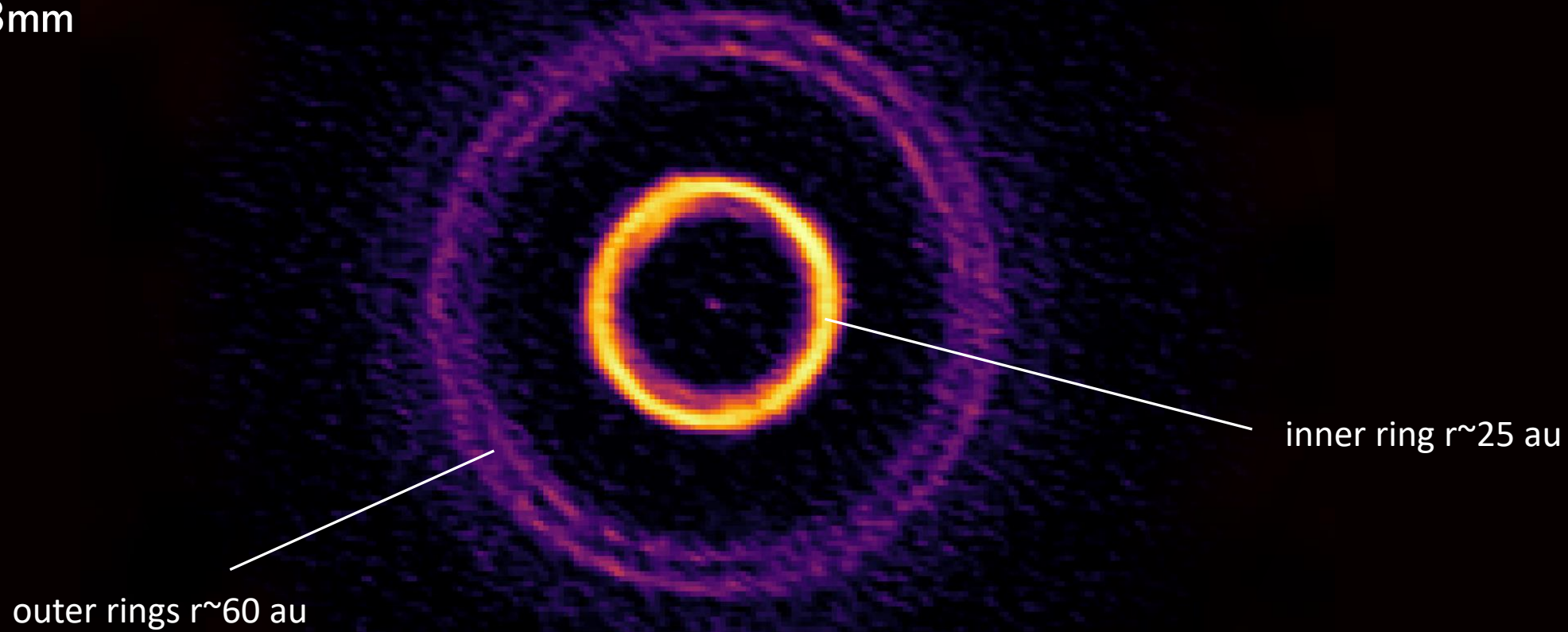


Luke Keyte (QMUL)

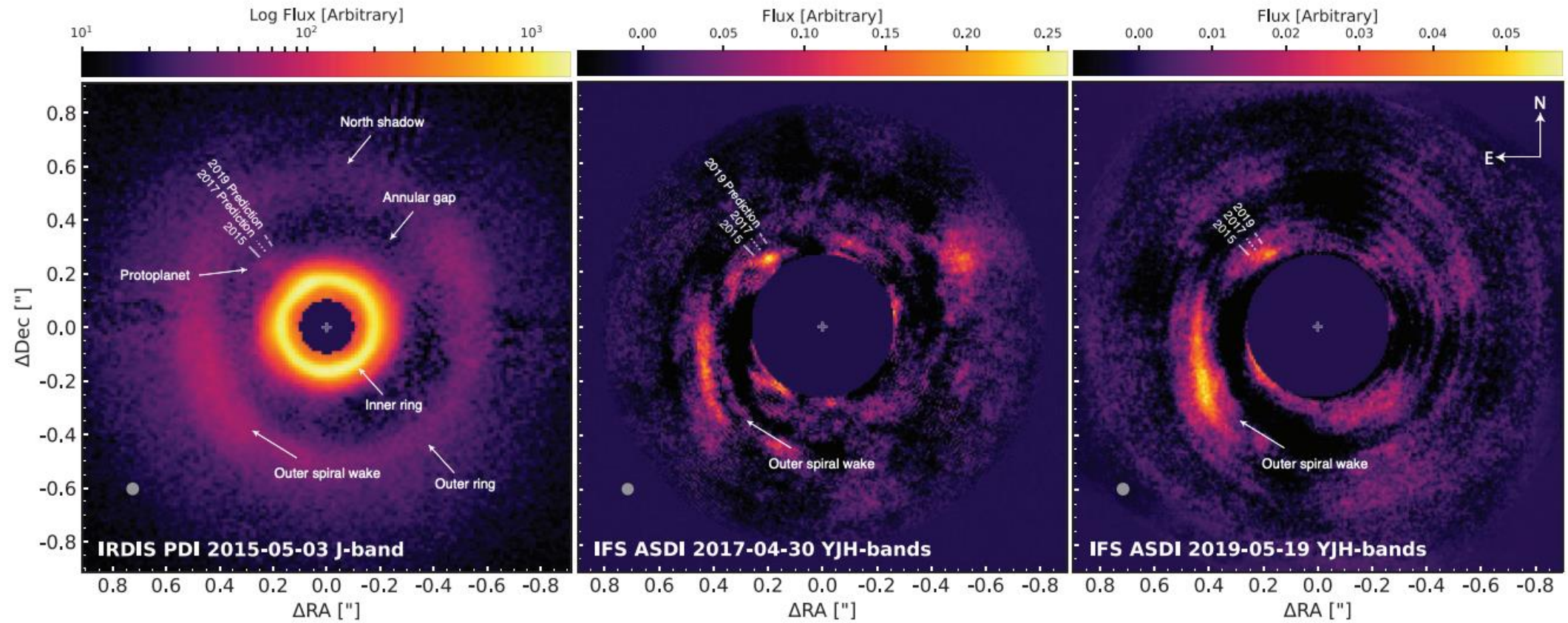
Volatile composition of the HD 169142 disk and its embedded planet

