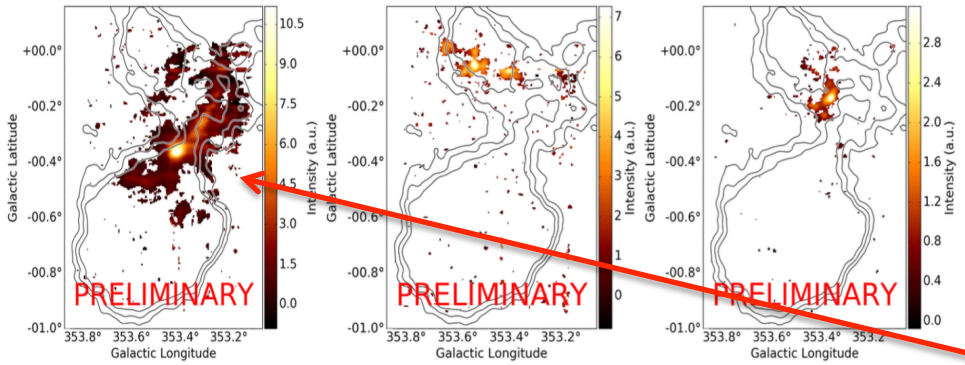
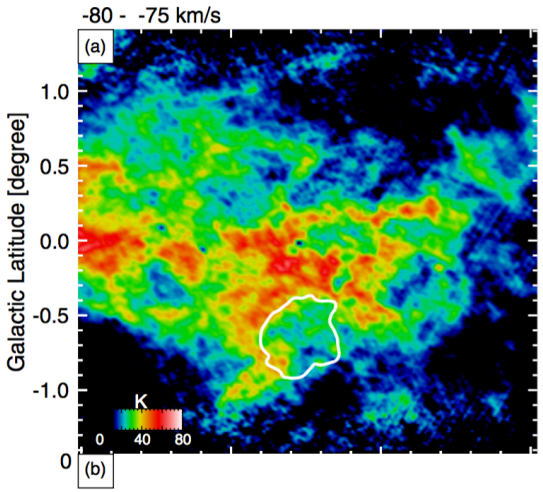
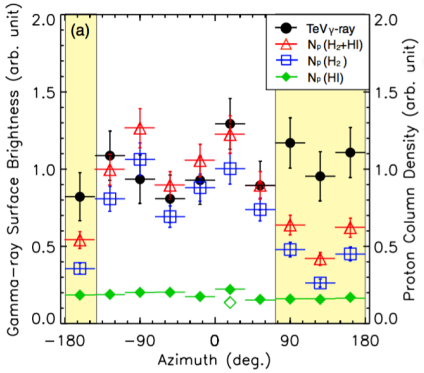


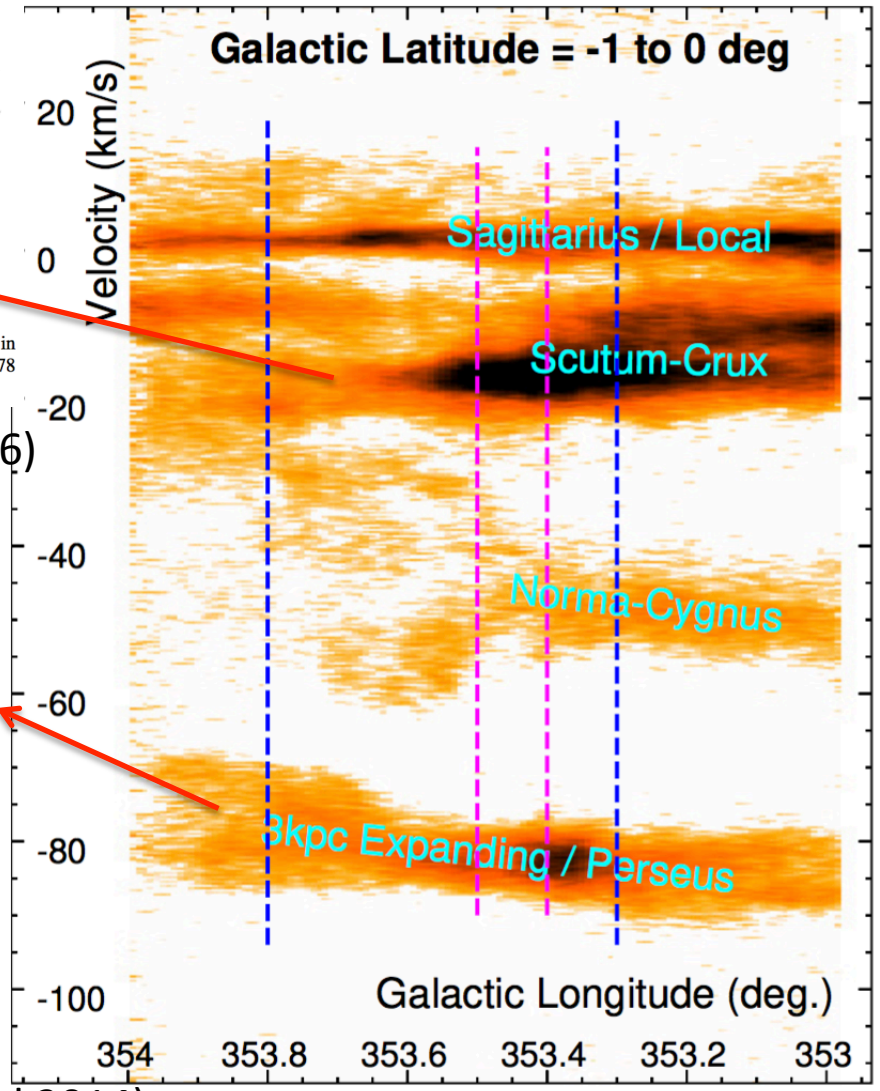

**FIGURE 2.** The figure shows the integrated intensity maps in the HESS J1731-347 region for the three different velocity ranges in which a signal from CS is detected [10]. *Left*: -23.7 to -7 km/s (~ 3.2 kpc) *Middle*: -65 to -35 km/s (~ 4.5 kpc) *Right*: -85.5 to -78 km/s (~ 5 – 6 kpc). Overlaid 3,4,5 significance contours from the H.E.S.S. analysis of the source presented in this work.

**3.2kpc** Low-sigma TeV bridge (Capasso et al 2016)




**5-6kpc** HI void & radial TeV-gas corr. (Fukuda et al 2014)

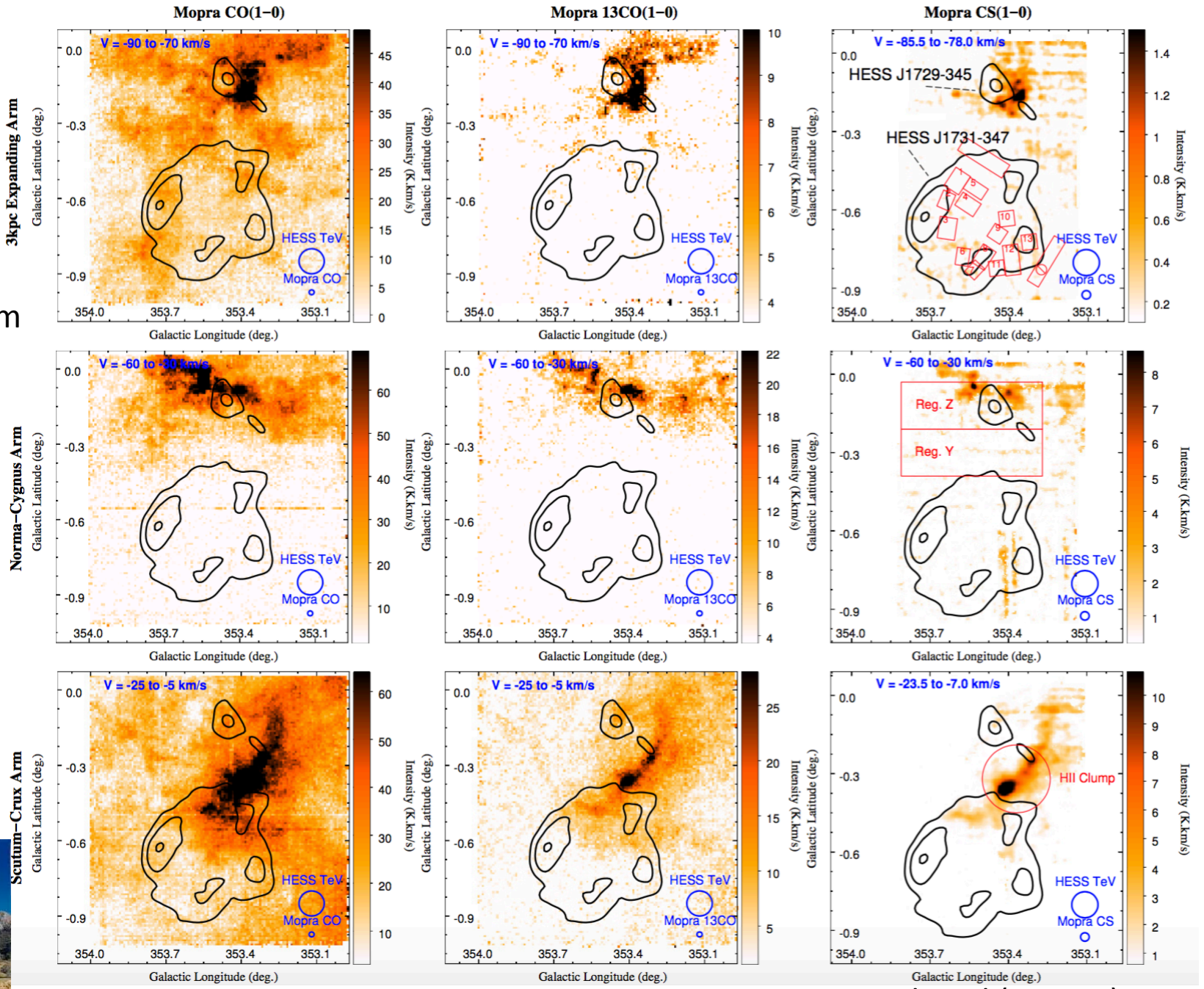



Maxted et al (in prep)

