



# Disk Parameters from CO isotopologues: It's COMplicated

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(they/them) (she/her) (she/her) (he/him)



Grid of model parameters:

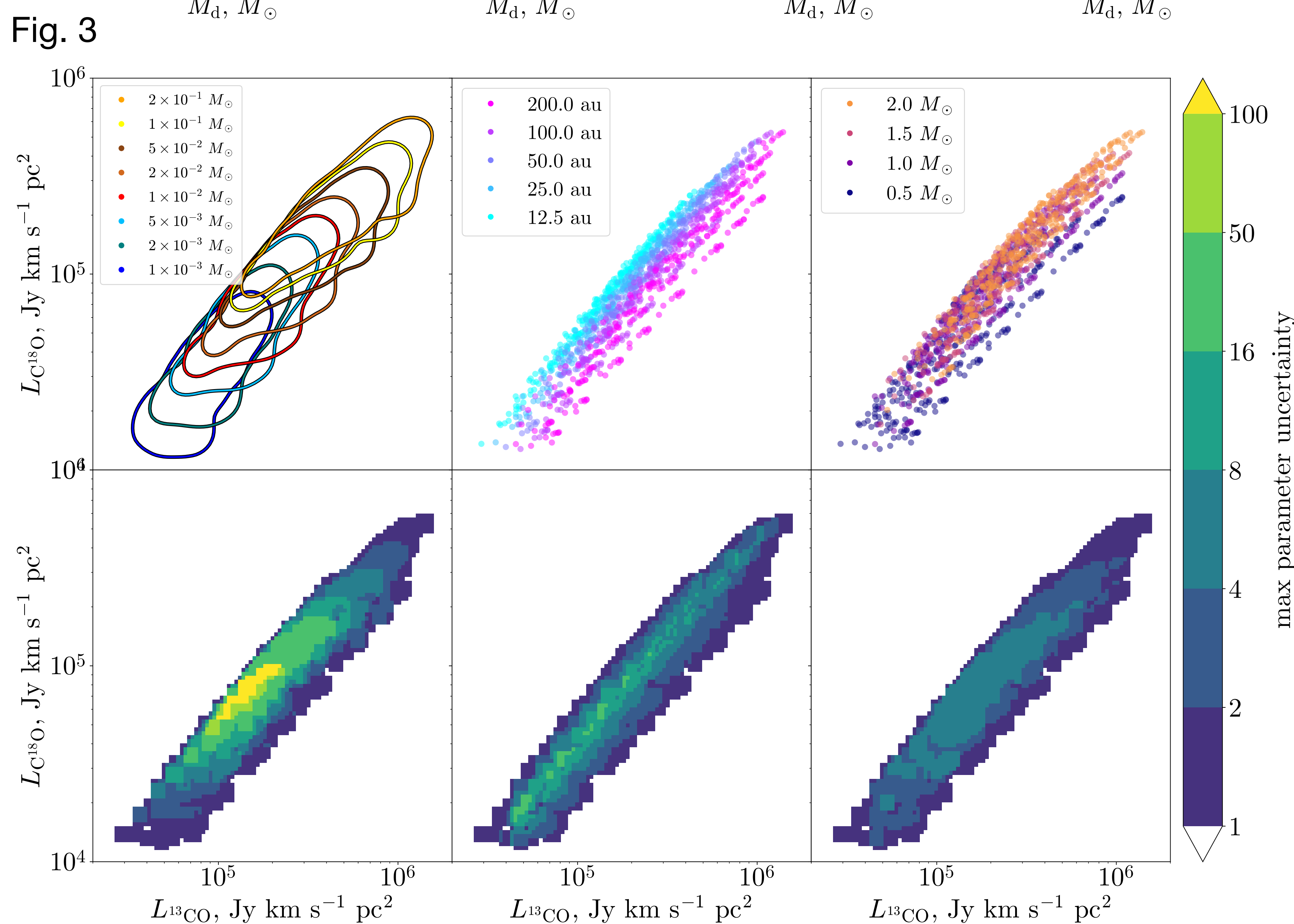
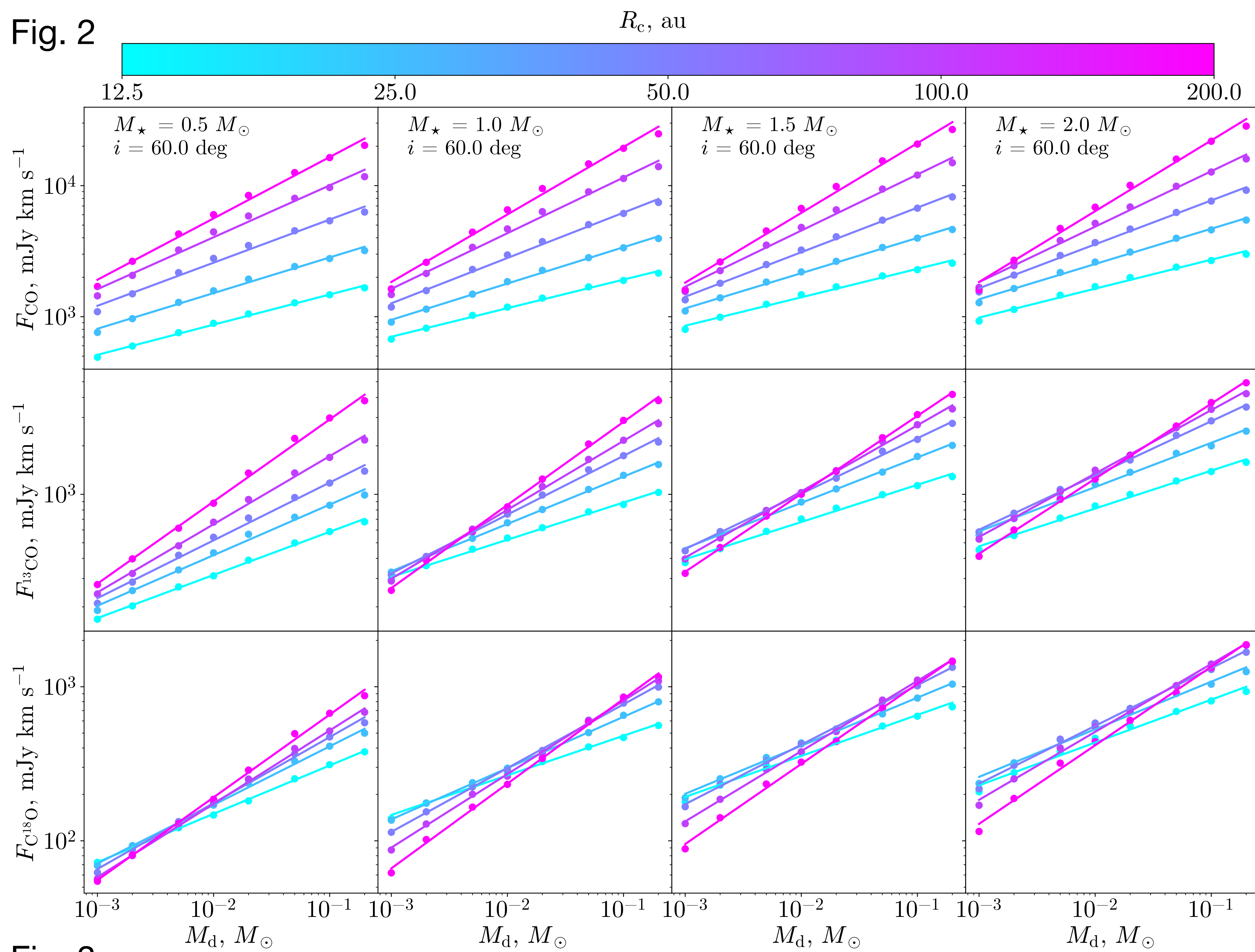
