

The main question

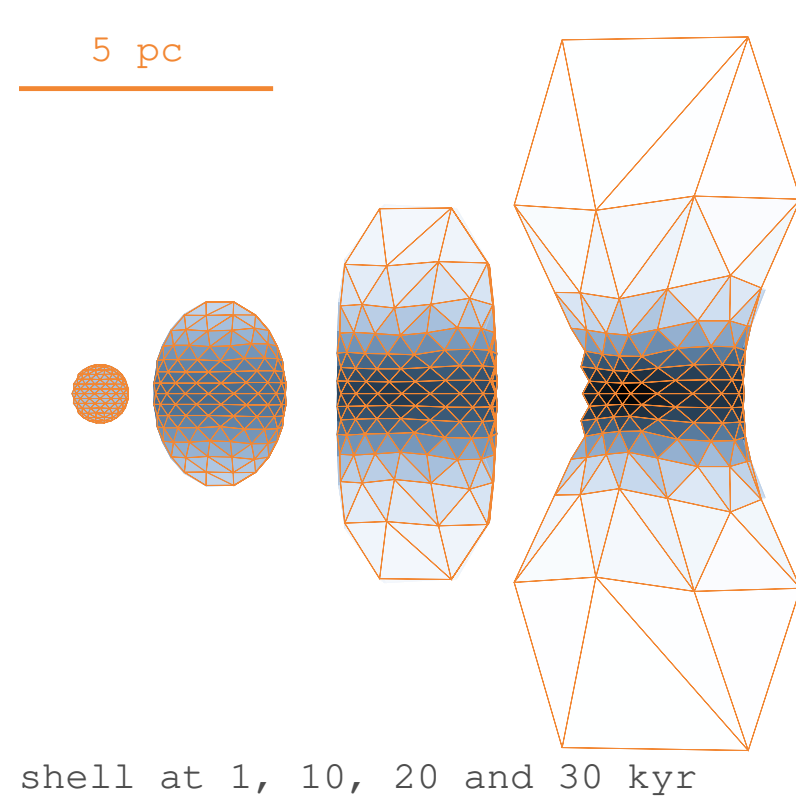
Do supernovae exploding in circumnuclear disks redistribute mass, do they feed the supermassive black holes, or do they destroy gaseous disks?

Our previous results: [1], [3]; see also the poster S73 by David Kománek.

Numerical model

We model expanding shells created by supernovae using

- infinitesimally thin approximation of the shock front (see [2]);
- the external gravitational potential (a nuclear star cluster + a black hole) [2];



- gaseous disk $n(z) = n_0 e^{-(z/\sigma)^2}$, no radial profile;
- energy of explosion: 10^{51} erg.

shell at 1, 10, 20 and 30 kyr

Evolution stops when majority of mass in an expanding shell becomes subsonic.

Redistribution of mass

- One supernova: pushes some gas to smaller and larger radii from the place of explosion, clears the place of explosion, blows some mass away from the disk.
- Many supernovae uniformly exploding in the disk: their average leads to the "area-weighted supernova" and the corresponding mass redistribution.

