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Recent Developments in the Understanding of Explosive H-Burning and the rp-Process Path: Classical Novae and Type I X-Ray Bursts

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Many stars form binary or multiple systems, with a fraction hosting one or two degenerate objects (white dwarfs and/or neutron stars) in short-period orbits, such that mass transfer episodes (accretion) onto the degenerate component ensue. This scenario is the framework for a suite of violent stellar events, such as *classical novae*, *type I X-ray bursts*, type Ia supernovae, or eventually, *stellar mergers*. The expected nucleosynthesis accompanying these cataclysmic events is very rich. Here, we will focus on the explosive H-burning regimes that caharacterize Classical Novae and some X-ray bursting systems.

Extensive numerical simulations of nova outbursts have shown that the accreted envelopes attain peak temperatures ranging between 10^8 and 4×10^8 K, for about several hundred seconds, and therefore, their ejecta is expected to show signatures of a significant nuclear activity, which is driven by proton-capture reactions in competition with β+-decays, proceeding close to the valley of stability, up to Ca. It has been claimed that novae can play a certain role in the enrichment of the interstellar medium in a number of intermediate-mass elements. This includes ^{17}O, ^{15}N, and ^{13}C, systematically overproduced in huge amounts with respect to solar abundances, with a lower contribution in a number of other species with A < 40, such as ^{7}Li, ^{19}F, or ^{26}Al. Some of the radioactive species synthesized drive characteristic gamma-ray signals that may be detected by current (and future) space observatories.

X-ray bursts, in turn, constitute the most frequent source of stellar explosions in the Galaxy (and the third most energetic events after supernovae and nova outbursts). They take place in the H/He-rich envelopes accreted onto neutron stars in binary systems. They are powered by a suite of nuclear processes, including the *rp-process* (rapid p-captures and β^+-decays), the 3α-reaction, and the *αp-process* (a sequence of (α,p) and (p,γ) reactions); here, the nuclear flow proceeds far away from the valley of stability, merging with the proton drip-line beyond A = 38, and reaching eventually the SnSbTe-mass region, or beyond.

This review will address recent advances in the modeling of such stellar explosions, with emphasis on state-of-the-art, hydrodynamic simulations (1-, 2- and 3-D), on their gross observational properties and on their associated nucleosynthesis. The impact of current nuclear uncertainties on the final nucleosynthetic yields will be discussed in detail for both astrophysical scenarios.