ALMA

$\lambda = 1.3\text{mm}$

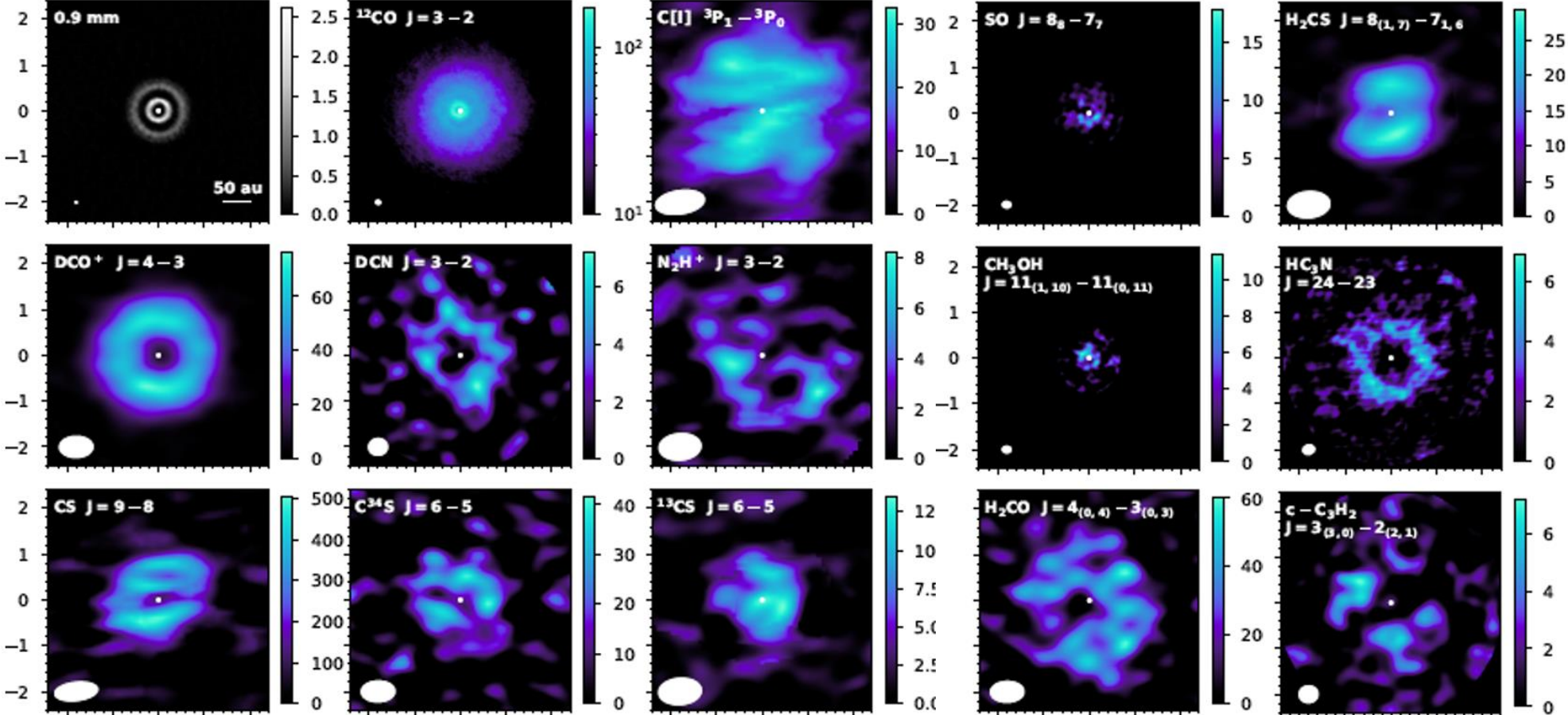


SPHERE NIR IMAGING



Hammond et al. (2023)

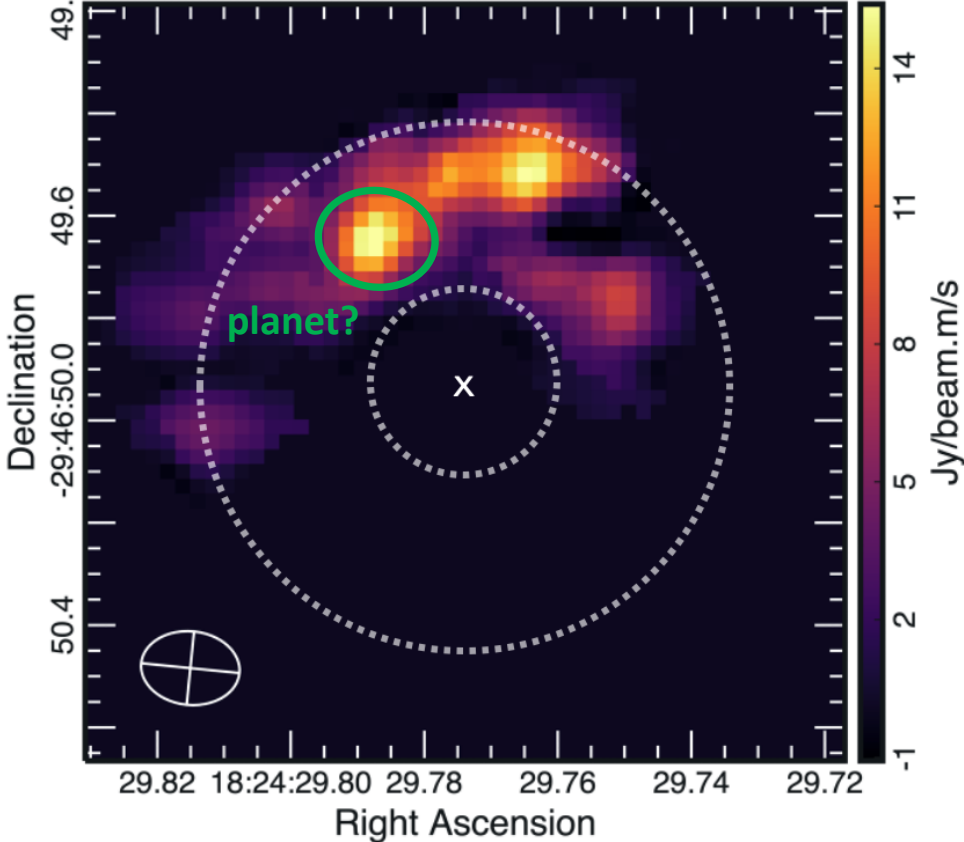
ALMA ARCHIVAL DATA



Booth et al. (2023)

