r-process enrichment of the lightest galaxies by fast merging neutron star binaries

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The observed statistics of *r*-process enrichment in the local universe points to the need for fast merging neutron star mergers!

How to study the sources of *r*-process elements in the early universe?

observe old (metal poor) stars that are *r*-process enhanced

Where are *r*-process metal poor stars?

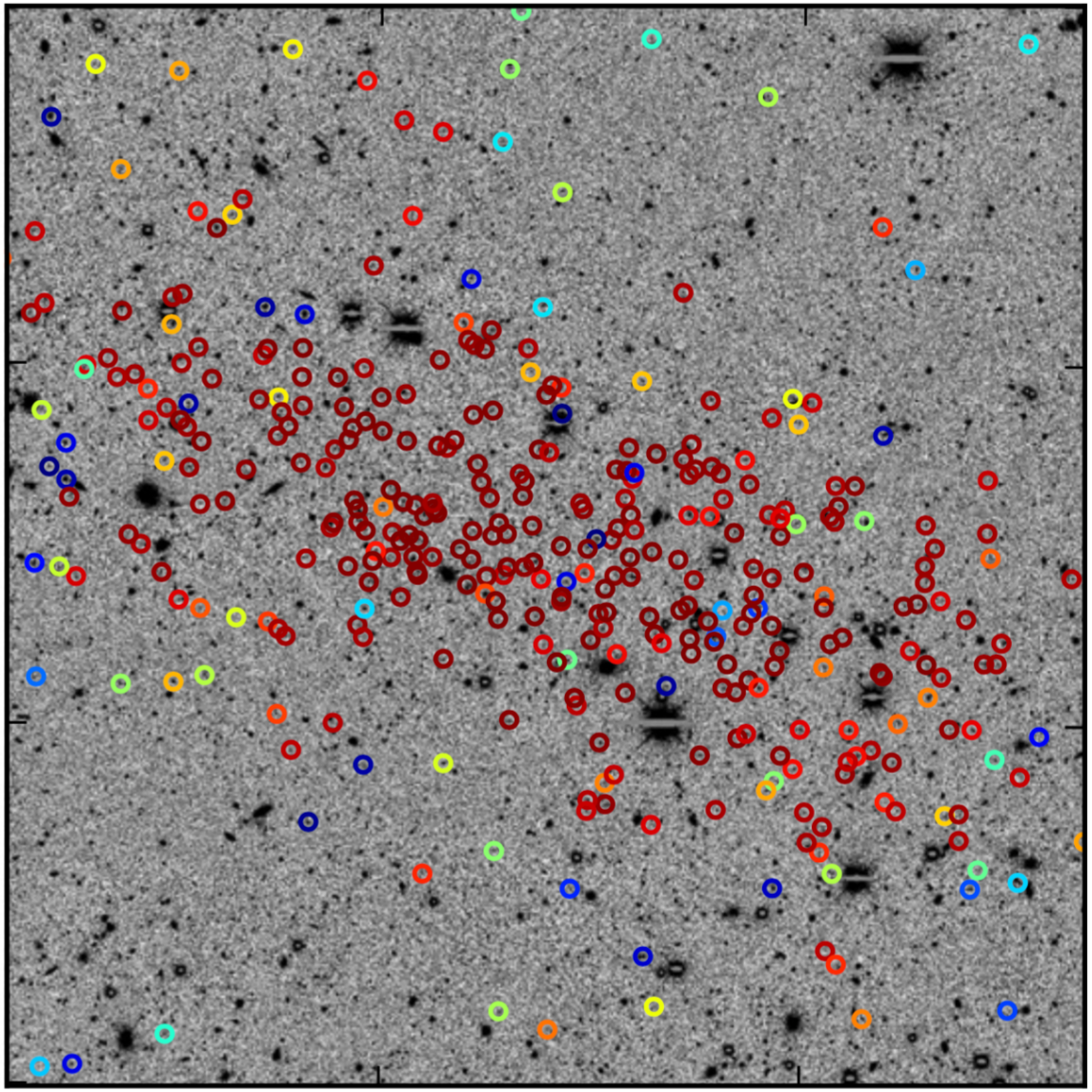

Ultra Faint
Dwarf
galaxies

Reticulum II

Bechtol et al. 2015

UFDs: Dead, dark matter dominated,
least luminous, least chemically evolved systems

