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DETECTION OF A GIANT HALO AROUND NGC 7027

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As a parallel result of an IT Project[2] aimed at determining accurate distances to more than 30 planetary nebulae using the extinction–distance method, we report here the serendipitous discovery of a giant halo around NGC 7027. We obtained the spectra of more than 60 field stars around each PN with the LDSS multi-slit spectrograph at the 4.2-m William Herschel Telescope (La Palma). In the spectra of the field around NGC 7027 we detected nebular lines of H I and [O III]. The variation of $I(5007)/I(4861)$ with distance to the central star indicates that the emission originates in the object, implying that the ionized halo around NGC 7027 extends beyond 1 pc.

The mass difference between the progenitor red giant and central star of a PN is generally not explained by the computed ionized mass in the nebula ($\sim 0.1 M_{\odot}$). The "missing mass" could be near one $M_{\odot}$ and is lost by the red giant during its evolution. This mass can be in the form of a faint, ionized giant halo, or a neutral atomic or molecular shell.

NGC 7027 is one of the best studied PN; nevertheless, its high surface brightness make it difficult to obtain deep images in which to detect a faint extended halo. As part of the ITP observations, we obtained the spectra of 56 field stars around NGC 7027 with the LDSS multi-slit spectrograph. The slits were distributed around the PN in a square of side 6′. The spectral resolution is 6 Å and the spectral coverage goes from 3700 to 6800 Å. All these spectra show bright emission Balmer and [O III] lines.

Middlemass, Clegg, & Walsh (1989; MCW89) call attention to problems in the detection of low surface brightness halos around bright PNe. Possible atmospheric and instrumental scattering and faint diffuse Galactic background contributions must be evaluated before making any definite conclusion. To test the possibility of scattered light, we calculated $I(5007)/I(4861)$ in each spectrum. In Figure 1 we plot this ratio versus distance to the central star. We choose these lines because the 5007 Å emission provides the best contrast with the diffuse Galactic background (MCW89) whereas Hβ is near enough to minimize the effect of interstellar reddening.

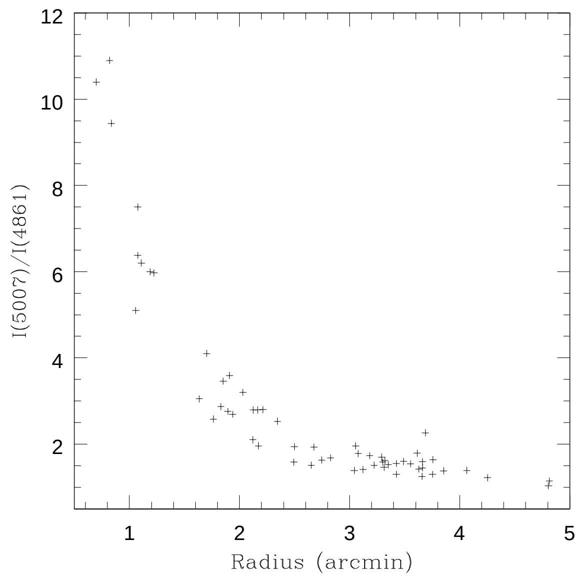

Fig. 1. Behavior of the flux ratio 5007/Hβ with distance to the PN center. We include two points from sky slits located at 4.′8).

Figure 1 shows that the ionized halo around NGC 7027 is detected out to 4′, nevertheless the contribution of the Galactic background can be important out to 2.′5. Then, we cannot determine the exact size of the halo but, if we take the farther detection in our spectra (4′), and the PN distance of 880 pc determined by Mason (1989) the size for the halo around NGC 7027 result to be greater than 1 pc.

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