

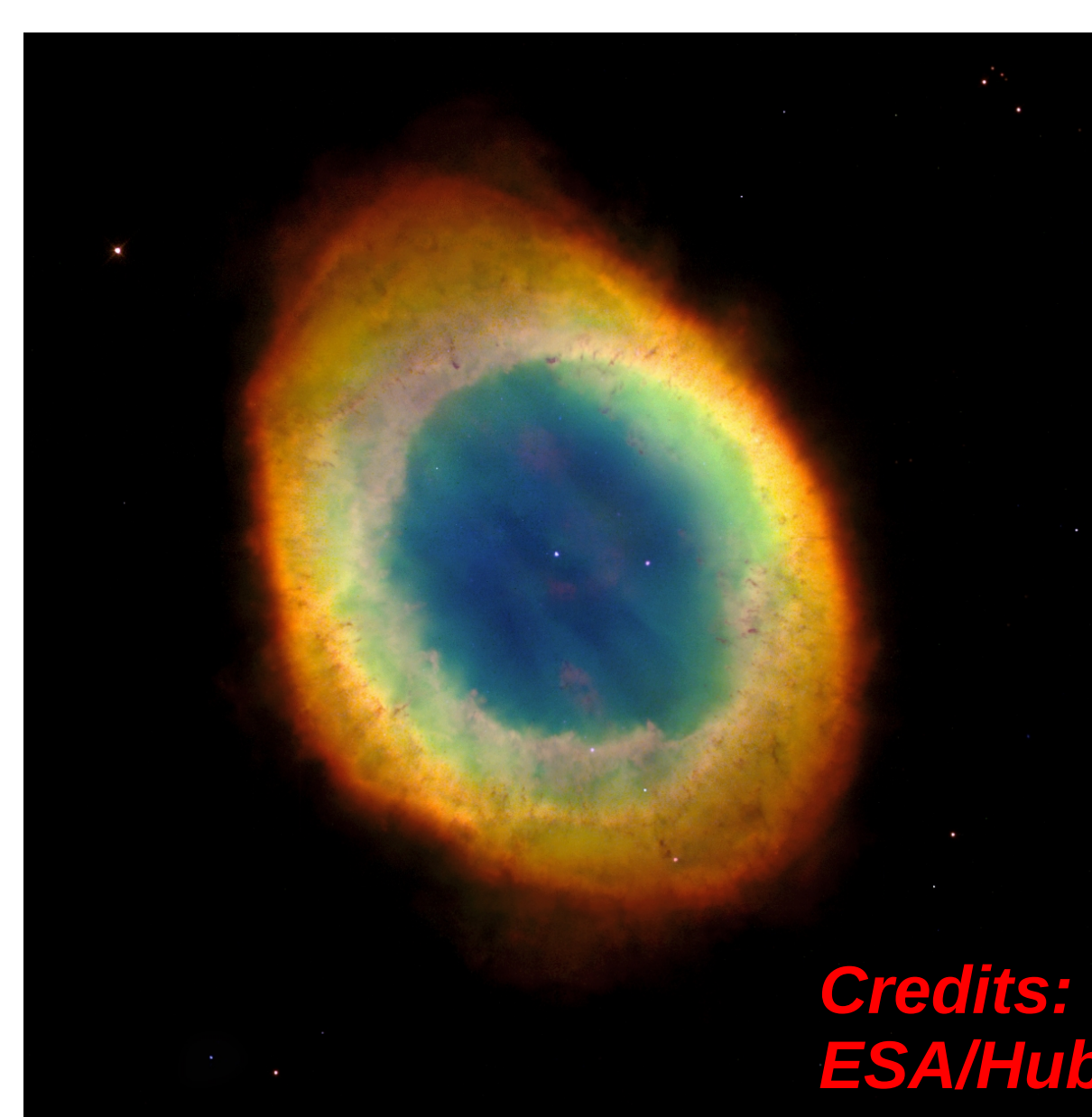
# S-PLUS: An atlas of integrated $H\alpha$ fluxes for planetary nebulae in the Magellanic Clouds

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## ABSTRACT

We present an atlas of  $H\alpha$  fluxes for planetary nebulae of the Magellanic Clouds (MC PNe) with measurements from the Southern Photometric Local Universe Survey (S-PLUS), a 12 band (7 narrow and 5 broad) imaging survey that allows us to perform a spatial analysis of the  $H\alpha$  emission. Aperture photometry on the continuum-subtracted images was performed to extract  $H\alpha + [N II]$  fluxes of the MC PNe observed by S-PLUS. The dust attenuation and  $[N II]$  contribution was corrected with empirical relations. Amongst its many applications, it can provide baseline data for photoionization and hydrodynamical modelling, and allow better estimates of Zanstra temperatures for PN central stars with accurate optical photometry.