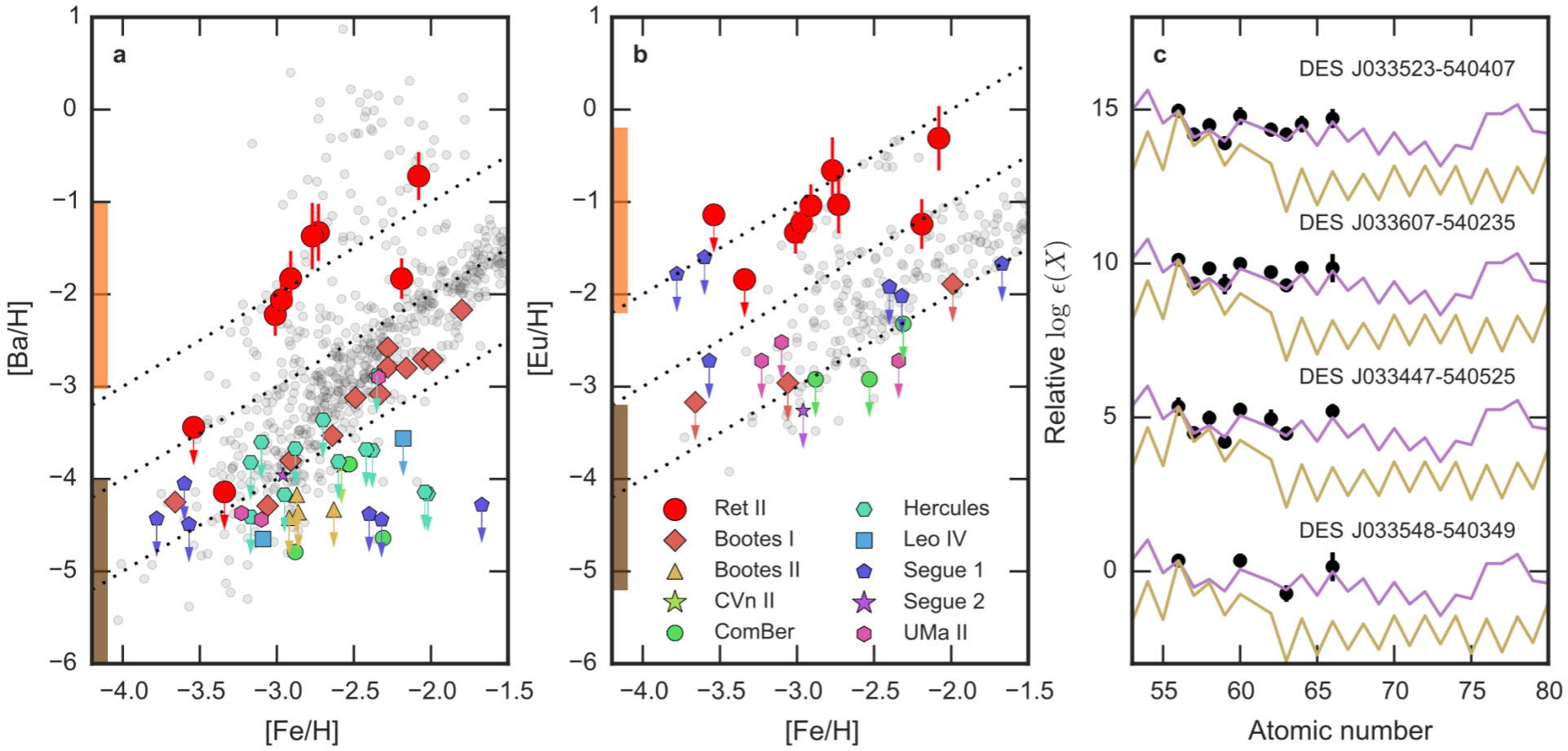
Reticulum II



Bechtol et al. 2015

UFDs: Dead, dark matter dominated,
least luminous, least chemically evolved systems

Reticulum II *r*-process abundance

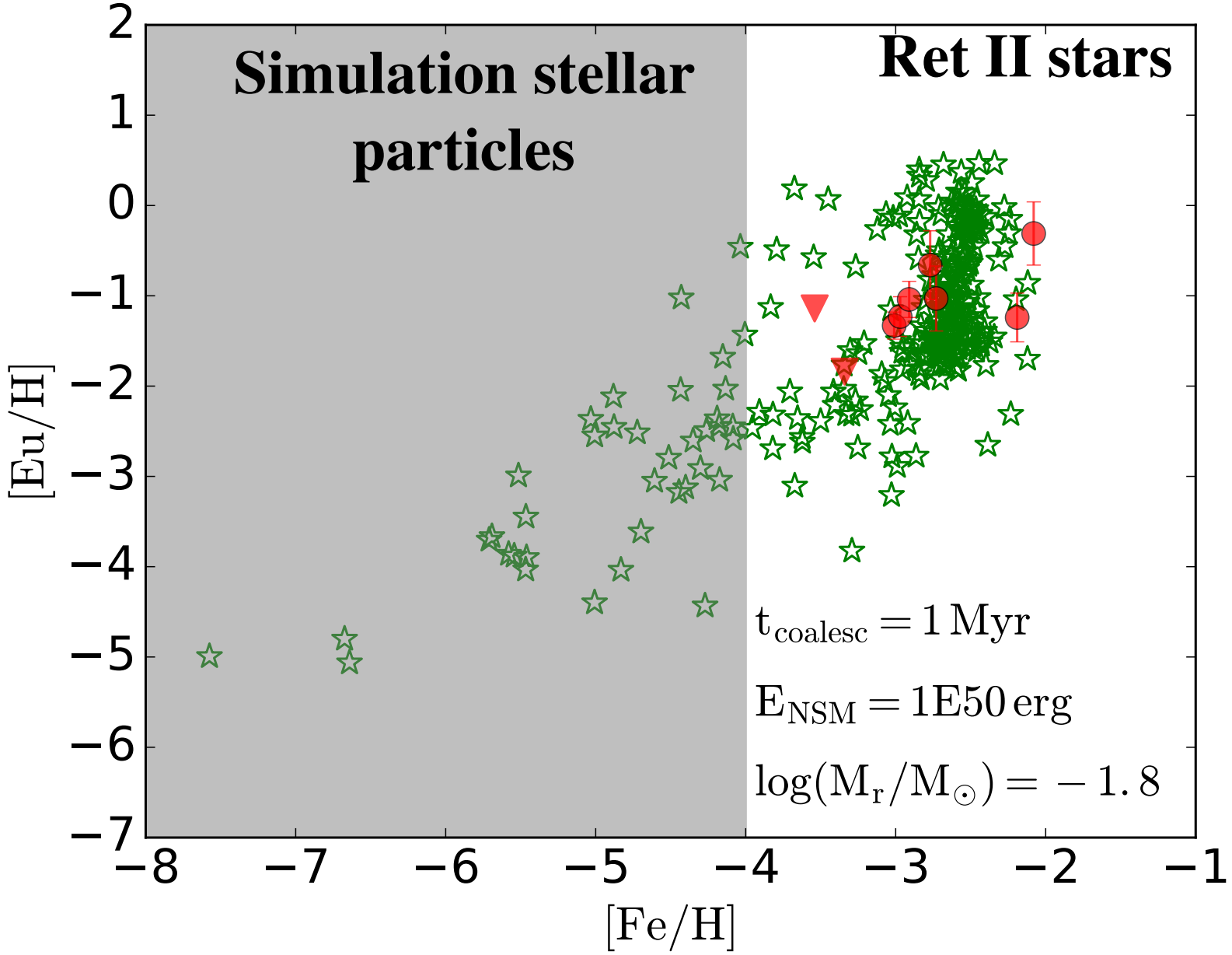


Ji et al. (2016)

