I. Physikalisches Institut • Universität zu Köln

Accretion, Disc Destruction and Binarity

Massive Stars in Young Clusters

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Introduction

Most stars are born in a cluster environment.

Model cluster here: Orion Nebula Cluster.

Why ONC?

★ **well observed**
limits parameters

★ **high stellar density**
encounters likely to be important

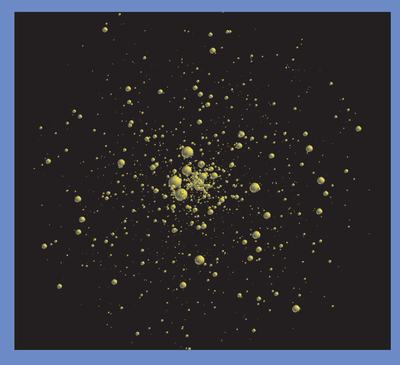
Massive stars:

- predominantly located close to cluster center
- location of highest stellar density
- function as gravitational foci
- experience much more encounters than lower mass stars
- encounters happen predominantly early on (<1 Myr) in cluster development

Method

Combination of two types of simulation

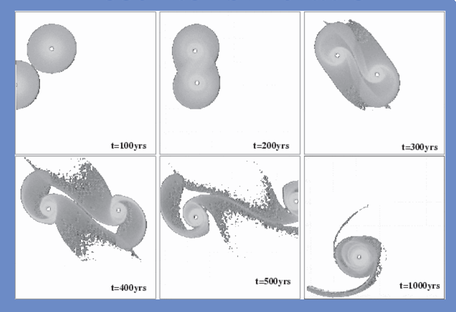
Cluster simulations



★ using Nbody6++
★ ~4000 stars
★ IMF according to Kroupa(2001)

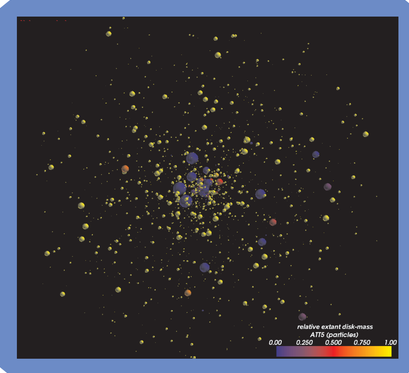
Simplifications:
★ no primordial binaries
★ no gas

Encounter simulation



•10 000 particles for
•$M_{disc}=M_*$

Simplifications:
prograde, coplanar, (parabolic) encounter



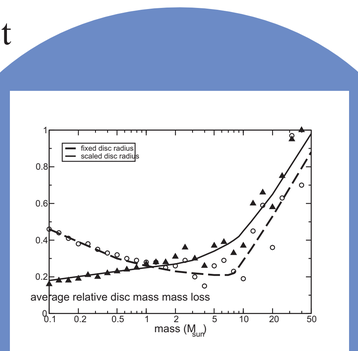
Combination of both results

Investigated properties:
- Discmass loss
- Angular momentum loss
- Capture-induced binarity

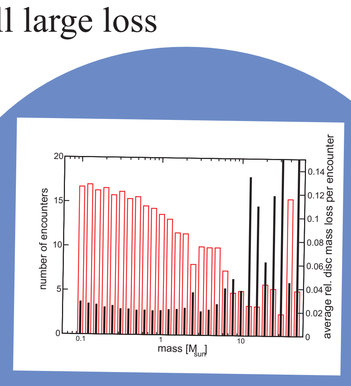
Size ~ stellar mass
Colour: still complete disc
> 95% of disc lost

Consequences for Massive Stars

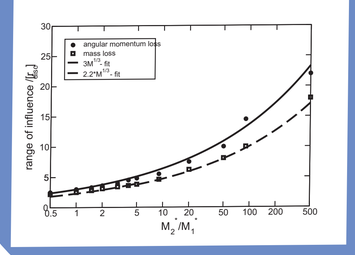
Disc mass loss highest in massive stars



Many encounters with small losses lead to overall large loss

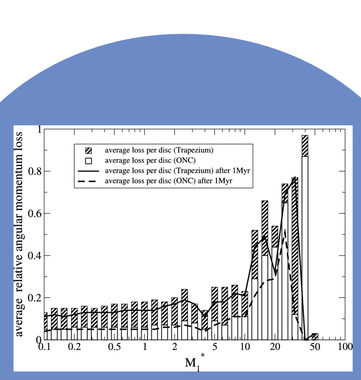


Angular momentum loss generally exceeds mass loss

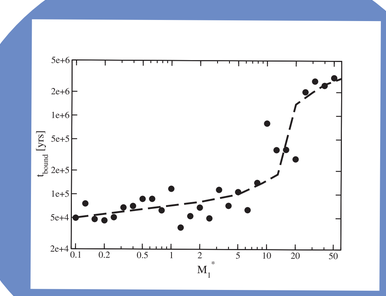


Massive stars are special in the cluster enviroment

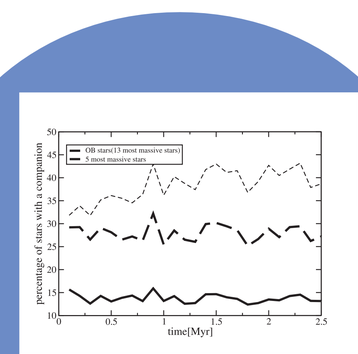
By-product: Accretion easier



Accretion highest for most massive stars



Massive capture-formed binaries are more stable. They develop towards tighter, similar mass binaries.



Capture processes play a vital role for the binarity of massive stars

Discussion

Main differences to lower-mass stars:

1. Massive stars loose their discs fast
⇨ **probably no planet formation possible**

2. Large specific angular momentum transport
⇨ **accretion easy**
⇨ **new growth mechanism for massive stars**
⇨ **cluster-induced accretion**

3.Capture-plays an importnat role for binarity
⇨ **could be sole reason for difference between binarity of massive stars and solar-mass stars**

Future:

Reduction of number of simplifications:

★ as well retrograde, non-coplanar encounters
★ simulate primordial binaries
★ include gas in cluster dynamics

References:

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