ALMA ARCHIVAL DATA

SiS J=19-18

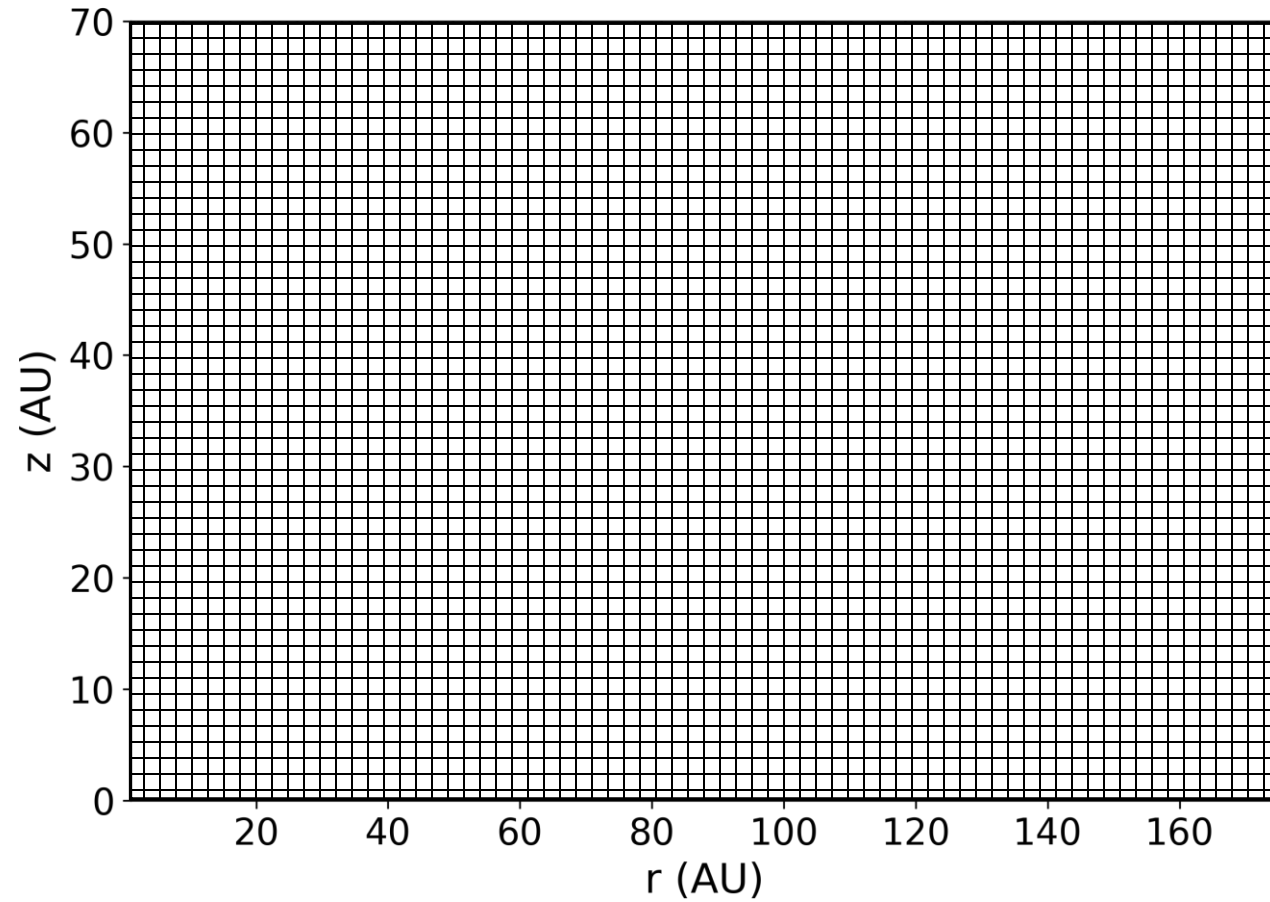


Law et al. (2023)

CHEMICAL MODEL

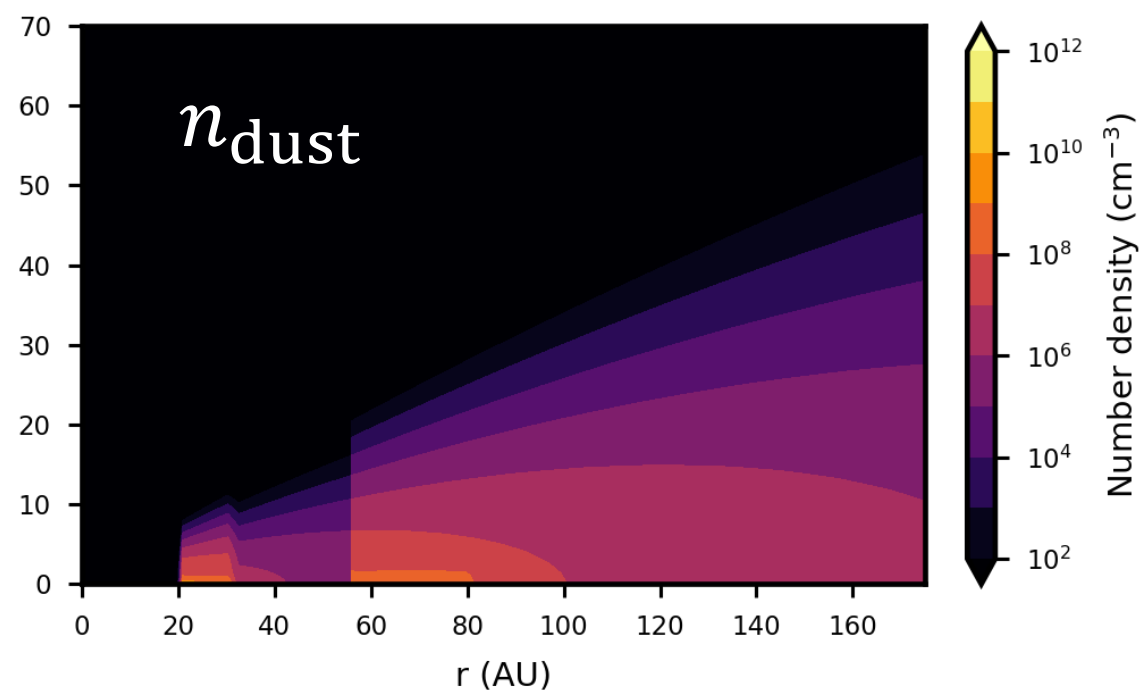
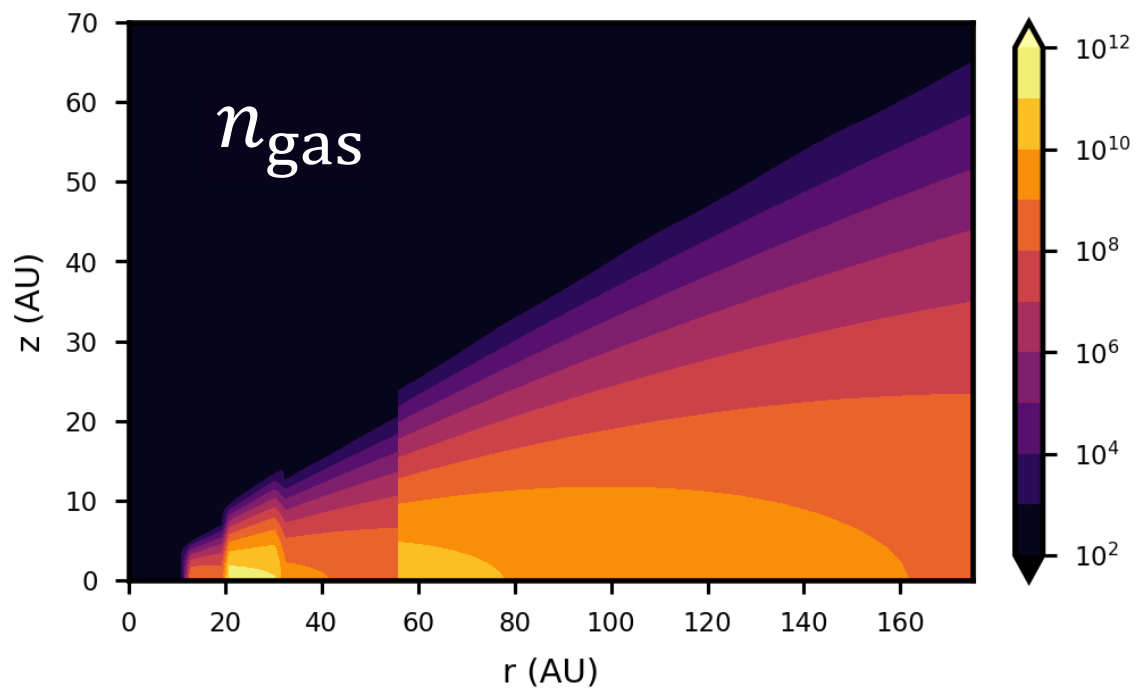
DALI MODELLING

