Can habitable planets form in clustered environments?

María de Juan Ovelar, D. Kruijssen, E. Bressert, L. Testi, N. Bastian and H. Cánovas Cabrera

NGC 3603 Credit: HST archive

Planet Formation and Evolution
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Can habitable planets form in clustered environments?

1. Environmental effects on protoplanetary discs?
   - external photoevaporation and dynamical interactions

2. Observational evidence?
   - not conclusive

3. Effect on the habitable zone?
   - ?

The study
de Juan Ovelar et al. 2012
(submitted)
(accepted)
The study

2. Observational evidence?

- Catalog of resolved Protoplanetary Discs (PPDs)
- Catalog of Young Stellar Objects (YSOs)

Diagram:
- disc radius $r$
- ambient stellar density around disc $(N_r \text{ stars/unit area})$ $\Sigma$
The study

Disc radius vs. ambient surface density

The graph shows the relationship between disc radius ($r_{tr}$) and ambient surface density ($\Sigma$). The data points represent different types of objects:

- *: Herbig Ae/Be
- △: T Tauri
- ×: Young Stellar Objects
- □: Orion Nebula Cluster Proplyd

The lines on the graph indicate two time periods: 0.3 Myr and 1 Myr.
The study

- KS-test to detect a change in the radius distribution
- 6, 7 and 8 objects per bin
- > 97% confidence level detection @ $\Sigma \geq 10^{3.5}$
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KS-test to detect a change in the radius distribution

6, 7 and 8 objects per bin

> 97% confidence level detection @ $\Sigma \geq 10^{3.5}$
Although results are highly suggestive we need to probe higher density environments:

**ALMA Cycle 1** proposal for studying disc mass function in **NGC3603** (∼3 Myr) with $\Sigma_{\text{max}} > 10^4$
The test

$\Sigma_{0''} \sim 2 \times 10^4$
$\Sigma_{30''} \sim 2 \times 10^3$
$\Sigma_{60''} \sim 5 \times 10^2$
3. Effect on the habitable zone?

but while we wait...
3. Effect on the habitable zone?

but while we wait...

\[ HZ_{LIFETIME} = T \left( R_{TR.} = R_{HZ} \right) \]
The habitable zone

HZ lifetime

![Graph showing HZ lifetime with logarithmic scales for mass and time.](image-url)
Conclusions

Can habitable planets form in clustered environments?

1. Environmental effects on protoplanetary discs?
   → photoevaporation and dynamical interactions

2. Observational evidence?
   → not conclusive

3. Effect on the habitable zone?
   → rough prediction of $\text{HZ}_{\text{LIFETIME}}$
   NO photoevaporation taken into account

> 97% confidence level that environment matters + ALMA Cycle 1 prop.

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Bottom line:
there’s a universe outside the disc…watch out!!

Thank you!!