

Studying Infall Towards 10 Class 0/I Protostars Using ALMA and FERIA

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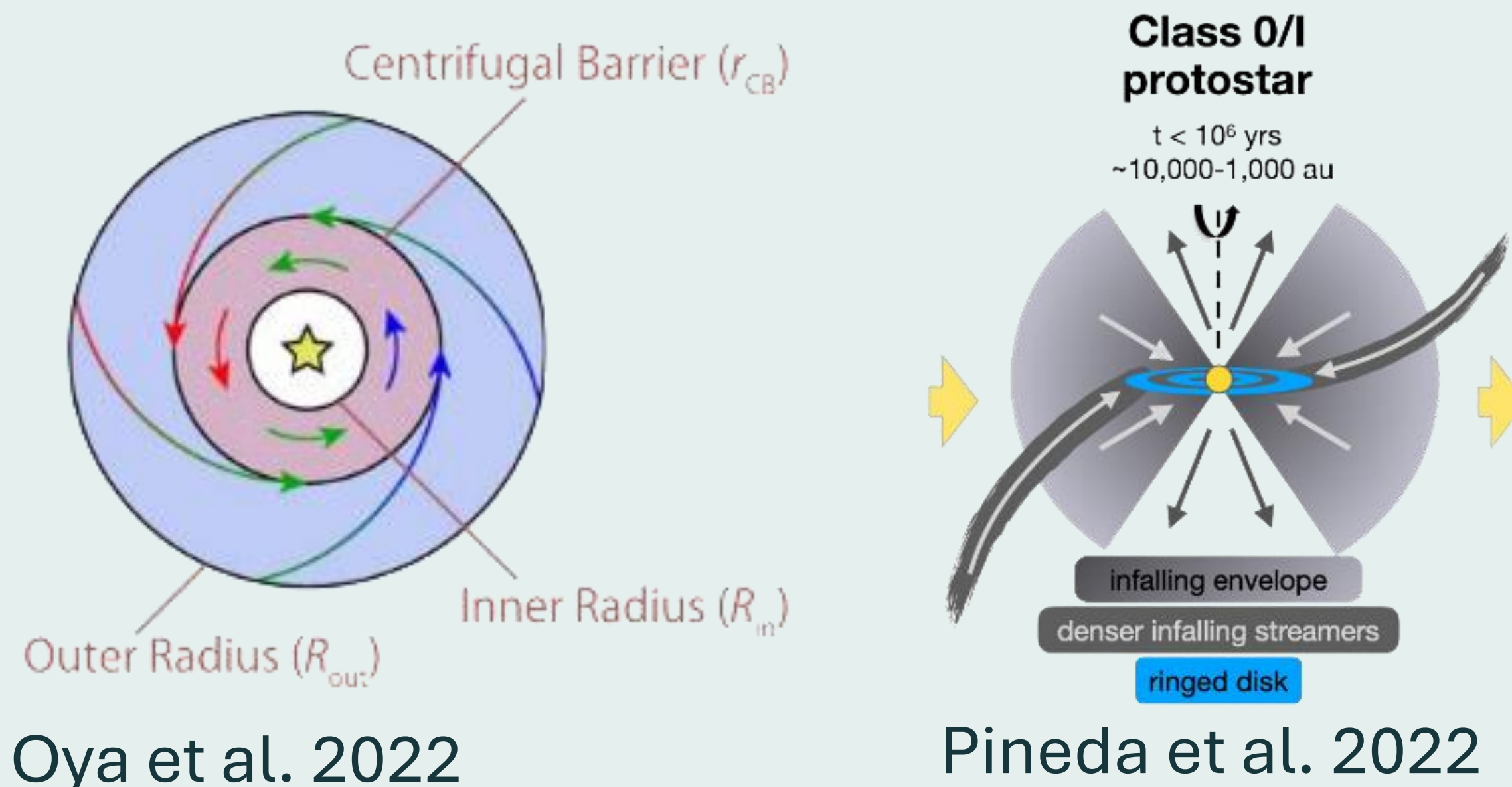
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Class 0/I Protostars

Fitting Keplerian disks to protostars can be a simple way of modeling, however contributions from an infalling envelope are often neglected.

