going a violent and unstable mass loss event. The photospheric chemical abundances correspond to the equilibrium CNO nuclear burning values, while the nebula has a normal chemical composition. Models fitting data from different epochs show that the fundamental stellar parameters remain constant with time, with values log $L_*/L_\odot = 4.53 \pm 0.10$, $T_* = 93\,300$ K, and $R_* = 0.71\ R_\odot$. The short- and long-term stellar variations are produced by large changes in the mass-loss rate, which varies by large factors, from $\dot{M} \leq 8 \times 10^{-7}\ M_\odot\ \mathrm{yr}^{-1}$ in 1983 (pre-outburst epoch) to $\dot{M} = 2.5 \times 10^{-5}\ M_\odot\ \mathrm{yr}^{-1}$ in early 1995 (maximum stellar brightness). No evidence to support the suggestion that the outburst was due to a late thermal pulse was found. We propose that the event taking place in CS N66 was produced by an atmospheric instability similar to those triggering the giant eruptions of Population I LBV stars. We briefly discuss an approach to the Eddington-limit due to changes in the opacity and a non-radial pulsational instability as two possible mechanism which could have caused the atmospheric outburst.

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SHAPING BIPOLAR AND ELLIPTICAL PLANETARY NEBULAE: EFFECTS OF STELLAR ROTATION AND MAGNETIC FIELDS

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We present hydrodynamical and magneto-hydrodynamical simulations for the evolution of planetary nebulae formed through the interaction of two succeeding constant stellar winds. The latitudal dependance of the wind parameters are described by a single wind function in our calculations. We explore various relevant parameters, including the effects of stellar rotation, ionizing radiation field and stellar magnetic field, and a catalogue of resulting nebula shapes is generated.

We find that strongly bipolar nebulae can be obtained when the stellar rotational velocity, v_{rot}, approaches the critical rotational velocity, v_{crit}, at the asymptotic giant branch (AGB) phase. As an example, the shape of the Hourglass Nebula (MyCn18) is obtained for the value of the ratio $\Omega = v_{\mathrm{rot}}/v_{\mathrm{crit}} \approx 0.98$. We estimate the evolution of the rotation rate and of the critical rotation rate in thermally pulsing AGB stars and find a plausible scenario which predicts critical rotation at the tip of the ABG for single stars with an initial mass of more than $\sim 1.3\ M_\odot$.

When a stellar magnetic field is combined with the effect of the rotation at the AGB phase, highly collimated bipolar nebulae can be obtained such as M2–9 or He 2–437. Provided that the field is sufficiently strong, the formation of ansae and jets in the polar regions of the nebula have also been found, such as IC 4593. On the other hand, weaker fields can account for classical elliptical nebulae such as NGC 6905 even in nonrotating (i.e., spherically symmetric) AGB winds.

Photoionization was found to be important in producing dynamical effects. It generates irregularities in the shape of the simulated nebulae, and may be responsible for the formation of irregularly shaped planetary nebulae, such as Sh 2-71 or WeSb 4. It also leads to the formation of cometary knots, preferentially at the equatorial region, similar to those seen in the Helix nebula (NGC 7293).

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CHEMODYNAMICAL MODEL OF THE GALAXY: ABUNDANCE GRADIENTS PREDICTED FOR H II REGIONS AND PLANETARY NEBULAE

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We present a chemodynamical evolution model of the Galaxy to determine chemical abundance gradients of different stellar populations. From this model we have determined the abundance gradients expected for H II regions as well as for planetary nebulae of different ages and different kinematical properties. We have compared the model predicted gradients with those derived from PNe of Types I, II and III. From this comparison we conclude that only about half of the stars evolving toward the white dwarf stage produce PNe and that the less massive stars are less likely to produce PNe. Other arguments supporting the previous conclusions are presented.

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