Zoom cosmological simulation of a MW type halo, tracking *r*-process enrichment

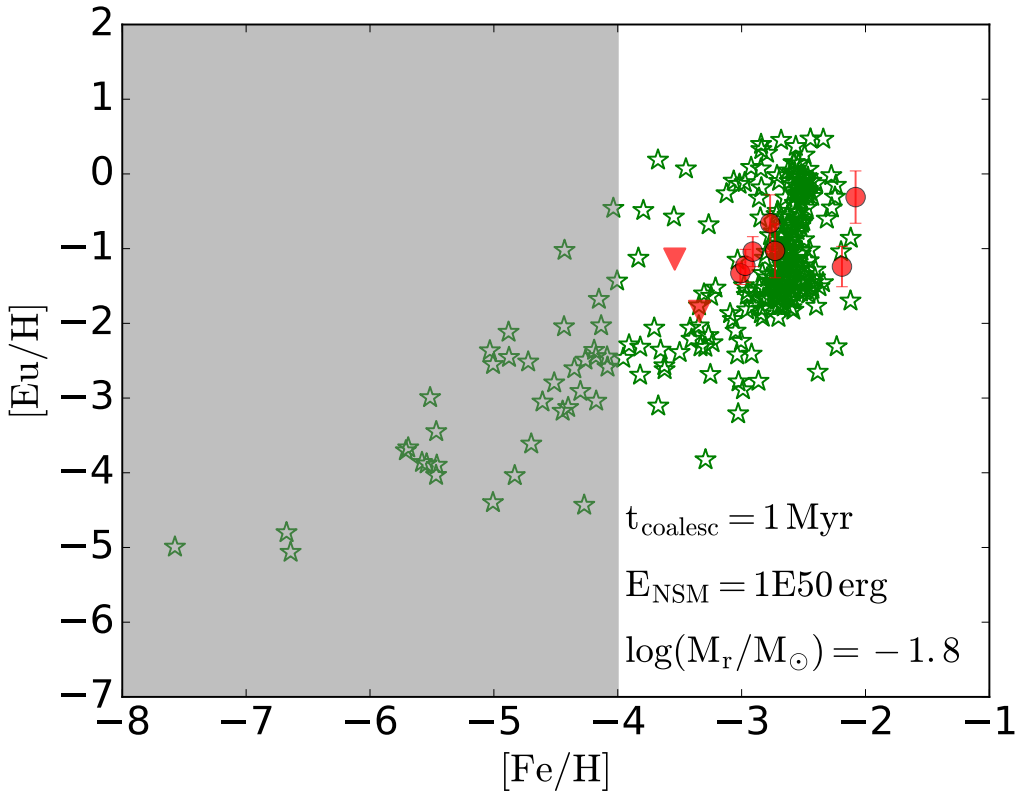
Results from zoom cosmological simulation of an ultra faint galaxy

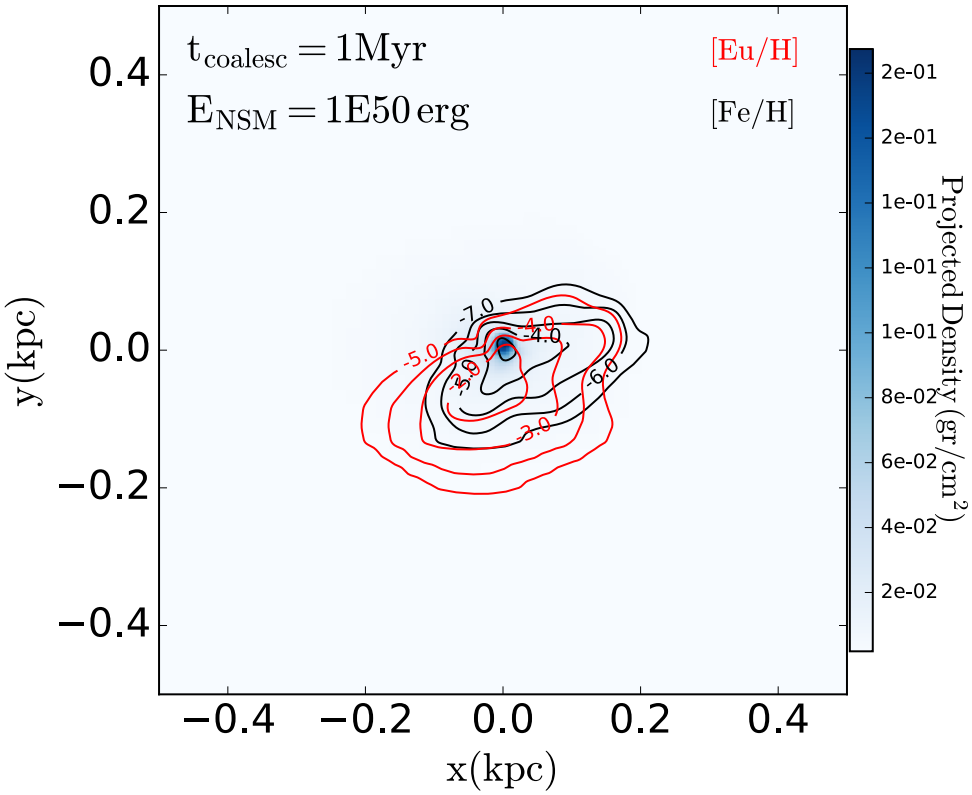
Comparing the results to Ret II



MTS & Scannapieco (2017)

