

THE PLANETARY ESO 166 - PN21

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ABSTRACT. Long slit, high and low resolution, spectrograms of this object were obtained using the telescopes at CTIO. From the [N II] $\lambda 6584$ line in the high resolution spectrum, we obtained a radial velocity difference between the front and back expanding shells at the center of the nebula of 56 km s^{-1} corresponding to an expansion velocity of 28 km s^{-1} . From the low resolution spectra we found [S II] $\lambda\lambda 6717/6731$ line ratios indicating densities between 500 cm^{-3} and less than 200 cm^{-3} . The temperature sensitive line ratios of [O III] and [N II] were not well determined due to the weakness of the $\lambda 4363$ and $\lambda 5733$ lines. A ionization structure is clearly seen with radial distance to the central star which shows that the inner shell (A2, A4, B2, B4) is not a projection of the outer one but a separate structure.

Average abundances were determined taking $N_e = 300 \text{ cm}^{-3}$ and assuming a $T_e = 10^4 \text{ K}$, consistent with the observed line ratios. We did not include positions A1, A5, B1 and B5 in which a considerable amount of neutral H could be present affecting the line ratios through charge transfer reactions. The abundances thus determined are $\text{He/H} = 11.15$, $\text{O/H} = 8.66$, $\text{N/H} = 8.33$ and $\text{Ne/H} = 8.13$.

The high He abundance and N/O abundance ratio are typical of planetaries with massive progenitors.

Spectrophotometry of a very blue star at the center of the nebula (indicated with an arrow in the figure) reveals a $m_V = 18.1$ mag star with a featureless spectrum and $(B-V)_0 = -0.38$. Considering that the nebula is $160''$ in diameter with an expansion velocity of 28 km s^{-1} and assuming a radius of 0.6 pc we get a maximum distance of 1547 pc and an age of 2.1×10^4 years. Taking the temperature of the central star to be 10^5 then its luminosity would be $L = 47 L_\odot$, however, given that the distance estimate is an upper limit, the actual luminosity could be even lower consistent with the abundances found, both pointing to a massive progenitor star.