**Mopra**

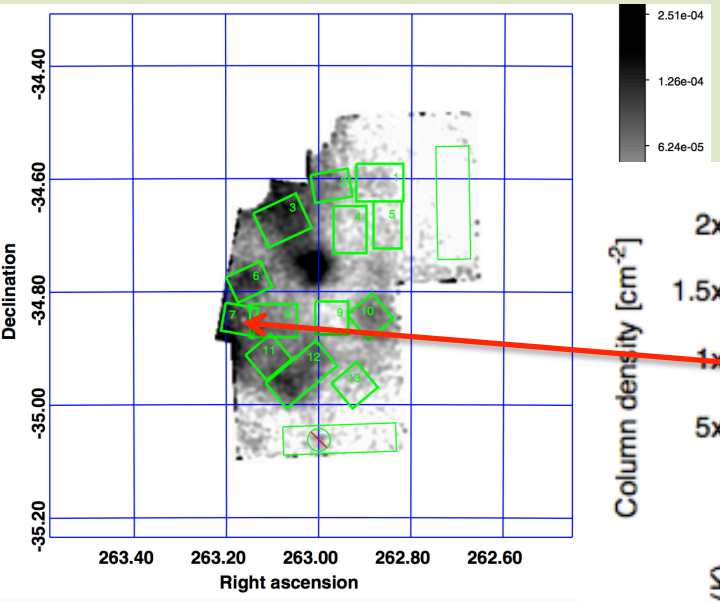
CO 0.5’ beam (& 13CO)

CS 1’ beam

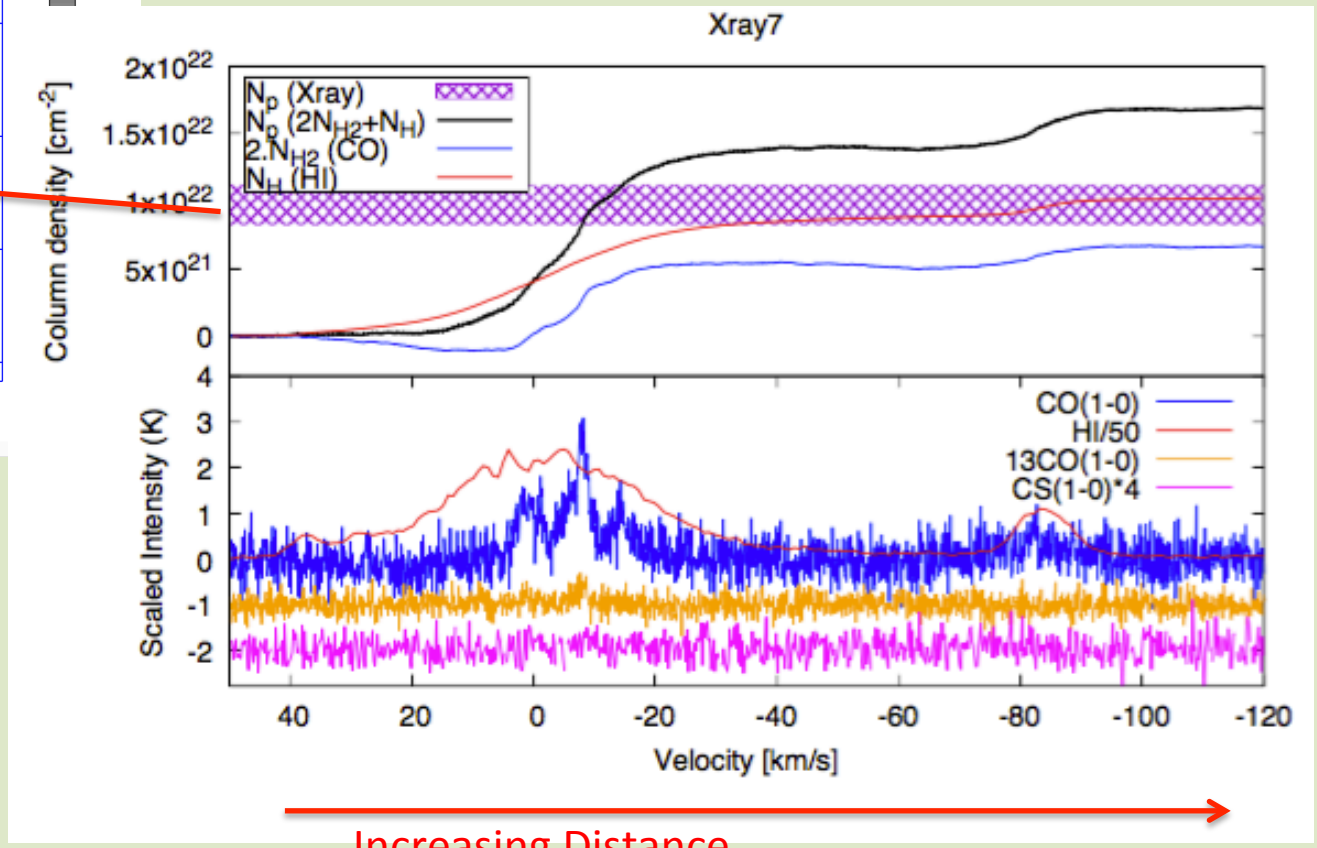



Maxted et al (in prep)

# 14 X-ray absorption column densities can be compared to Spectral CO + H data




Bamba_etal_2012




Increasing Distance

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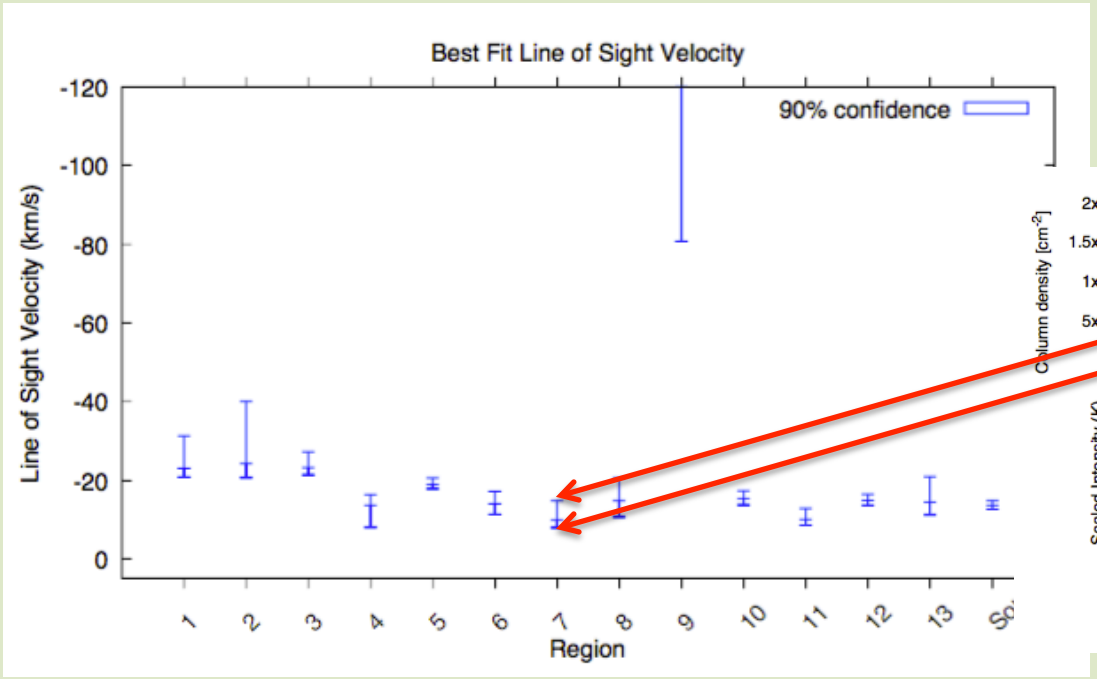
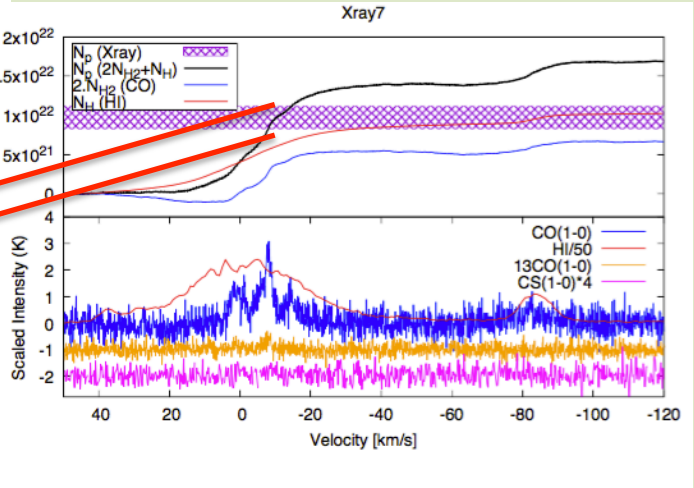
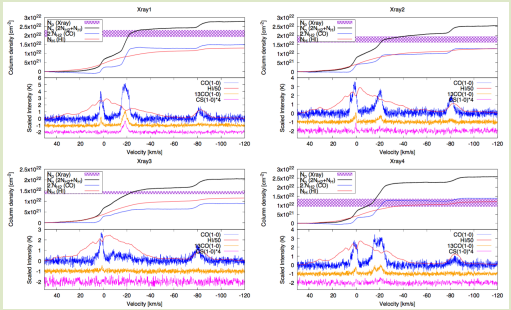
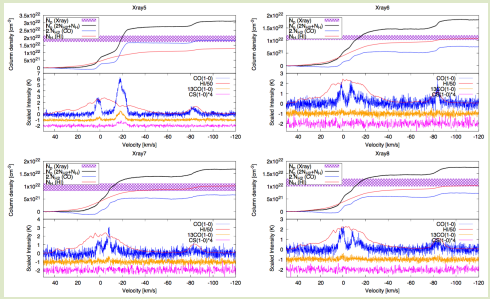
# HESS J1731 – preferred velocity

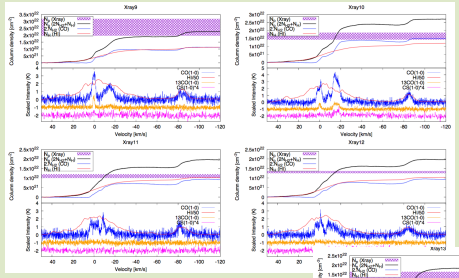


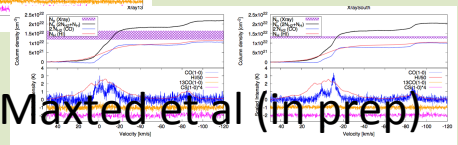




This graph favours the -20km/s solution over -80km/s.









