INAF – Osservatorio Astronomico di Padova

Black holes dynamics: some ideas for the discussion

Mario Spera (mario.spera@oapd.inaf.it) (mario.spera@live.it)
Postdoctoral fellow at Astronomical Observatory of Padova (**FIRB2012**, Co-PI: Michela Mapelli)

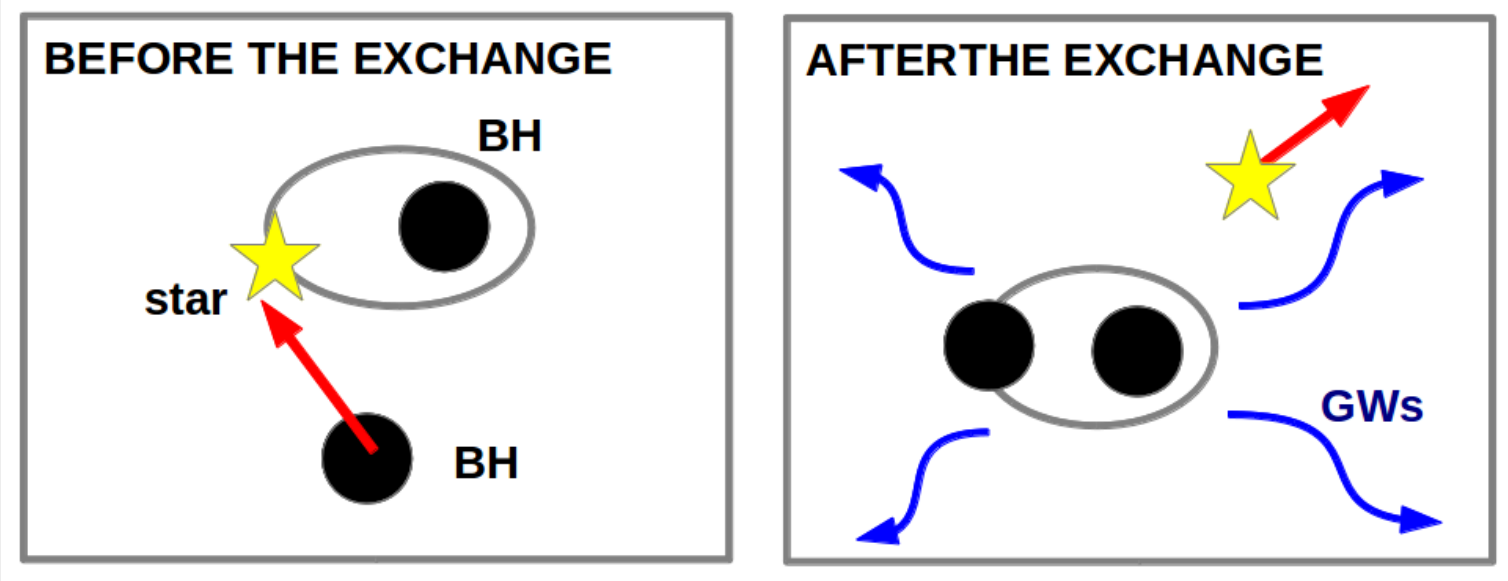
Rome, April 11th 2016

DYNAMICAL or PRIMORDIAL origin?

How can we put constraints?

From **Michela's talk:** dynamics produces **more massive** binaries and with **larger eccentricity** (Ziosi+ 2014)

Is this always true?



DYNAMICAL or PRIMORDIAL origin?

How can we put constraints?

Issues to be addressed

Uncertainties in dynamical processes: Spitzer instability

Realistic initial conditions of star cluster simulations (gas, primordial binary fraction, …)