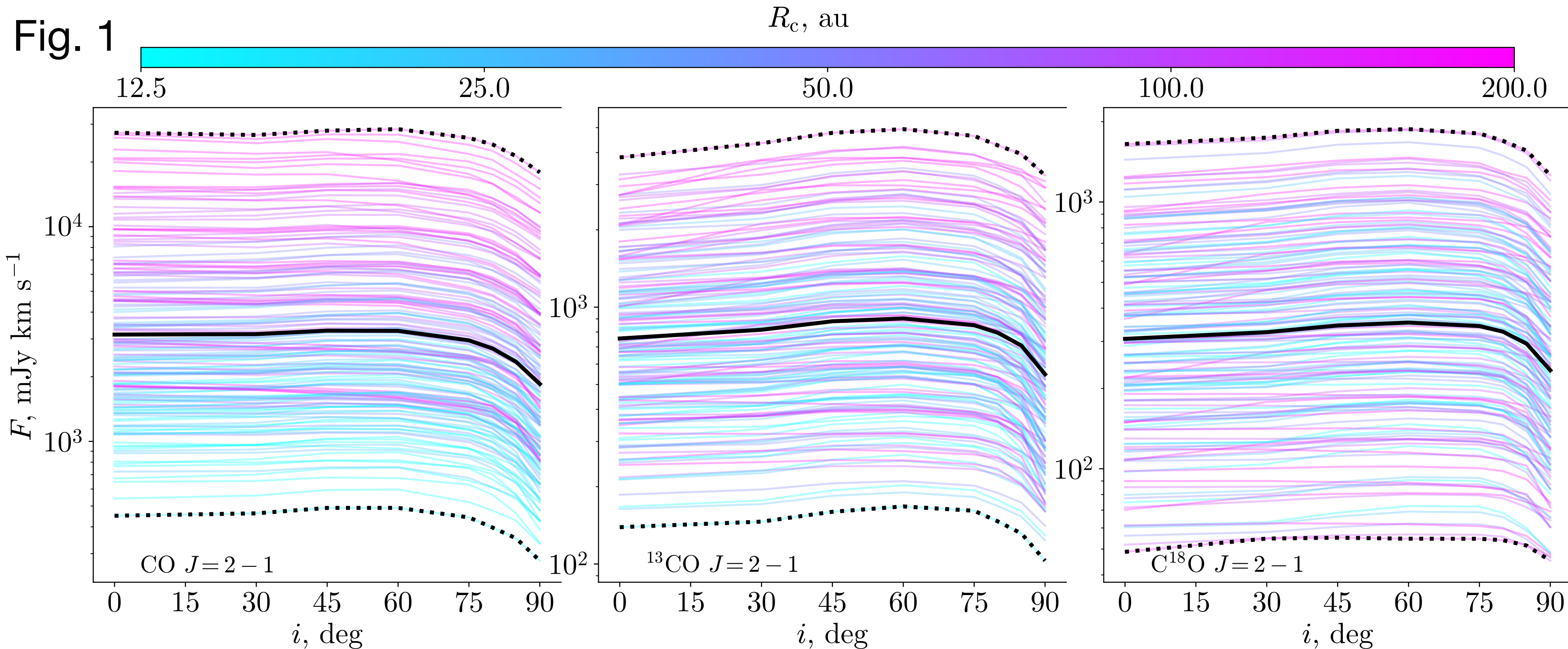
Parameter	Values
$M_{\star}$	0.5, 1.0, 1.5, 2.0 $M_{\odot}$
$M_d$	0.001, 0.002, 0.005, 0.01, 0.02, 0.05, 0.1, 0.2 $M_{\odot}$
$R_c$	12.5, 25, 50, 100, 200 au
$i$	0°, 30°, 45°, 60°, 75°, 80°, 85°, 90°