Maxted et al (in prep)

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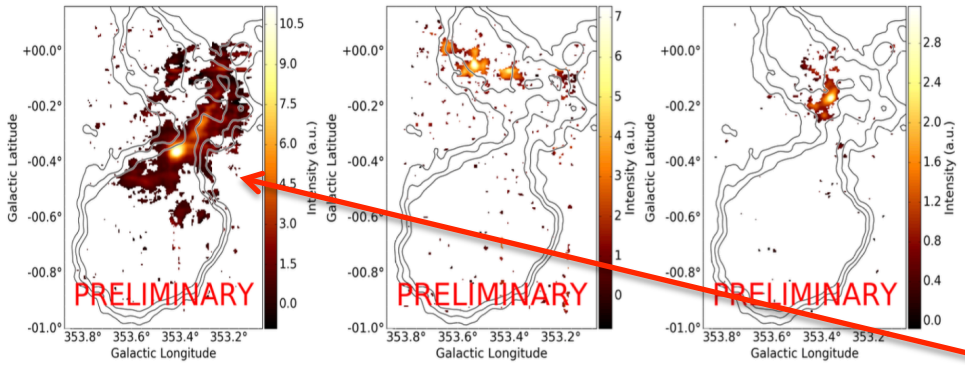


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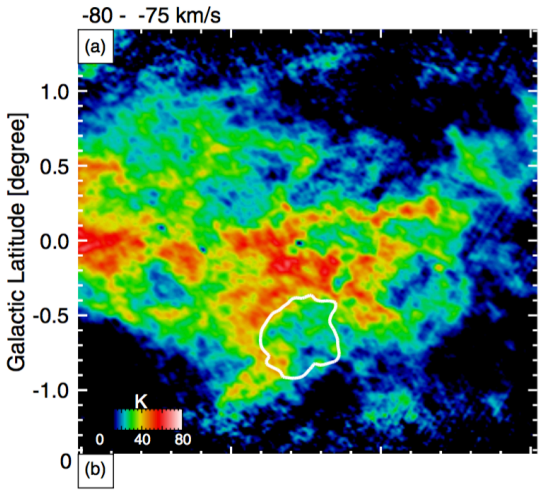


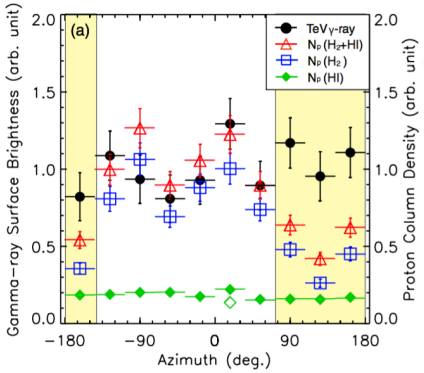


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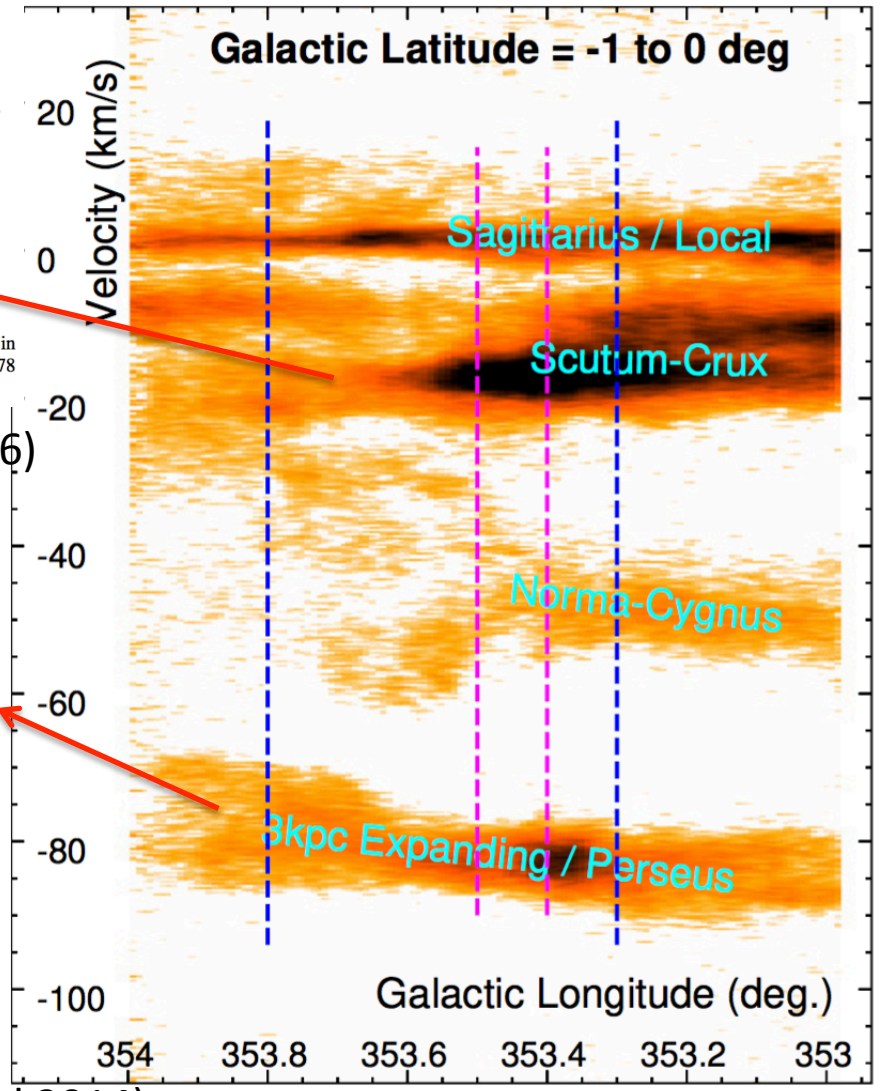
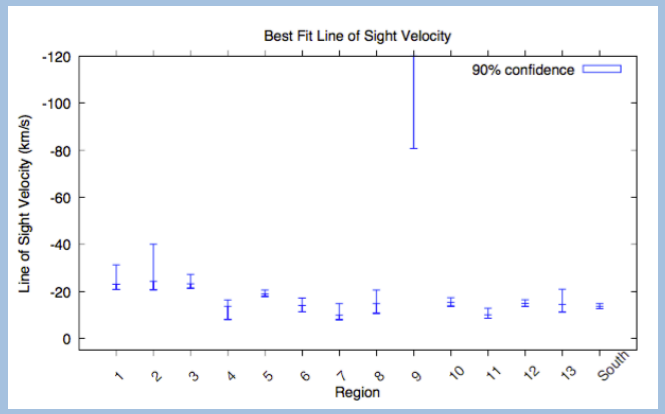


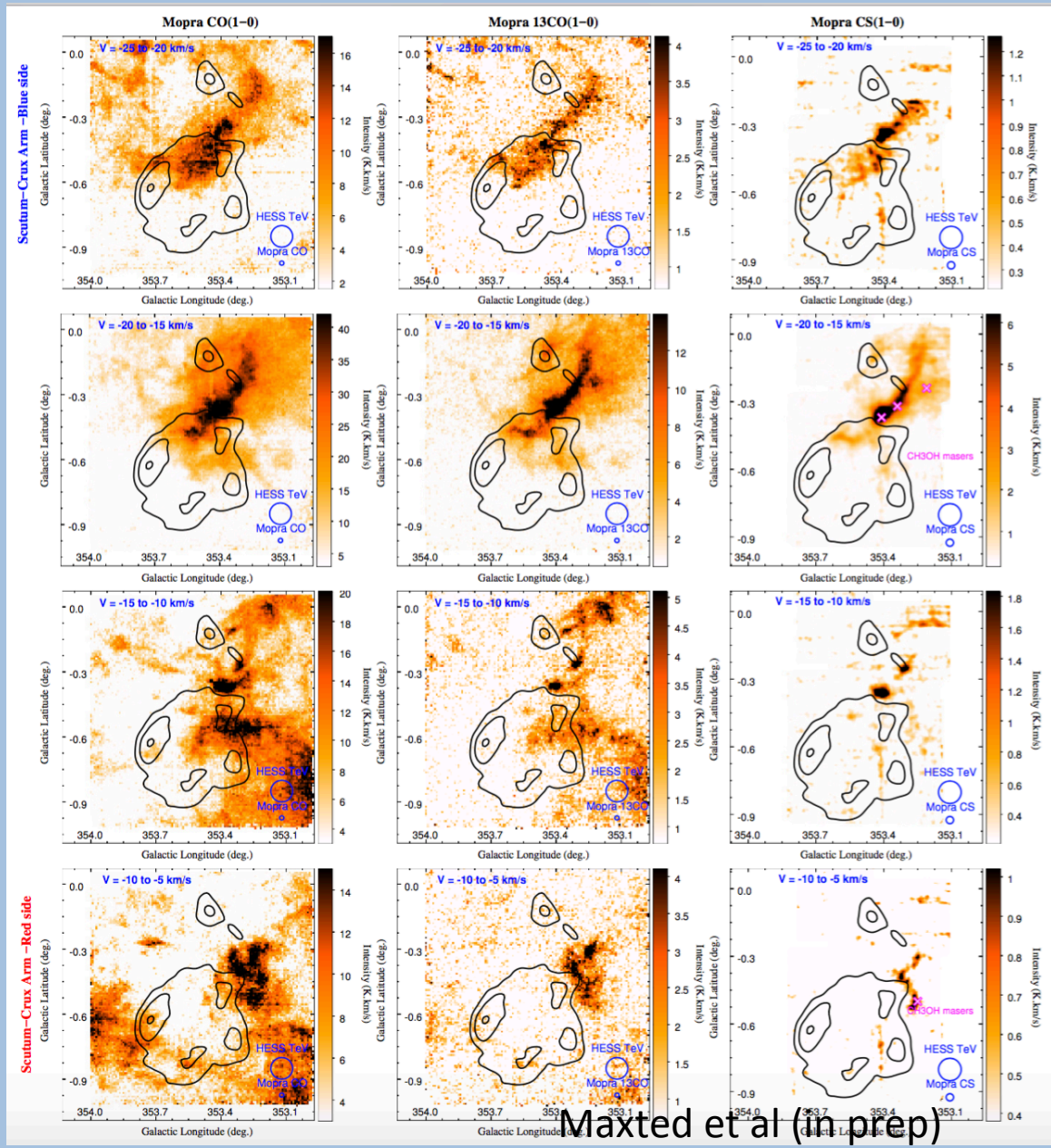

Maxted et al (in prep)

