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Precision mass measurements on neutron-rich rare-earth isotopes at JYFLTRAP - reduced neutron pairing and implications for the r-process calculations

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The astrophysical r-process generates around half of the elements heavier than iron, yet precisely where or how this occurs remains a topic of intense inquiry. Understanding the formation of one of its hallmarks, the rare-earth abundance peak, could shed light on the astrophysical sites because this feature is very sensitive to underlying nuclear properties, particularly to nuclear binding energies which have so far been largely derived from theoretical mass models. We have performed precise atomic mass measurements of 12 neutron-rich rare-earth isotopes using the JYFLTRAP double Penning trap mass spectrometer. The atomic masses of 158Nd, 160Pm, 162Sm, and 164–166Gd have been experimentally determined for the first time, and the precisions for 156Nd, 158Pm, 162,163Eu, 163Gd, and 164Tb have been significantly improved. Changes in two-neutron separation and neutron pairing energies show systematic deviations from theoretical mass model predictions. Their impact on the calculated r-process abundances will also be examined.

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