

## Thermonuclear reaction rate of $^{57}\text{Cu}(p, \gamma)^{58}\text{Zn}$ in rp-process

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The thermonuclear reaction rate of  $^{57}\text{Cu}(p, \gamma)^{58}\text{Zn}$ , which depends exponentially on the neutron-deficient nuclide  $^{58}\text{Zn}$  mass, is of great importance to understand how the rp-process proceed beyond the  $^{56}\text{Ni}$  waiting point in type-I X-ray bursts.

So far the uncertainty of  $^{57}\text{Cu}(p, \gamma)^{58}\text{Zn}$  reaction rate is dominated by the 50-keV uncertainty of the proton separation energy ( $S_p$ ) of  $^{58}\text{Zn}$  [1,2] propagated from its mass [3], which was determined indirectly by measuring the  $Q$  value of a double charge-exchange reaction  $^{58}\text{Ni}(\pi^+, \pi^-)^{58}\text{Zn}$  nearly 40 years ago [4].

Recently, We directly measured the mass of  $^{58}\text{Zn}$  by using  $B\rho$ -defined isochronous mass spectrometry [5], resulting in a more precise proton separation energy of  $S_p(^{58}\text{Zn}) = 2227(36)$ -keV.

With this new  $S_p$  value, the thermonuclear rate of the  $^{57}\text{Cu}(p, \gamma)^{58}\text{Zn}$  reaction has been reevaluated to be higher than the most recently published rate [2] by a factor of up to 3 in the temperature range of 0.2-GK

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The new rate is used to investigate its astrophysical impact via one-zone post-processing type-I X-ray burst calculations.

It shows that the updated rate and new  $S_p(^{58}\text{Zn})$  value result in noticeable abundance variations for nuclei with  $A = 56$ -59 and a reduction in  $A = 57$  abundance by up to 20.7%, compared with the results using the recently published rate.

### References

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- [3] M. Wang *et al.*, Chinese Physics C **45** (2021) 030003.
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