# Investigating the ~-20 km/s gas



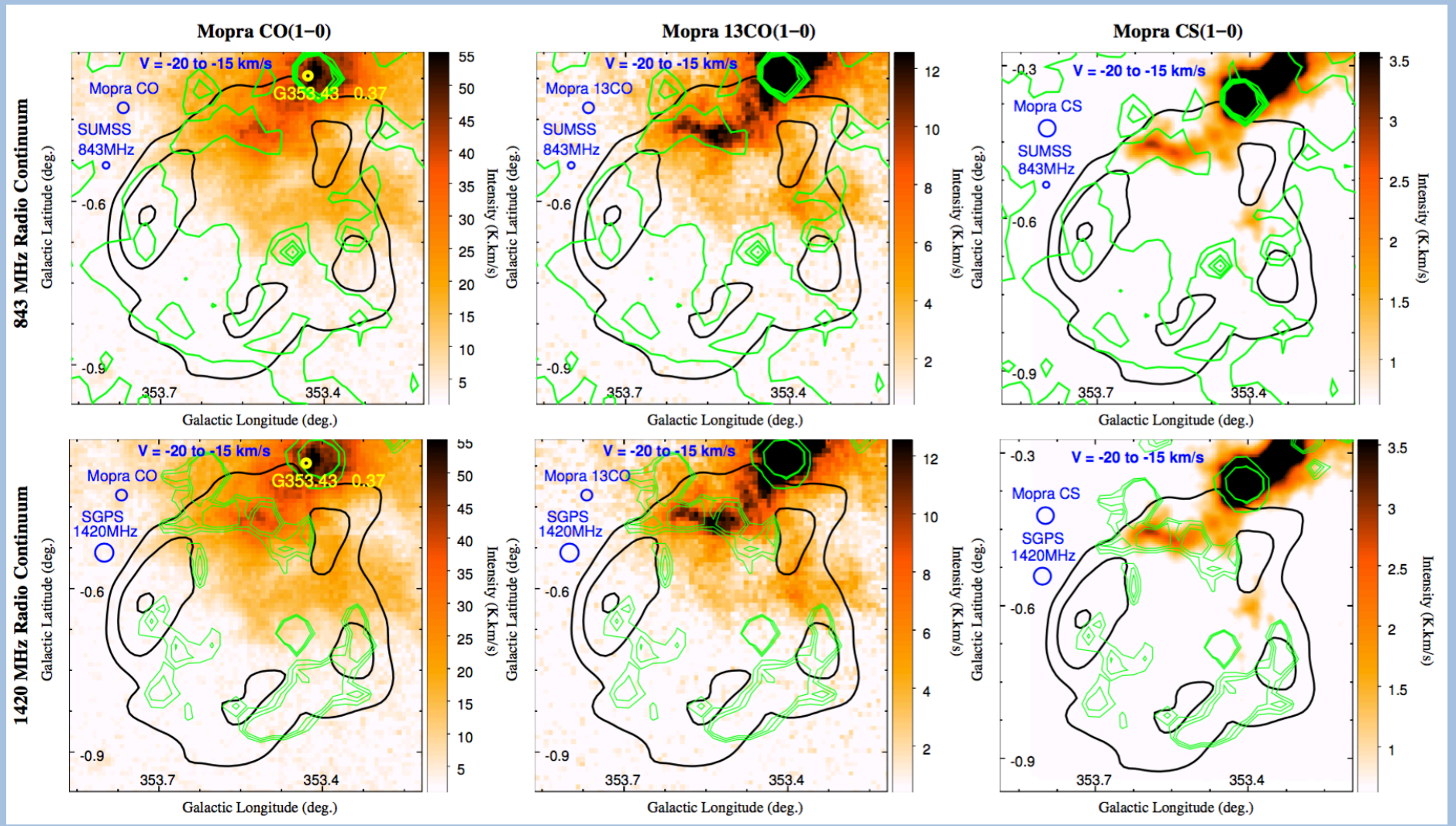

5 km/s slices of the Scutum-Crux arm

CO 13CO CS

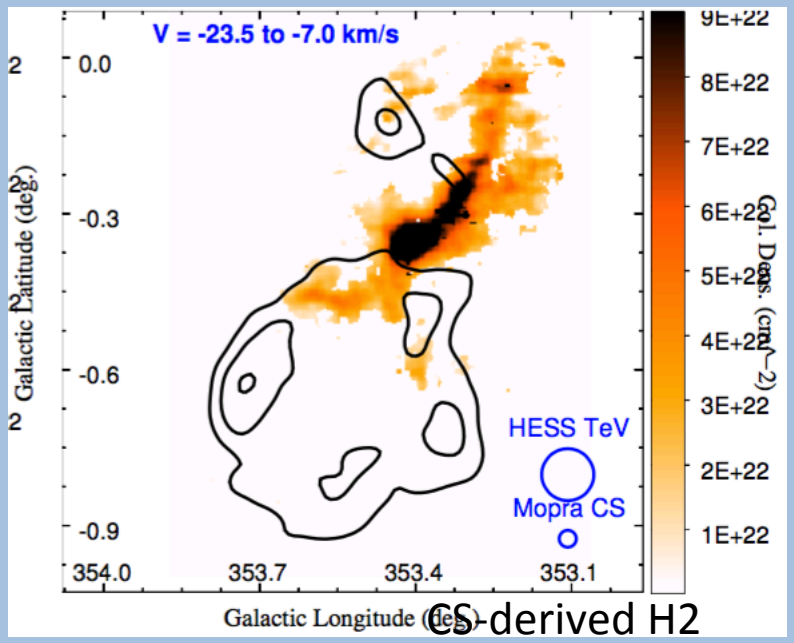



Maxted et al (in prep)

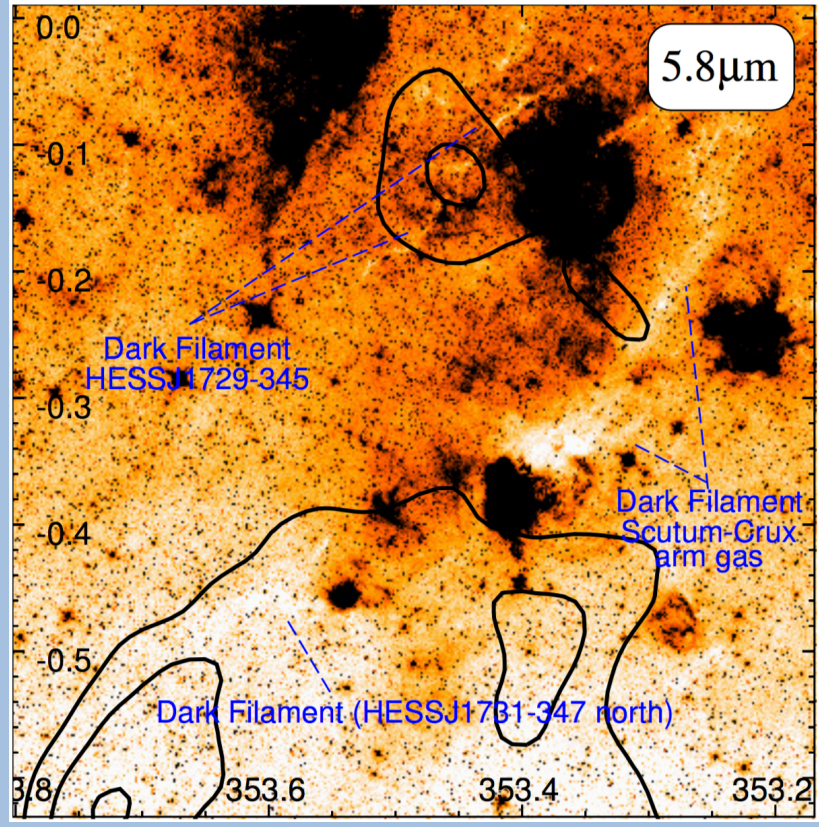
# HESSJ1731-347 radio continuum



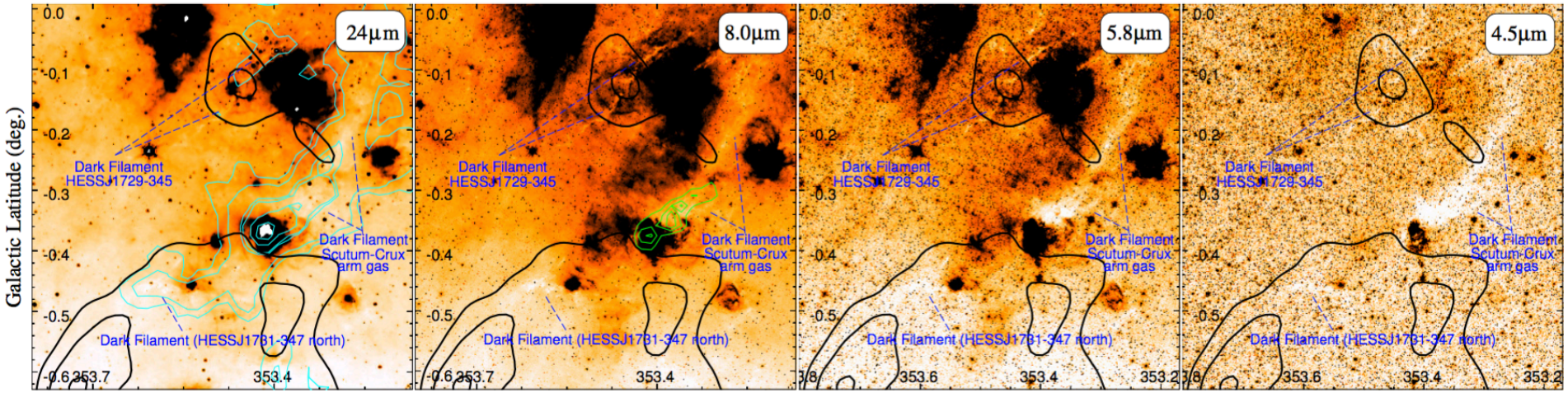

Maxted et al (in prep)




CS-derived H2 column density

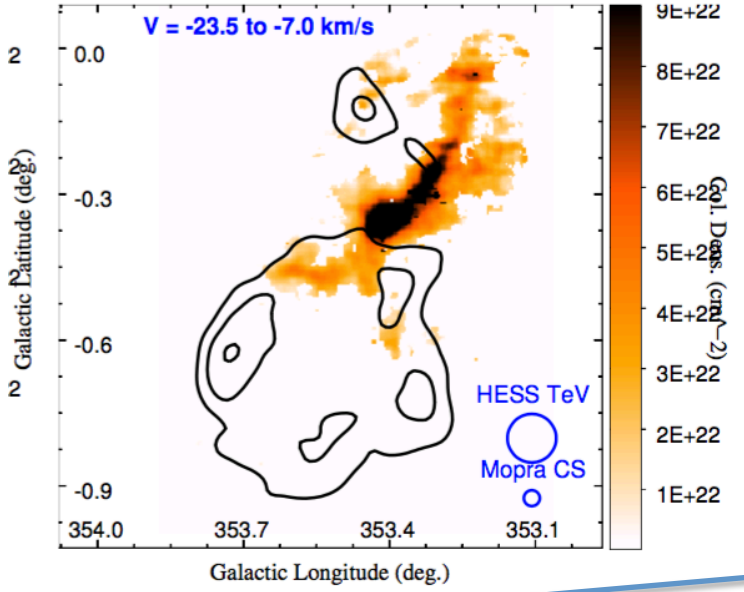



# Infrared emission




Maxted et al (in prep)

