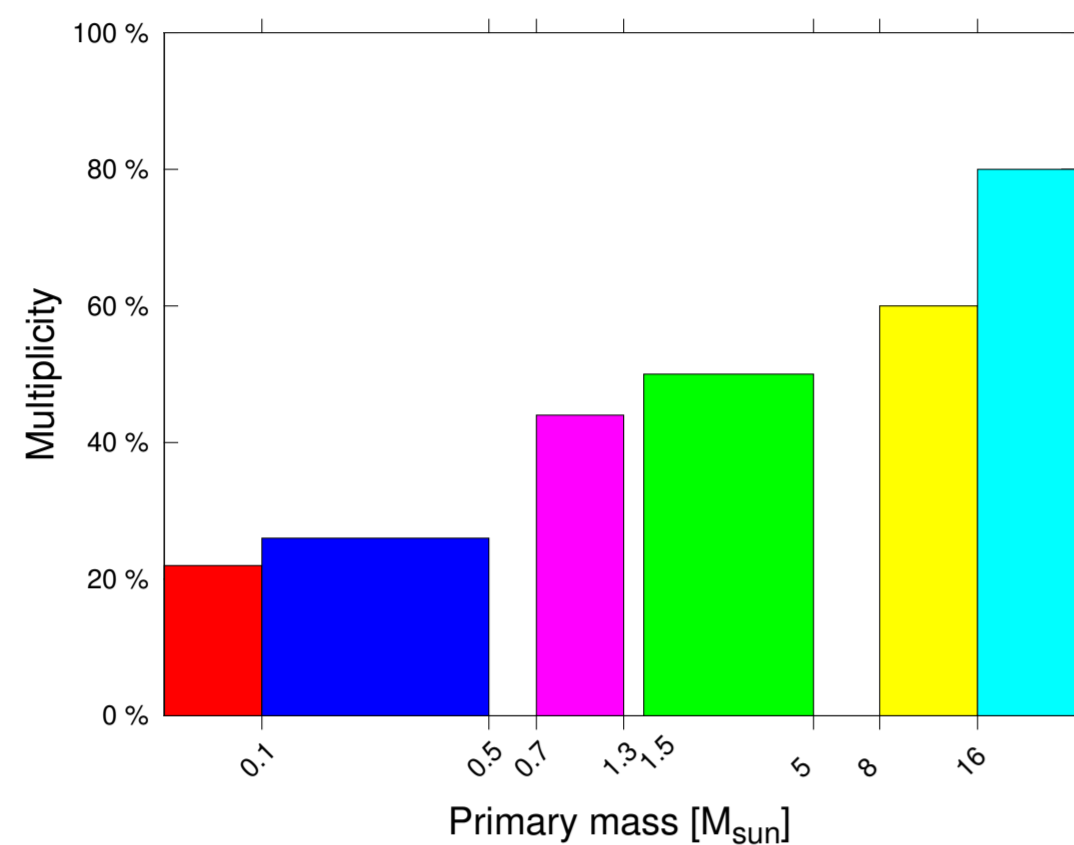


Binary Population Evolution

Influences of the embedded phase onto the evolution of the period distribution.