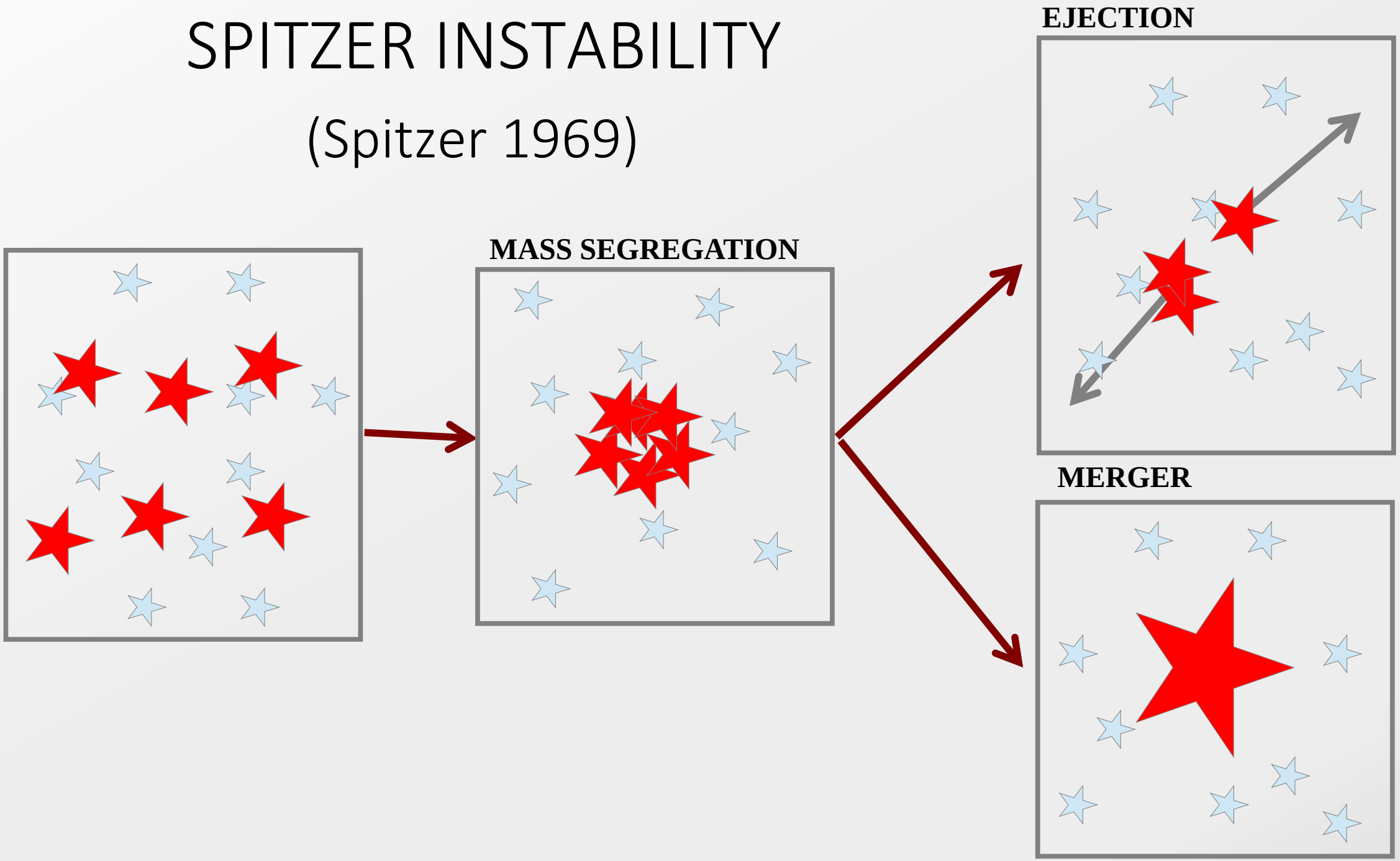
Statistics of simulations

Supernova explosion models (mass, kicks, …)

Binary stellar evolution (common envelope phase)