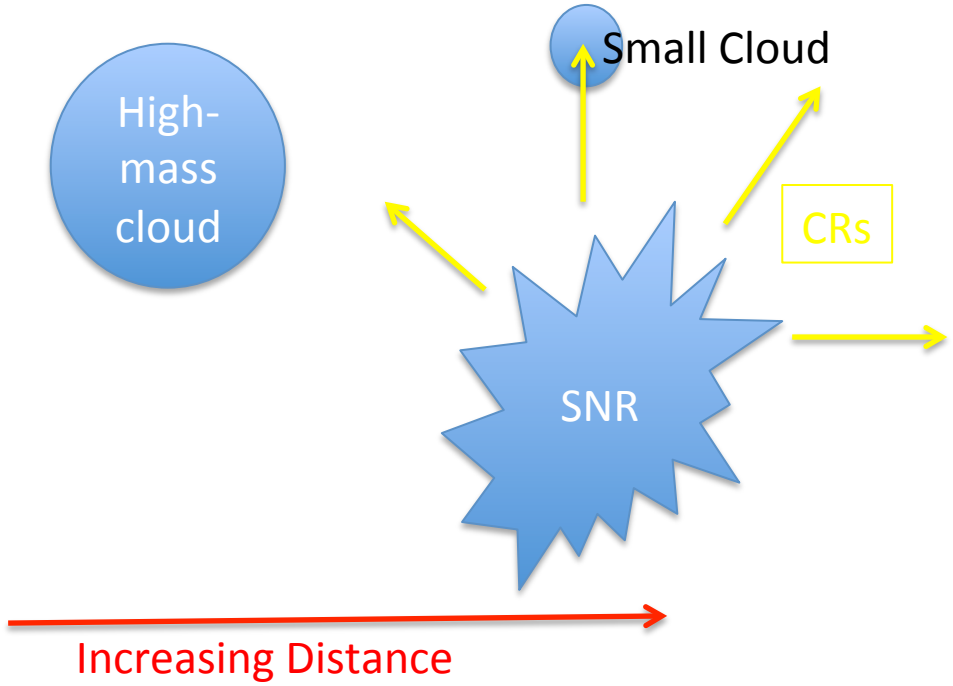
# Two extreme scenarios



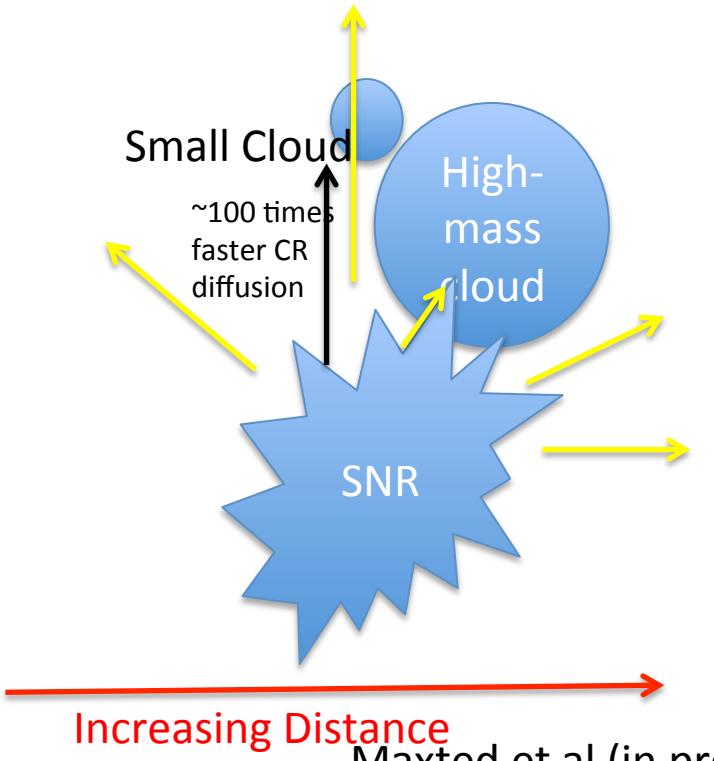

D ~ sqrt (6Dt)

## Geometry within the arm

>50-70pc



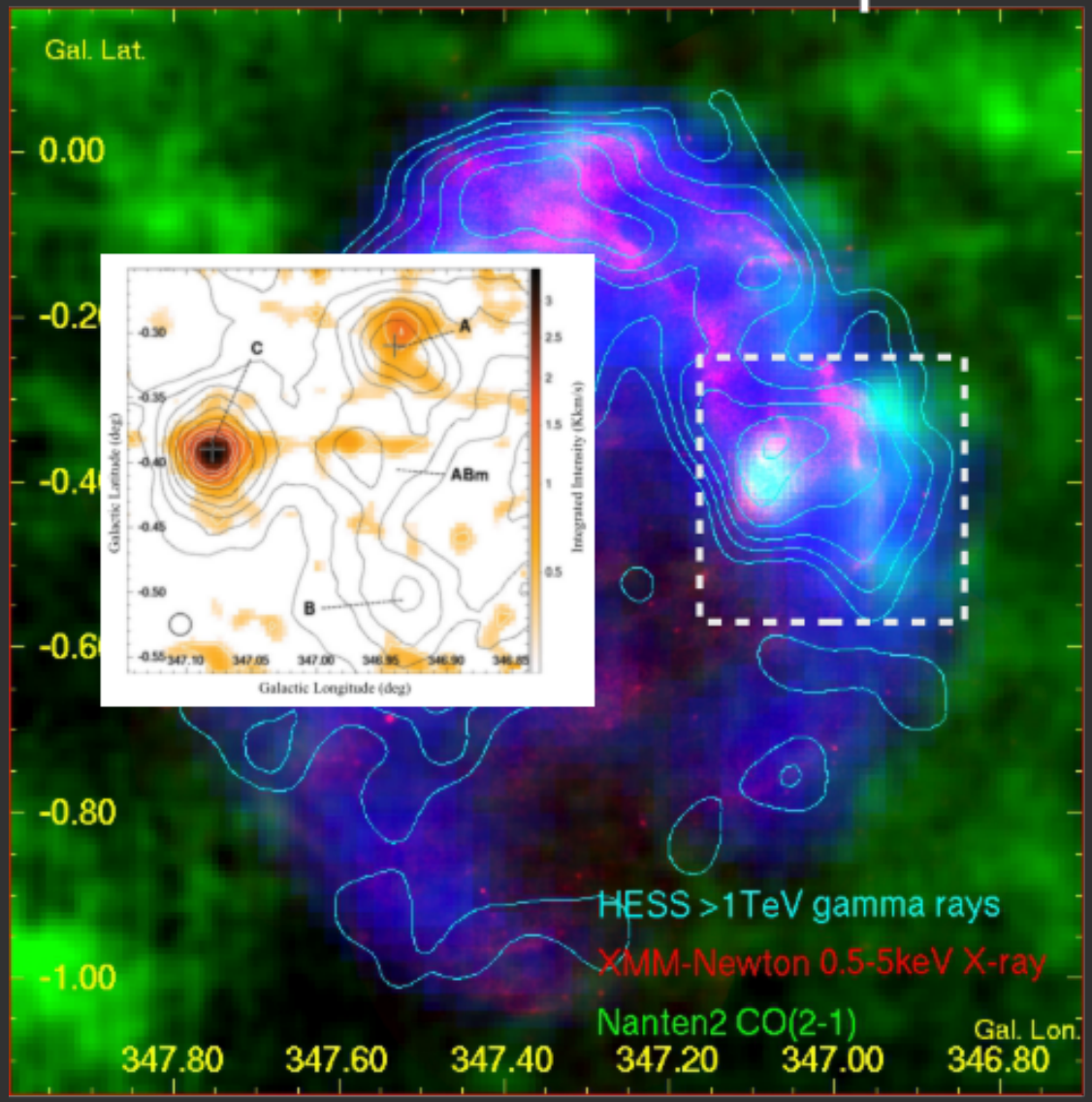

## Diffusion slowed inside the massive core

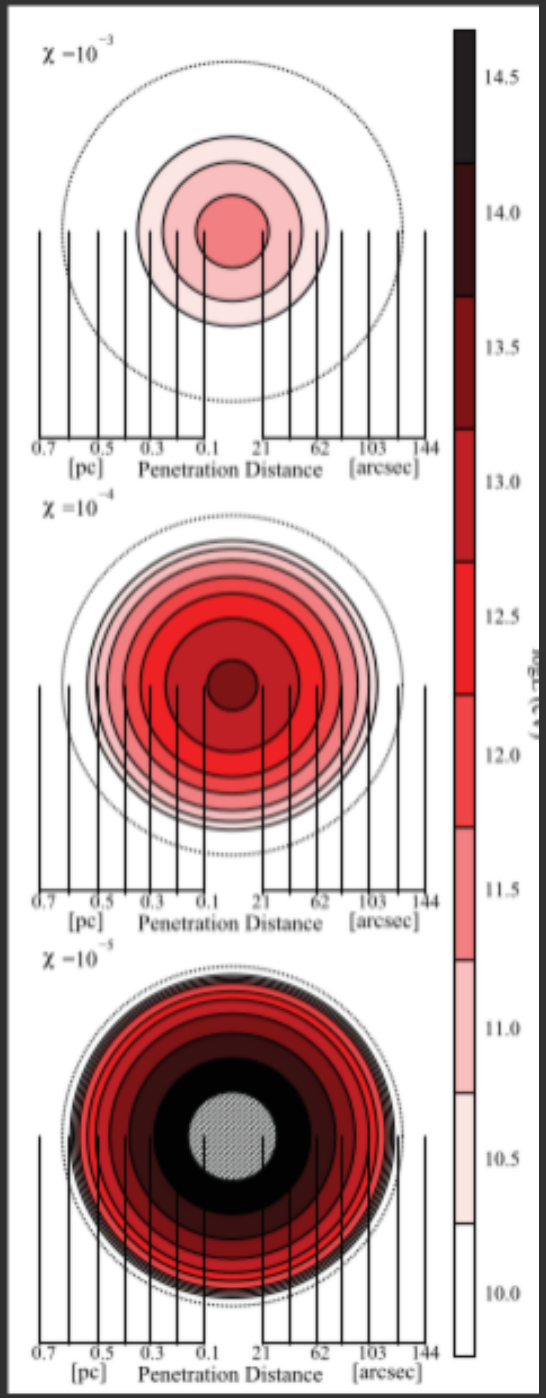



Maxted et al (in prep)