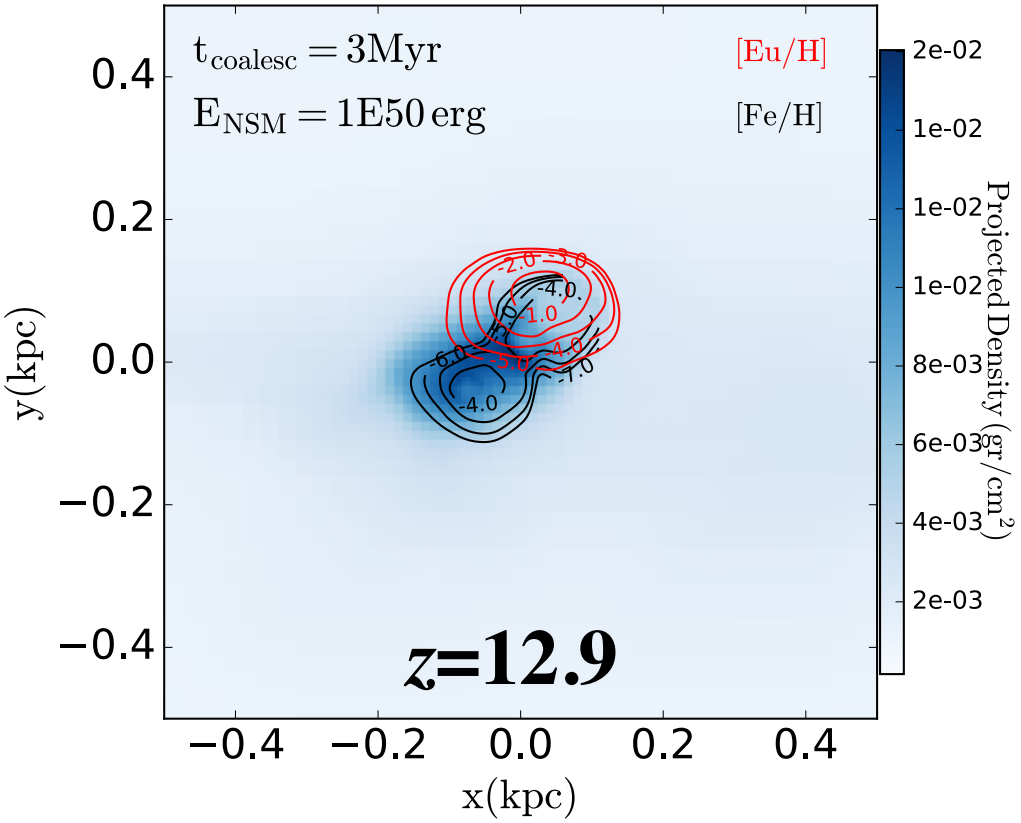
Comparing the results to Ret II

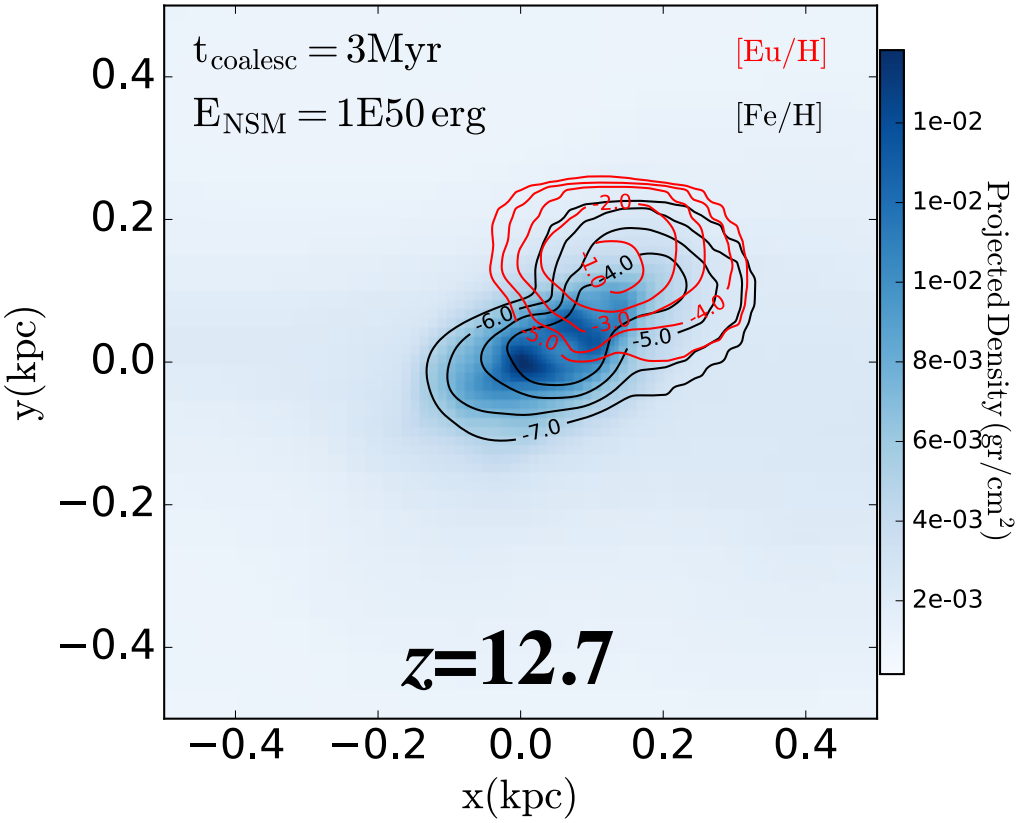




MTS & Scannapieco (2017)