Perfectly Keplerian models and perfectly IRE models can differ by up to a factor of 2 in protostellar mass estimates, potentially causing overestimation of protostellar masses.

This effect would be most pronounced in Class 0/I protostars where envelope infall is prevalent.

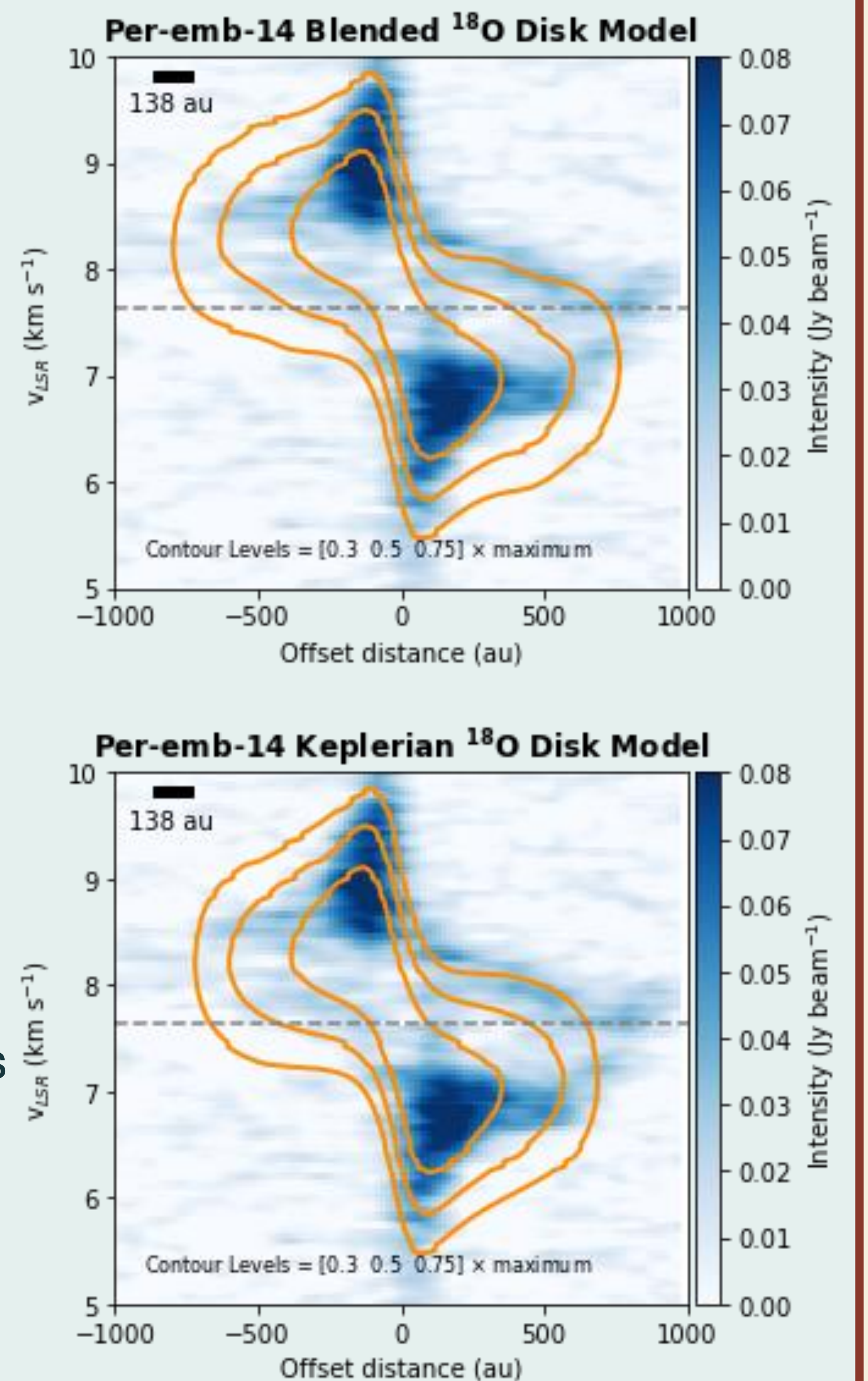


Infalling Envelope Contribution

FERIA is used to generate models using a grid search approach across 4 parameters: protostellar mass, inner and outer disk radii, and the centrifugal barrier radius.