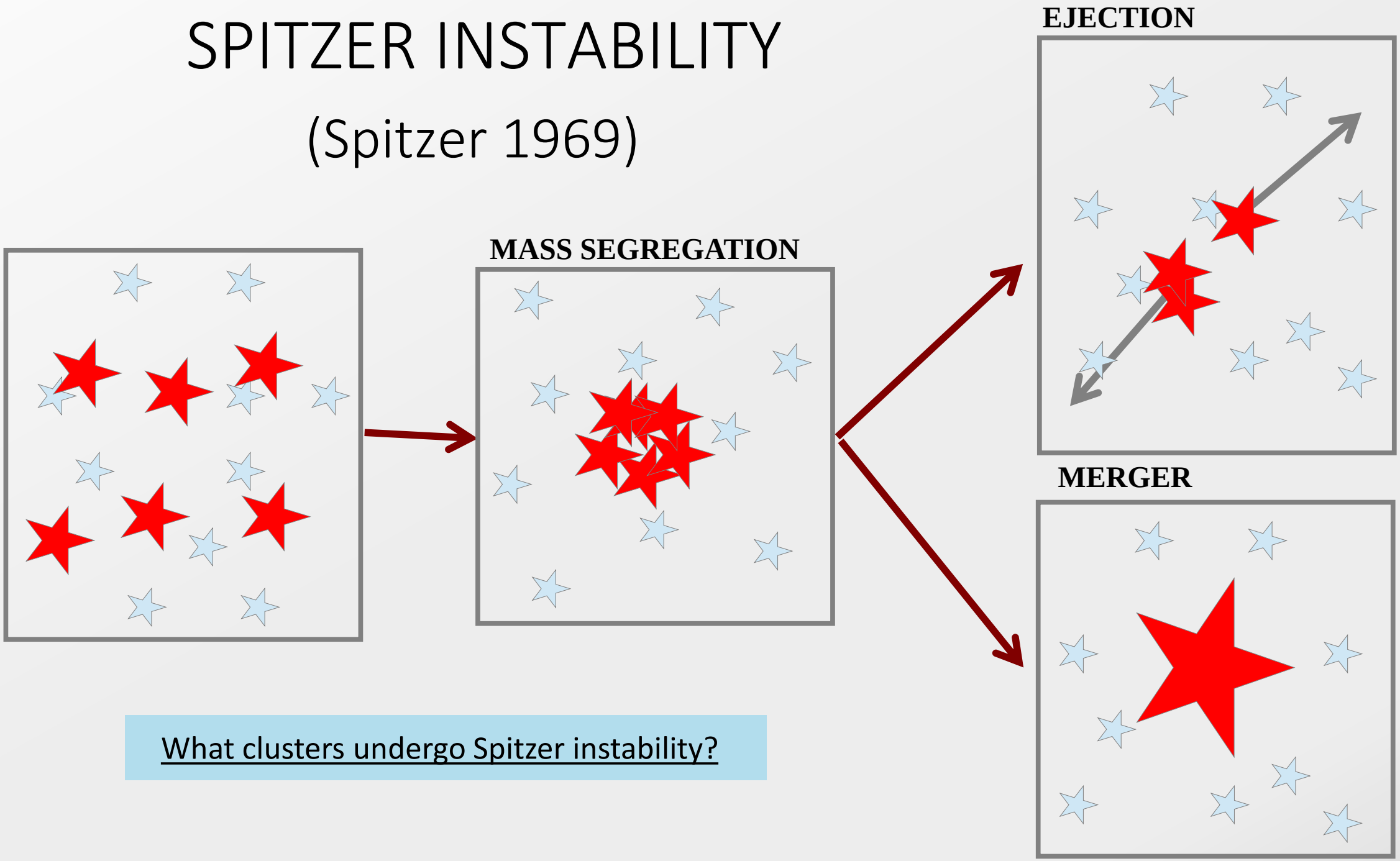
SPITZER INSTABILITY

(Spitzer 1969)



SPITZER INSTABILITY

(Spitzer 1969)



What clusters undergo Spitzer instability?

DYNAMICAL or PRIMORDIAL origin?

How can we put constraints?

Issues to be addressed

Uncertainties in dynamical processes: Spitzer instability

Realistic initial conditions of star cluster simulations
(gas, primordial binary fraction, …)

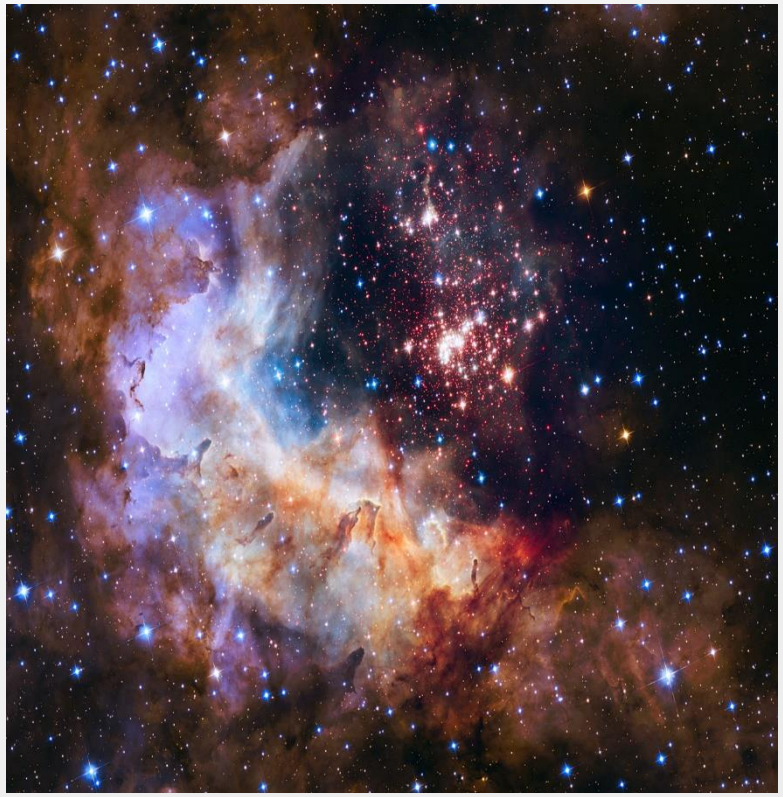
Statistics of simulations

Supernova explosion models (mass, kicks, …)