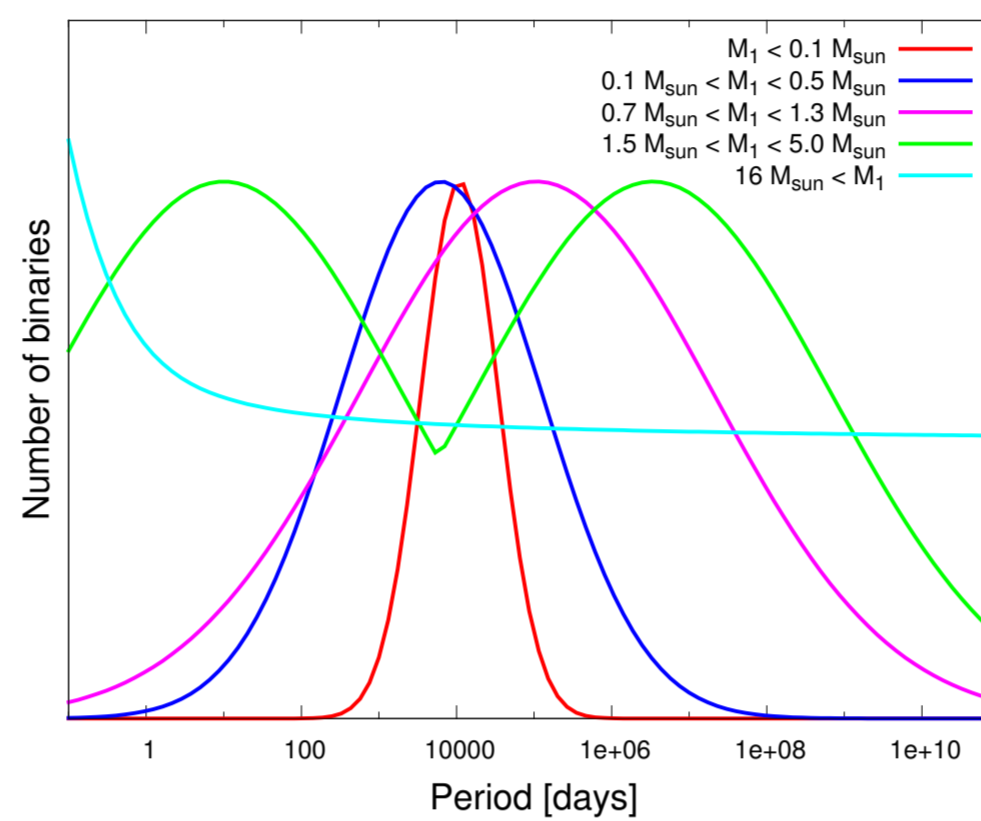
C. Korntreff¹, L. Arnold¹, S. Pfalzner²

Multiplicity



- Main-sequence multiplicity [1] is lower limit for the pre-main-sequence
- Knowledge of binary evolution helps to understand stellar evolution process

Observations



Main-sequence period distribution changes from low- to high-mass stars [1]:

- log-normal** low & solar mass stars
- bimodal** intermediate mass stars
- power law** high mass stars

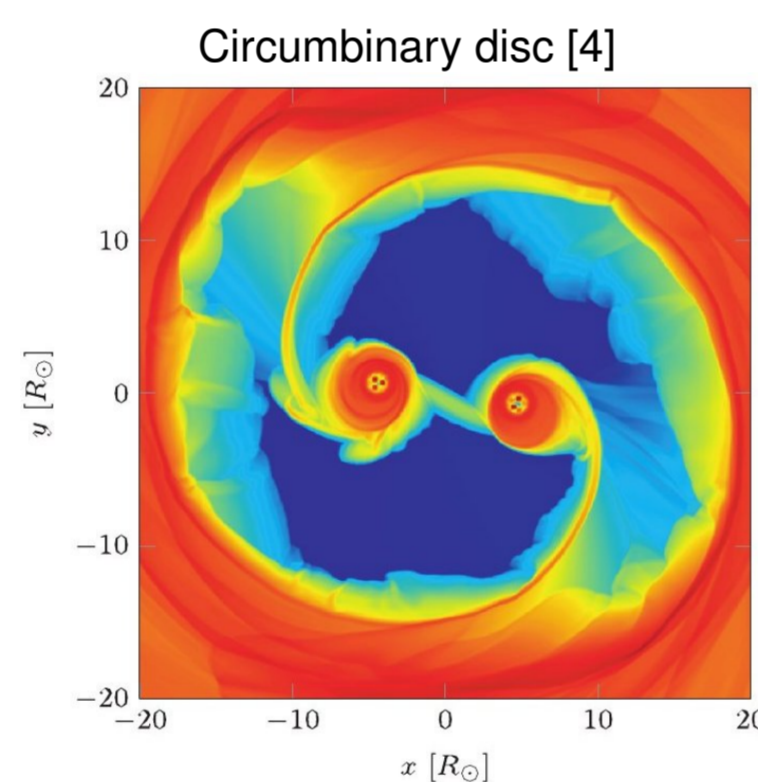
Binary evolution

- Dynamical evolution of binary population is well known [2] ⇒ Destruction of wide binaries
- Influence of accretion on binary period small [3]
- Hydro-dynamical simulations for young embedded binaries often keep binary period fixed [4]