# RX J1713.7-3946

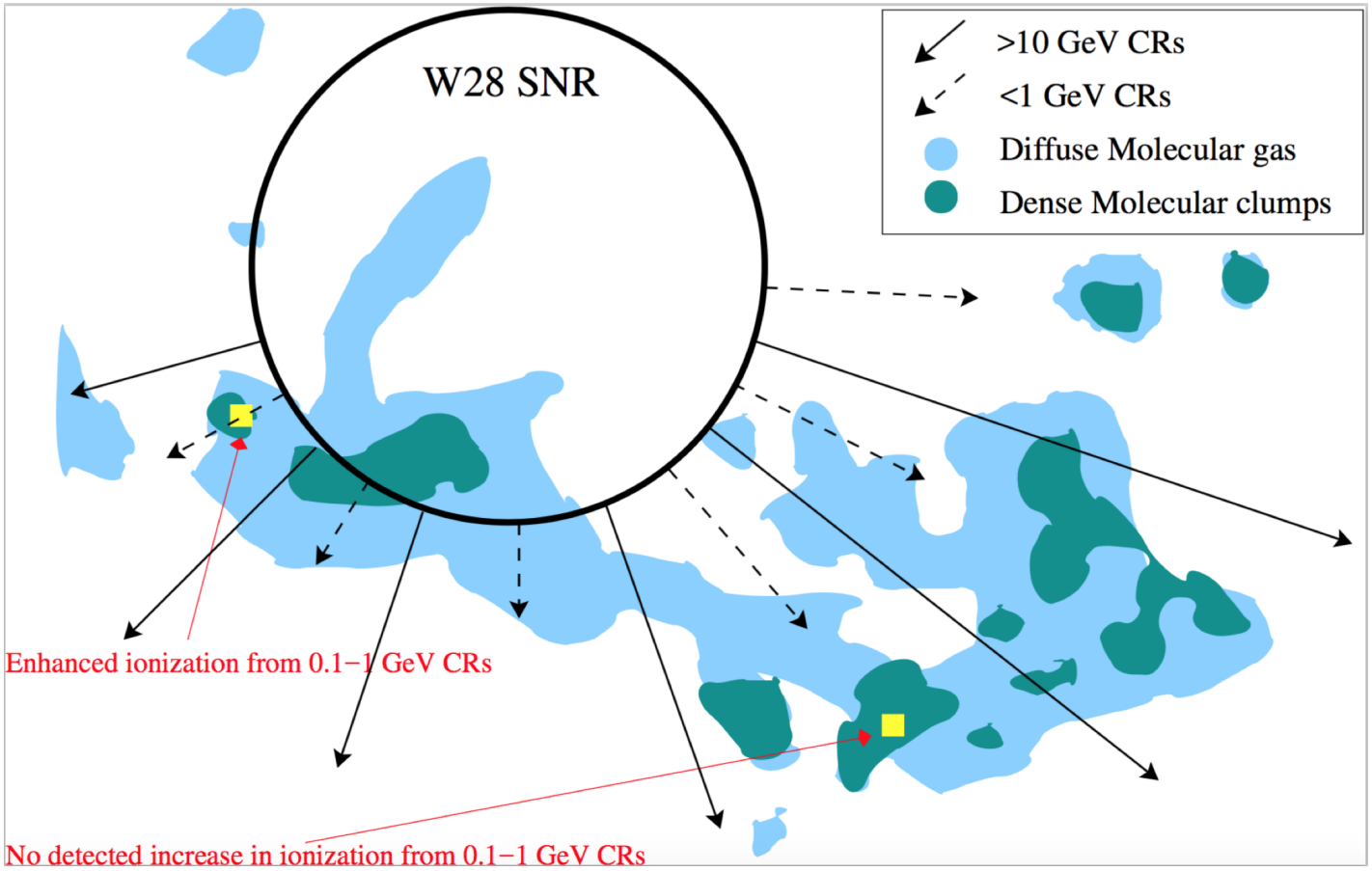
## Diffusion into clumps?




Maxted et al 2012

# W28 - CR diffusion



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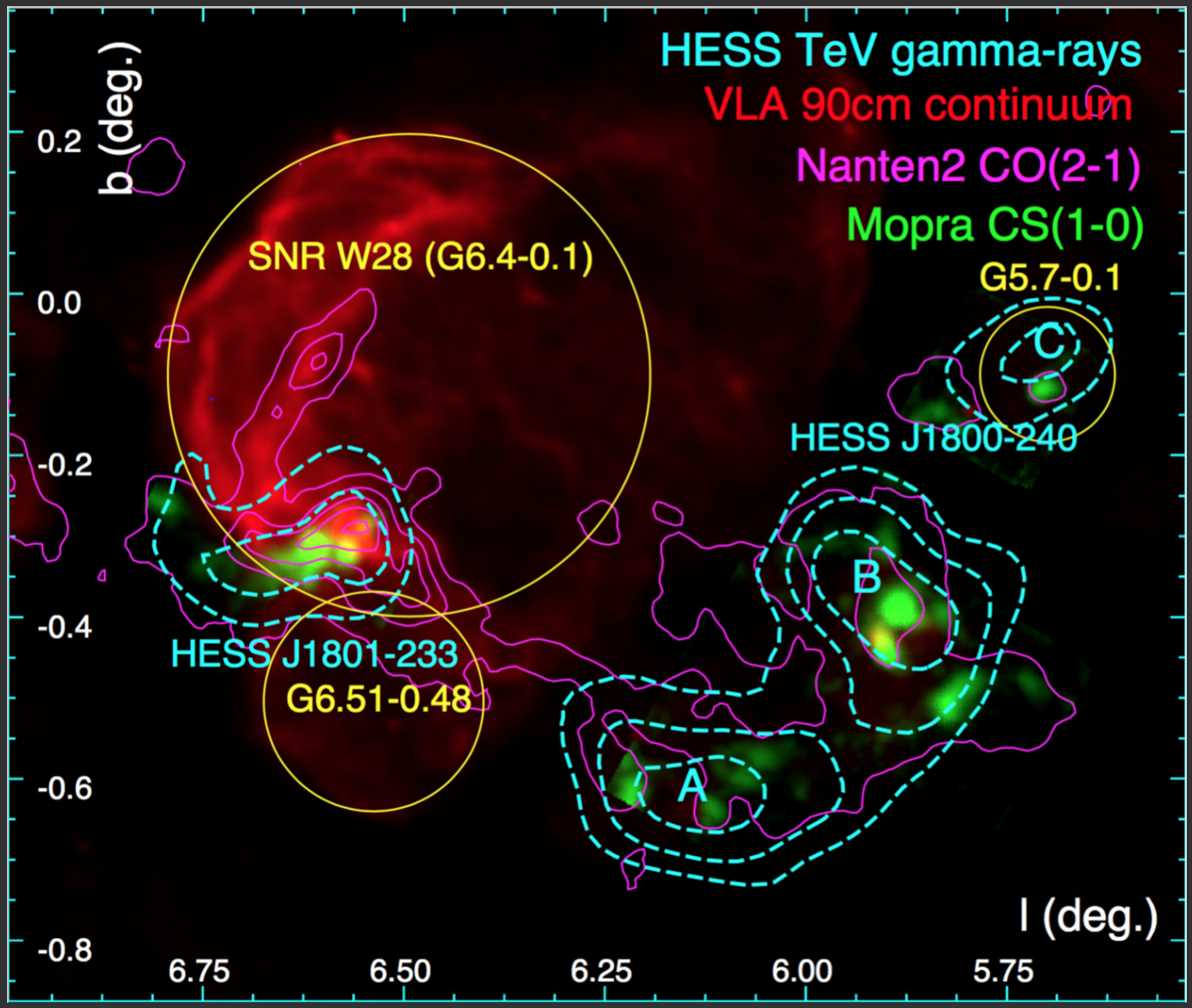
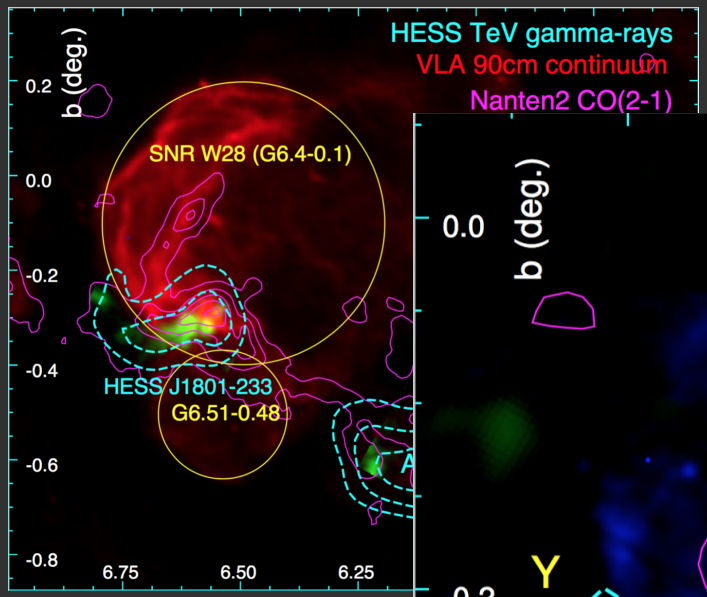
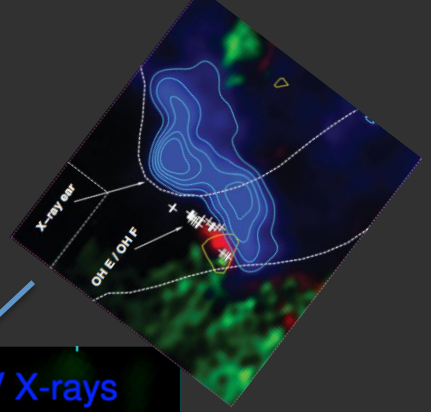
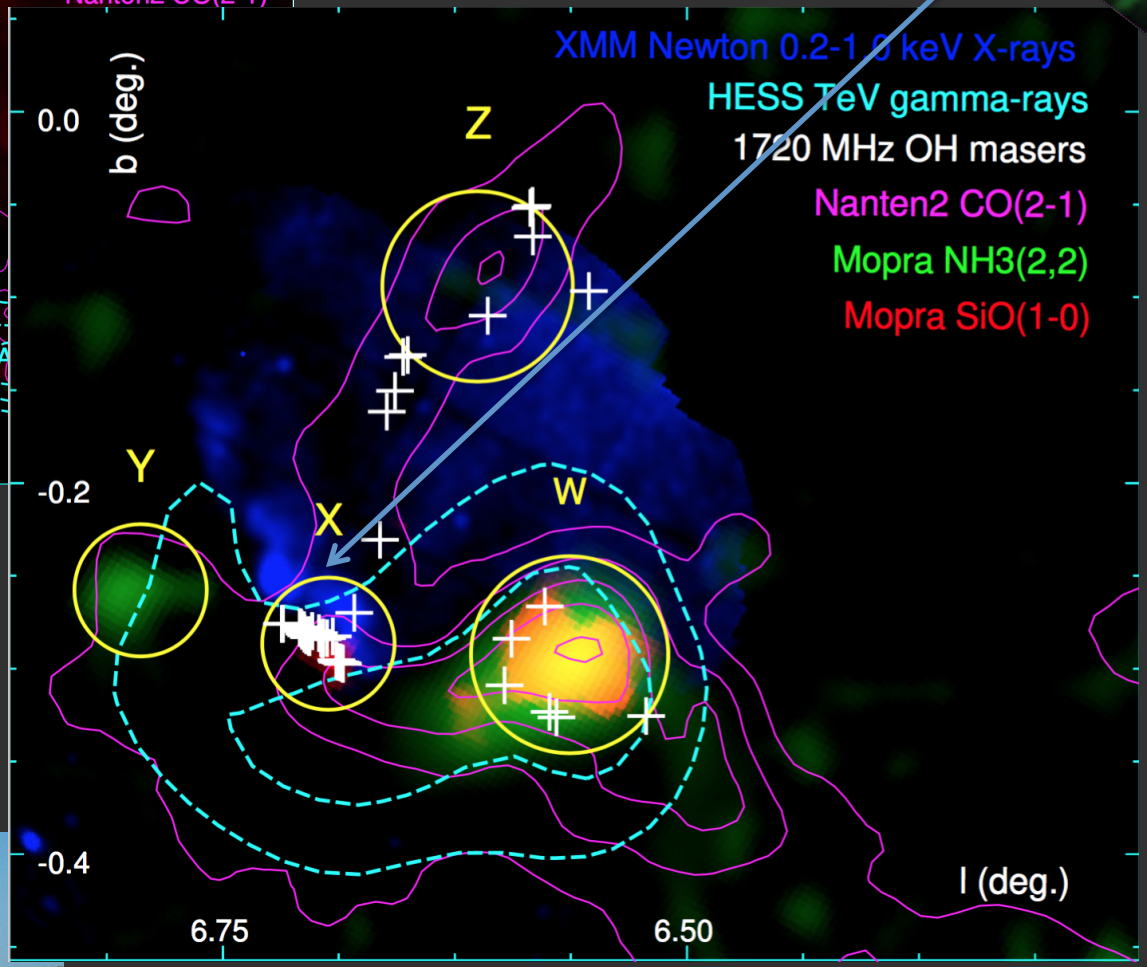