Binary stellar evolution (common envelope phase)

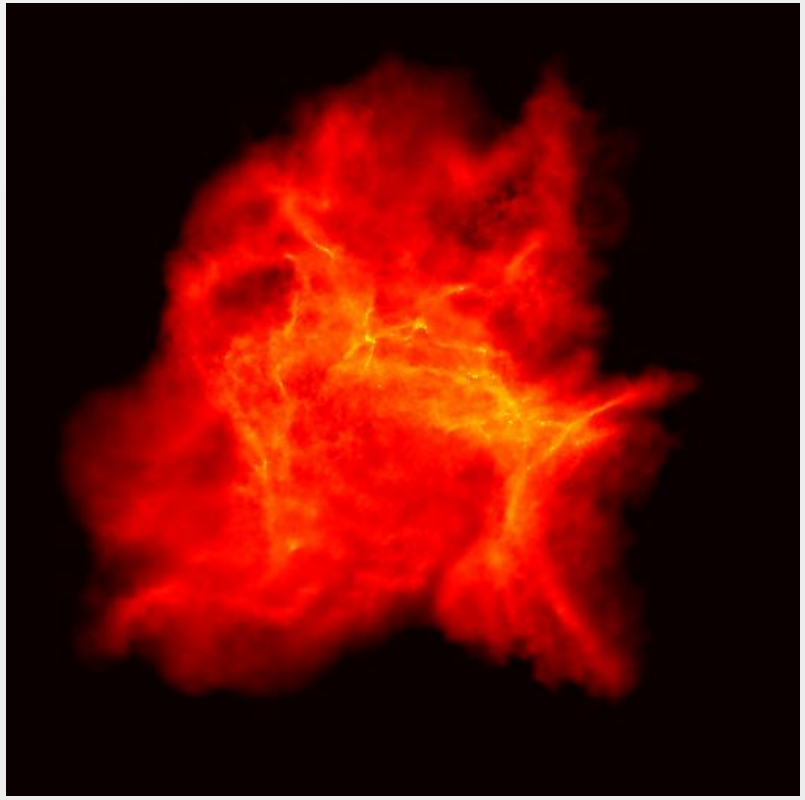
Initial conditions of star clusters

Westerlund 2, OC (real)

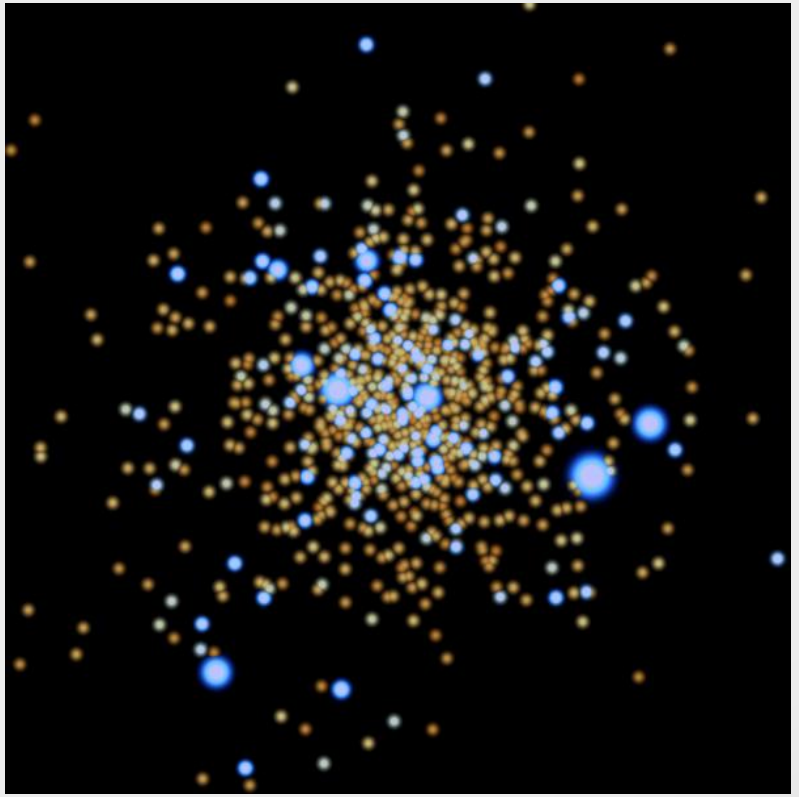


NASA/ESA HST image

Our group sim: gas only



Our group sim: dynamics only



DYNAMICAL or PRIMORDIAL origin?

How can we put constraints?

Issues to be addressed

Uncertainties in dynamical processes: Spitzer instability

Realistic initial conditions of star cluster simulations (gas, primordial binary fraction, …)

Statistics of simulations

Supernova explosion models (mass, kicks, …)

Binary stellar evolution (common envelope phase)

DYNAMICAL or PRIMORDIAL origin?

