

# Kinematic profiles of NGC3918 and NGC6302 from high dispersion spectra



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## Abstract

Planetary nebulae have typical expansion velocities between 20 and 40 km/s. Using high dispersion, long slit spectroscopy obtained with the 1.60m telescope and the Coudé spectrograph at Pico dos Dias Observatory (MCT/LNA) in Brazil, we derived the kinematic profiles from forbidden lines for different angular positions along the slit for a sample of southern PNe.

Results allowed us to derive velocity profiles for the nebulae, and, for some of them, parameters such as distance and kinematic age. For NGC6302 we estimate a distance of  $805 \pm 143$ pc, in a good agreement with other results from the literature. For NGC3918, the velocity profiles were used to estimate its kinematic age, assuming expansion with uniform velocity; the result was 3111 years for the external shell. Hereafter we intend to use the kinematic profiles to model these planetary nebulae with the SHAPE code, and apply this technique for a large number of southern planetary nebulae.

## Observations

During May of 2012 were observed NGC 6302 and NGC 3918, two southern and angularly resolved nebulae. NGC 6302 is a bipolar and massively studied nebula, its kinematics is well known. NGC 3918 is a multi shell nebula that don't have a detailed kinematic study.

The 1.6m Perkin Elmer telescope of Pico dos Dias Observatory (OPD), MCT/LNA, Brazil, was used with the Coudé spectrograph, with a 1800/mm grating; resulting in a velocity resolution of 11km/s. The spectrograph have great velocity stability, but a poor contrast, being indicated for objects with high surface brightness.

NGC 3918 was observed in only one slit position, perpendicular to the polar structure of the inner shell; in order to study the kinematics of outer shell, apparently spherical, according to Figure 1.

NGC 6302 was observed using four slit positions (Figure 1) in order to derive a detailed kinematic profile of the bipolar structure.

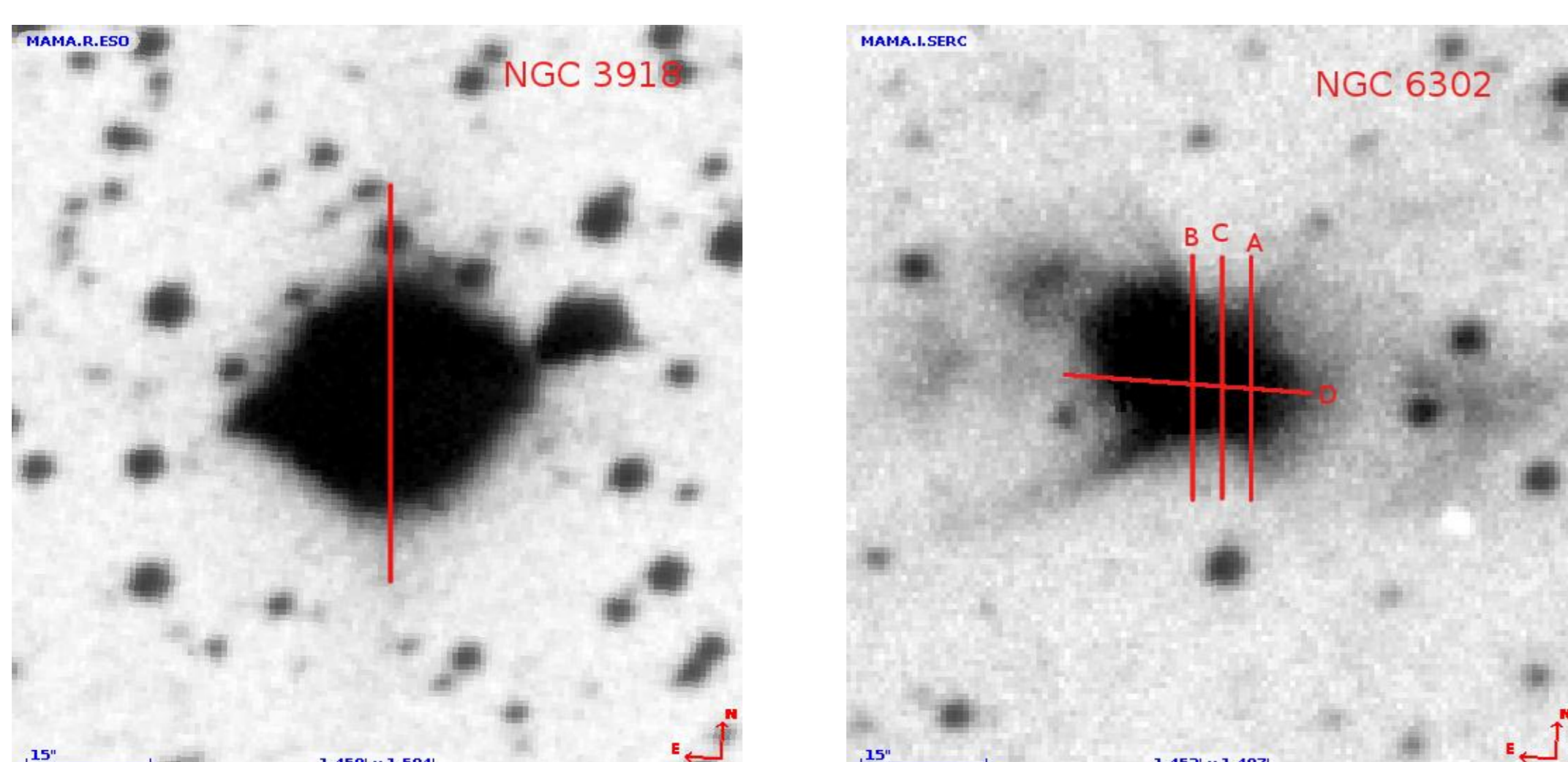


Figure 1: Images of studied objects with the slit positions.

