Direct mass measurement for ^{103}Sn and its impact on rp-process endpoint SnSbTe cycle

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The nuclide ^{103}Sn was produced by projectile fragmentation of ^{112}Sn at a energy of 400 MeV/u, and its mass was directly measured by a storage-ring based isochronous mass spectrometry at HIRFL-CSR facility in Lanzhou, China. The new mass value deviated the literature one, which was indirectly determined from β-decay spectrum of ^{103}In, by about 2.5σ, and the mass precision was improved by a factor of two.

Since the decay energies of proton or α particle were precisely measured in the decay chain of ^{112}Cs$(p)^{111}$Xe$(\alpha)^{107}$Te$(\alpha)^{103}$Sn, masses of other three nuclides will also shift following the change of ^{103}Sn mass. The mass surfure of the four isotopic chain seem to be more smooth according to the systematic behavior of two-neutron separation energies.

Astrophysical network calculations indicate that the rp process in x-ray bursts ends at a SnSbTe cycle and cannot proceed past tellurium isotopes due to the low α separation energies of neutron-deficient tellurium isotopes. The main reaction flow of this cycle is ^{103}Sn$(\beta+)^{103}$In$(p,\gamma)^{104}$Sn$(\beta+)^{104}$In$(p,\gamma)^{105}$Sn$(p,\gamma)^{106}$Sb$(p,\gamma)^{107}$Te$(\gamma,\alpha)^{103}$Sn.
The change of ^{107}Te mass will influence on the competition between ^{106}Sb$(p,\gamma)^{107}$Te and 106Sb $(\beta+)$ 106Sn, and thus determine the amount of the SnSbTe cycle. However, since the reaction rate of ^{106}Sb$(p,\gamma)^{107}$Te is about 3 orders of magnitude stronger than that of ^{106}Sb$(p,\gamma)^{107}$Te. Our new mass will not change amount of the SnSbTe cycle too much.