Models are compared to observations using cubechi2, a voxel χ^2 calculator bundled with FERIA.

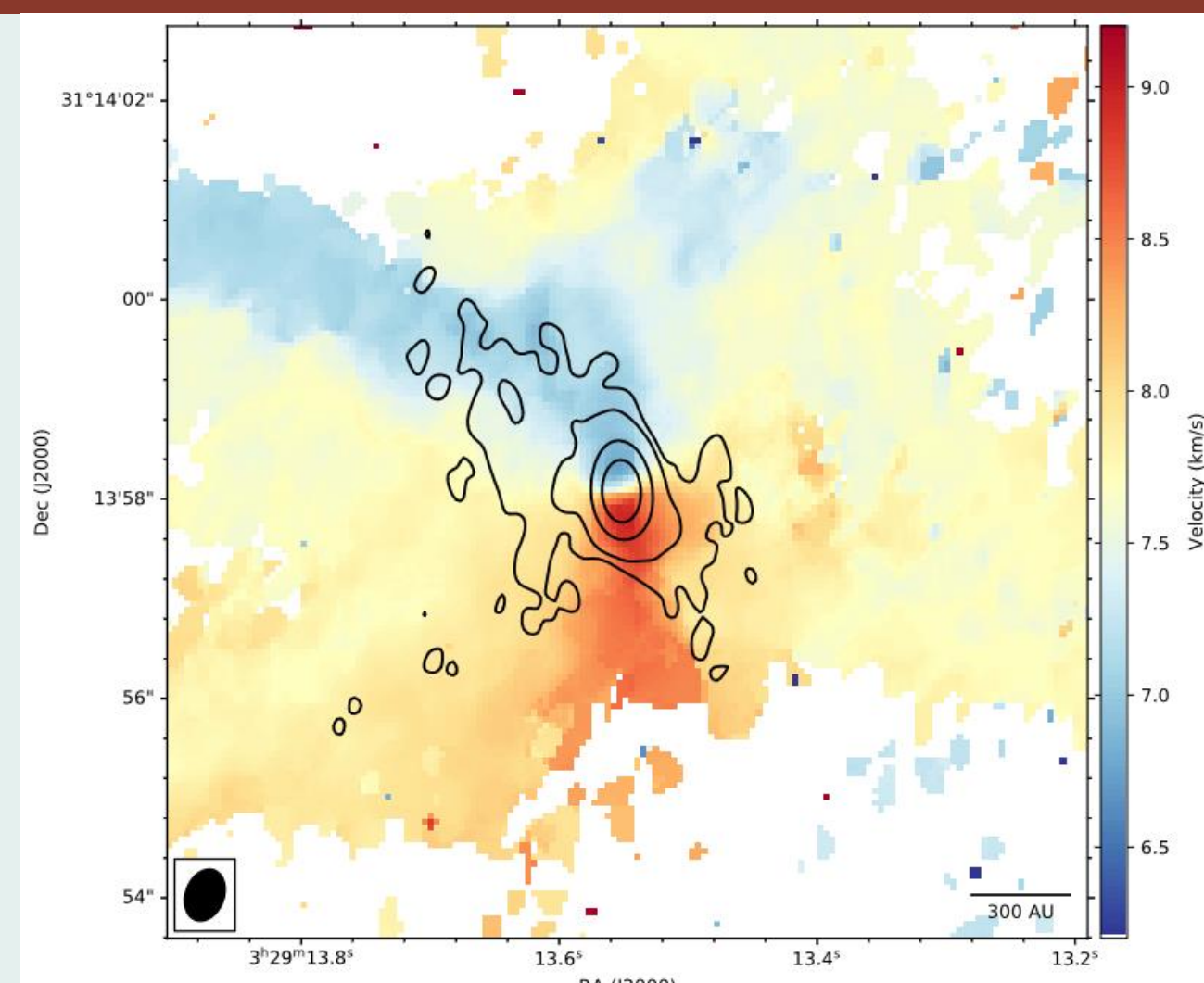
While allowing a blended model significantly changes the best model's parameters, averaging the best models shows little difference from a purely Keplerian approach.



