

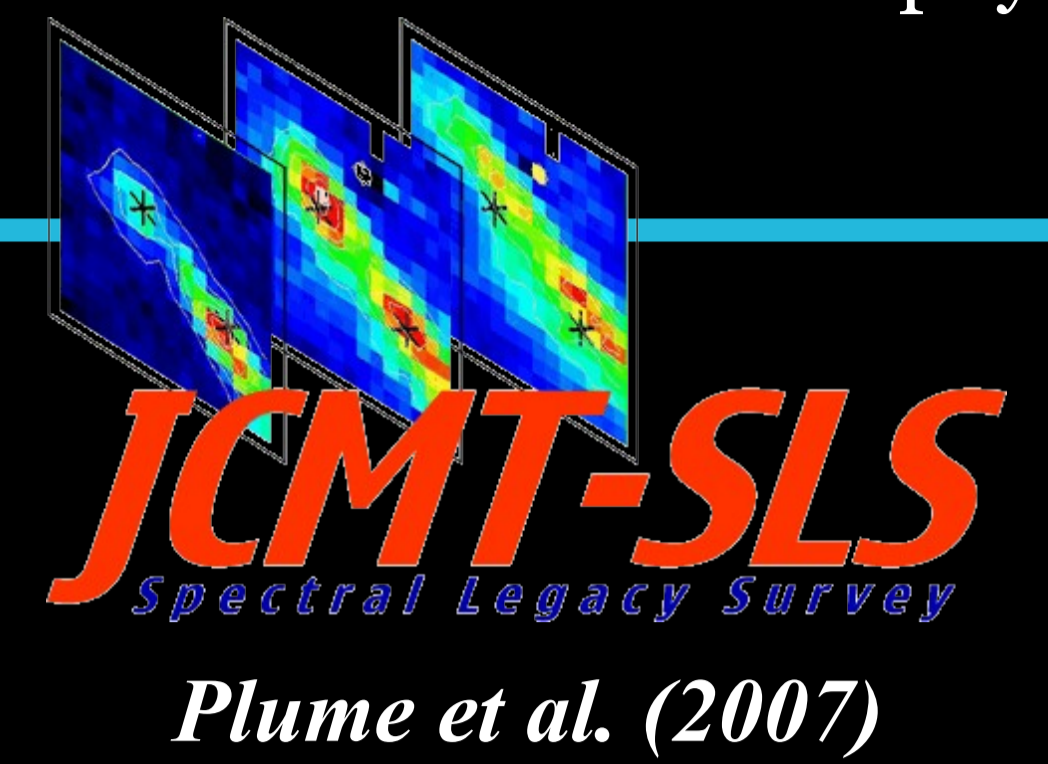
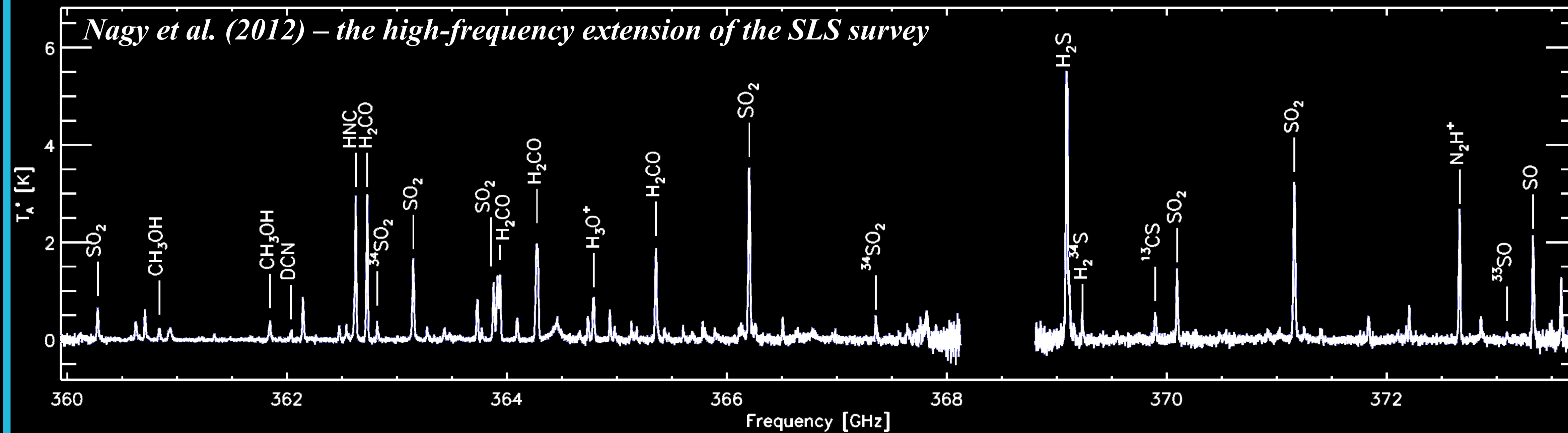
Molecular line tracers of high-mass star forming regions*

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Signatures of shocks, UV irradiation, and hot cores: W49A

W49A: luminous ($>10^7 L_{\odot}$) and massive ($\sim 10^6 M_{\odot}$) star-forming region (Sievers et al. 1991) at a distance of 11.4 kpc (Gwinn et al. 1992).