Supported by:



## NGC 6302

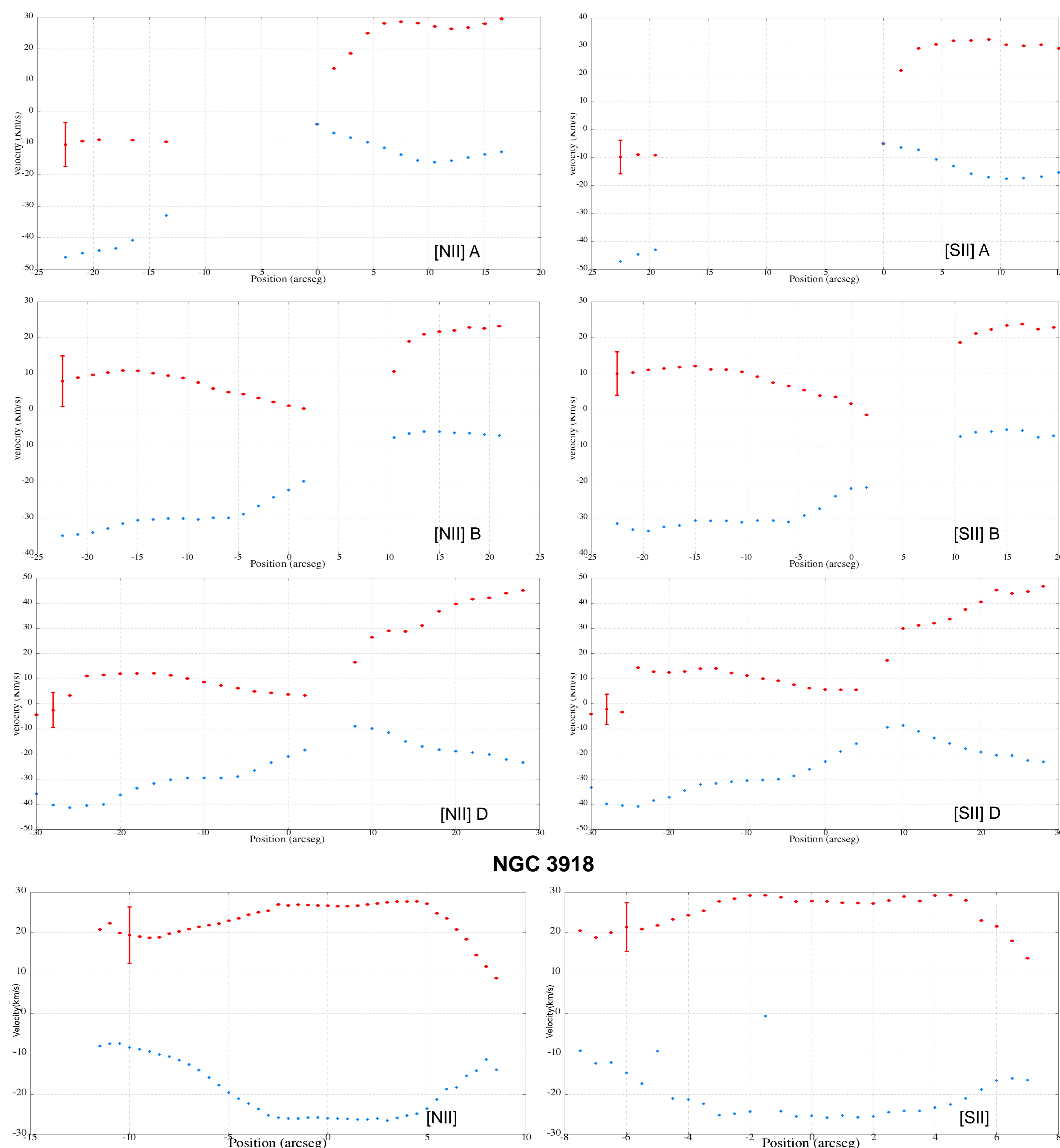


Figure 2: Kinematic diagrams of NGC 6302 and 3918, for different ions and slit positions. For NGC 6302 position "C" don't have a kinematic diagram due to bad sampling. The bar is the typical error.

## Discussion

Figure 2 shows the kinematics of NGC 6302, for two duplets, [NII], (654.8nm + 658.4nm) and [SII], (671.6nm+673.1nm) and in both cases a linear increase of the velocity with the distance of center (Hubble like outflow) can be seen. All velocities were corrected by the proper motion of nebula. Using the geometry, the orientation of the nebula's major axis with the line of sight ( $12.8 \pm 2^\circ$  according to Meaburn et al. 2008) and a detailed kinematic map of the nebula (Szyszka et al 2011), its distance was estimated in  $805 \pm 143$ pc).

NGC 3918 had its dynamical age estimated in 3111 years, for the outer shell. For this calculation the distance of 1.5kpc was used (Clegg et al., 1987), and was assumed uniform expansion velocity.

## References:

Clegg R. E. S., Harrington J. P., Barlow M. J., Walsh J. R., The planetary nebula NGC 3918, ApJ, 1987, vol. 314, p. 551

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