Environmental-induced disc destruction

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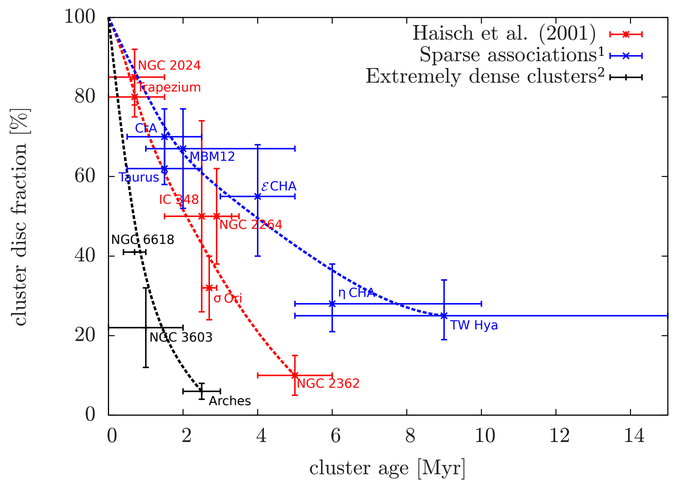
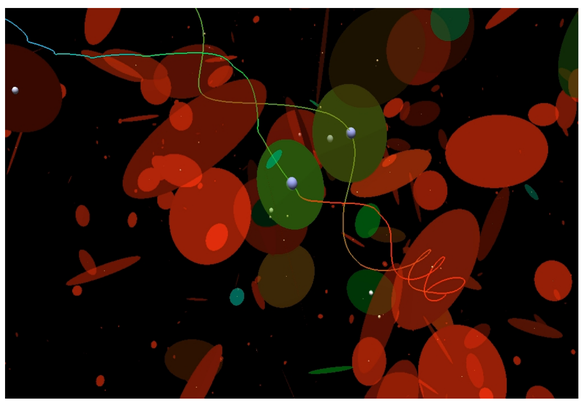
How can one find out whether photo-evaporation or tidal stripping dominates?

Introduction



- Most stars form in a cluster
- Stars initially surrounded by disc
- Disc dispersal time depends on cluster environment.
- Environmentally induced disc destruction
  - Tidal stripping by stellar encounters
  - Photo-evaporation by massive stars

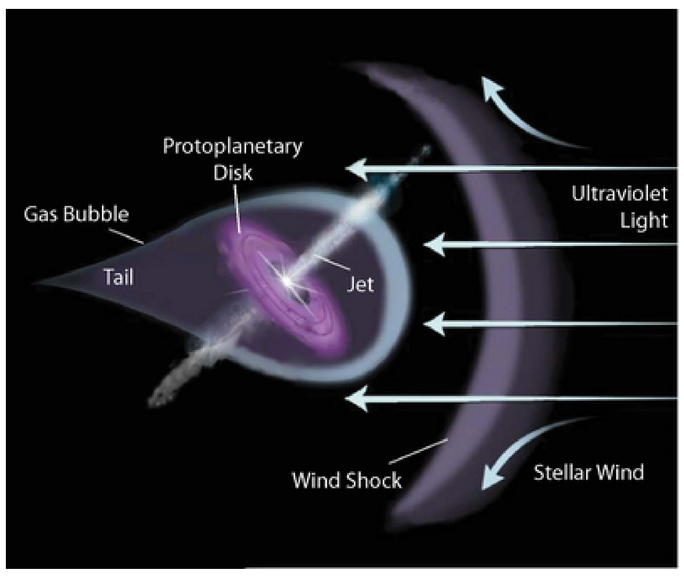
Method



- Nbody simulations of cluster dynamics
- Numerical parameter study of encounters

$\longrightarrow$ Disc loss in cluster environment

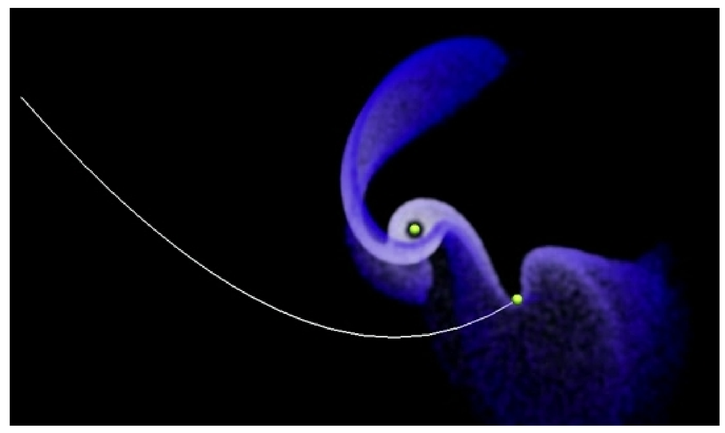
Photo-evaporation



Disc destruction by radiation from massive stars

Mass segregation $\Rightarrow$ massive stars concentrated at center of cluster
Disc frequency lower at cluster center