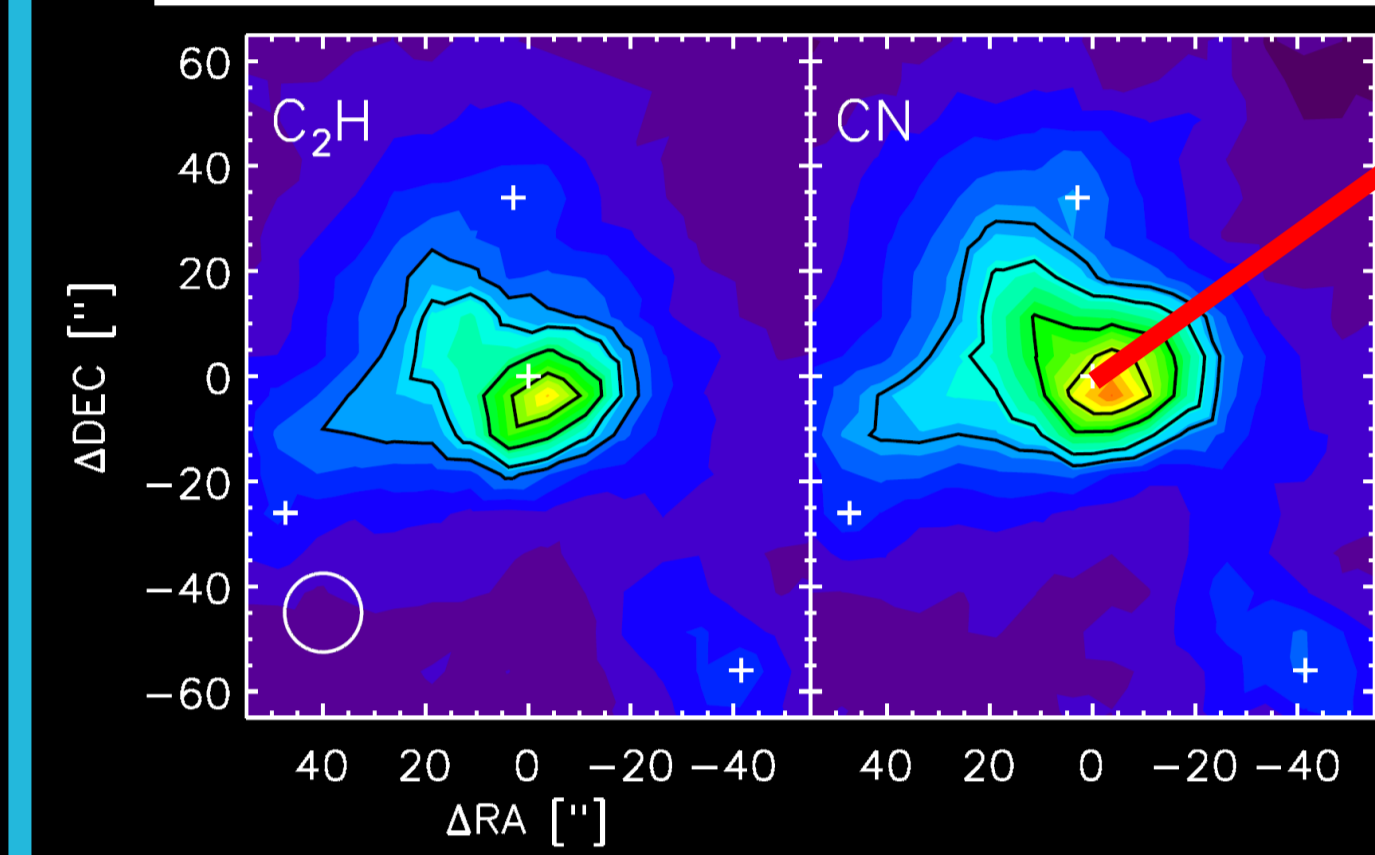
-Sub-mm spectral line survey
-330-373 GHz
-2x2 arcminute fields
-15" (~0.8 pc) spatial resolution
-0.8-0.9 km/s spectral resolution