PHYSICAL STRUCTURE



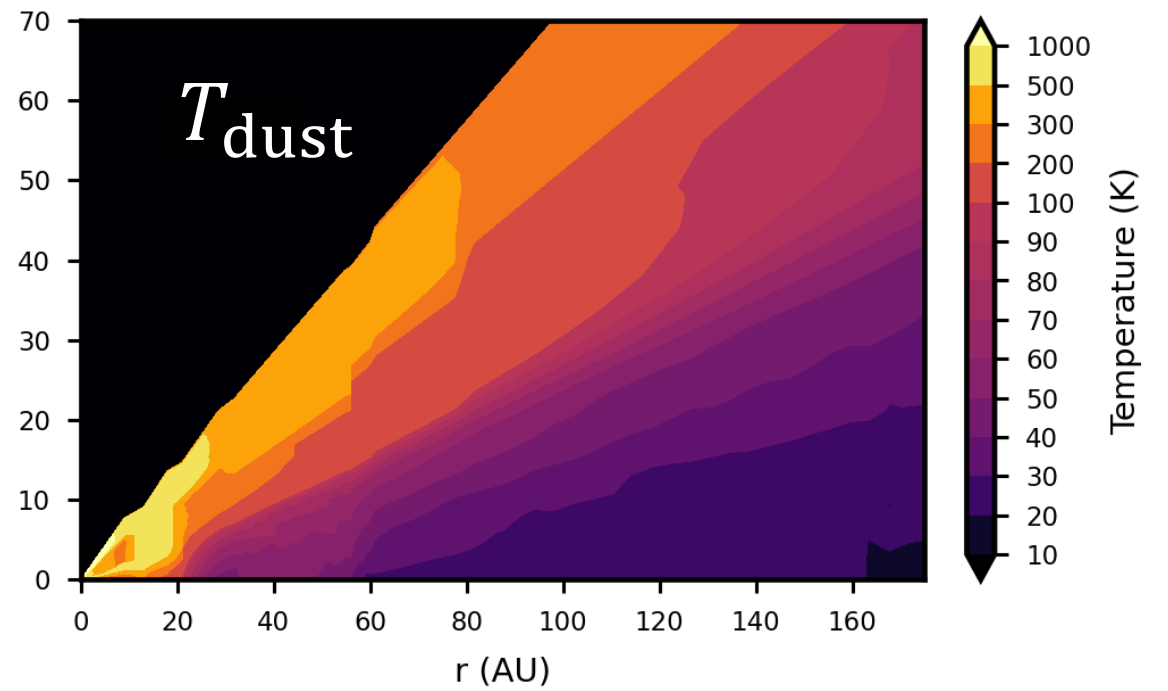
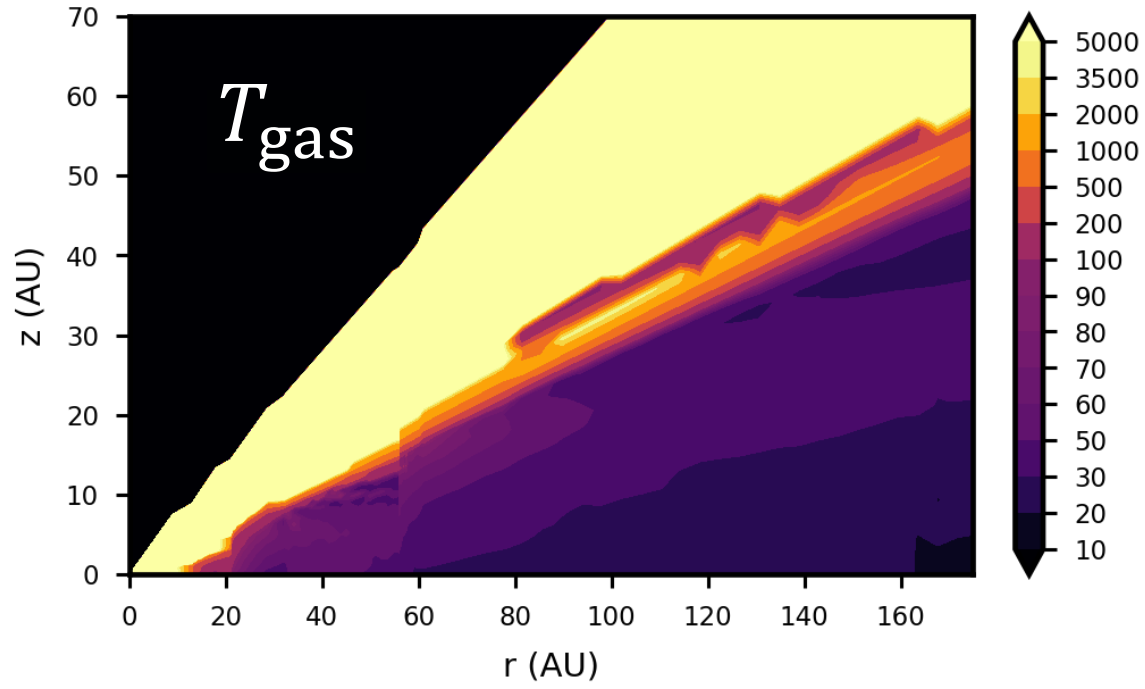
DALI MODELLING

PHYSICAL STRUCTURE



DALI MODELLING

TEMPERATURE STRUCTURE



DALI MODELLING

CHEMISTRY

INITIAL ABUNDANCES

Species	Abundance
H	1.00×10^0
He	7.59×10^{-2}
C	1.00×10^{-4}
N	2.14×10^{-5}
O	2.00×10^{-4}
Mg	1.00×10^{-11}
Si	1.00×10^{-11}
S	1.00×10^{-8}
Fe	1.00×10^{-11}