Ring Nebula (Messier 57)



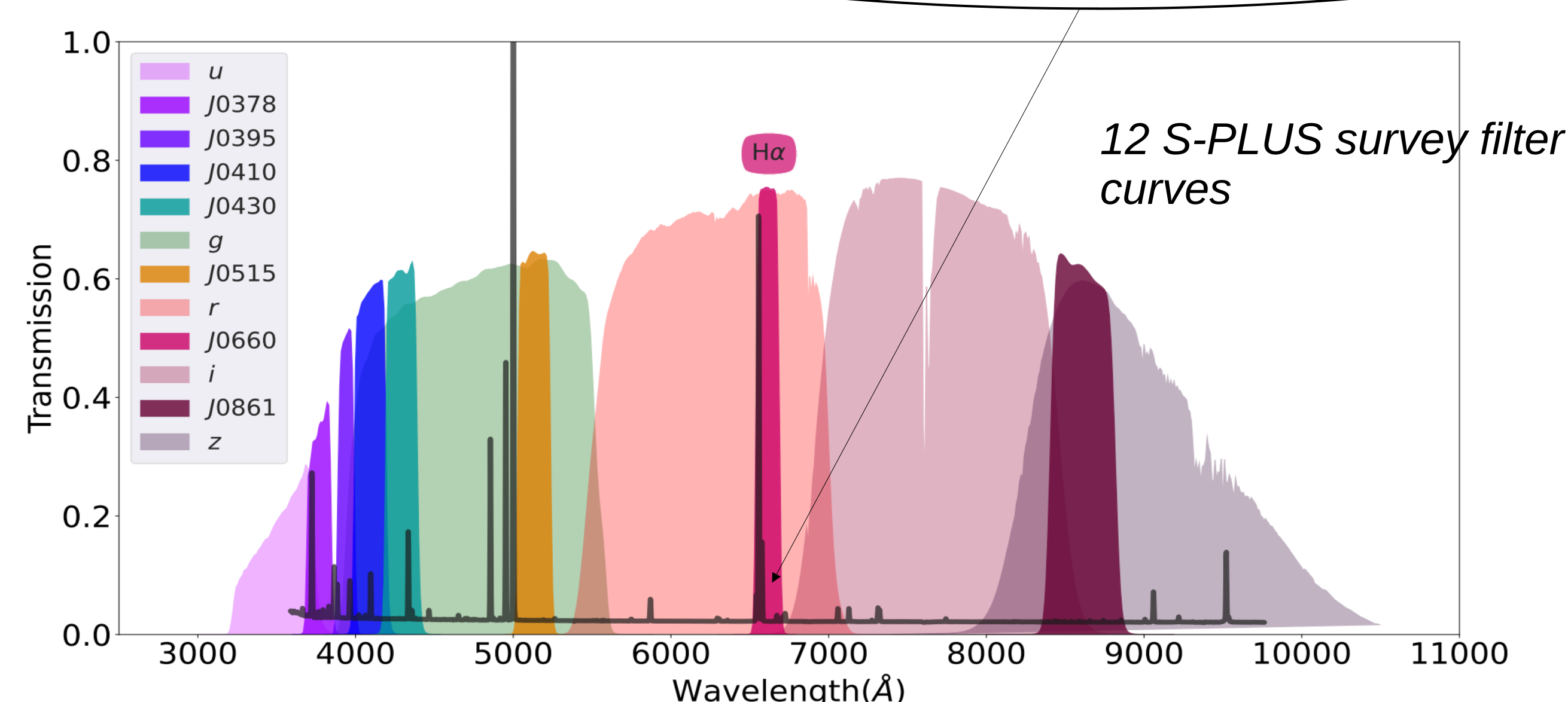
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## What are planetary nebulae?

Planetary nebulae (PNe) are emission line nebulae that represent a short phase in the late evolution of low- and intermediate-mass stars.

