MASS LOSS IN TWO LOW TEMPERATURE CENTRAL STARS OF PLANETARY NEBULAE

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The high resolution IUE images SWP 16742 and SWP 42675 have been studied to derive the fast wind properties of the central stars of the two low temperature planetary nebulae IC 2149 and Tc 1. The first image is from the IUE archive, while the second one has been taken by us.

IC 2149 and Tc 1 exhibit clearly developed P Cygni profiles only in the lines of the ions: CIV, NIV, and, in Tc 1, also SiIV, consistent with a T_{eff} of around 34,000 K. IC 2149 has a faint P Cygni profile also in the NV doublet at 1240 Å, which comes out in the spectrum with a very low S/N ratio. The OIV triplet, with its bluest (and strongest) component at 1339 Å, appears quite narrow in both stars, suggesting an essentially photospheric origin. The SiIV line appears in IC 2149 in absorption, with its blue edge shifted of about -150 km/s, from which can be inferred that it forms very close to the photospheric layers.

The observed P Cygni profiles have been matched with theoretical profiles calculated with the SEI method (Lamers, Cerruti-Sola, and Perinotto 1987, Ap. J. 314, 726). In this method the velocity and opacity law across the wind are parametrized.

Essentials of the SEI method are: a) the solution of the transfer equation in the line across the wind is performed exactly, under the Sobolev hypothesis for the calculation of the source function, and b) the effects of turbolence are considered via a Doppler widening.

From the theoretical best fitting parameters β (velocity law), and T,α_1,α_2 (opacity law), the mass loss rate follows, provided we specify: the terminal velocity, the stellar radius, the fractional ionization of the ion, the corresponding elemental abundance, and, for excited lines, also the radiation temperature at the wavelenght of the line populating the lower level of the observed transition.

We obtain the following preliminary values. For IC 2149:

$\dot{M}q_i$ (CIV) > 2.0 10^{-10} $M_\odot$ yr^{-1}; $\dot{M}q_i$ (NIV) = 2.2 10^{-8} $M_\odot$ yr^{-1}

Since the NV P Cygni profile is present, but very faint, we infer that the assumption of q(NIV) to be about 0.5 is correct to within a factor of 2. Then $\dot{M}$ (IC 2149) = 4. 10^{-8} $M_\odot$ yr^{-1}.

For Tc 1 we derive:

$\dot{M}q_i$ (CIV) > 1.9 10^{-10} $M_\odot$ yr^{-1}; $\dot{M}q_i$ (NIV) = 6.4 10^{-7} $M_\odot$ yr^{-1}; $\dot{M}q_i$ (SiIV) = 3.7 10^{-9} $M_\odot$ yr^{-1}

The two last values are also low limits to the "true" $\dot{M}$ because $0 \leq q \leq 1$. From the same argument used for IC 2149, we infer a $\dot{M}$ = 10^{-6} $M_\odot$ yr^{-1}. This is the highest value of $\dot{M}$ so far obtained in central stars of planetary nebulae studied with the SEI method.

Its amount is such that the effects both on the evolution of the central star and on the interaction of the fast wind with the previously ejected material, are relevant.