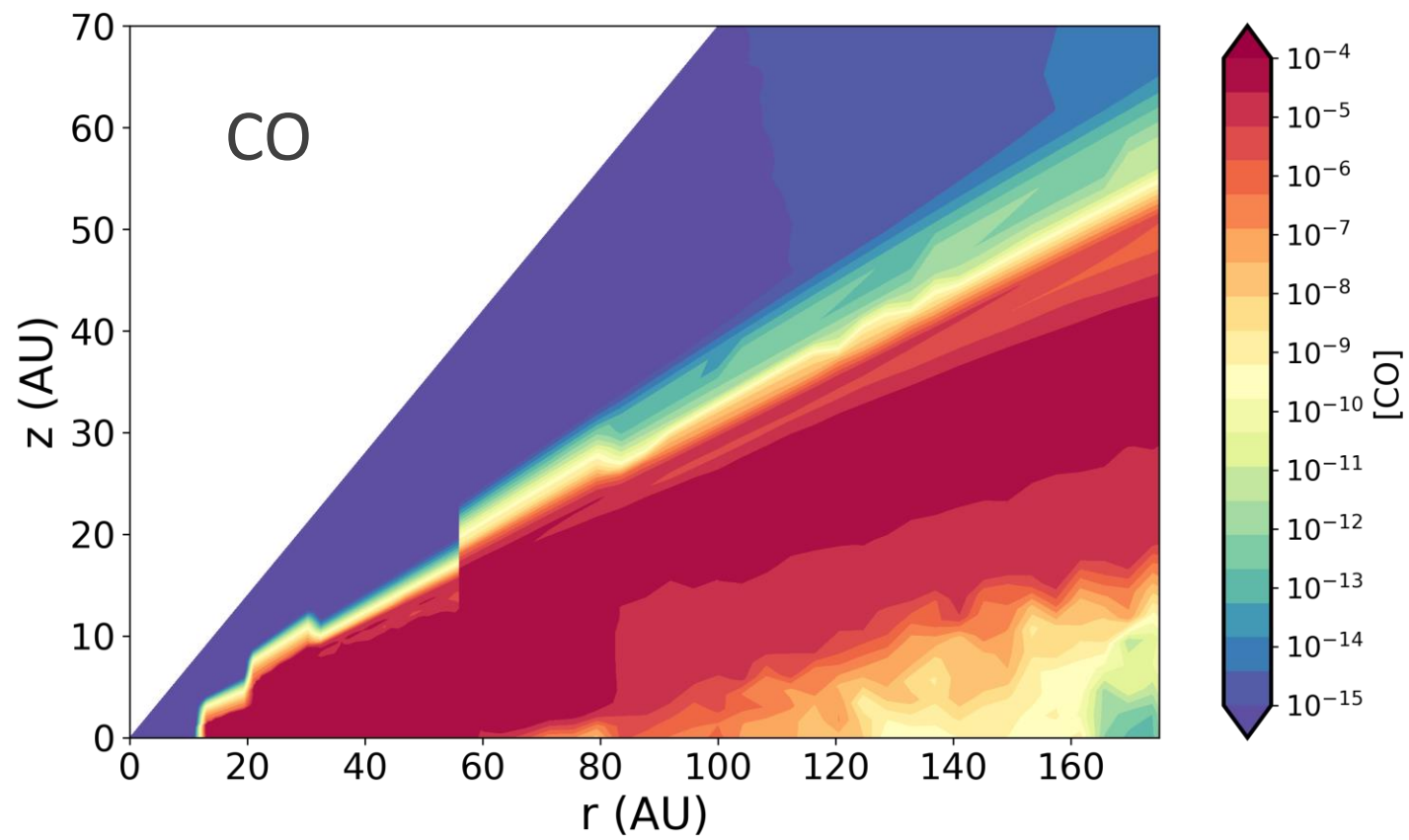


REACTIONS AND RATES

Reaction	α	β	γ
$\text{H} + \text{CH} \rightarrow \text{C} + \text{H}_2$	1.3×10^{-10}	0	8×10^1
$\text{H} + \text{CH}_2 \rightarrow \text{CH} + \text{H}_2$	6.1×10^{-12}	0.5	2×10^2
$\text{H} + \text{NH} \rightarrow \text{N} + \text{H}_2$	2.5×10^{-11}	0	8×10^3
$\text{H} + \text{CH}_3 \rightarrow \text{CH}_2 + \text{H}_2$	3.6×10^{-10}	0	5×10^3
$\text{H} + \text{NH}_2 \rightarrow \text{NH} + \text{H}_2$	2.8×10^{-10}	0.7	6×10^3
$\text{H} + \text{NH}_2 \rightarrow \text{NH} + \text{H}_2$	9.9×10^{-13}	0	7×10^1
$\text{H} + \text{CH}_4 \rightarrow \text{CH}_3 + \text{H}_2$	6.2×10^{-12}	0.4	3×10^1
$\text{H} + \text{OH} \rightarrow \text{O} + \text{H}_2$	3.4×10^{-11}	0	2×10^3
$\text{H} + \text{NH}_3 \rightarrow \text{NH}_2 + \text{H}_2$	4.7×10^{-10}	0.2	6×10^2