Tracers related to UV irradiation e.g. CN, C₂H, HCO, SO⁺, CO⁺

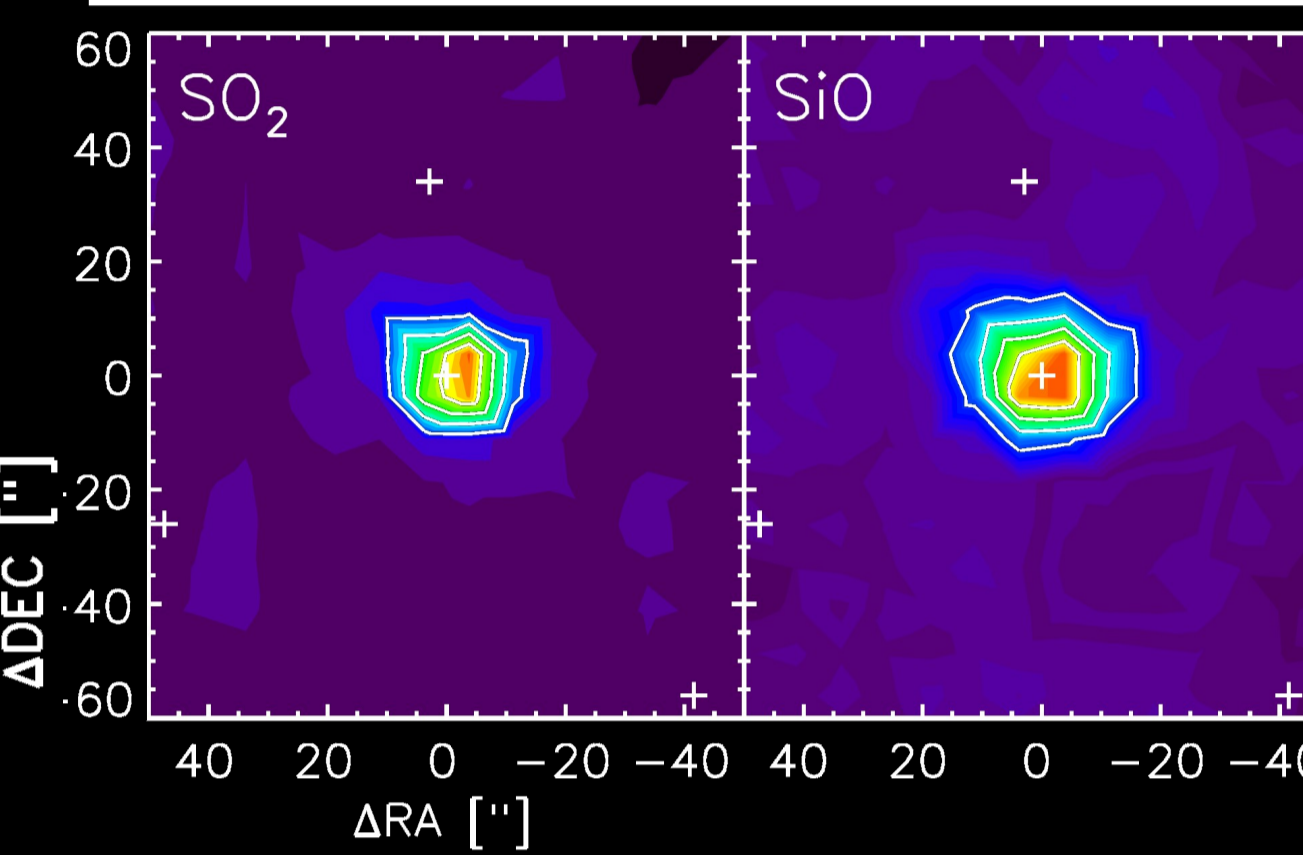
Tracers related to shocks e.g. SiO, SO, SO₂, H₂S, OCS, HNCO

