Abstract Submitted
for the APR21 Meeting of
The American Physical Society

Reconstructing Neutron Star Merger Masses from Metal-poor Stars[1] ERIKA HOLMBECK, Rochester Institute of Technology, ANNA FREBEL, Massachusetts Institute of Technology, G. MCLAUGHLIN, North Carolina State University, REBECCA SURMAN, University of Notre Dame, RODRIGO FERNANDEZ, University of Alberta, BRIAN METZGER, Columbia University, MATTHEW MUMPOWER, TREVOR SPROUSE, Los Alamos National Laboratory — Neutron star mergers (NSMs) are promising astrophysical sites for the rapid neutron-capture ("*r*") process, but can their integrated yields explain the majority of heavy-element material in the Galaxy, especially those present in metal-poor stars? One method to address this question implements a forward approach that propagates NSM rates and yields along with stellar formation rates and compares with the observed elemental abundances of metal-poor stars. In this work, we take the inverse approach by utilizing *r*-process signatures of metal-poor stars as input to reconstruct the masses of the neutron star (NS) binary progenitors that would have merged to create those elements. Notably, with our model assumptions and the studied stellar sample, we postulate that the most *r*-process-enhanced stars on their own would require progenitor NSMs of asymmetric systems that are distinctly different from present ones in the Galaxy. However, we find that NSMs can still account for all *r*-process material in metal-poor stars that display *r*-process signatures, while simultaneously reproducing the present-day distribution of double-NS systems.

[1]This work was supported by National Science Foundation under Grant No. PHY-1430152 (JINA Center for the Evolution of the Elements).

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Date submitted: 07 Jan 2021 Electronic form version 1.4