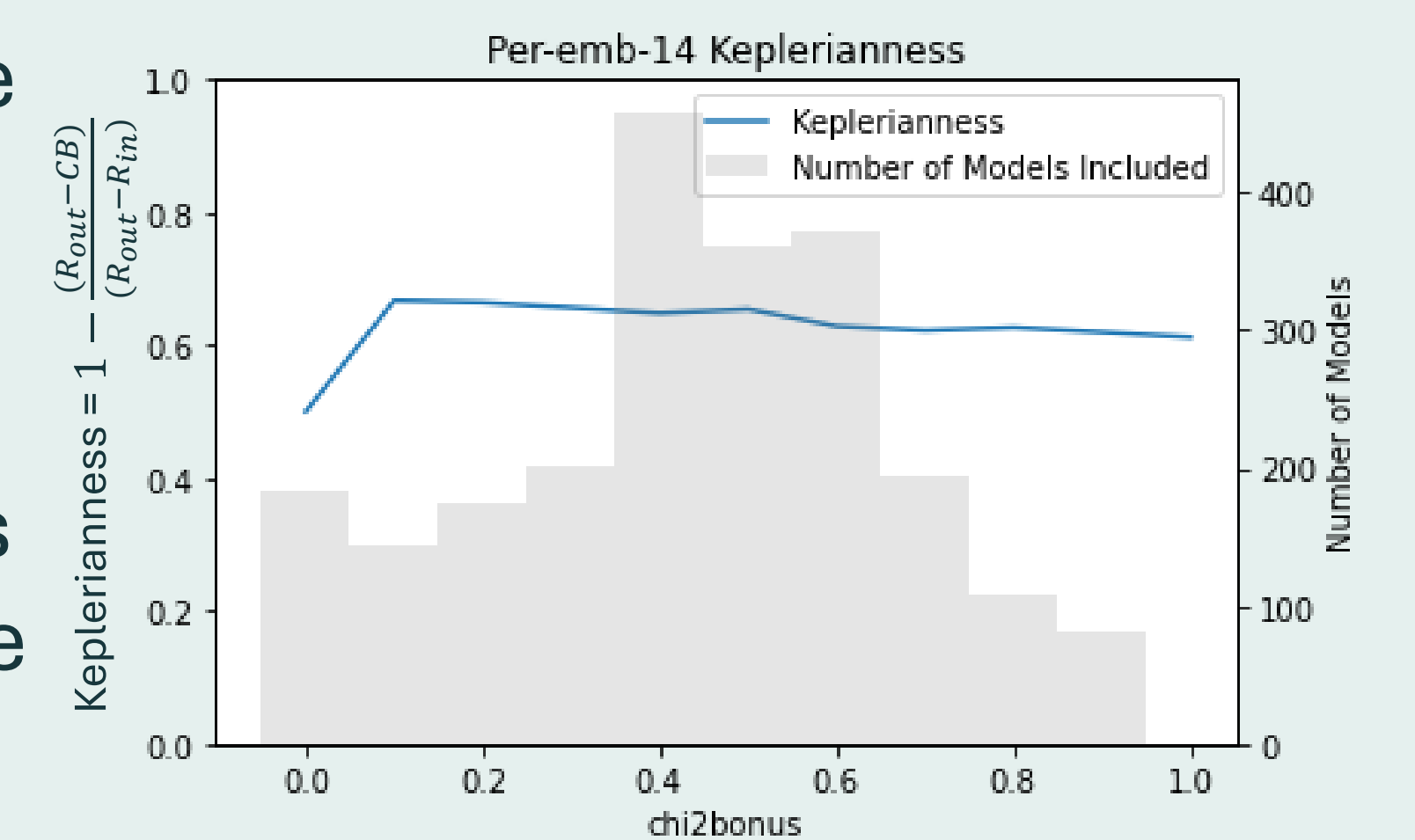
ALMA Data

Project
2017.1.01078.S

0.538" x 0.383"
 (~161 au x 115 au at a distance of 300 pc) resolution.



The best fitting models have the centrifugal barrier roughly halfway between R_{out} and R_{in} , however protostellar mass estimates overlap with Keplerian curve fitting.