Complex organic molecules

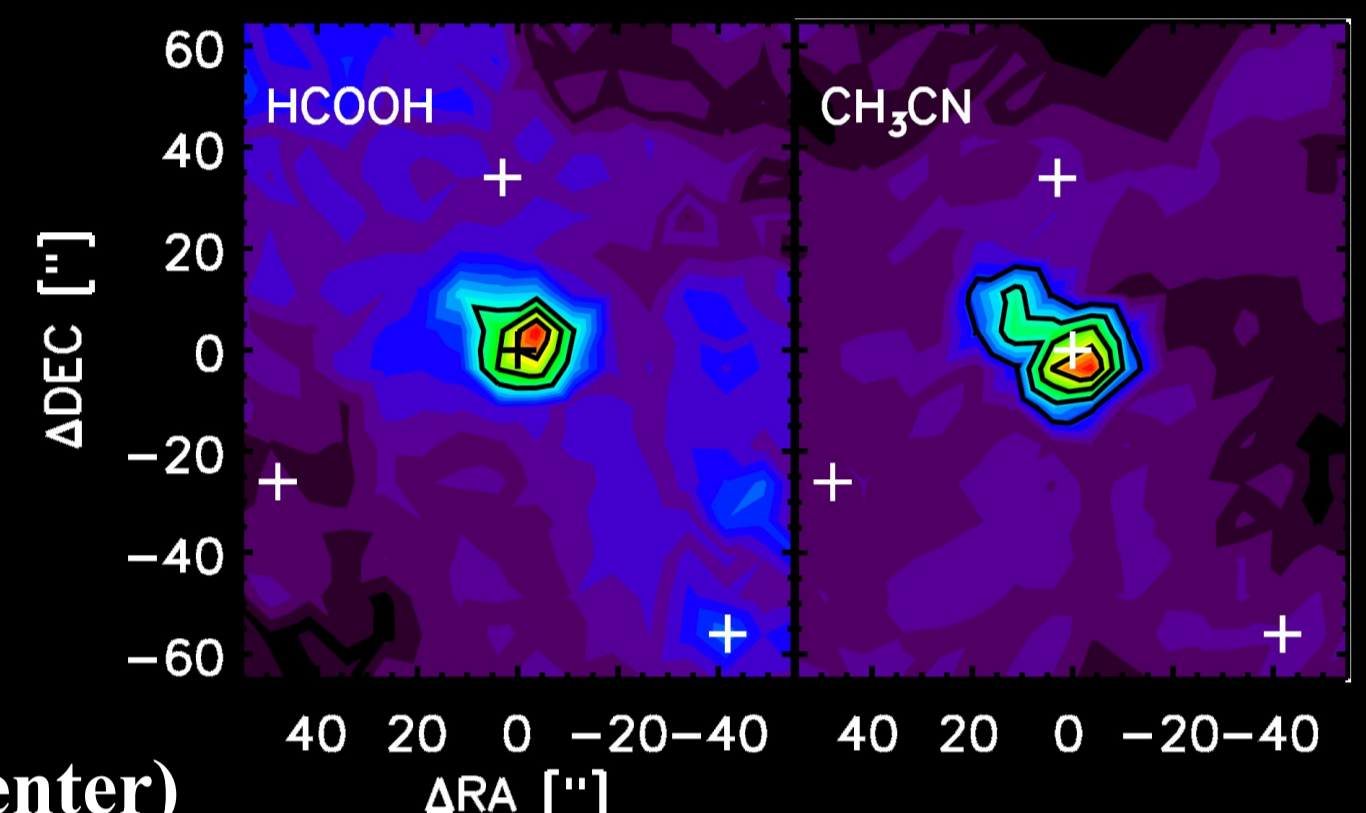
e.g. H₂CO, H₂CS, CH₃OH, CH₃CN, HC₃N, CH₃CHO, CH₃CCH, HCOOH