How can we put constraints?

Issues to be addressed

Uncertainties in dynamical processes: Spitzer instability

Realistic initial conditions of star cluster simulations (gas, primordial binary fraction, …)

Statistics of simulations

Supernova explosion models (mass, kicks, …)

Binary stellar evolution (common envelope phase)

SN explosion

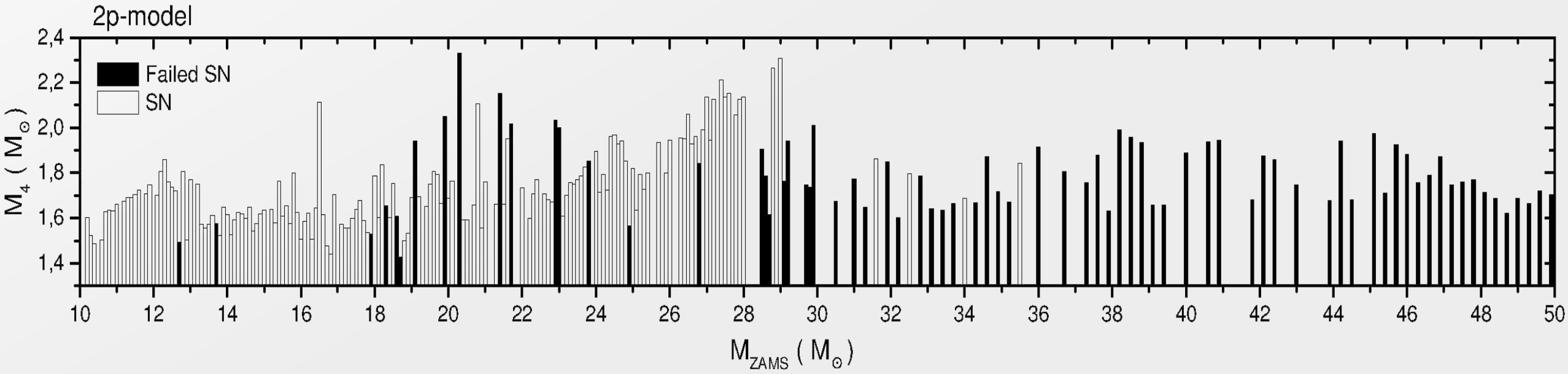
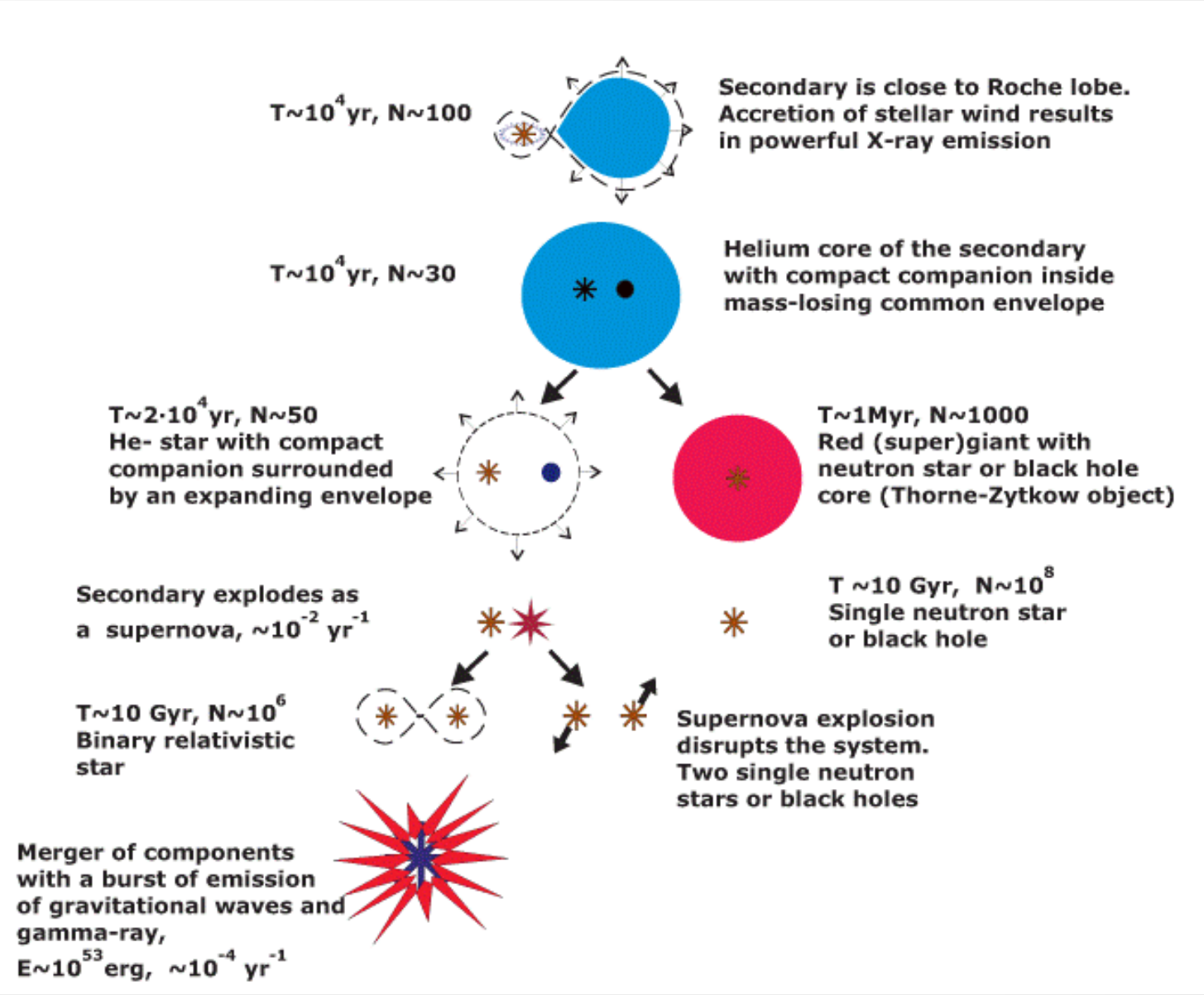