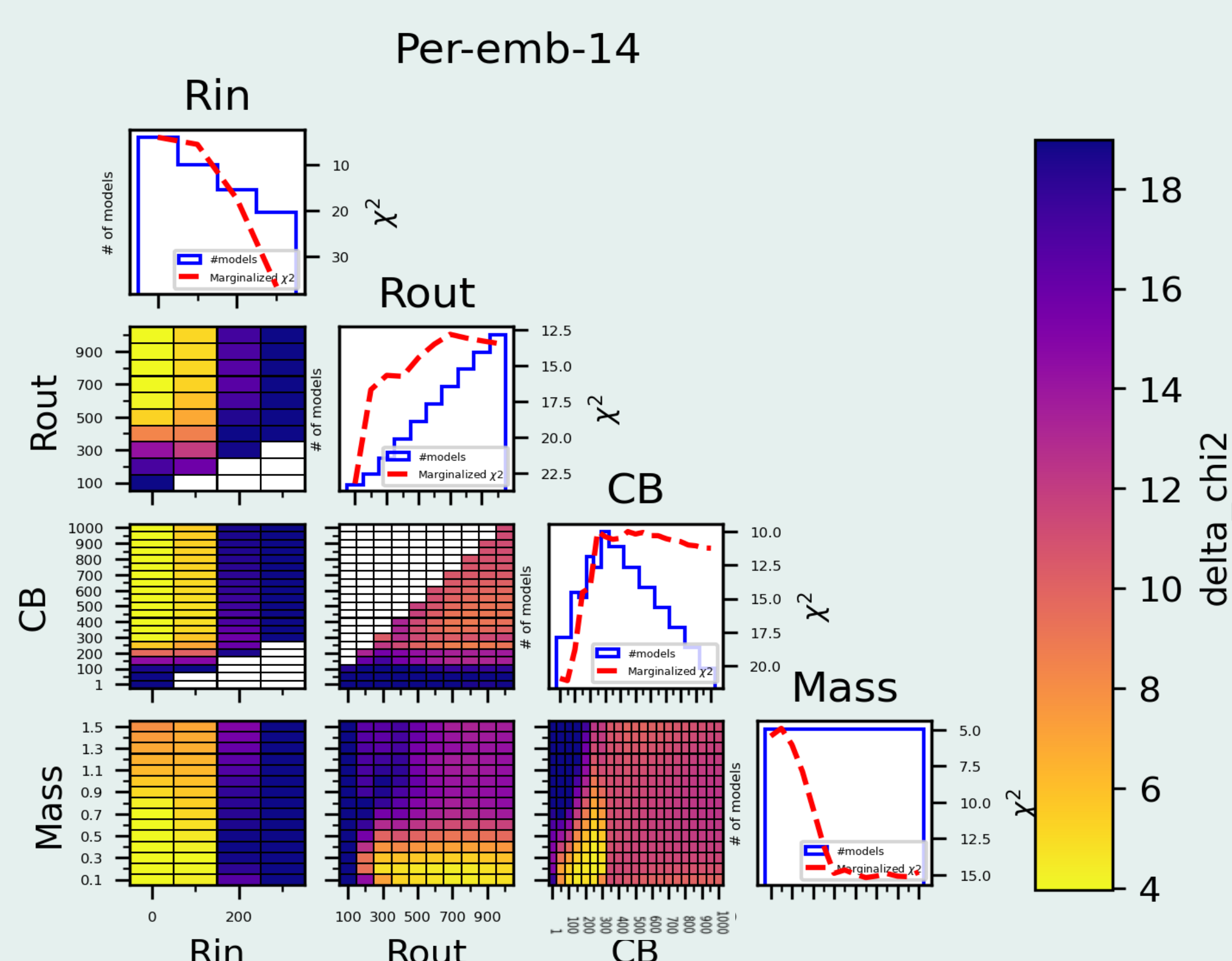
Model Parameter Optimization and Results

Our grid search method allows for the collection of models which are 'good enough', providing a group to do statistics on. Model parameters can be reported with uncertainties.

In general, disk radii are overestimated compared to traditional values. We believe our parameters are tracing the envelope rather than the gas disk.

We do not see significant deviation from a traditional Keplerian mass fitting approach at this resolution. We therefore claim the IRE component is not significant enough to affect mass measurements.

A full manuscript for 10 protostellar sources is being written for publication.



References

Oya et al. (2022) PASP, 134, 1039. Pineda et al (2022) Nature Astronomy, 4, 1158