Influence of gas-binary interactions onto the period so far neglected

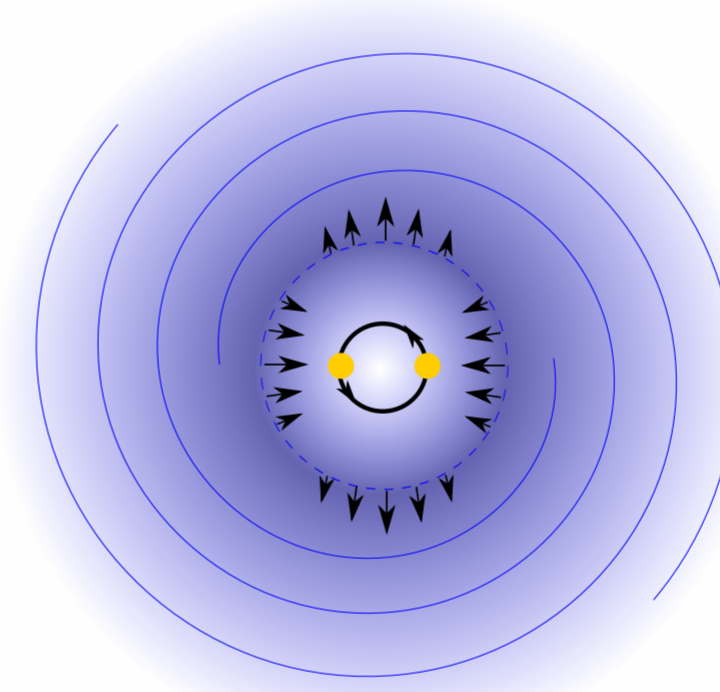
Embedded binaries

- During first Myr: star cluster embedded in gas
- Simulations show a gap between circumstellar and circumbinary disc/gas
- Far-field decoupled from near-field dynamics



We simulate interaction between binary and circumbinary disc/gas

Gas-induced orbital decay



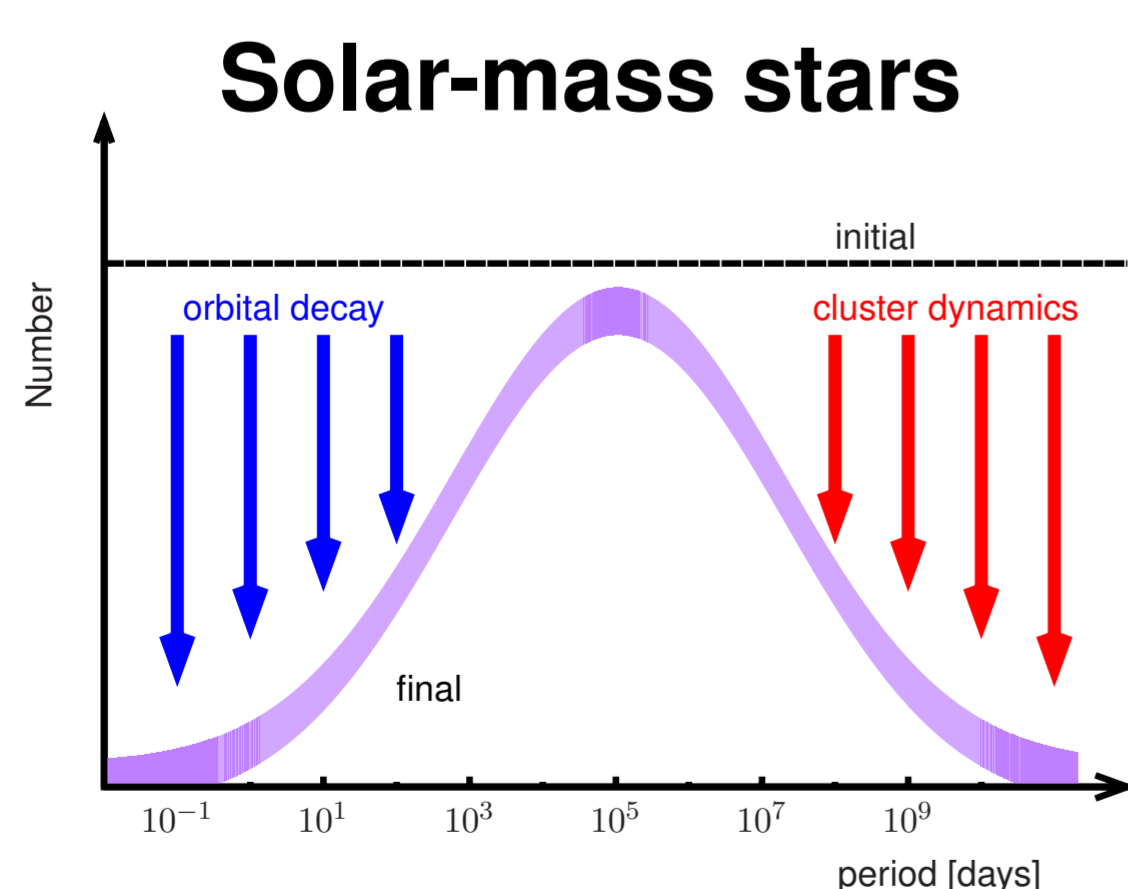
- Binary embedded in gas ⇒ Oscillating gravitational potential torques nearby gas
- ⇒ Outgoing acoustic waves
- ⇒ Angular momentum transport

