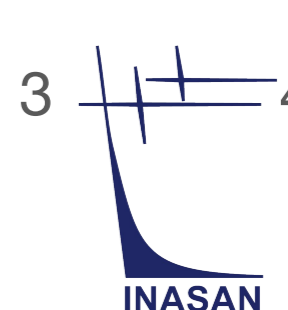


Observational and Chemical Modelling of Protoplanetary Disks after FU Ori outbursts

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



ANDES
(Akimkin+2013)

Physico-chemical structure of the axisymmetric quasistationary disk

RADMC-3D
(Dullemond+2012)

Radiative transfer in 8 molecular lines and dust continuum

CASA
(Bean+2022)

Simulating ALMA C-2 observations

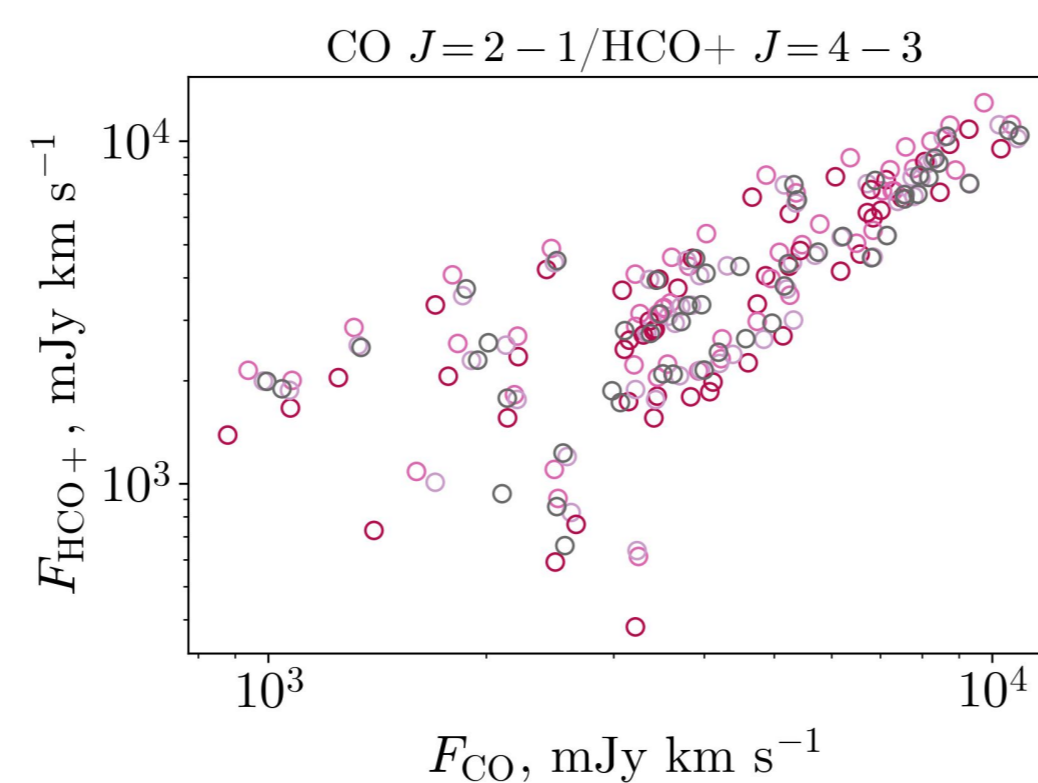
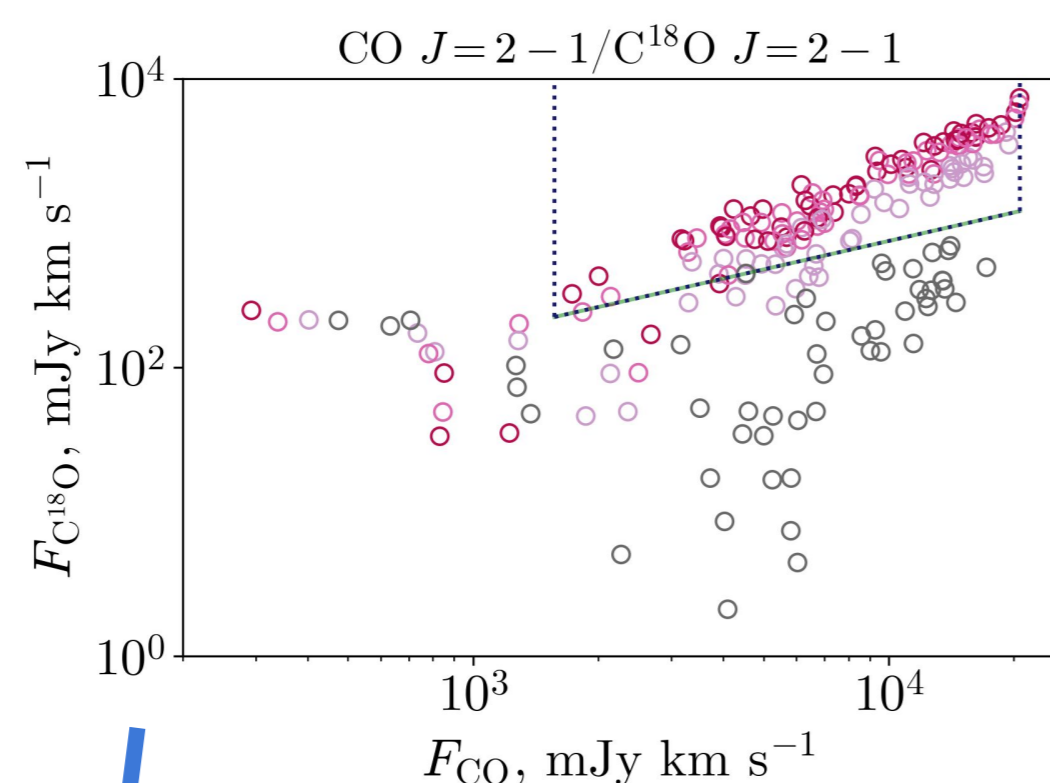
Set of models