Fukui et al 2008 Nicholas et al 2012 Pic: Maxted et al 2016b

# W28 – shocked cloud

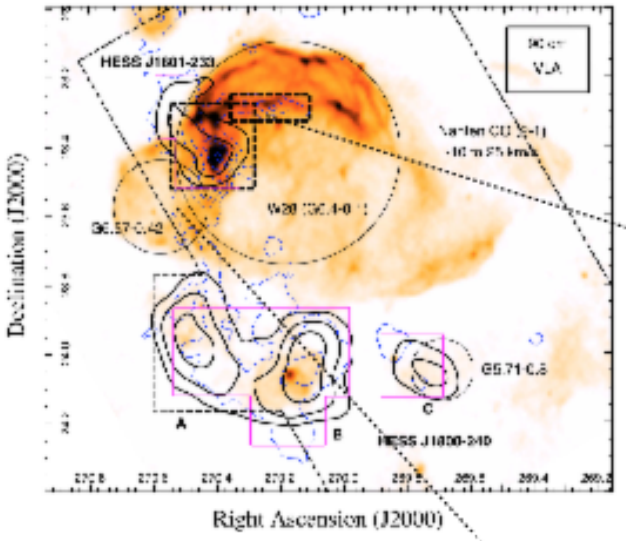


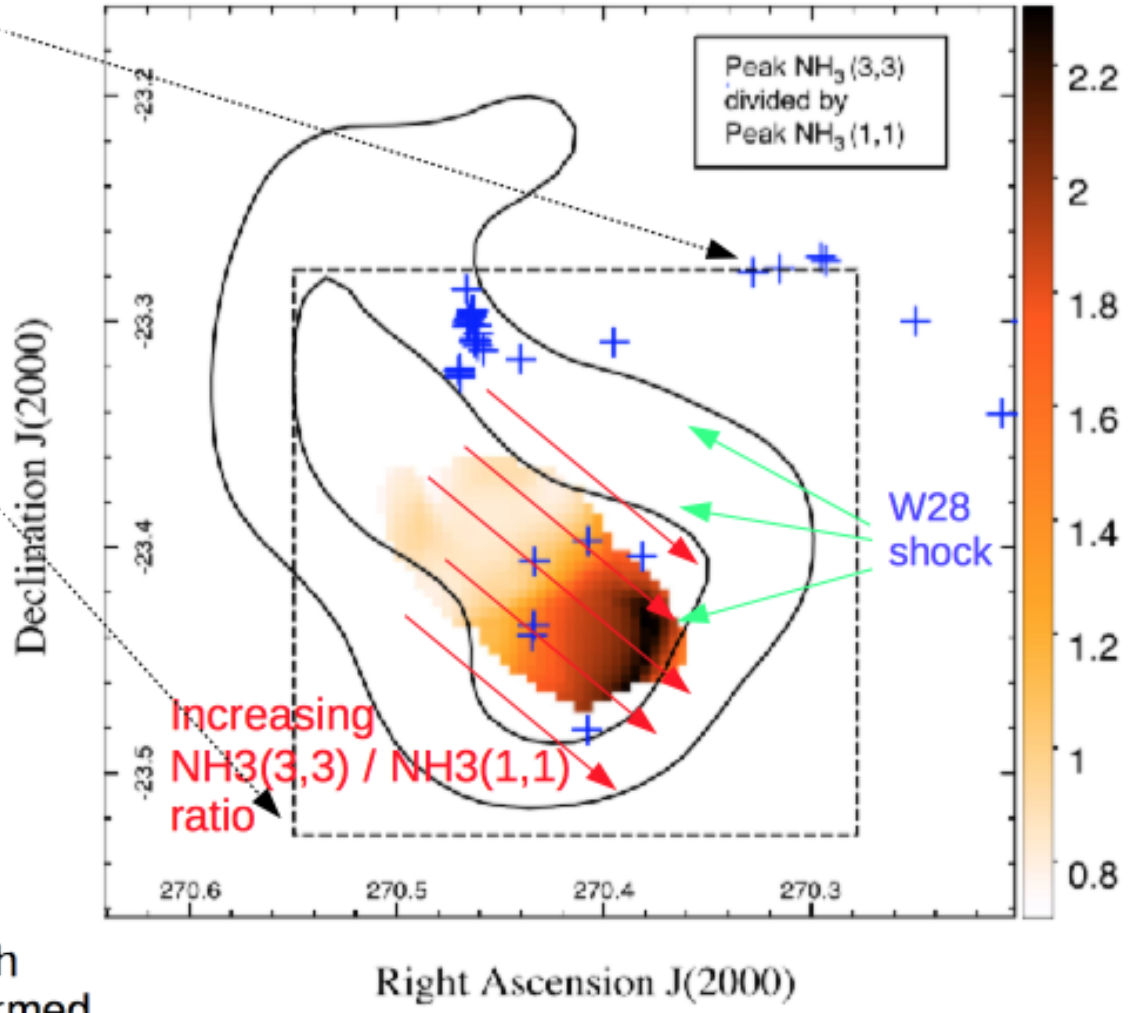

Nicholas et al 2011
Nicholas et al 2012
Maxted et al 2016a
Maxted et al 2016b

# W28 NH3 study



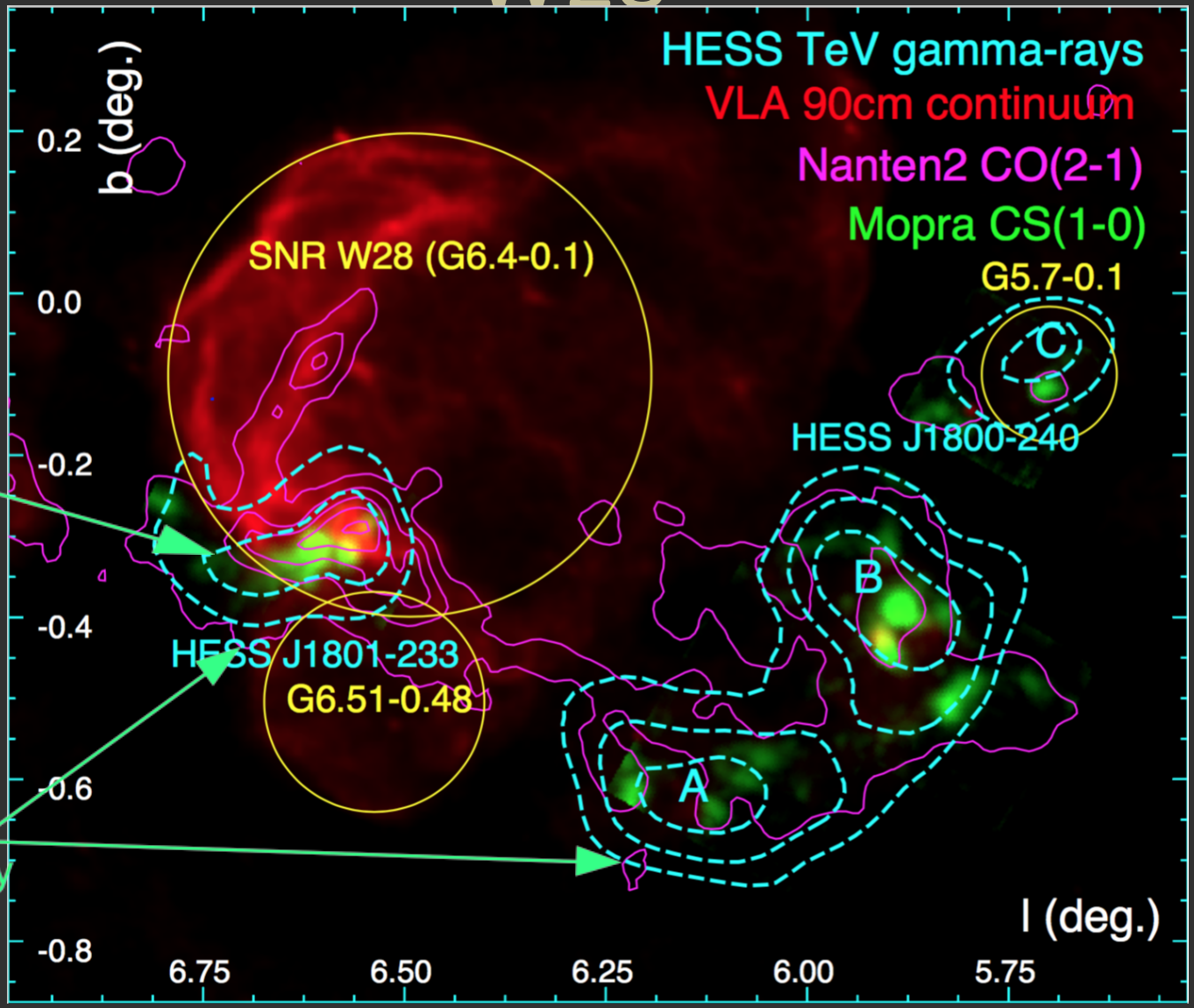

Transition Energies

NH3(1,1) : 22.7 K
NH3(3,3) : 123 K




Other evidence for shocked NH3 include:
*velocity dispersion maps
*high 'ortho-para-NH3' ratio, which suggests that most of the NH3 formed on dust grains → see Maxted et al 2016, de Wilt et al 2017.