⇒ Gas leads to orbital decay

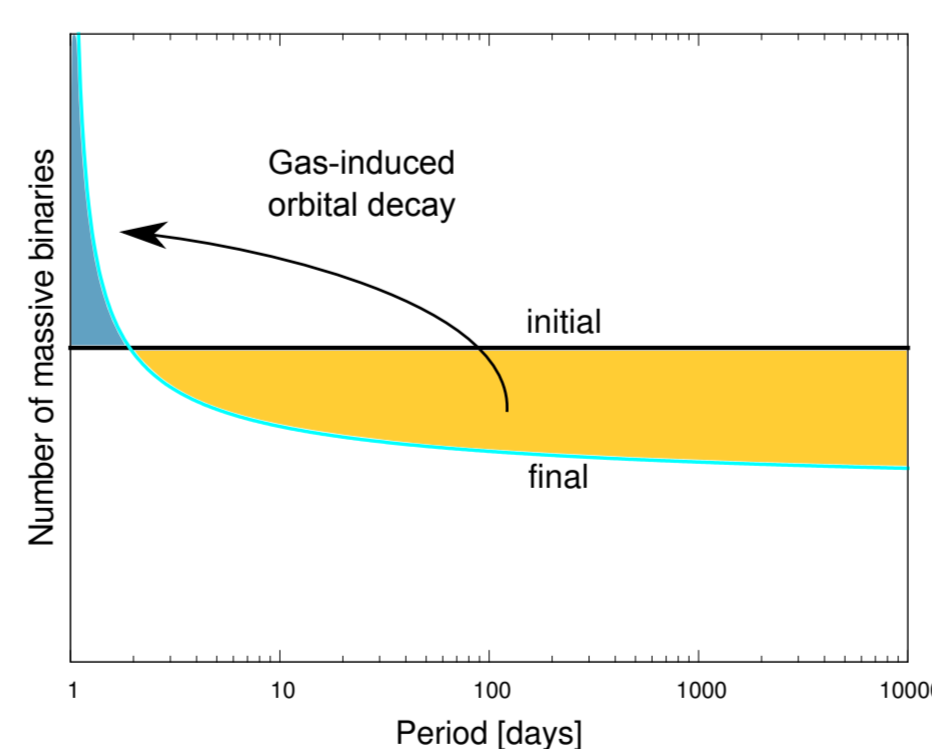
Have a look at our simulations with this QR -Code or at <http://tinyurl.com/embedded-binary>



Comparison with observations



High-mass stars



- Gas-induced orbital decay and dynamical interactions act in two separate regimes
- Combination of both effects explains change from log-uniform to log-normal period distribution (Korntreff, Kaczmarek & Pfalzner 2012 [5])

- Gas-induced orbital decay alters binary period distribution.
- Resulting overabundance of short period binaries fits observations
- Dynamical binary destruction plays minor role for high-mass stars

Conclusion

- Embedded phase alters binary period distribution
- Gas-induced orbital decay converts initial log-uniform period distributions to observed main-sequence distributions
- In extreme cases gas-induced orbital decay leads to binary merger

References

- [1] G. Duchene and A. Kraus, Stellar Multiplicity, *ARA&A*, vol. 51, 2013 and references therein. [2] T. Kaczmarek, C. Olczak, and S. Pfalzner, Evolution of the binary population in young dense star clusters, *A&A*, 528, A144, 2011 and references therein. [3] P. Artymowicz and S. H. Lubow, Dynamics of binary-disk interaction., *ApJ*, 421:651-667, 1994. [4] M. de Val-Borro, G. F. Gahm, H. C. Stempels, and A. Peplinski, Modelling circumbinary gas flows in close T Tauri binaries, *MNRAS*, 413:2679-2688, 2011. [5] C. Korntreff, T. Kaczmarek, and S. Pfalzner, Towards the field binary population: influence of orbital decay on close binaries, *A&A*, 543, A126, 2012

Contact: c.korntreff@fz-juelich.de - Website: www.fz-juelich.de/ias/jsc/slpp

Institutes: 1 - Forschungszentrum Jülich GmbH // 2 - Max-Planck-Institut für Radioastronomie