[HCO]/[H¹³CO⁺]
[CO⁺]/[H¹³CO⁺]
-A PDR model with
-10⁷ cm⁻³ K
-χ=3.5x10⁵



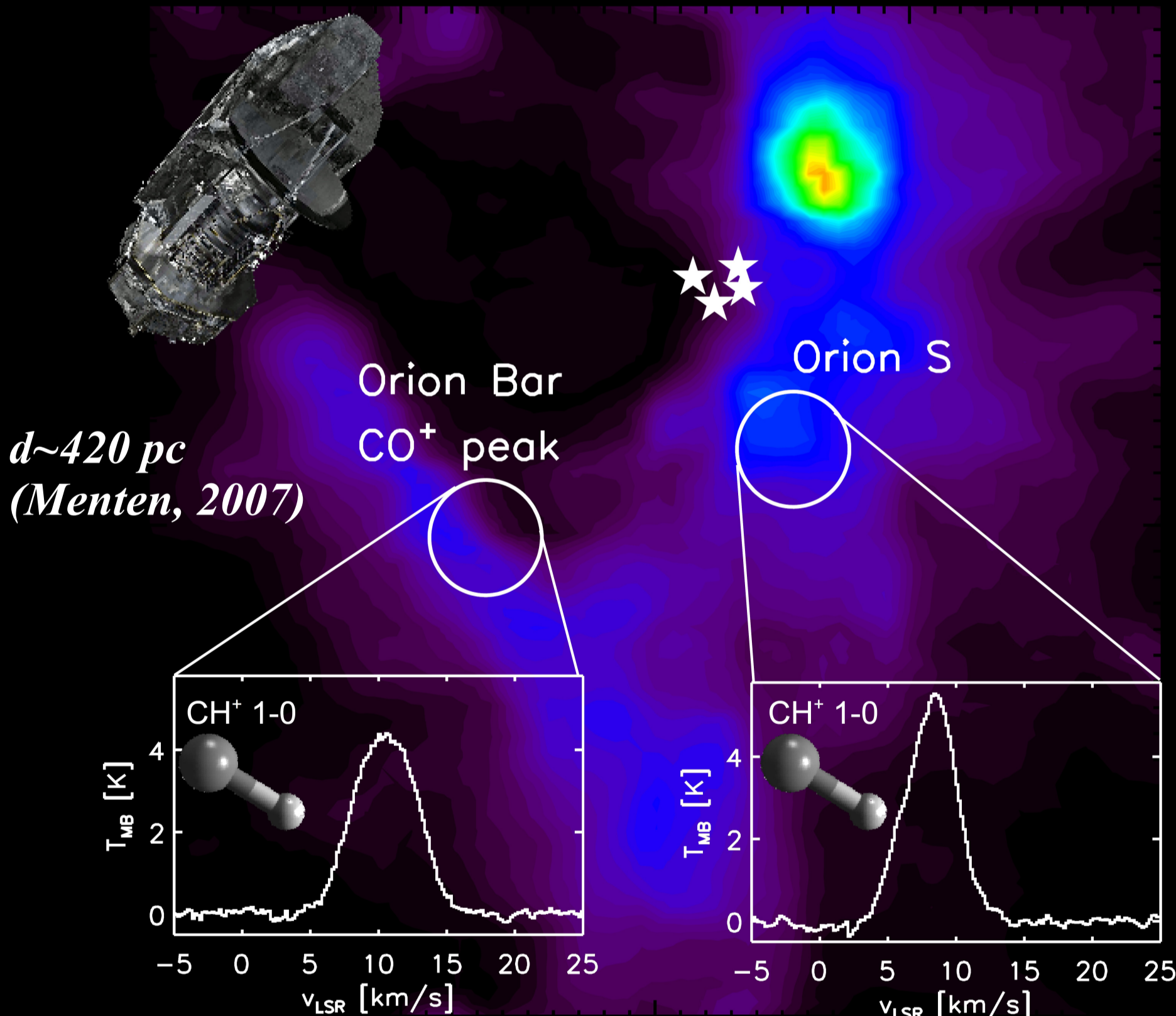
-Column density ratios e.g.
OCS/CS, CS/HCO⁺, H₂CO/H₂CS,
SiO/H₂CO, SO₂/H₂CO
match those measured in
W3 IRS 5 within a factor of 3
(Helmich & Van Dishoeck, 1997)
-Detected in a 20"x20" region



-W49A center: some species originate in a PDR component
-But: shocks dominate the chemistry

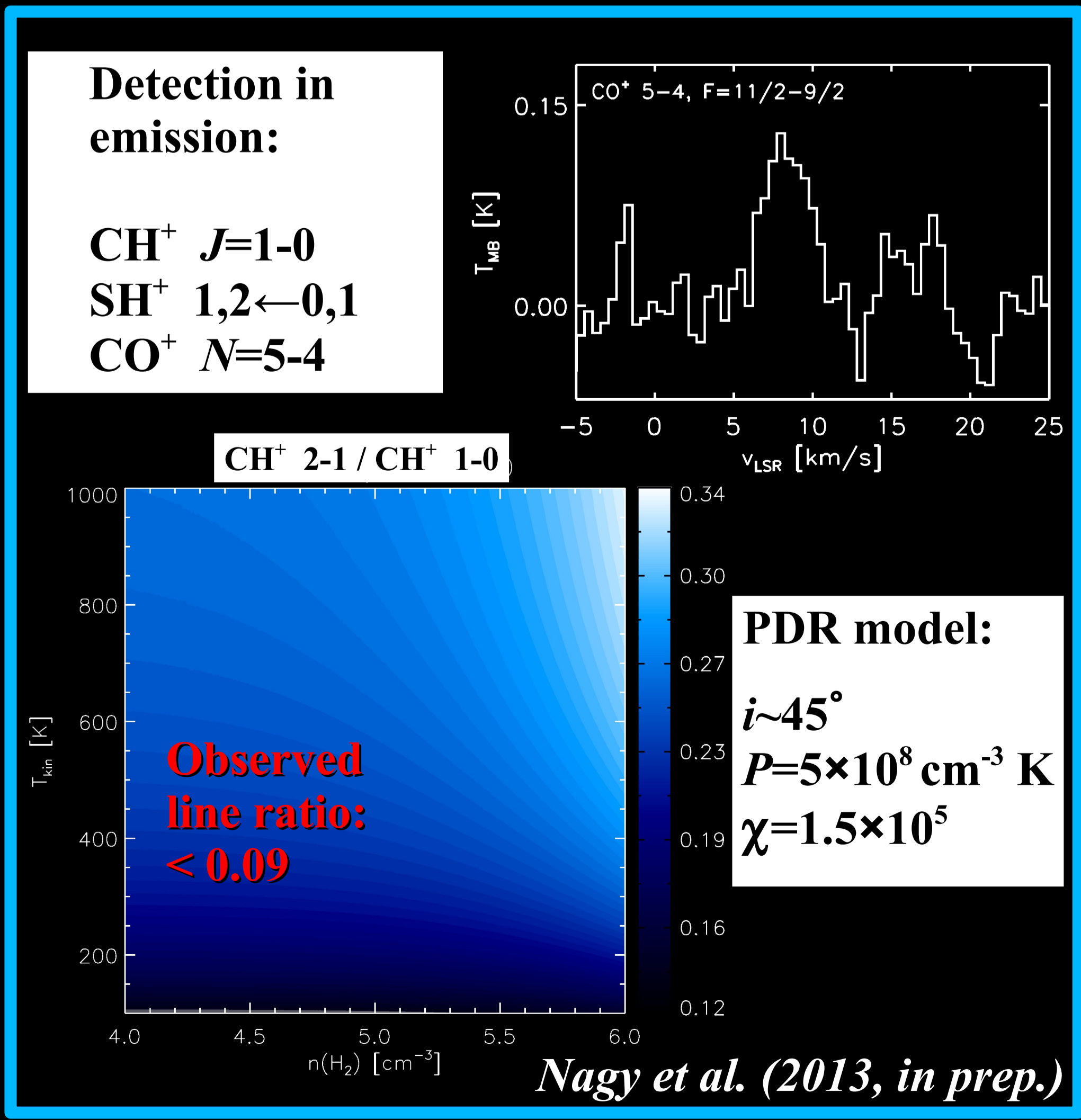
-W49A off-center: mostly PDR emission as suggested by the observed [CN]/[HCN] ratios of ~1-7 (white crosses in the maps outside of the center)