Physics and chemistry  
of the disk:

**ANDES**  
(Akimkin+2013)

Radiative transfer:

**RADMC-3D**  
(Dullemond+2012)



## Abstract

One of the most important problems in the study of protoplanetary disks is the determination of their parameters, such as their size, age, stellar characteristics, and, most importantly, gas mass in the disk. At the moment, one of the main ways to infer the disk mass is to use a combination of CO isotopologue line observations.

The aim of this work is to study the dependence of the CO isotopologue millimeter line fluxes on the astrochemical model parameters of the protoplanetary disk of a T Tauri star and to conclude whether they or their combinations can be reliably used to determine disk parameters.

While this has been done in previous works, our case is set apart by the usage of a comprehensive chemical network with grain surface chemistry together with line radiative transfer.

## Figures

1. Dependence of line flux on inclination
2. Dependence of line flux on disk mass, characteristic radius of the disk and stellar mass
3. Luminosity diagrams with model values grouped by disk mass (upper left), characteristic radius (upper middle), stellar mass (upper right). Lower panels show the parameter uncertainty within 10% of the luminosity of the point on the diagram.

## Conclusions

- CO isotopologue flux depends very weakly on inclination
- CO isotopologue flux always increases with disk mass
- How it increases with it depends on the disk radius, up to a factor of two
- You cannot reliably estimate disk mass from  $^{13}\text{CO}$  and  $\text{C}^{18}\text{O}$  flux combination (two orders of magnitude uncertainty)
- You can, however, estimate one parameter from any of the lines if you have independent constraints on other parameters.

## Acknowledgements

This work was supported by the NKFIH NKKP grant ADVANCED 149943. This poster is based upon work from COST Action PLANETS CA22133, supported by COST (European Cooperation in Science and Technology).