

Kinematics of recombination and collisionally excited lines in PNe

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For some time there has been the concern that the abundances derived from recombination lines do not agree with those derived from collisionally excited lines. There have been many attempts to explain this discrepancy. In a previous study we analyzed the kinematics of emission lines in NGC 7009 as a function of ionization structure (Richer et al. 2013 – shown in Poster A2 by Arrieta), by comparing the behavior of the position – velocity diagrams of the emission lines.

We plan to continue these studies by analyzing the most significant cases of discrepancy to try to ascertain the origin of this discrepancy.

On NGC 7009:

The results in the study of NGC 7009 showed ...*“the only anomaly we found is that the kinematics of the collisionally excited [Oiii] $\lambda\lambda$ 4363,4959 lines does not coincide with that of the Oii $\lambda\lambda$ 4639,4649 recombination lines. The kinematics favor at least two emission components for the Oii $\lambda\lambda$ 4639,4649 recombination lines. The plasma from which a large fraction of the Oii emission arises clearly does not originate within the volume expected from the viewpoint of ionization equilibrium as traced by the [Oiii] emission. Instead, it arises from a zone interior to it. There is also a widely distributed plasma component, co-spatial with the collisional [O iii] emission, that also gives rise to Oii $\lambda\lambda$ 4639,4649 recombination emission”.*

About the data base:

There are significant number of high dispersion spectroscopical observations of planetary nebulae in the ESO UVES-VLT database. I plan to continue the comparison of the kinematics of the recombination lines with the collisionally excited lines. This is possible by studying the Position-Velocity emission for significant lines.

M1-42 (PN G2.7-04.8):

In this case we present some P-V diagrams of the emission lines of M1-42. This object has been widely studied, and abundance analysis have been carried out by Liu et al. 2001, and Pottasch et al. 2007.

It is a rather faint planetary nebula (PN) with a high radial velocity which is located in the direction of the galactic center. For this reason it has been considered to be a galactic bulge PN. Liu et al. (2001) found that it has a very low Balmer jump temperature and the abundances derived from the measured recombination lines are an order of magnitude higher than those derived from the collisional excited lines. It has also been studied by Pottasch et al 2007,

This nebula has a very prominent ORL spectrum from CNO and Ne ions, remarkably similar to those observed from NGC 7009 and 6153. According to Liu et al. the ORL ionic abundances derived for M 1-42 are respectively, about a factor of 20 higher than those derived from CELs. This object is one with the highest abundance discrepancy factor, ADF.

According to Pottasch, *“The only clues [of this discrepancy] are that the recombination lines of oxygen seem to be formed at a position different from the collisional lines of oxygen and closer to the center of the nebula”* .