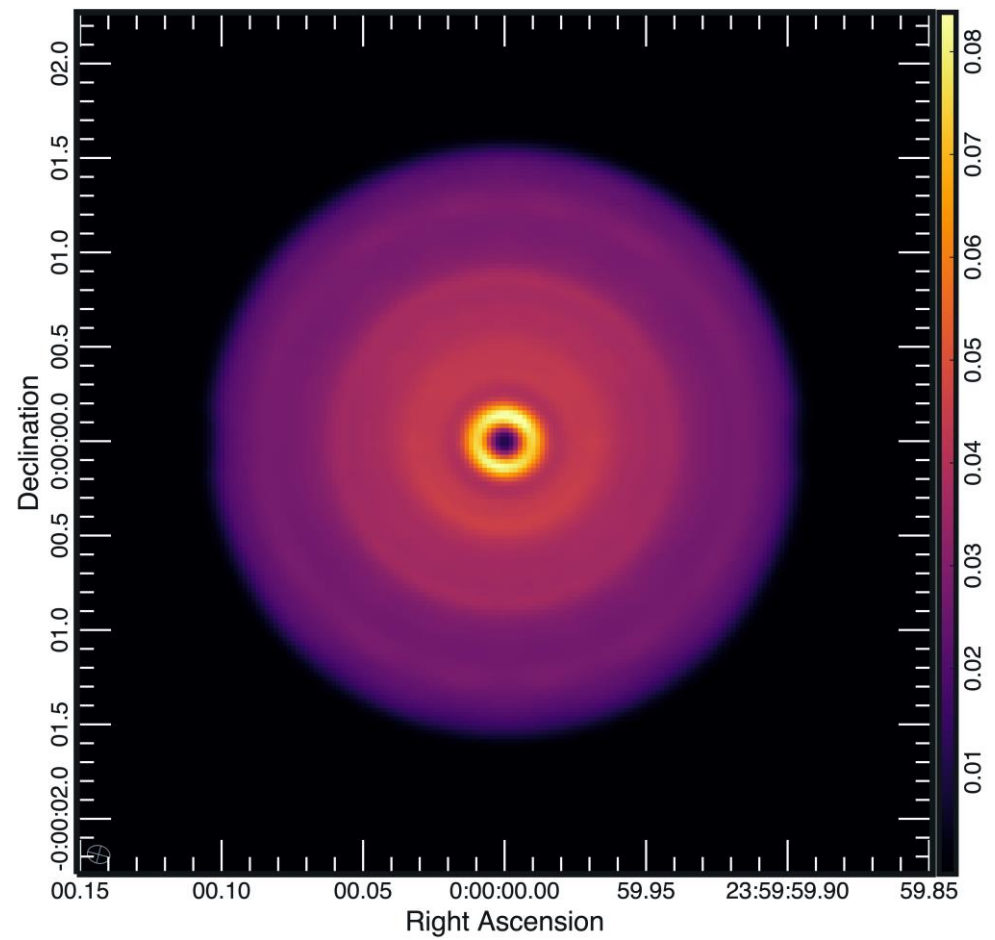
DALI MODELLING

CHEMISTRY



DALI MODELLING

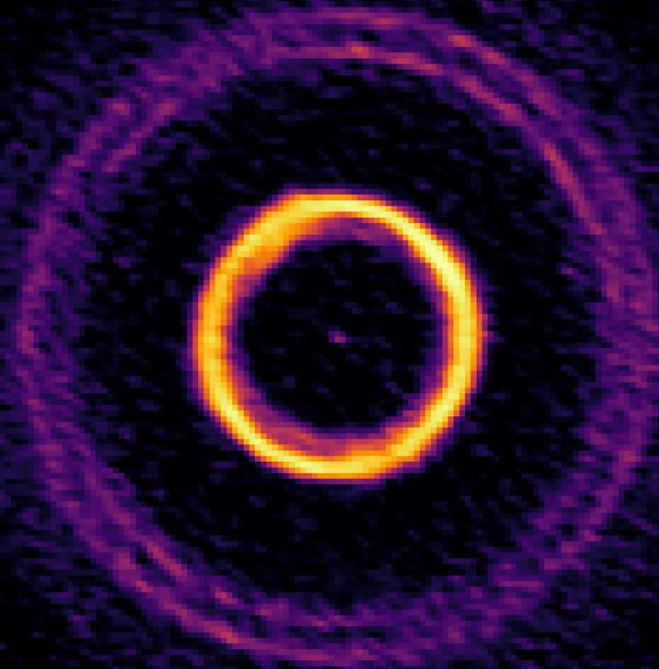
CHEMISTRY



RESULTS

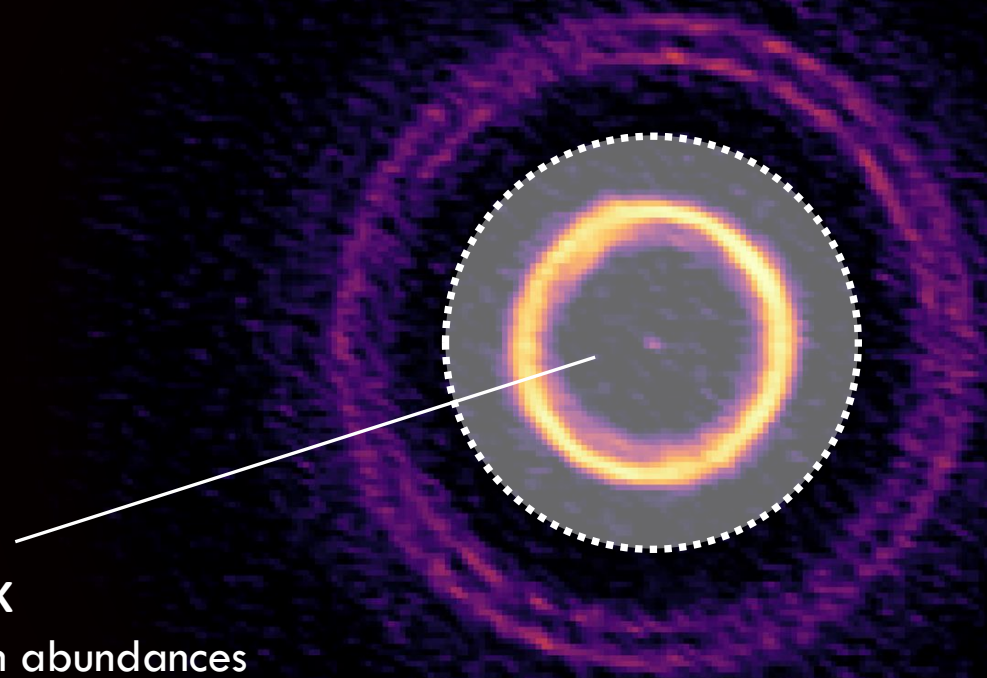
RESULTS

CARBON AND OXYGEN



RESULTS

CARBON AND OXYGEN



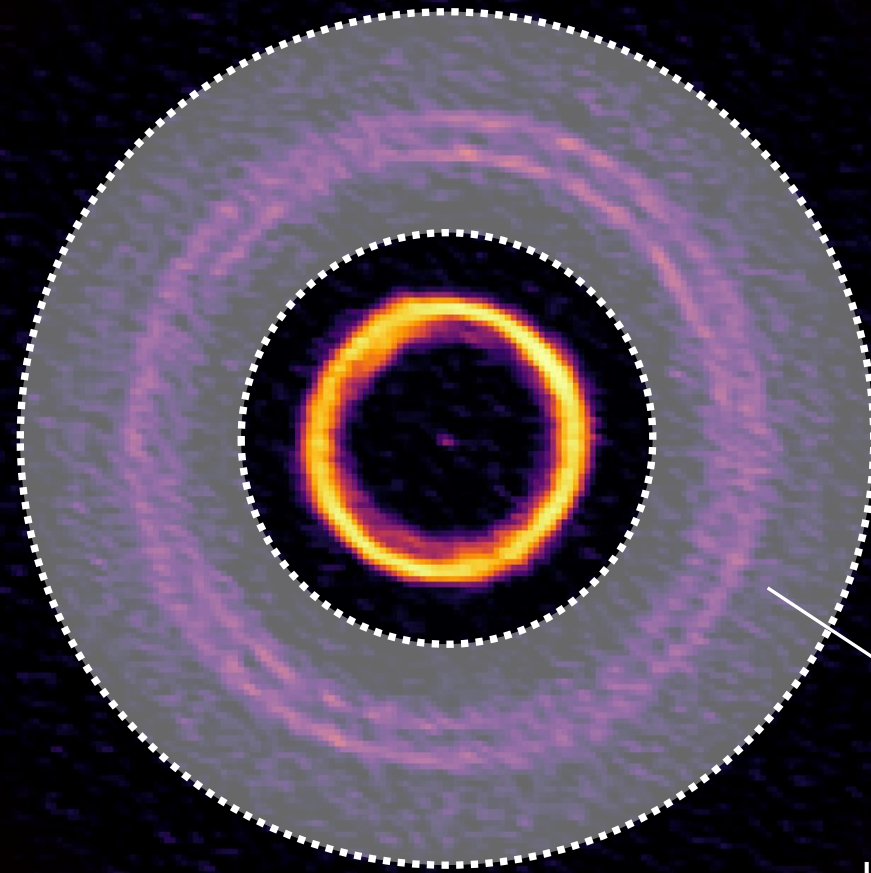
INNER DISK

ISM carbon and oxygen abundances

$$\text{C/O} \approx 0.5$$

RESULTS

CARBON AND OXYGEN