Fig. from ***Spera, Mapelli, Bressan, 2015, MNRAS 451, 4086***

Model by ***Ertl et al. 2015***

Common envelope



DYNAMICAL or PRIMORDIAL origin?

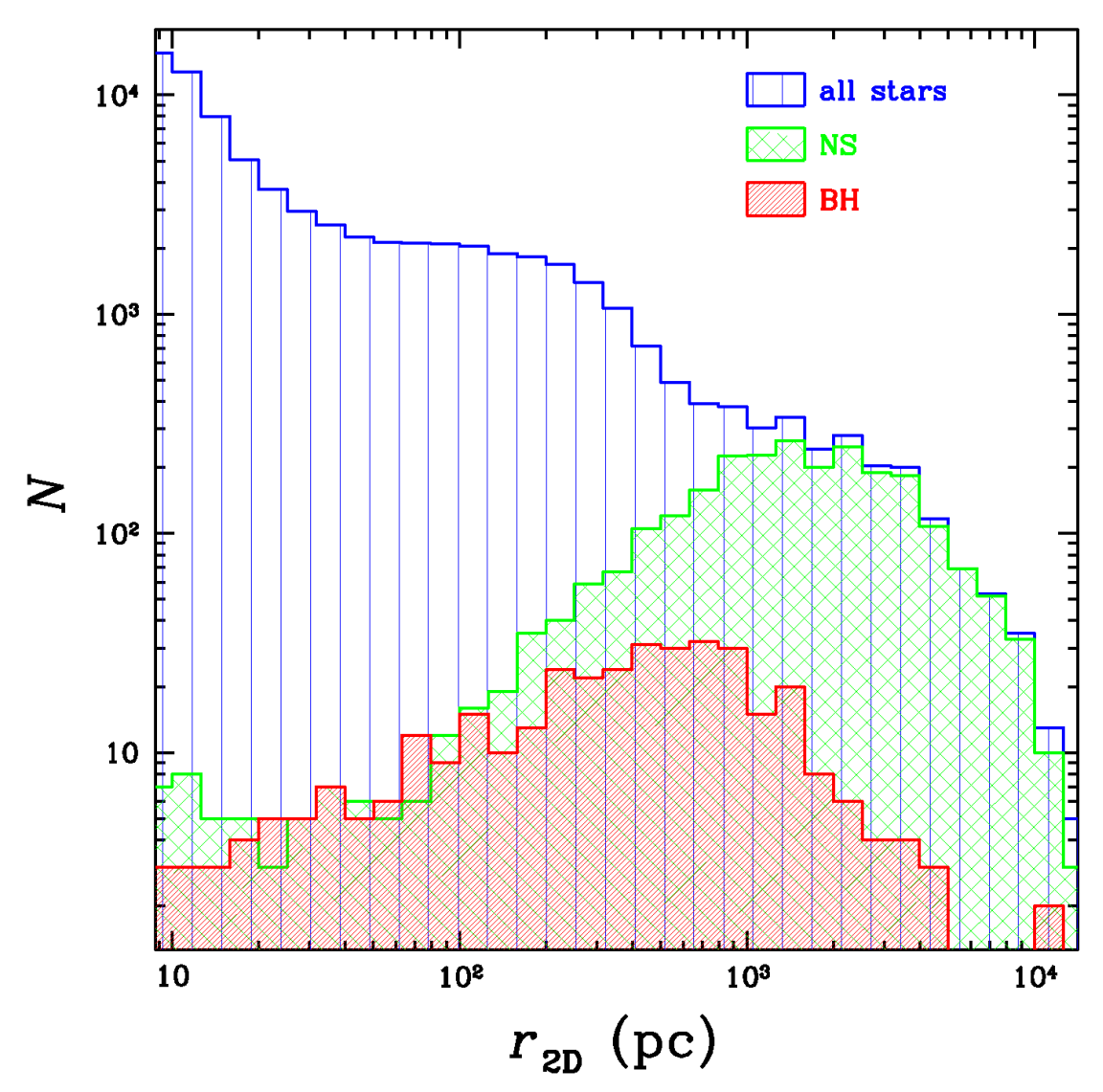
What is the preferred environment for mergers of dynamically formed binaries?