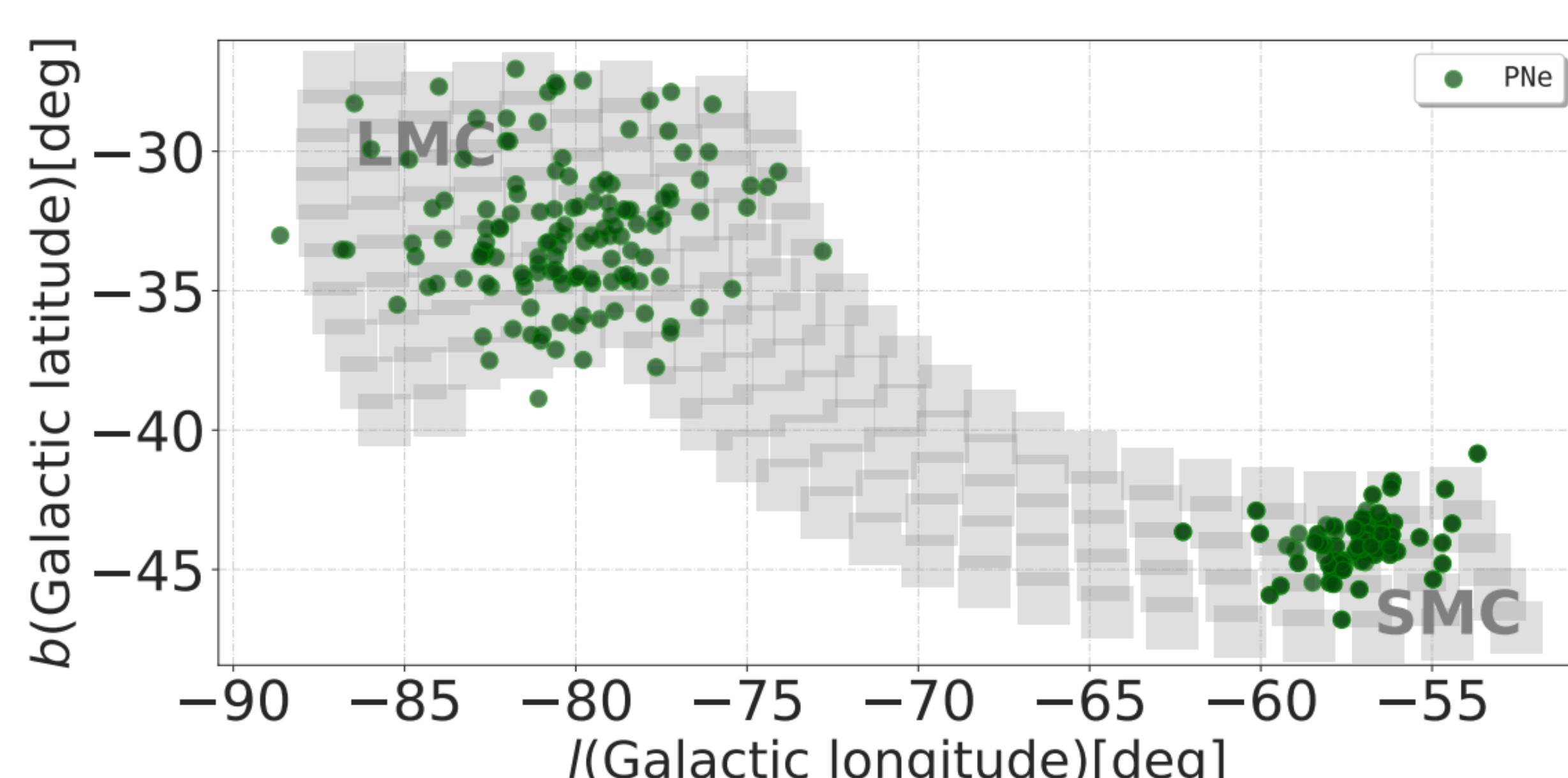
## About S-PLUS:

Typical spectrum of a PN: the  $H\alpha$  and  $[N II]$  emission lines are detected by J0660 filter for sources with a redshift up to 0.015



As part of its effort to map 9,000 square degrees of the Southern Hemisphere, the S-PLUS project (Mendes de Oliveira et al. 2019) has a crucial feature: images of the entire field captured using the  $H\alpha$  narrow-band J0660 filter.