Off-center explosion





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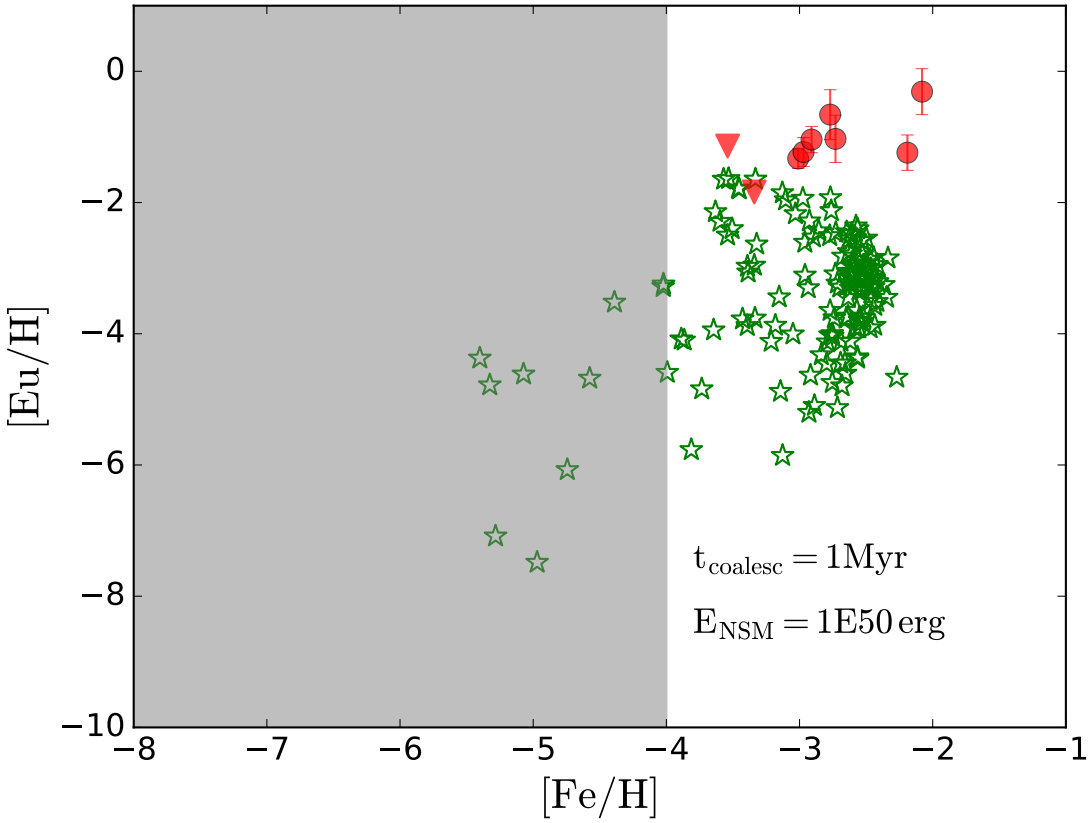
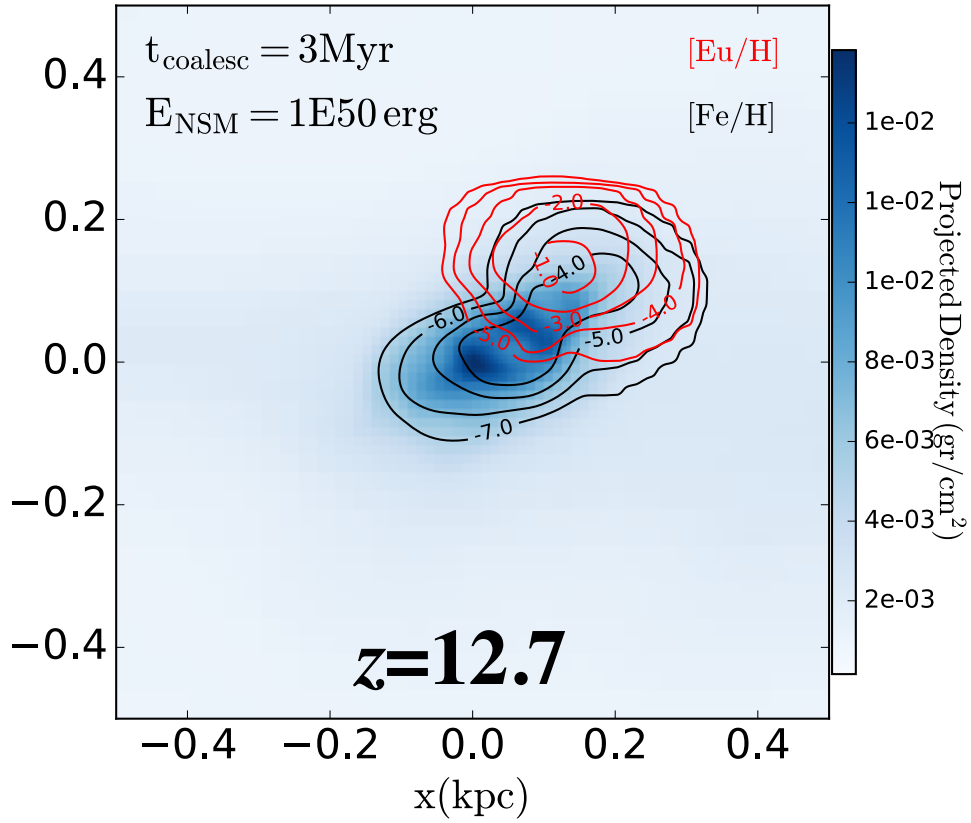
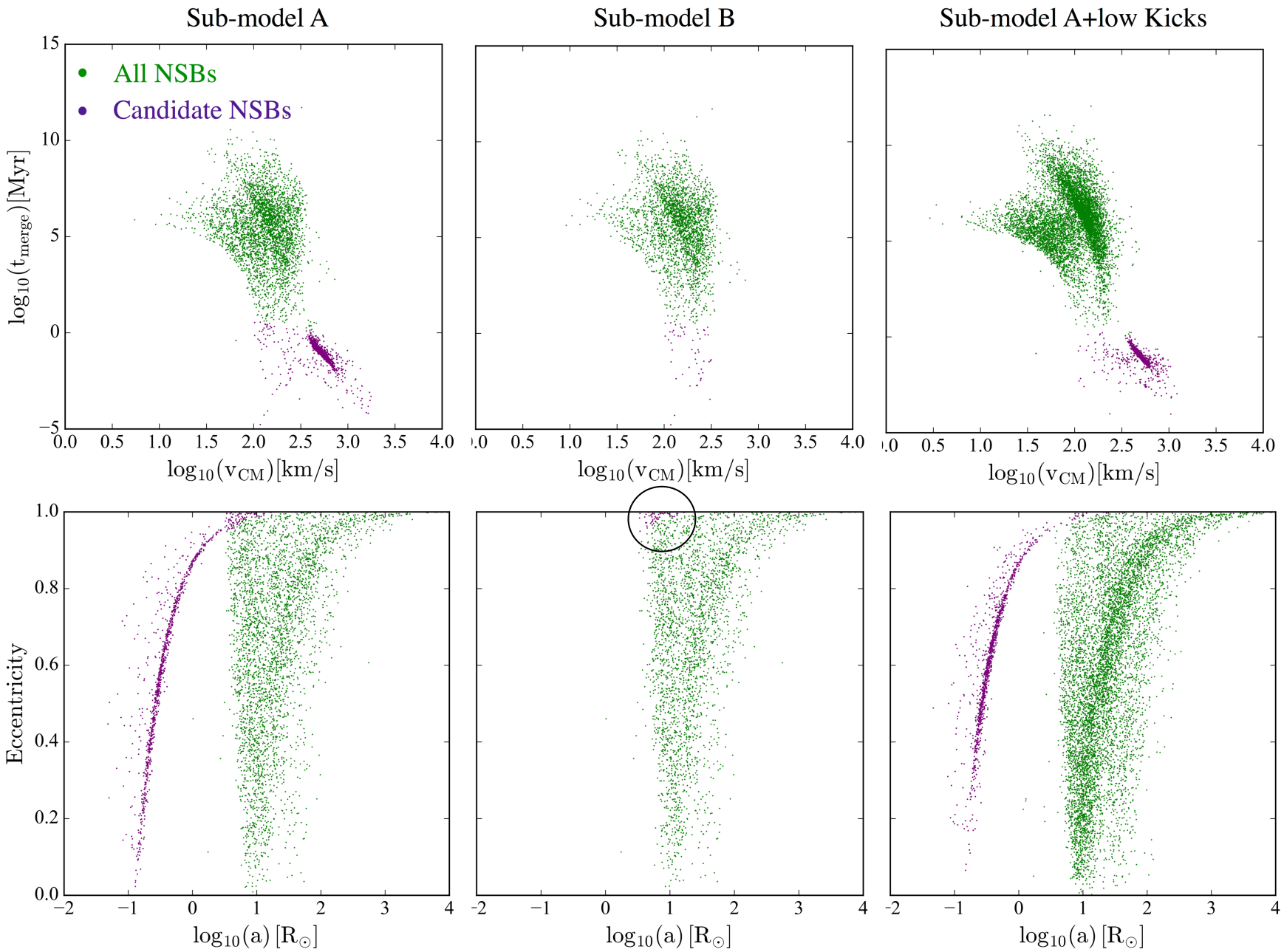