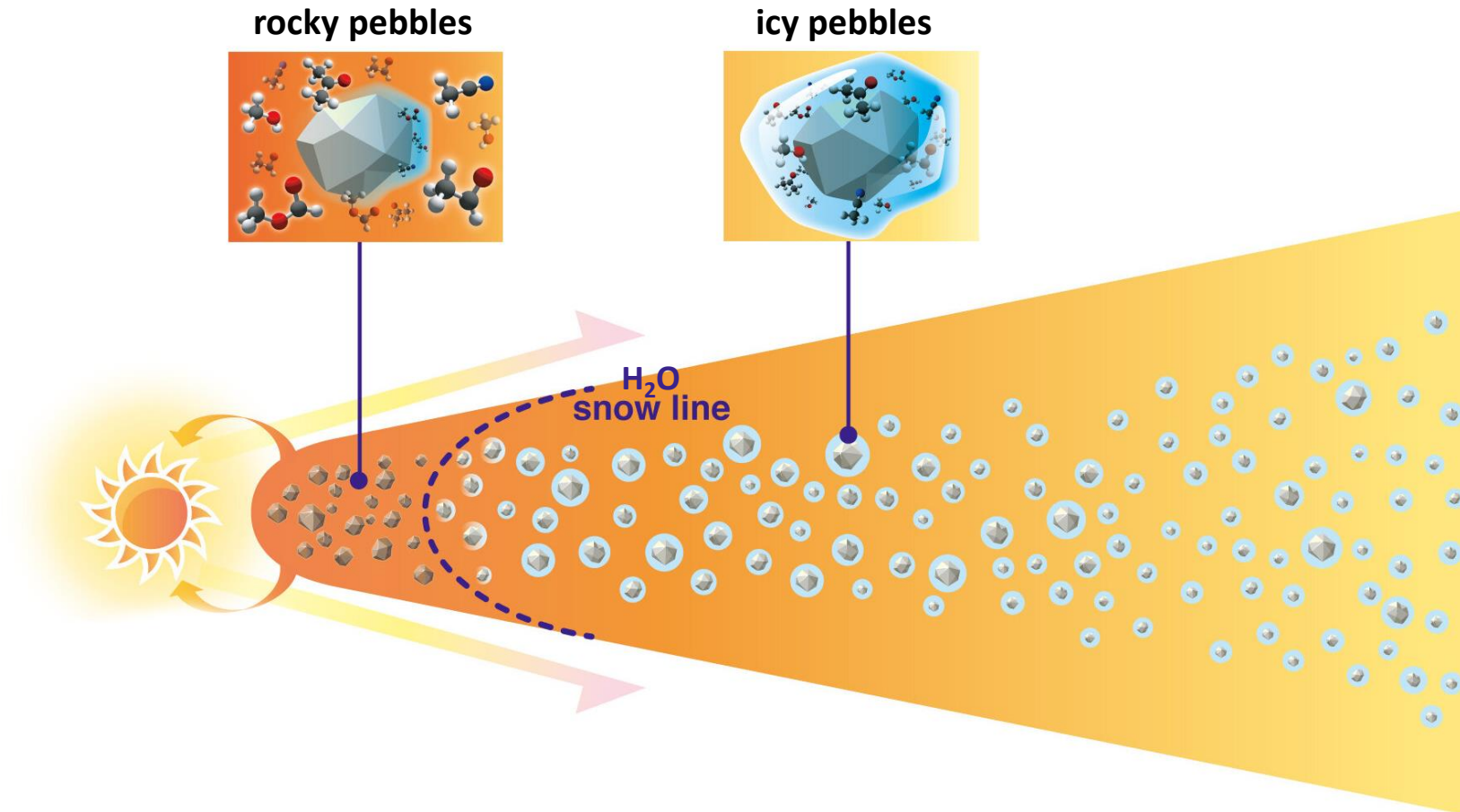
OUTER DISK

ISM carbon but depleted oxygen

$C/O > 0.5$

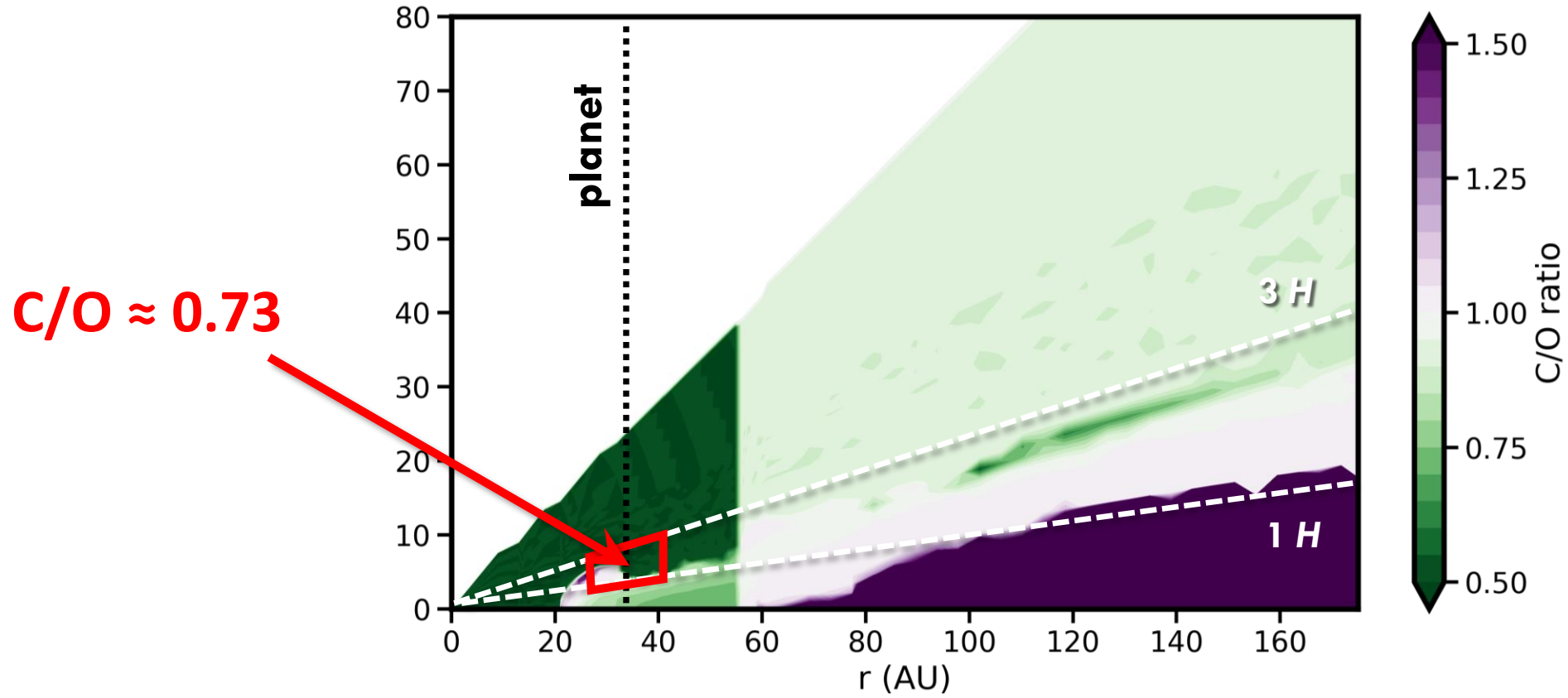
RESULTS

CARBON AND OXYGEN



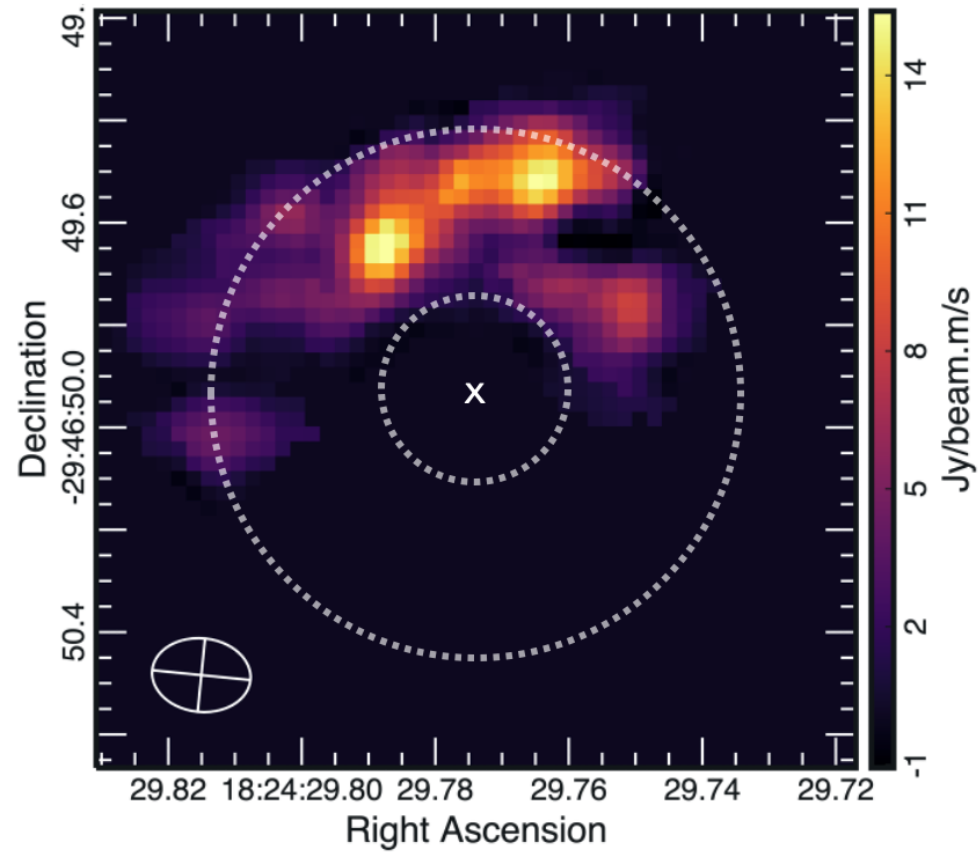
RESULTS

C/O RATIO



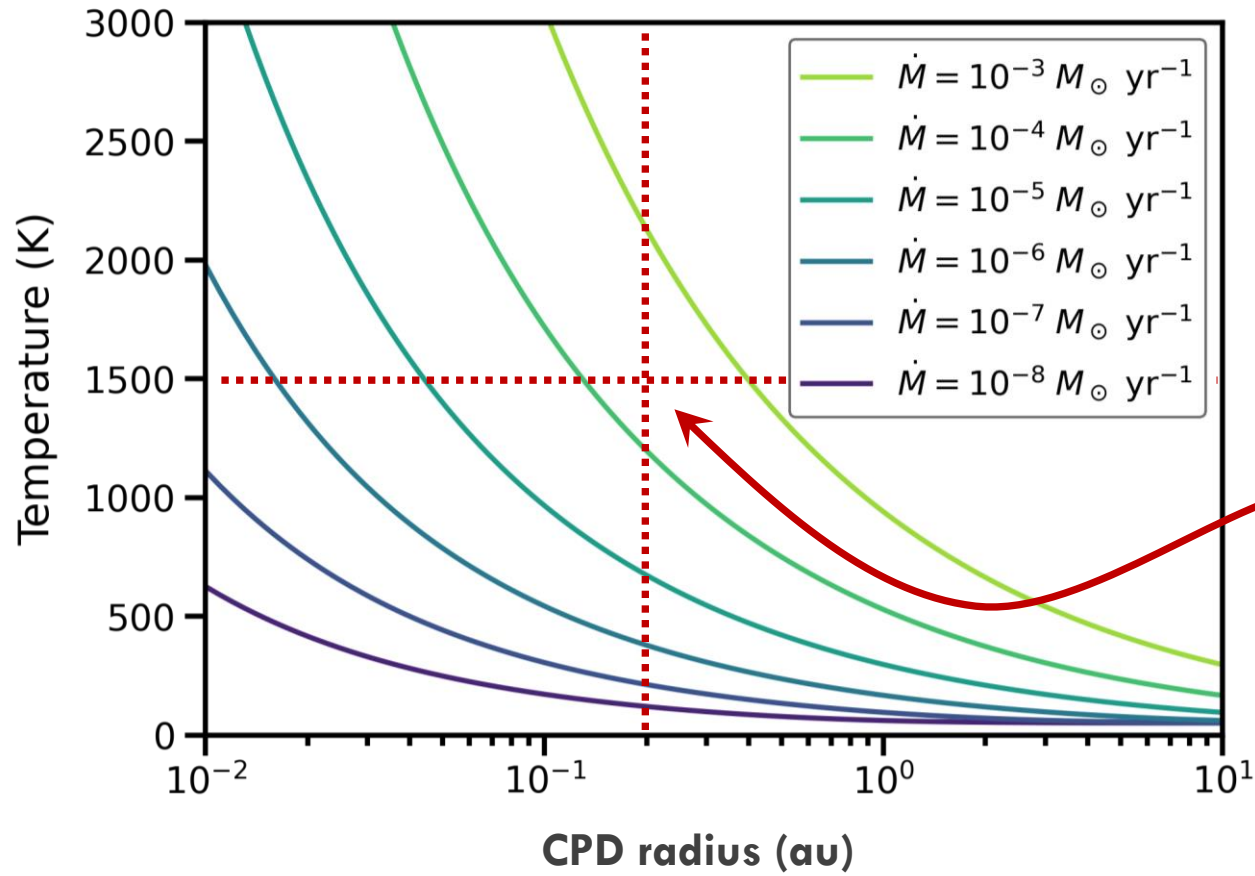
RESULTS

SiS emission



Law et al. (2023)

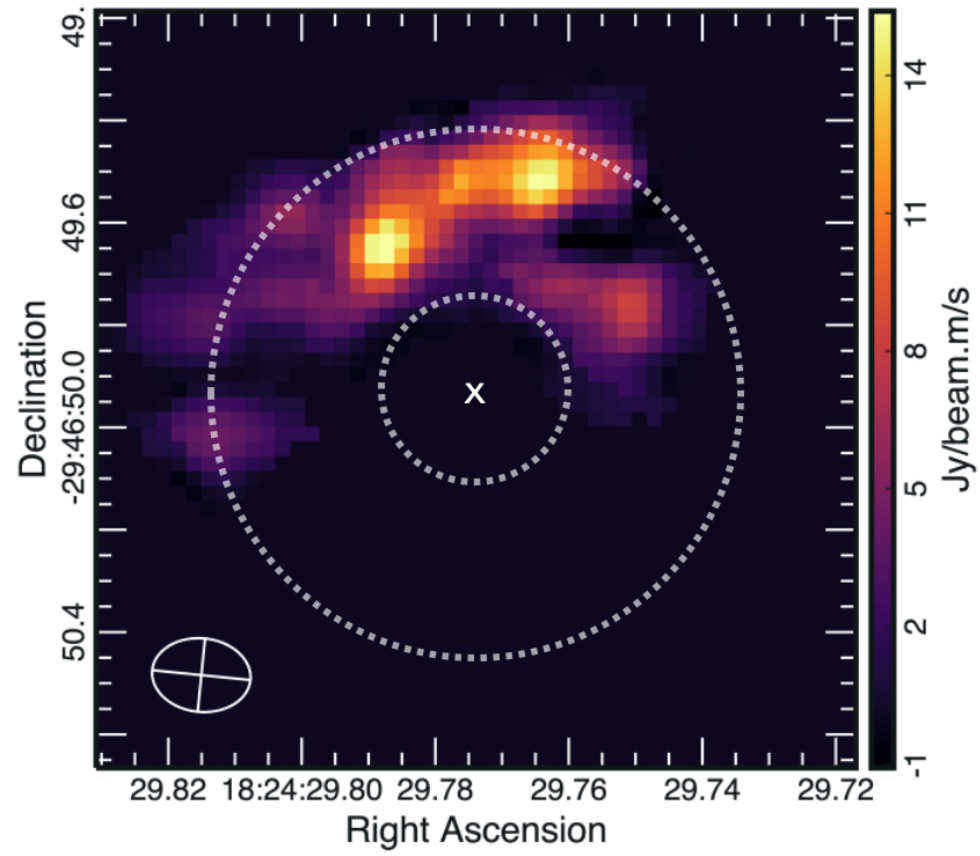
Is it a CPD?



$\dot{M} \sim 10^{-4} M_{\odot} \text{ yr}^{-1}$

RESULTS

SiS emission



Law et al. (2023)

SUMMARY

- 1** HD 169142 has a rich chemical inventory
- 2** Carbon and oxygen are in high abundance in the gas phase
 - little/no depletion in the inner disk
 - oxygen depleted in the outer disk
- 3** Sulfur depleted by factor ~ 1000
 - model dramatically underpredicts SiS emission
- 4** SiS likely traces an outflow or shock, not a CPD