Convective-reactive processes in evolved massive stars

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One-dimensional simulations show that violent mergers of convective O- and C-burning shells in massive stars can open new nucleosynthesis pathways to the production of the odd-Z elements P, Cl, P, and Sc, which are underproduced in current chemical evolution models of the Galaxy. Such mergers would likely be strongly aspherical with further implications for supernova explosion models. I will present the results of high-resolution 3D hydrodynamic simulations performed in Falk Herwig's group at the University of Victoria in collaboration with Paul Woodward, which quantify the dynamic feedback from the burning of C-rich material convectively entrained into an O-burning shell. Although most of our numerical experiments lead to quasi-stationary C burning, one shows markedly different behaviour with a convective-reactive instability causing large-scale oscillations with Mach numbers $\mathrm{Ma} > 0.2$.