Parameter	Range
L_b	100 – 600 L_\odot
M_\star	0.1 – 2 M_\odot
M_d	0.001 – 0.1 M_\star
R_c	20 – 200 au
i	0° – 90°

Uniform distribution
50 models with an envelope
50 models without
150 pc distance

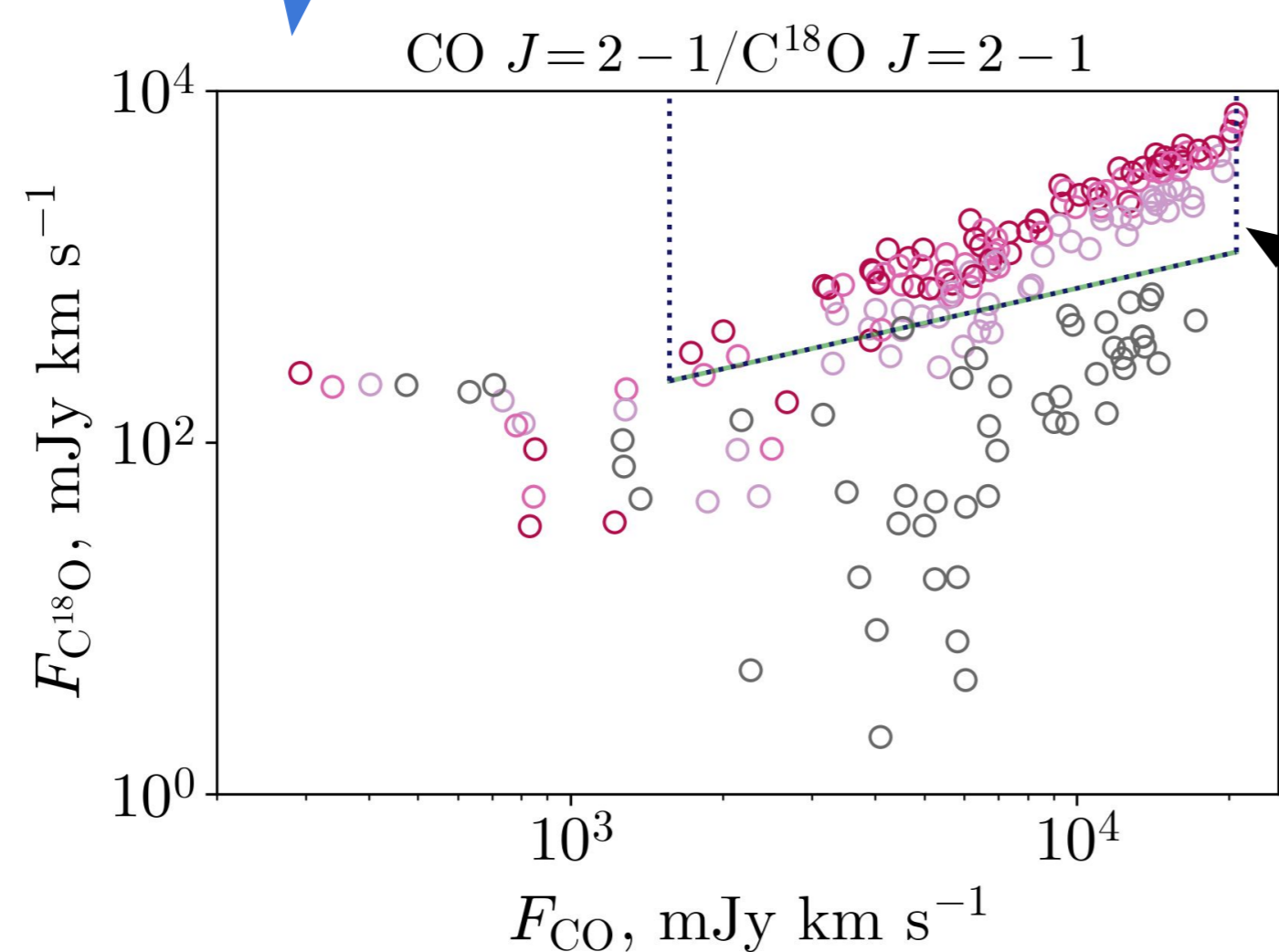
Tracer definition

Subtracting continuum and integrating into line fluxes on a set of models



separable => tracer

otherwise => not a tracer



An area where only post-outburst values lie is called post-FUor area.

If the observed object is inside, it is suspected to be a post-FUor

Details on post-FUor tracers, their efficiency and chemistry can be found in Zwicky+2024:



Conclusions

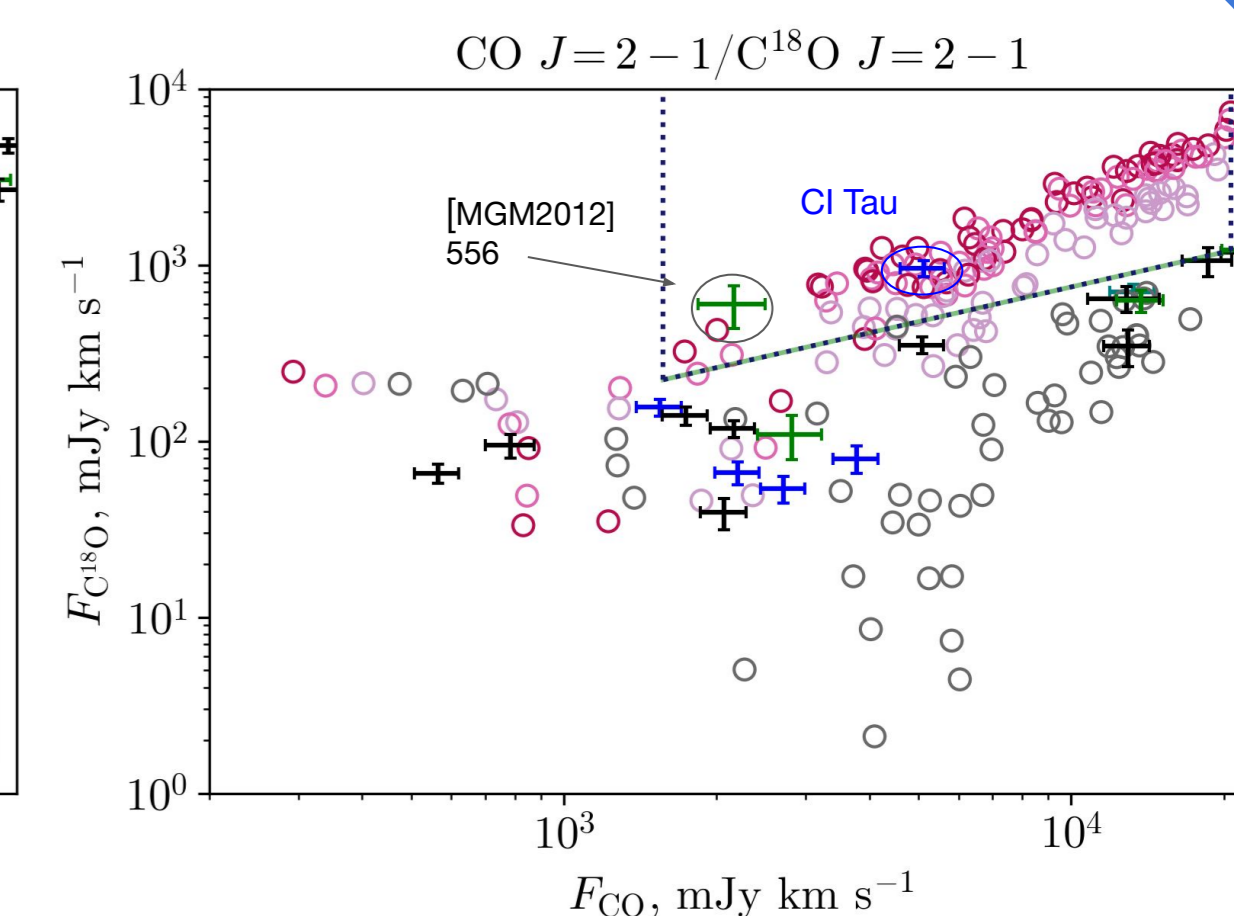
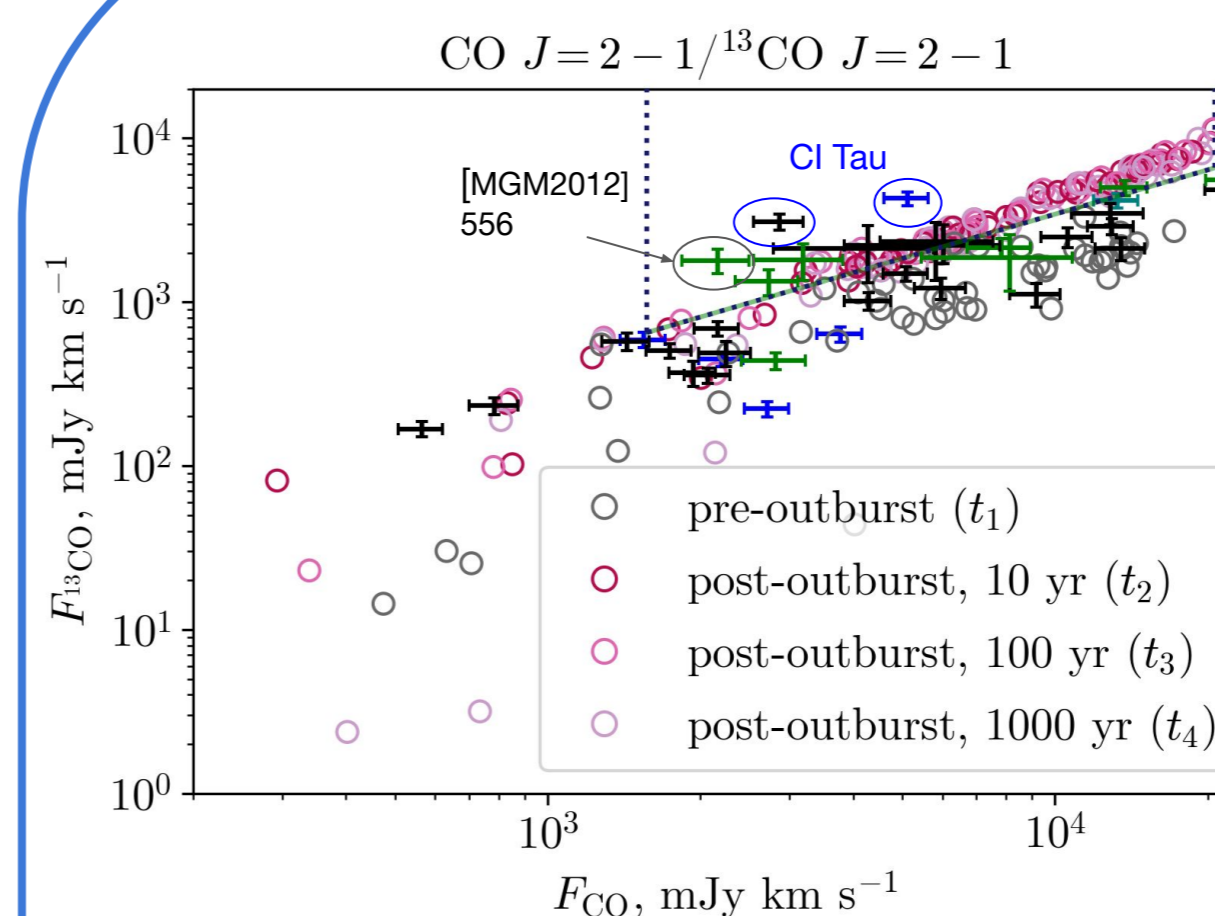
- 10 tracers for embedded disks and 21 for non-embedded
- Best among them — based on HCN, H₂CO, N₂H⁺ and C¹⁸O lines
- Chemistry — desorption and enhanced reactions in the molecular layer
- 10 post-FUor candidates

Abstract

FU Ori stars (FUors) are undergoing powerful luminosity outbursts of $\sim 100 L_\odot$ in magnitude and of several decades in duration. Such outbursts inevitably affect physical and chemical structure of the surrounding protoplanetary disk.

Using astrochemical and radiative transfer modelling, we study the lasting impact of the outburst on disks with and without an envelope and how it changes flux in chosen molecular lines. We formulate a number of criteria indicative of a recent outburst activity based on the molecular emission, analyze the chemistry behind the flux change and apply the criteria to available observations of quiescent protoplanetary disks. The latter revealed ten objects with possible outbursts in the past and four of them satisfy multiple proposed criteria.

Application to observations



Our post-FUor candidates:

- | | |
|------------------------|-----------------|
| Transitional disks | Class II YSOs |
| • [MGM2012] 307 | • Cl Tau |
| • [MGM2012] 971 | • IM Lup |
| • [MGM2012] 556 | • AS 209 |
| • DM Tau | • J1604-2130 |
| • LkCa 15 | • GM Aur |

Disks with several identifications are in bold