Dance to Demise -- How Massive Stars May Form Dense Circumstellar Shells Before Explosion

Sutirtha Sengupta, Das Sujit, Arkaprabha Sarangi

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We investigate the evolution of red supergiant (RSG) progenitors of core-collapse (CC) supernovae (SNe) with initial masses between 12-20 Msun focusing on effects of enhanced mass loss due to pulsation-driven instabilities in their envelopes and subsequent dynamical ejections during advanced stages of nuclear burning. Using time-dependent mass loss rates from detailed MESA stellar evolution models, including prescriptions for both pulsation-driven superwinds and shock-induced ejections, we construct the circumstellar medium (CSM) before the SN explosion. We calculate resulting CSM density profiles and column densities considering the radiation-driven acceleration of the stellar wind. Our models produce episodes of enhanced mass loss ~10^-4-10^-2 Msun/yr in the last centuries-decades before explosion forming dense CSM (>~10^-15 g/cm^3 at distances <~10^15 cm) - consistent with multi-wavelength observations of Type II SNe such as SN 2023ixf, SN 2020ywx, SN 2017hcc, SN 2005ip and SN 1998S. The formation of such dense CS shells, as predicted by our single star RSG models, provides a natural explanation for observed flash-ionization signatures, X-ray and radio emission, and has important implications for dust formation around Type II Sne.