# W28

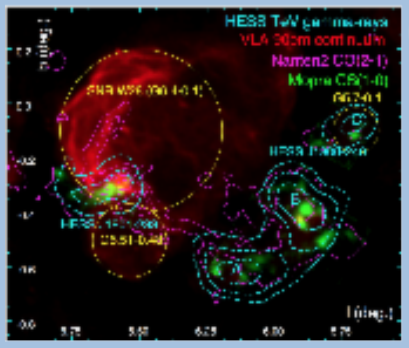



Clear physical connection between shock and cloud

Gas probably bombarded by GeV-TeV CRs

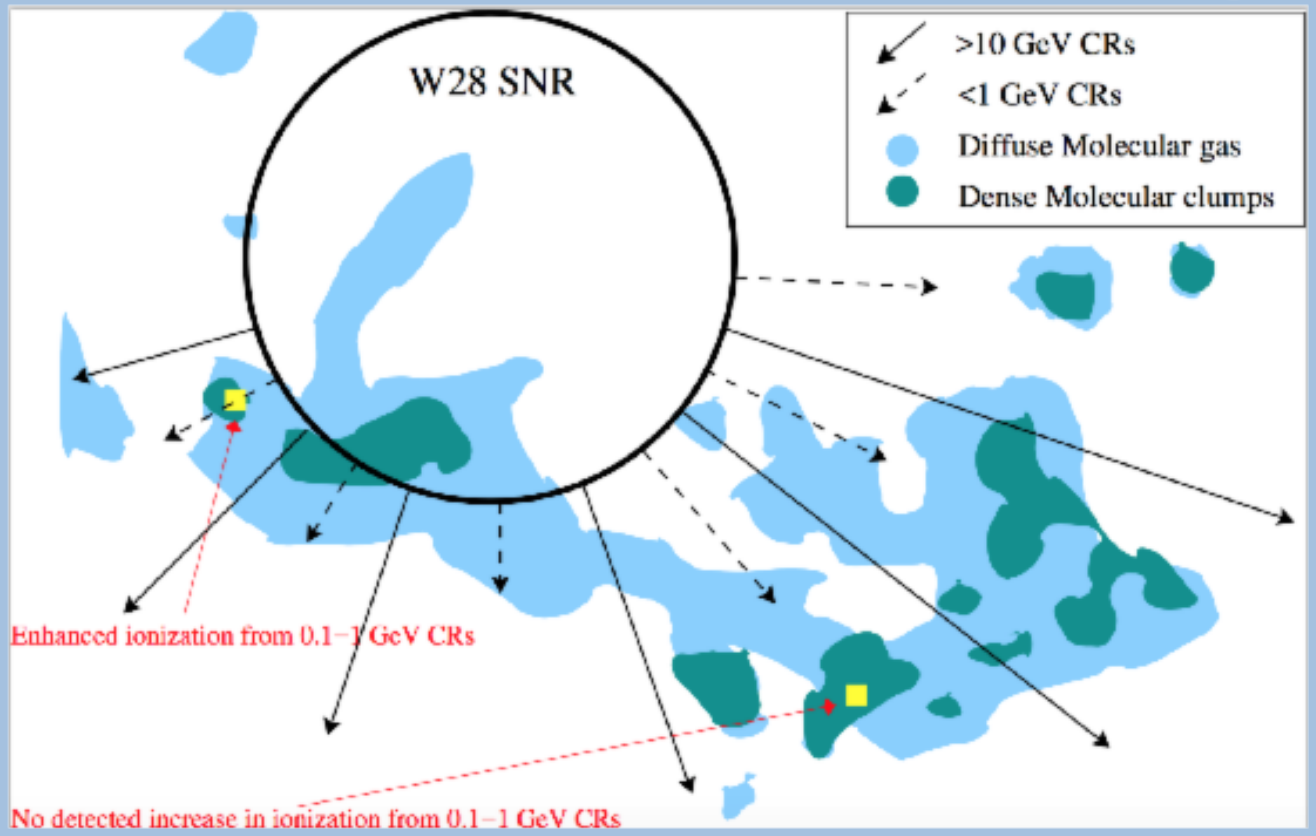
Fukui et al 2008 Nicholas et al 2012 Pic: Maxted et al 2016b

# CR diffusion in the W28 region



Ionisation measurements are new CR diffusion constraints.

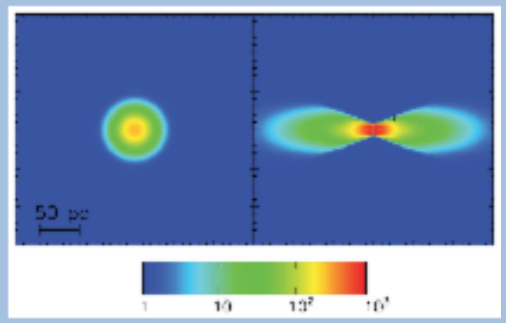
CR ionisation from <1 GeV CRs ~100 times larger than in quiescent clouds (Vaupre et al 2014)



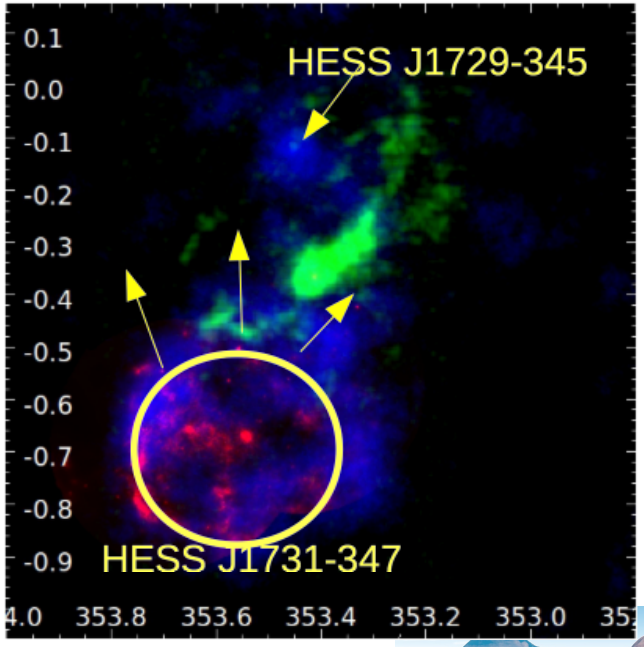

Pic: Maxted et al 2016b

The W28 gamma-ray emission already puts strong constraints on isotropic diffusion in the region (Gabici, Cassanova et al 2010, Hanabata et al 2014). Ionisation measurements a step further (Gabici & Montmerle 2015)

Anisotropic diffusion may be playing a role (Nava & Gabici et al 2013)

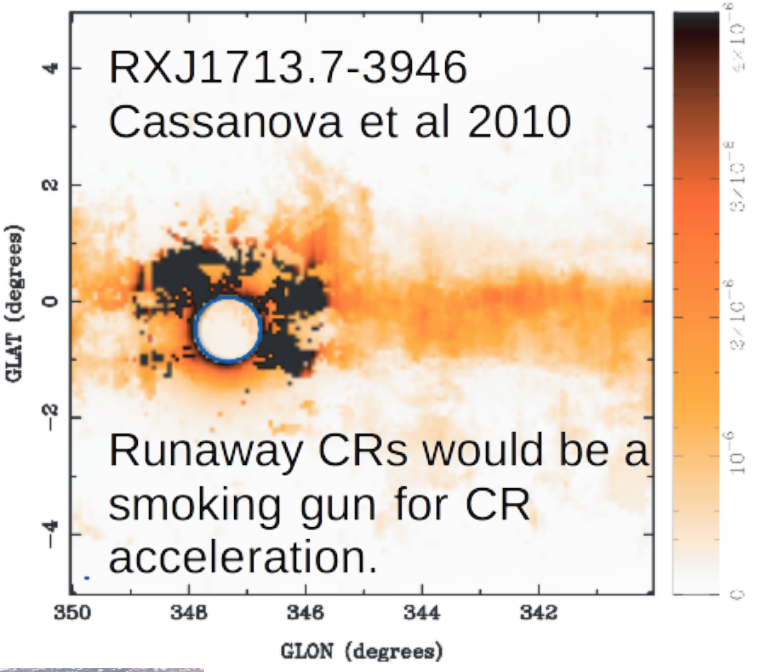


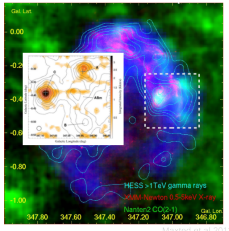
# CR diffusion -young SNRs

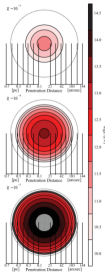


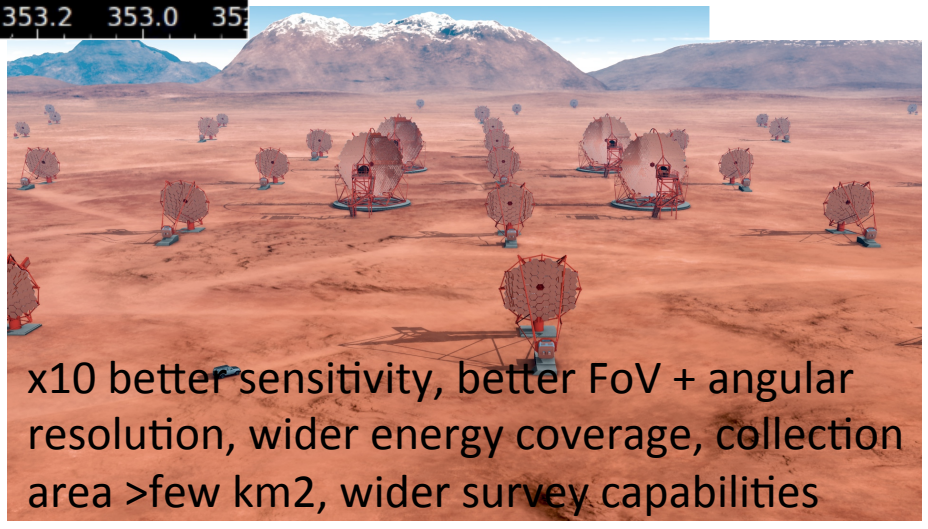

← Unidentified gamma-ray sources caused by runaway CRs?

Using gas maps as a template, modeling predicts signatures of runaway PeV CRs at gamma-ray wavelengths →







x10 better sensitivity, better FoV + angular resolution, wider energy coverage, collection area >few km2, wider survey capabilities

Thankyou