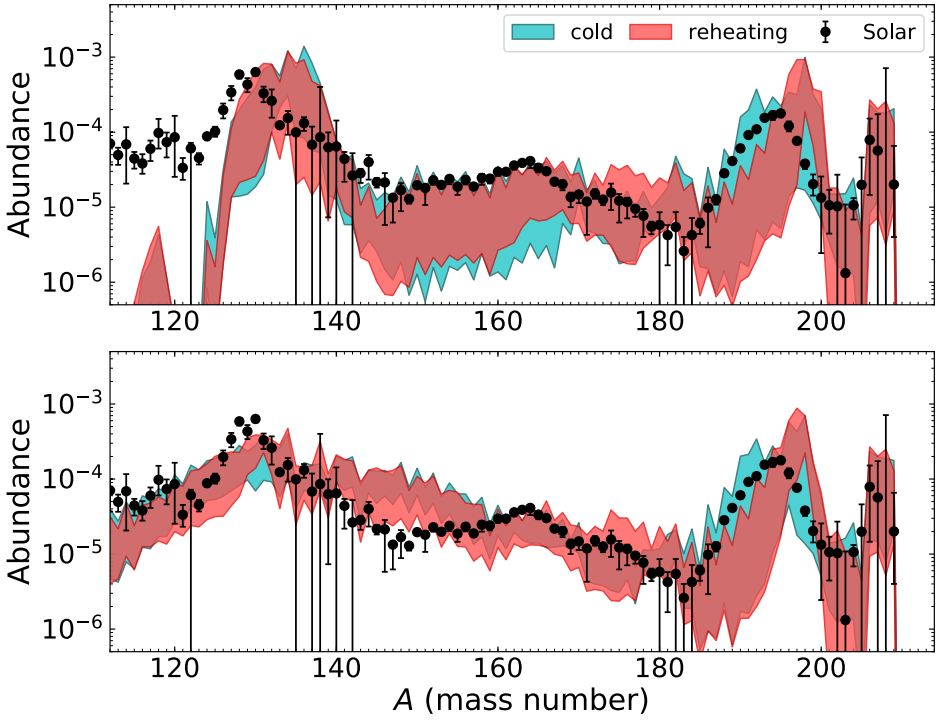
Neutron star mergers and the origin of the heaviest elements

OBJECTIVES

- The light observed from the multi-messenger GW170817 neutron star merger suggests lanthanide elements were produced
- Are such mergers the origin of all the heavy elements in the galaxy?
- We perform state-of-the-art *r*-process simulations to predict the merger rate required to account for the amount of europium observed in the Milky Way and compare with GW170817 data



Current uncertainties in calculated r-process abundances. Top vs. bottom panel: impact of different models for fission fragment distributions. Shaded bands: impact of different mass models

Neutron star merger rate: uncertainty from the single GW170817 observation and from nuclear physics inputs

Reference: Côté et al, Astrophysical Journal **855**, 2, (2018)

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IMPACT

- We find that the local neutron star merger rate reported by LIGO/Virgo falls within the range needed to explain the total observed europium in the galaxy
- Current nuclear physics uncertainties cannot exclude the possibility that a higher merger rate is required
- Future work under the FIRE collaboration will provide more realistic and self-consistent nuclear physics inputs to reduce the uncertainties affecting *r*-process observables