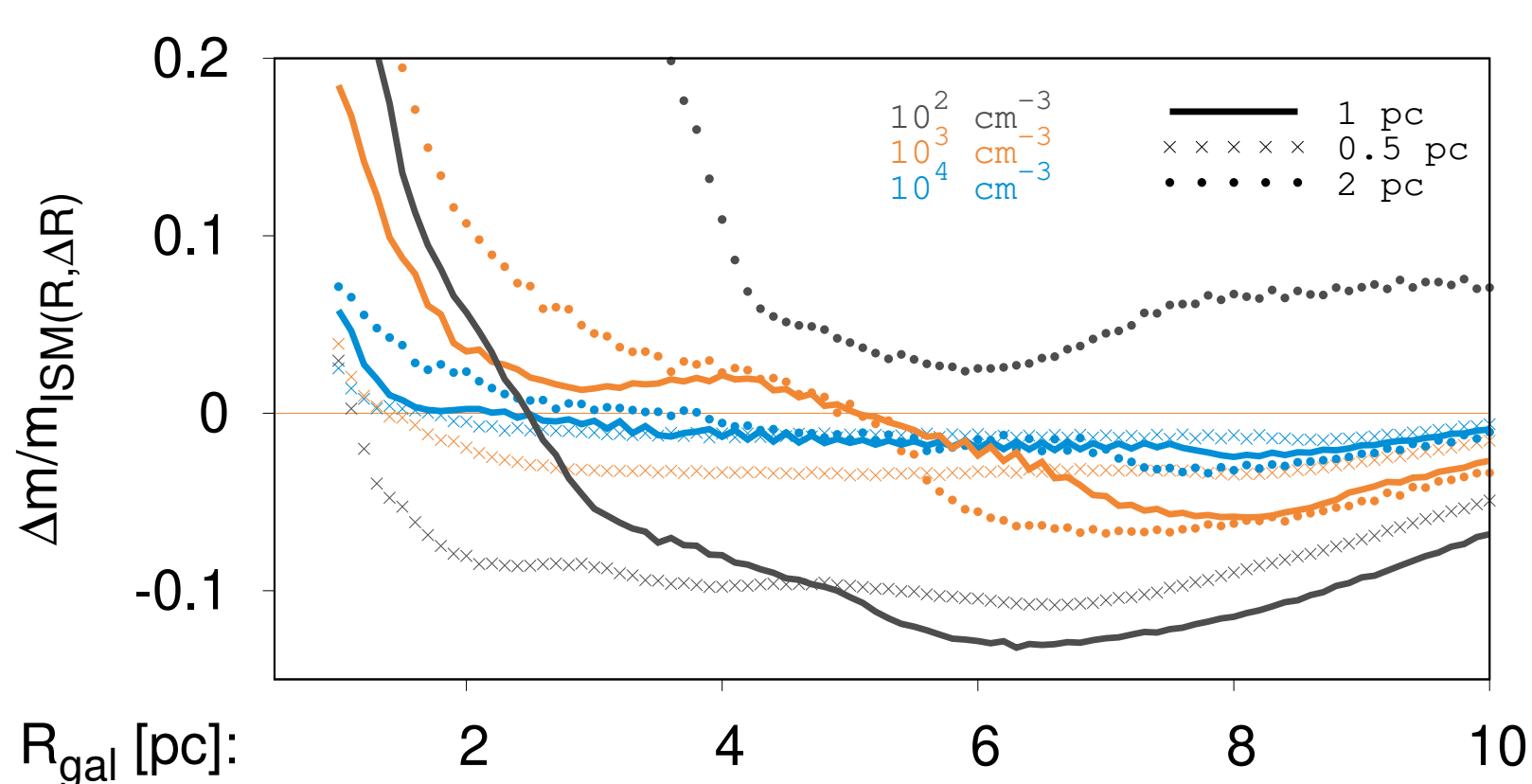


Figure 1. Mass redistribution on an "area-weighted supernova", for three different densities n_0 and three different thicknesses σ .

Supernovae increase the mass (density) in inner regions of disks, but overall they destroy the disk.

Feeding the centre

Supernovae deliver mass to central regions (= central 1 pc).

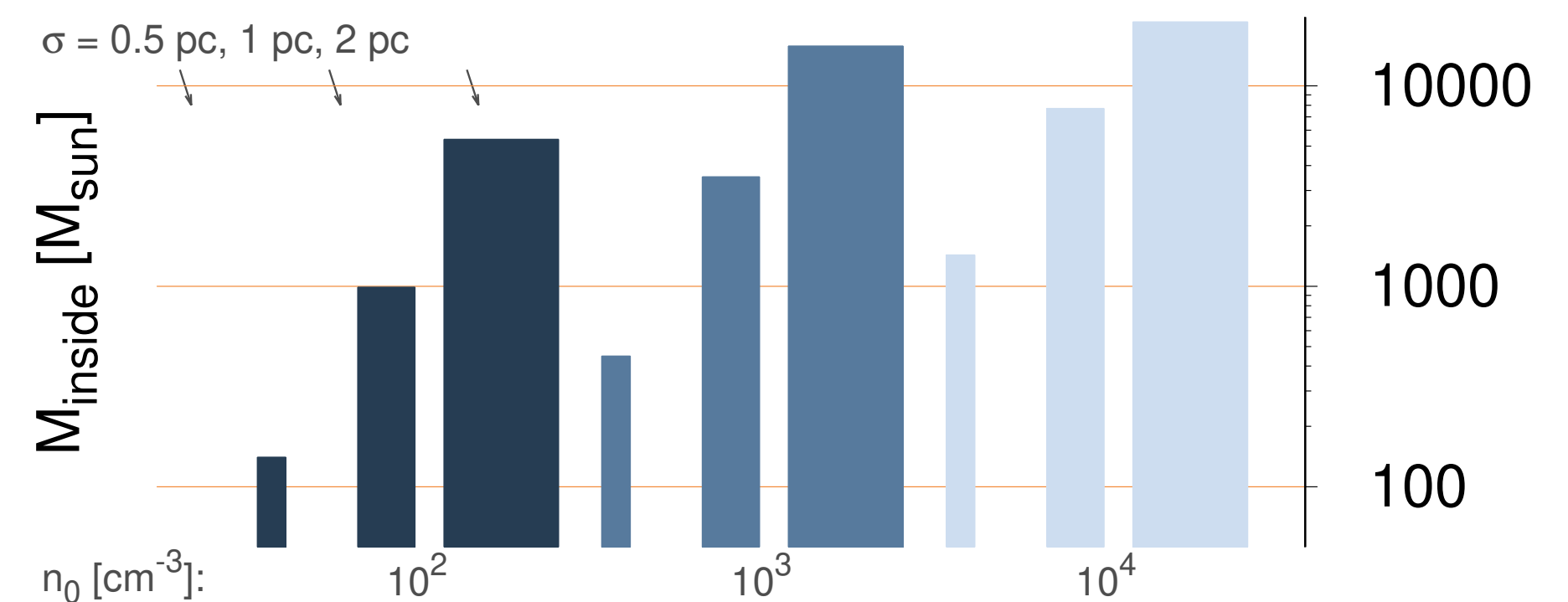


Figure 2. Mass delivered to the central 1 pc by the "area-weighted supernova", for three different densities and three different thicknesses.