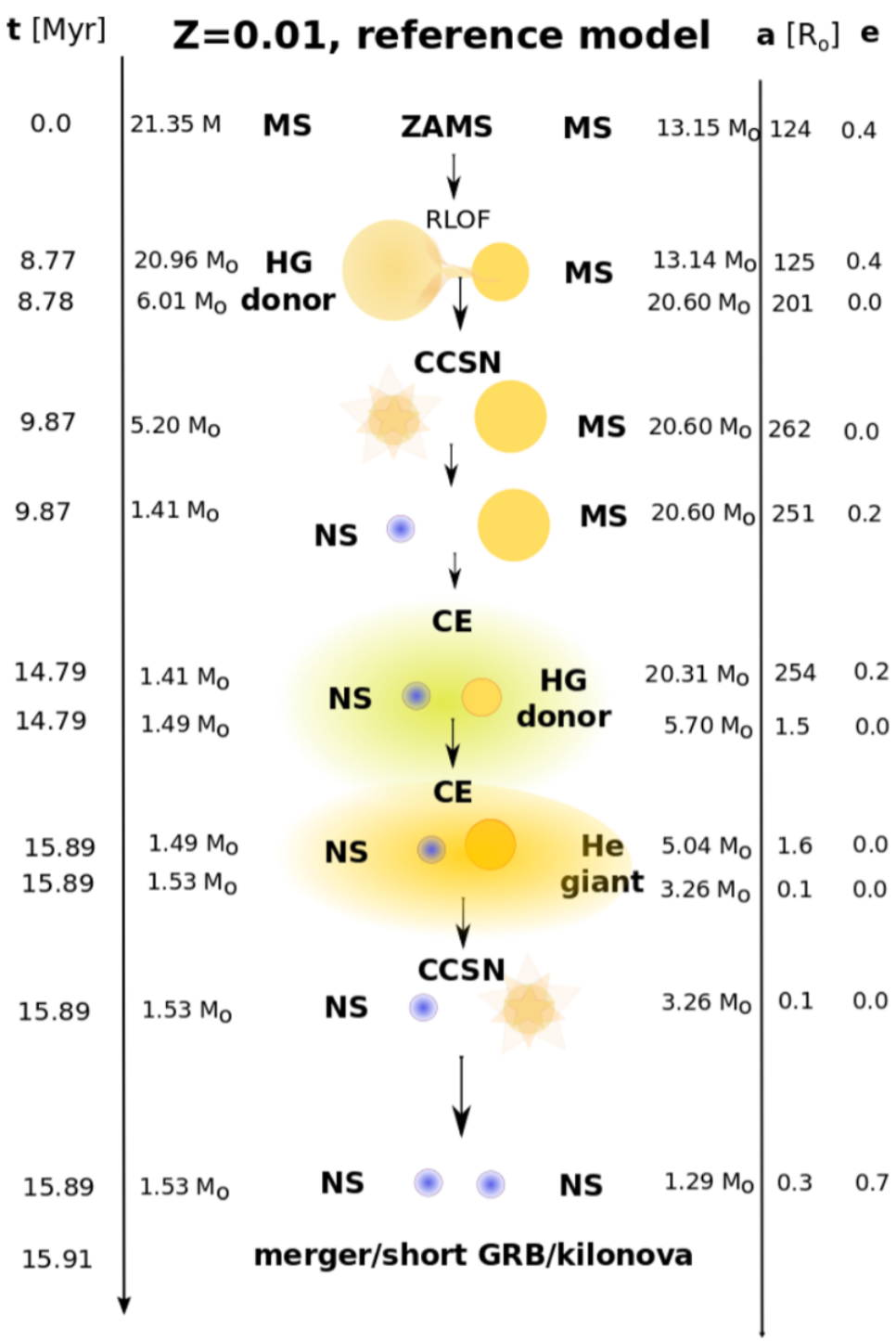
How can a NSM event enrich a galaxy?

Results from a distance cut on the NS binaries.



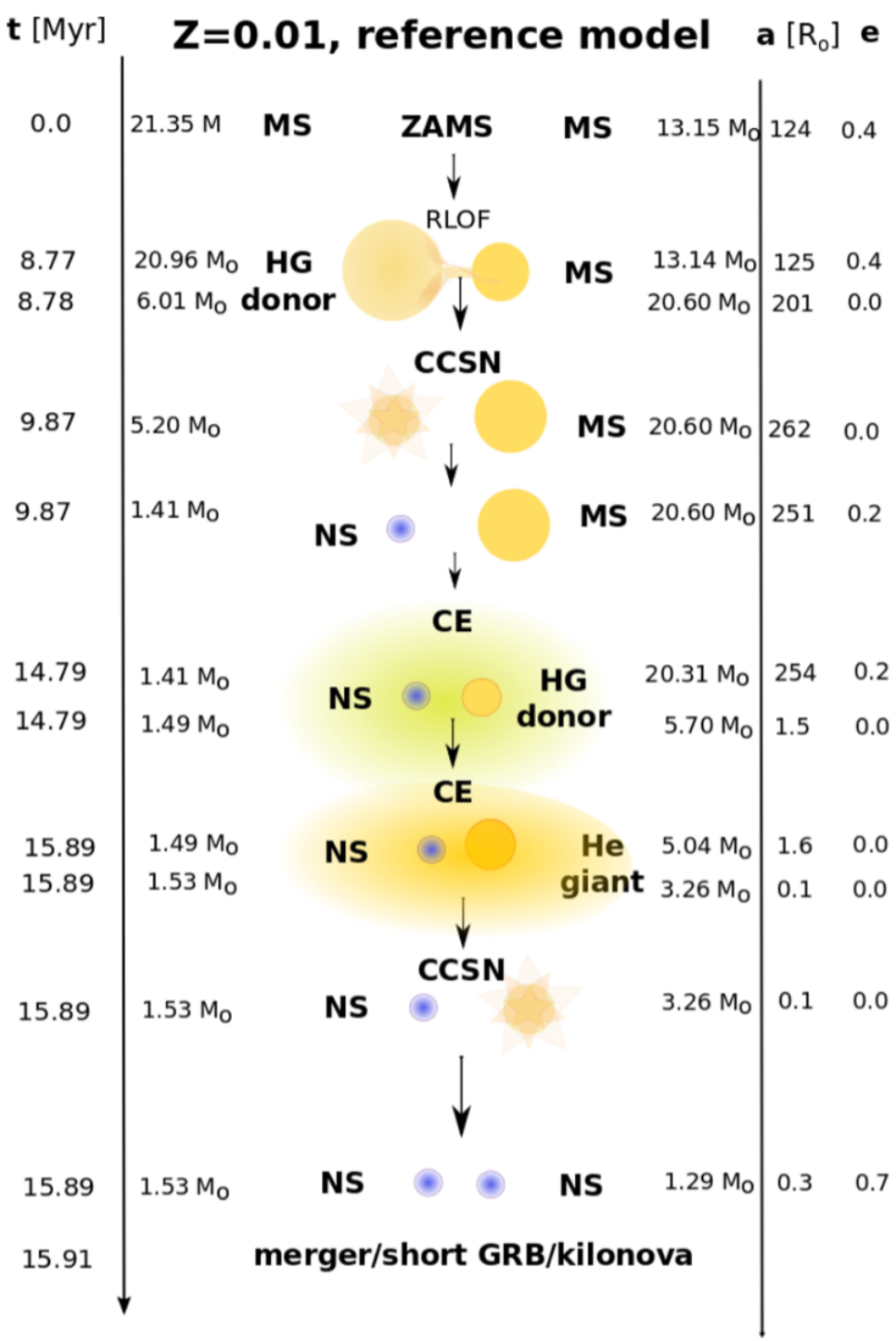
MTS, Ramirez-Ruiz et al. (2018)

