New reaction rates of ^{64}Ge(p,γ)^{65}As and ^{65}As(p,γ)^{66}Se and the impact on nucleosynthesis in type I x-ray bursts

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The nucleosynthesis occurring in Type I X-ray bursts (XRBs) and the respective energy released in these thermonuclear explosions are sensitive to nuclear masses and reaction rates around the ^{64}Ge waiting point. Based on the recently measured masses of ^{64}Ge and ^{65}As, the deduced proton separation energies S_p(^{65}As) and S_p(^{66}Se), and nuclear structure information from large-scale shell model calculations, we have obtained new reaction rates of ^{64}Ge(p,γ)^{65}As and ^{65}As(p,γ)^{66}Se with reliable uncertainties. Our new thermonuclear reaction rate of ^{64}Ge(p,γ)^{65}As differs from those available in REACLIB by up to two orders of magnitude at temperature range associated with Type I X-ray bursts. We evaluate the impact of these new rates, particularly the energy generation and the burst light curve, with two XRB models, namely one-zone post-processing model (Parikh *et al*. 2008, 2009); and full *rp*-process in one-zone model, (Schatz *et al*. 2001). Also, we identify the pivotal nuclear physics uncertainties determining the role of the ^{64}Ge to be a waiting point in XRBs, and strongly affecting XRB model predictions of the synthesis of ^{64}Zn and the synthesis of nuclei $A \geq 64$.