Tidal destruction



Disc destruction by tidal interactions between stars

Effect strongest for close encounters
$\Rightarrow$ most common in cluster center
Disc frequency lower at cluster center

Radial dependence of disc frequencies allows no distinction between the two mechanisms

Long times close to massive stars favour destruction
$\Rightarrow$ Discless stars have low velocities

$\Rightarrow$ Stars with discs same velocity dispersion as those without discs

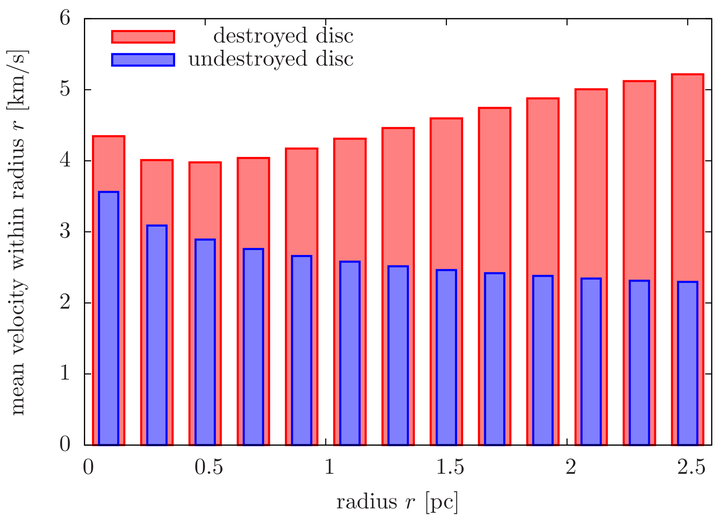
High impact interactions are most damaging
$\Rightarrow$ Discless stars high velocity

$\Rightarrow$ Stars with discs lower velocity dispersion than those without discs

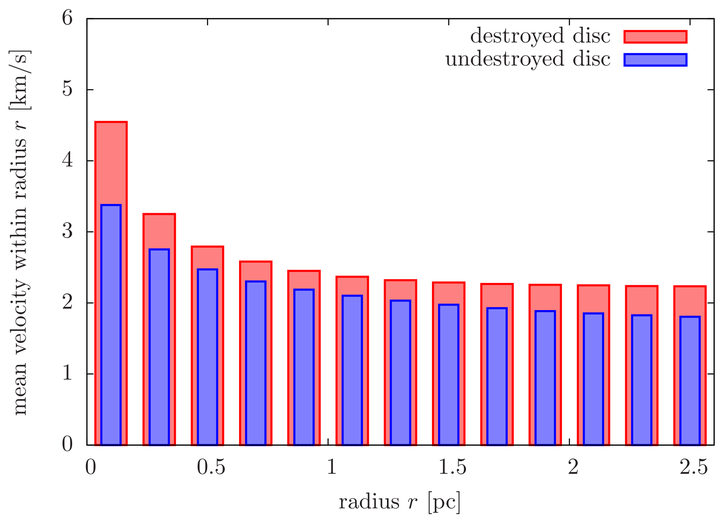
Velocity dispersion allows distinction between the two mechanisms

Results

At 0.2 Myr



At 2.0 Myr



- Circumstellar discs are destroyed via stellar encounters
- Discless stars increased mean velocity compared to disc-surrounded stars
- Discless stars are rapidly ejected from cluster (< 2 Myr)
- After 2 Myr velocity distribution of discless and disc-surrounded stars similar

Encounter-induced disc destruction can be traced by high stellar velocities in early evolutionary phase

Conclusion

- Disc frequency can not decide which process dominates external disc destruction
- Velocity dispersion does the trick:
  Low dispersion $\rightarrow$ Tidal destruction
  Equal dispersion $\rightarrow$ Photo-evaporation
- Narrow time window:
  Clusters have to be younger than 2 Myr
  Afterwards tidally stripped stars have left cluster

References

[1] Fang, M. and van Boekel, R. and Bouwman, J. and Henning, T. and Lawson, W. A. and Sicilia-Aguilar, A., Young stars in ϵ Chamaleontis and their disks: disk evolution in sparse associations, *A&A*, 549:A15, 2013 and references therein; [2] Stolte, A. and Morris, M. R. and Ghez, A. M. and Do, T. and Lu, J. R. and Wright, S. A. and Ballard, C. and Mills, E. and Matthews, K., Disks in the Arches Cluster - Survival in a Starburst Environment, *ApJ*,718:810, 2010 and references therein

For further information, check out
www.mpifr-bonn.mpg.de/staff/spfalzner