Signatures of UV irradiation: Orion



Line survey of the HEXOS key program (PI: E. Bergin): the detection of reactive ions toward the Orion Bar and Orion S

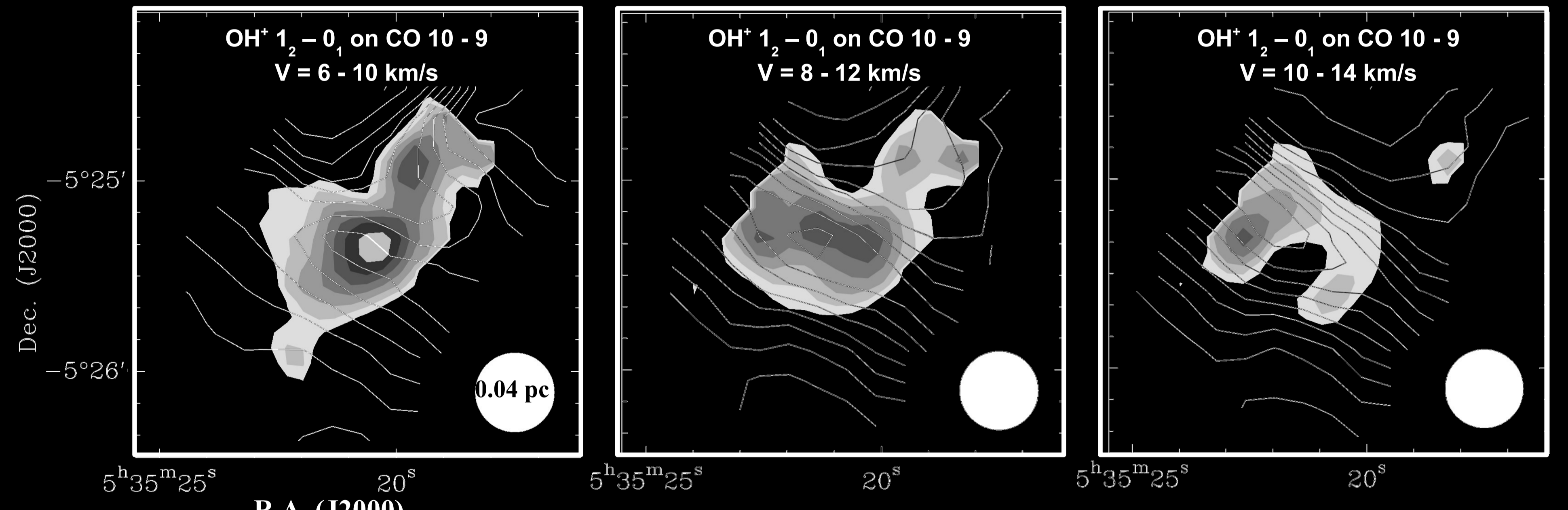
Orion S



Nagy et al. (2013, in prep.)