Old clusters, young clusters, the field?

Issues

- ✓ Young clusters dissolve in the field: what happens to their binaries?
- ✓ Binaries can be ejected dynamically in the field
  (e.g. Spitzer instability) – how many binaries?
- ✓ What can we get from simulations + EM follow-up about the environment?

Ejections from a star cluster

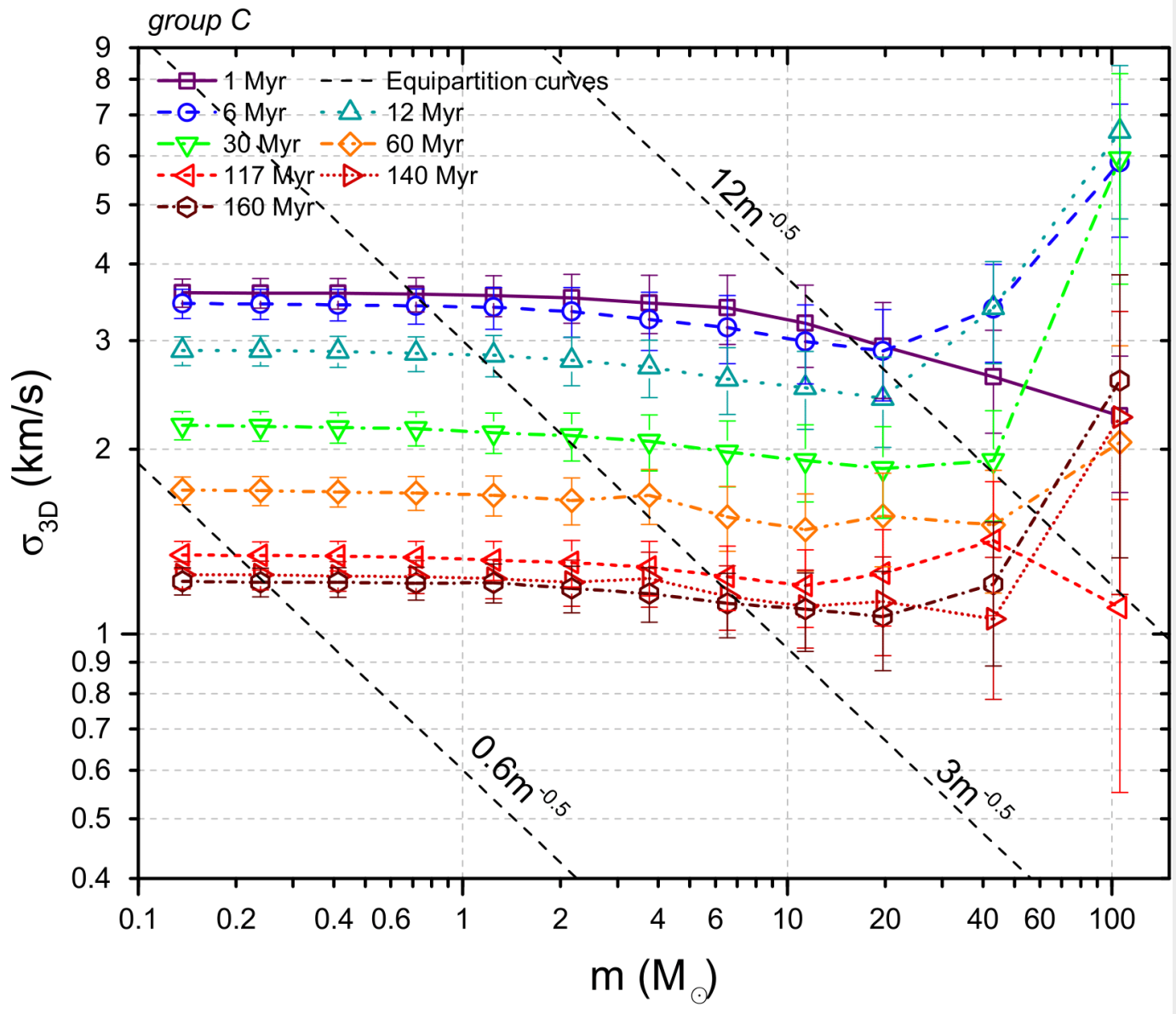
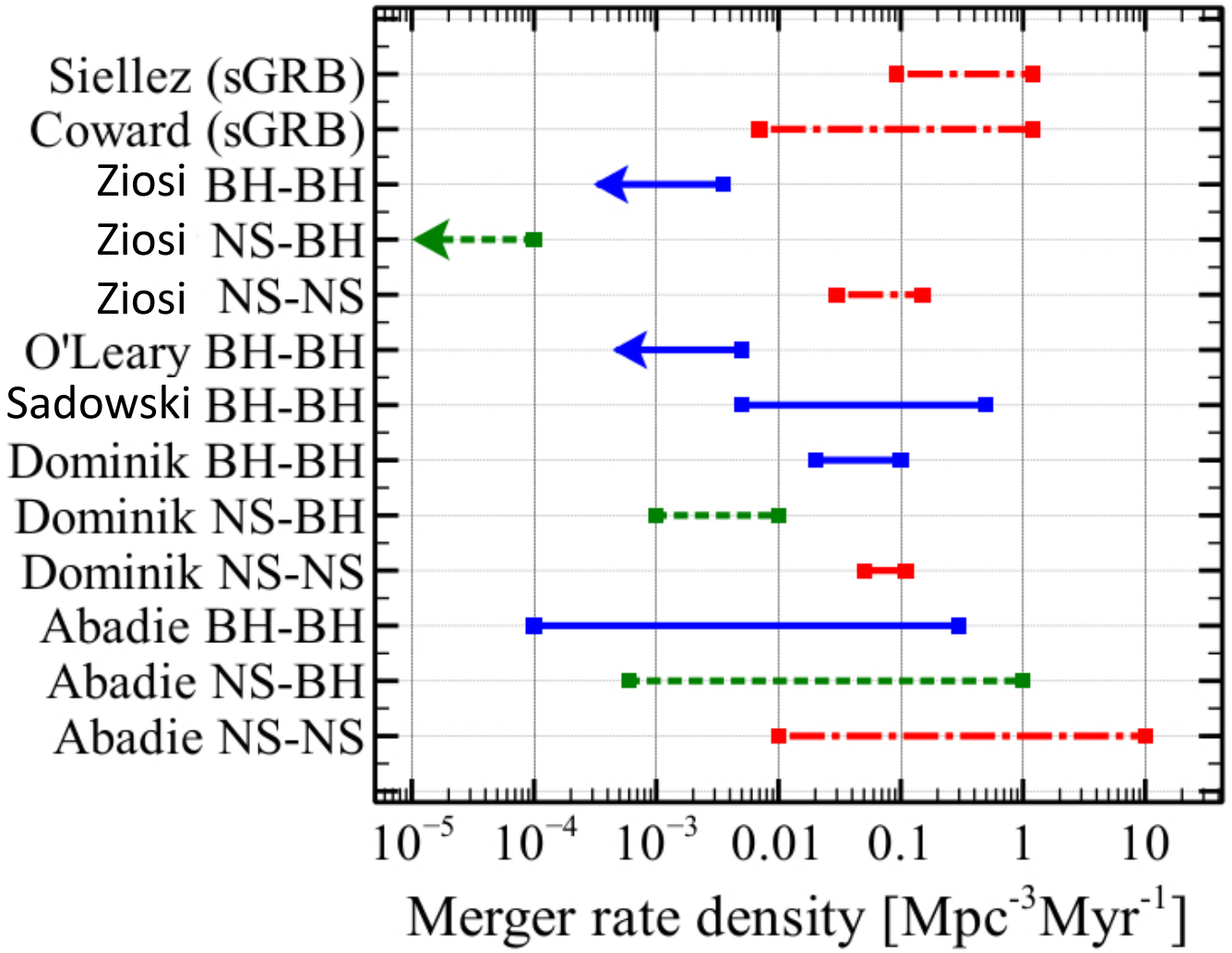


@ 100 Myr

80 – 90 % NSs are ejected

40 % BHs are ejected

Spitzer instability in star clusters



Merger rates