Assuming the connection $\Sigma_{\text{gas}} \rightarrow \Sigma_{\text{SFR}} \rightarrow \Sigma_{\text{SNR}}$ we get the mass infall rate to central 1 pc $\dot{M}_{\text{infall}}$.

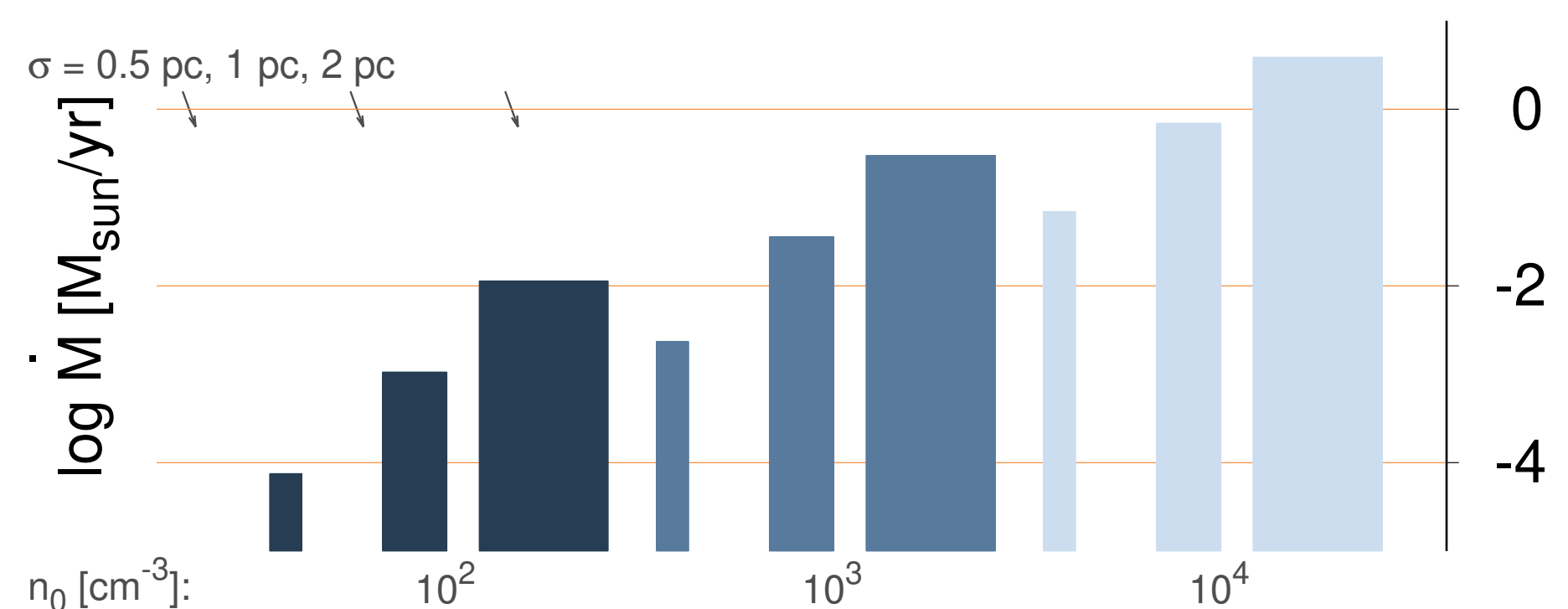


Figure 3. Mass infall rate to the central 1 pc by the "area-weighted supernova", for three different densities and three different thicknesses.

Conclusions

- The star forming disk can survive only if the gas is supplied from outside.
- The mass delivered into central 1 pc is proportional to the disk thickness and its surface density.
- The existence of the black hole, and its mass, increases the mass delivery.

References

- [1] B. Barna, R. Wünsch, J. Palous, M. R. Morris, S. Ehlerová, and P. Vermot. *A&A*, 695:A92, 2025.
- [2] S. Ehlerová, J. Palouš, M. R. Morris, R. Wünsch, B. Barna, and P. Vermot. *A&A*, 668:A124, 2022.
- [3] J. Palouš, S. Ehlerová, R. Wünsch, and M. R. Morris. *A&A*, 644:A72, 2020.