Fast merging channel of NS binaries



Case BB unstable mass transfer

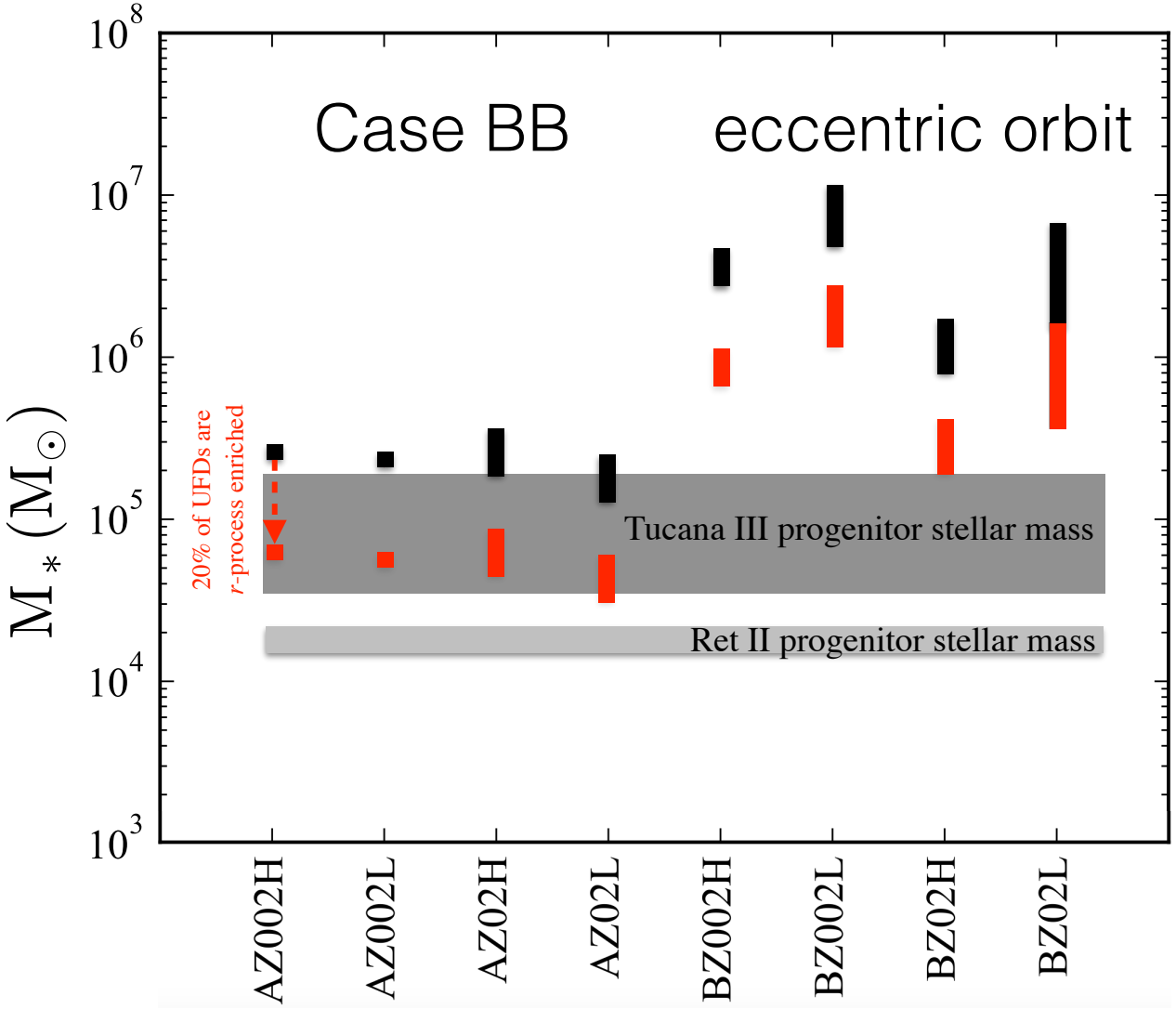
Chruslinska+18



Case BB unstable mass transfer

No CE simulation successfully ejects the envelope!

