N21a Physical properties of the fluorine and neutron capture element rich PN J900

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We performed detailed spectroscopic analyses of a young C-rich planetary nebula (PN) Jonckheere900 (J900) in order to characterise the properties of the central star and nebula. We firstly detected the [F IV] 4059.9 Å, [F V] 13.4 μm, and [Rb IV] 5759.6 Å lines in J900. Of the derived 17 elemental abundances, the first determination of eight elemental abundances is done by us. J900 exhibits the large enhancement of F and neutron capture elements Se, Kr, Rb, and Xe. We investigated the physical conditions of H_2 using the newly detected mid-IR H_2 with the combined use of the previously measured near-IR H_2. H_2 lines are emitted from the warm ($\sim$670 K) and hot ($\sim$3200 K) temperature regions. We built the spectral energy distribution (SED) model to be consistent with all the observed quantities. We found that about 67 % of the total dust and gas components ($4.5 \times 10^{-4}\,M_\odot$ and $0.84\,M_\odot$, respectively) exists beyond the ionisation front, meaning critical importance of investigations of photodissociation regions in understanding of the stellar mass-loss. The best fitting SED model indicates that the progenitor evolved from an initially $\sim$2.0 $M_\odot$ star is presently in the course of the He-burning shell phase. Indeed, the derived elemental abundance pattern is consistent with that predicted by the asymptotic giant branch star nucleosynthesis model for the 2.0 $M_\odot$ stars with $Z = 0.003$ and partial mixing zone mass of $6.0\times10^{-3}\,M_\odot$. Our study recognises how the accurately determined abundances of C/F/Ne/neutron-capture elements and gas/dust masses help us understanding the origin and the internal evolution of the PN progenitors.