Orion Bar

Spatially extended OH⁺ emission toward the Orion Bar and Orion Ridge

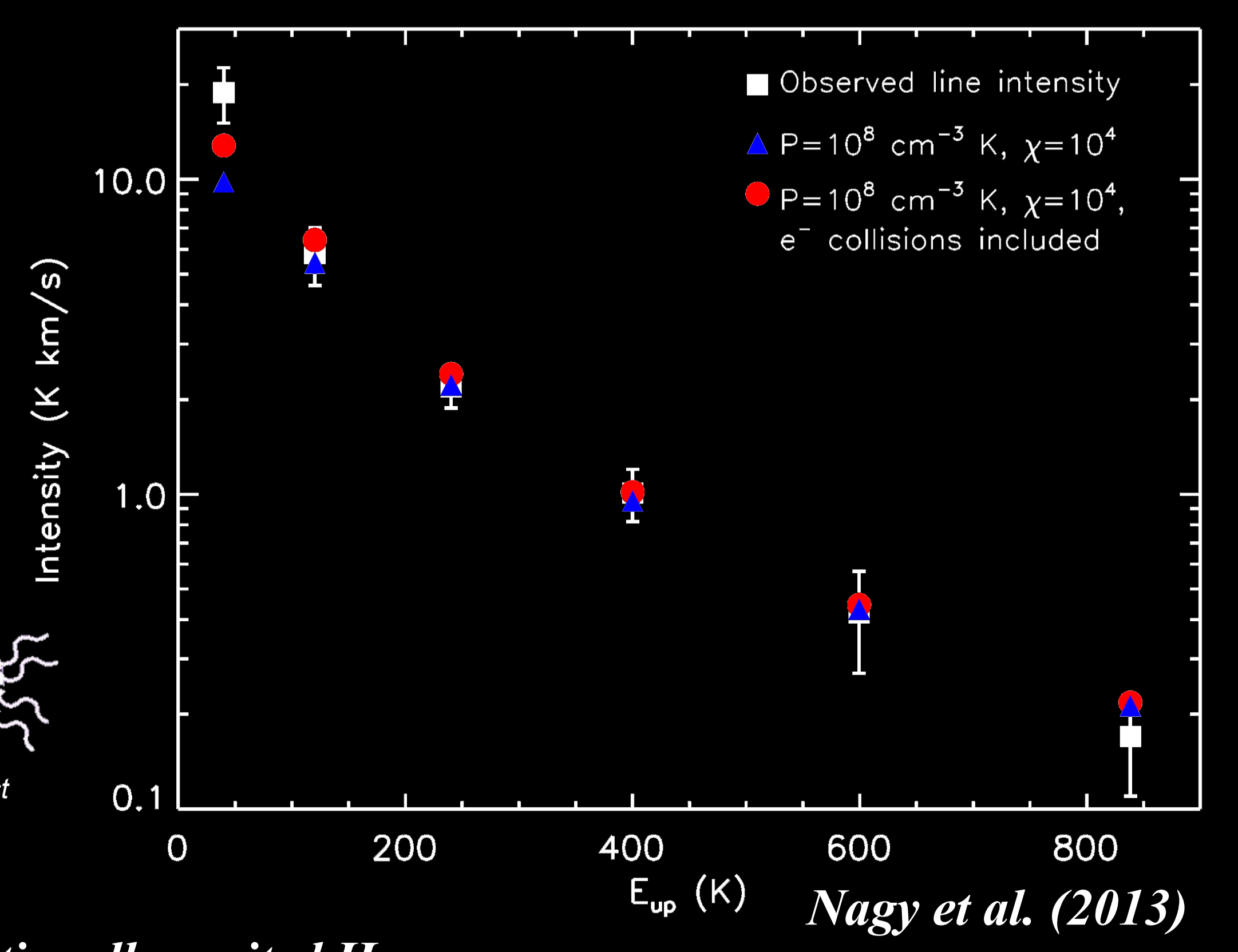
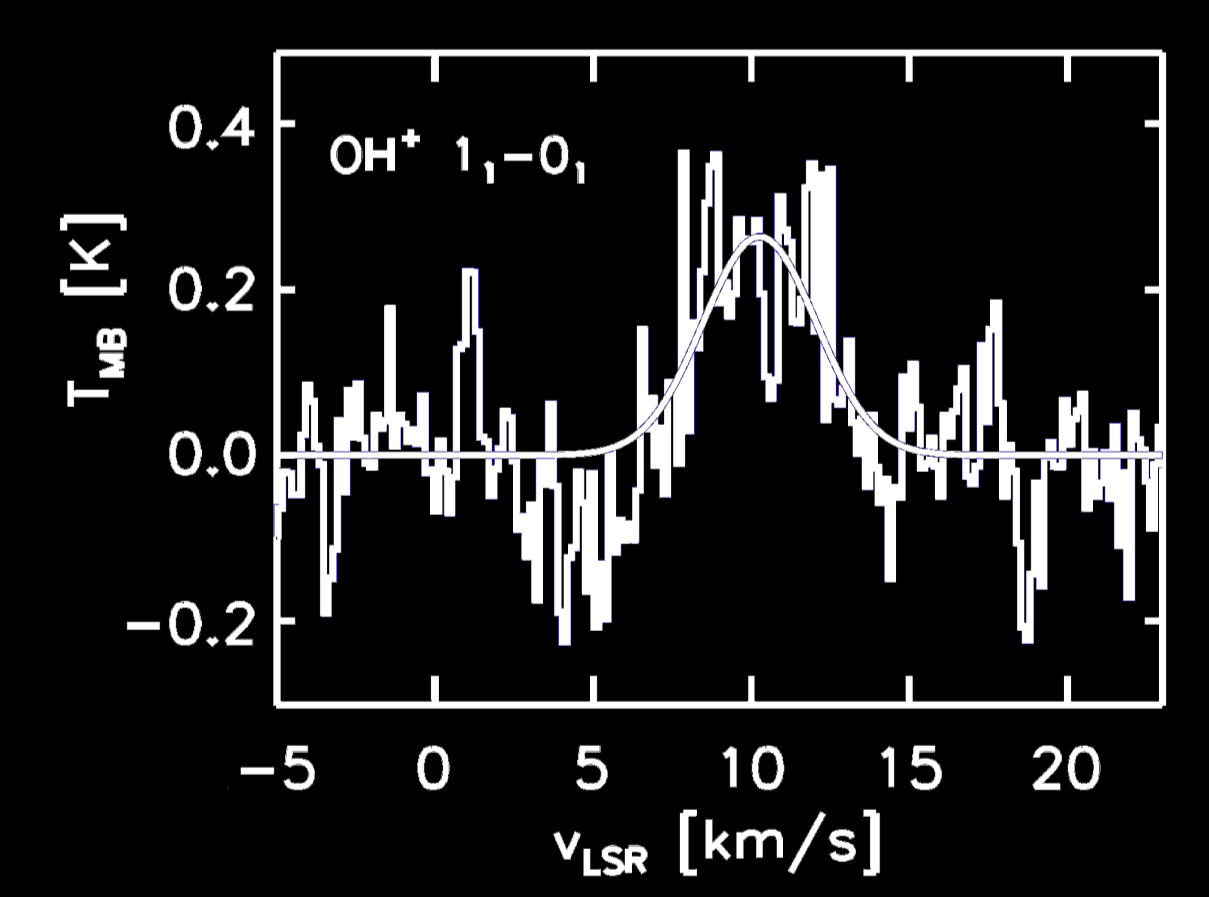
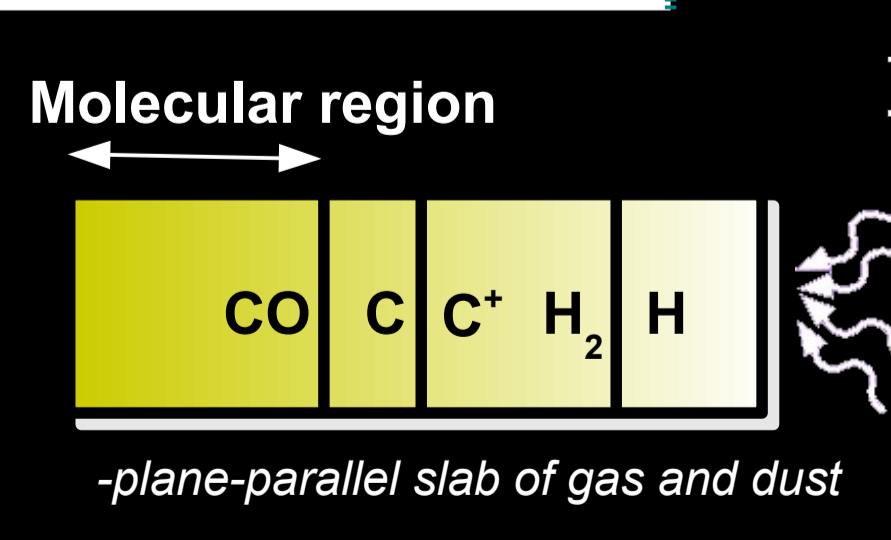


Van der Tak & Nagy et al. (2013, submitted)

Orion Bar
CH⁺ J=1-0, ..., 6-5
SH⁺ 1,2←0,1
OH⁺ 1,2-0,1; 1,1-0,1 } emission

Model for reactive ions in the Orion Bar

-Meudon code (Le Petit et al., 2006, Goicoechea & Le Bourlot, 2007, Gonzalez-Garcia et al., 2008)
-Isobaric models
-P=5x10⁷ - 2x10⁸ cm⁻³ K
-A_{v,max} = 10
-χ_{obs} = 7x10³ - 3x10⁴
-χ_{back} = χ_{obs} / 100



Nagy et al. (2013)

CH⁺ and SH⁺ formation: reactions with vibrationally excited H₂

*This work is part of my PhD thesis with the same title, to be defended on September 23, 2013.

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