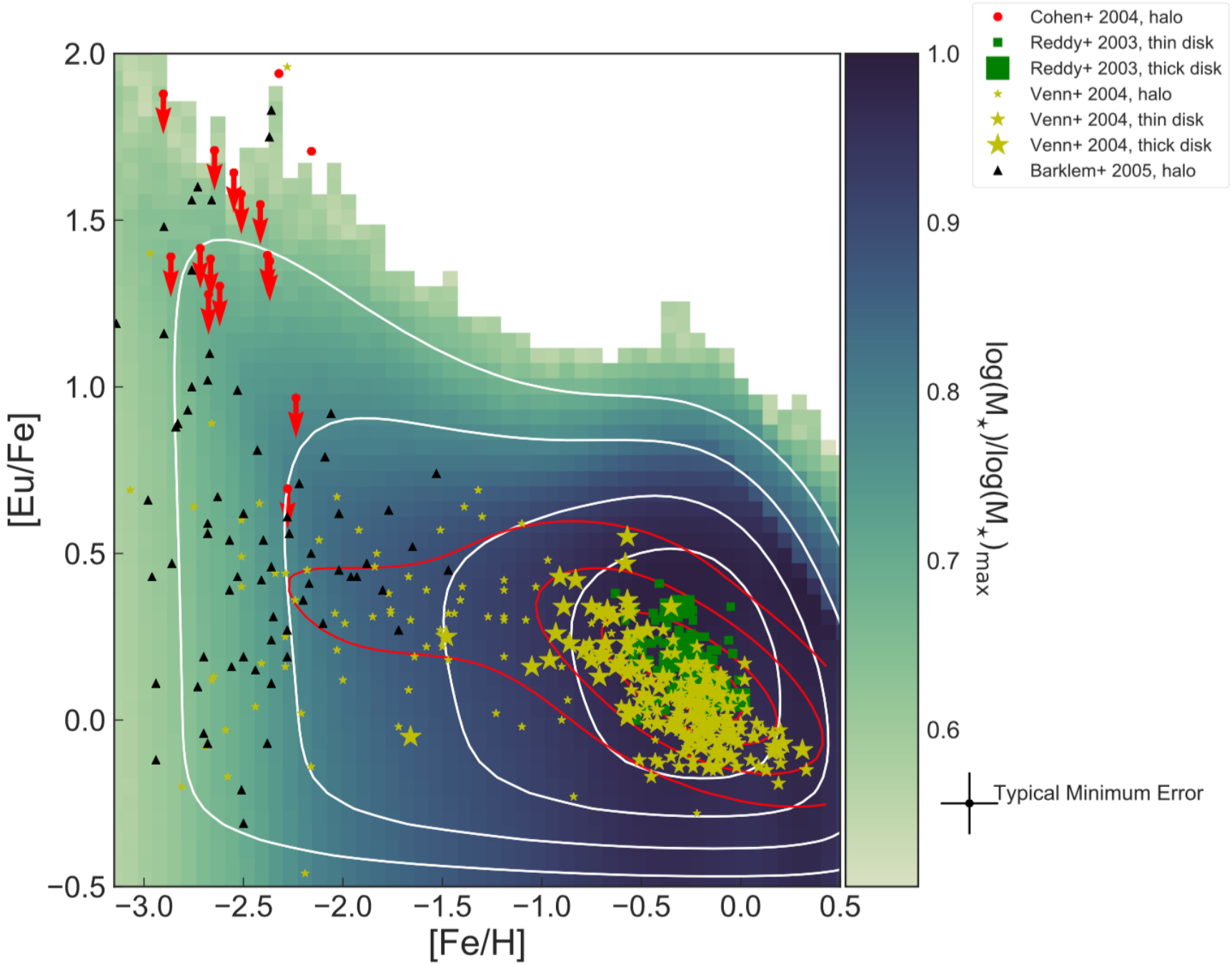
Chruslinska+18



MTS, Ramirez-Ruiz et al. (to be submitted)

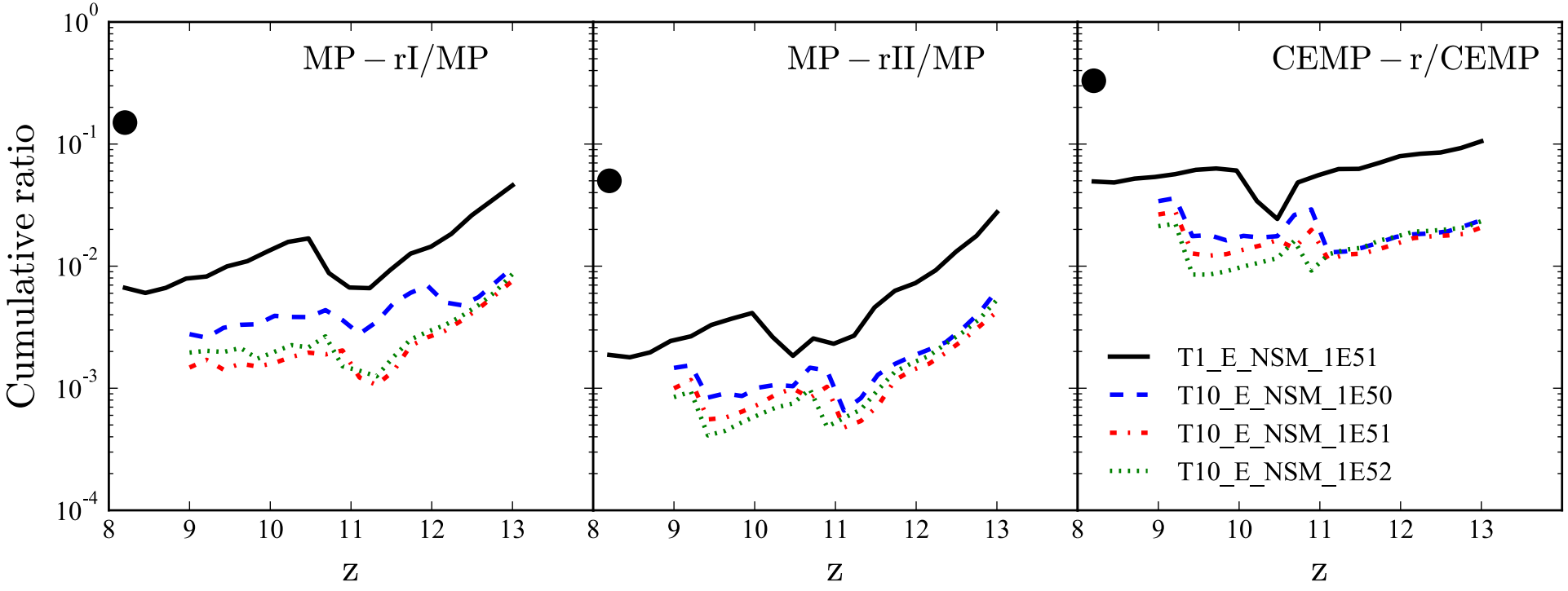
What is next?

Perform the same simulations on a suite of MW type halos to obtain a robust halo-to-halo scatter



Naiman et al., 2018

Performing cosmological zoom simulation of *r*-process enrichment on a MW type halo



MTS, sarmento & Scannapieco., in prep

Summary

A single NSM event in star formation history of a UFD is compatible with Ret II observations.

***r*-process enrichment efficiency is highly dependent on the location of NSM event, therefore natal kicks play a crucial role.**

Fast merging channels are crucial to explain Ret II like systems.

- **Case BB unstable mass transfer**
- **Highly eccentric orbits**