## PNe in the Magellanic Clouds

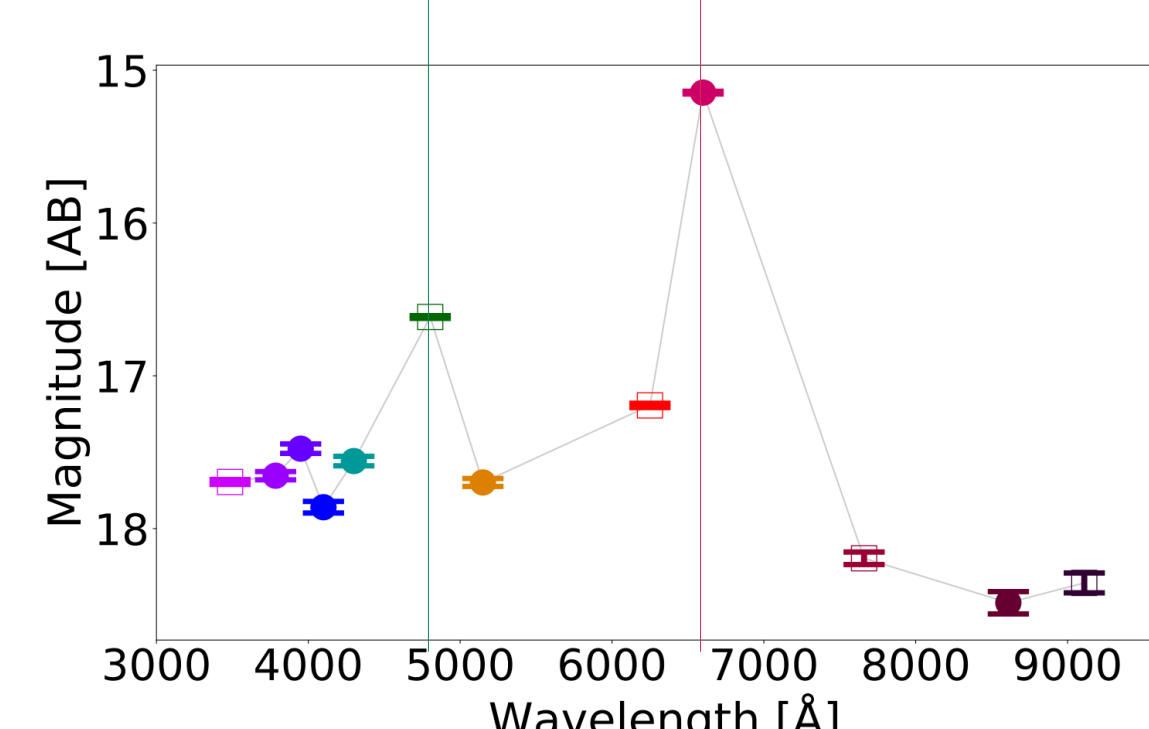
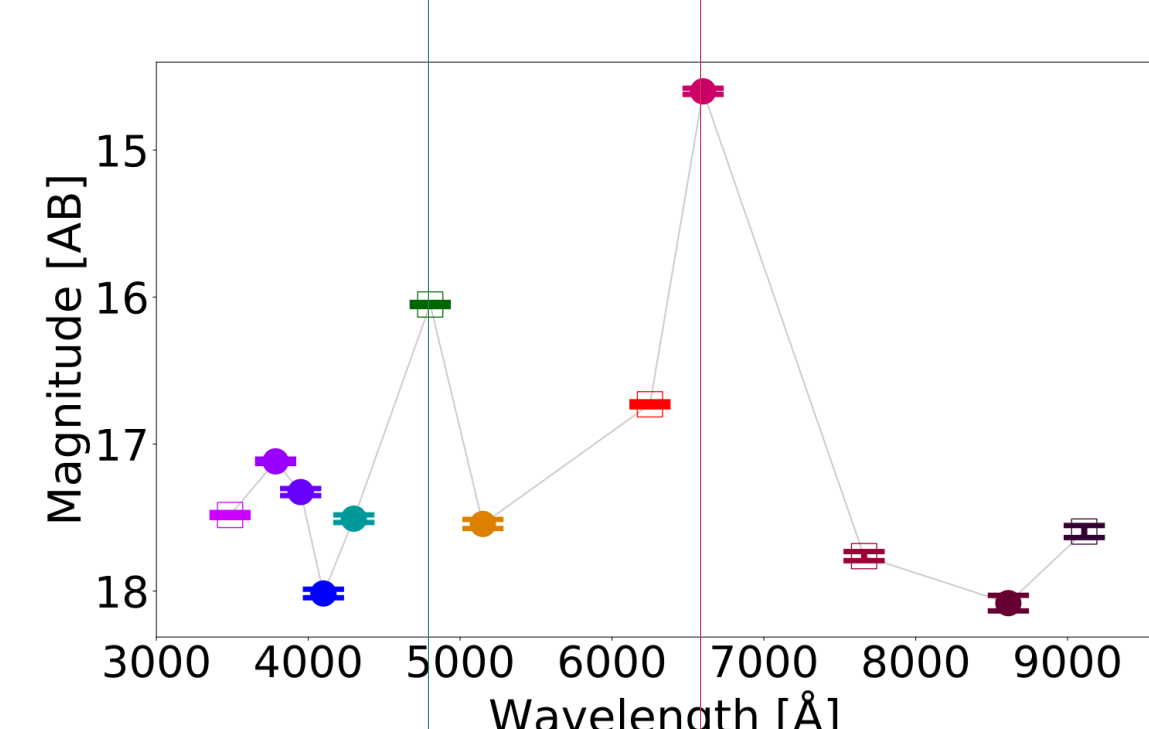
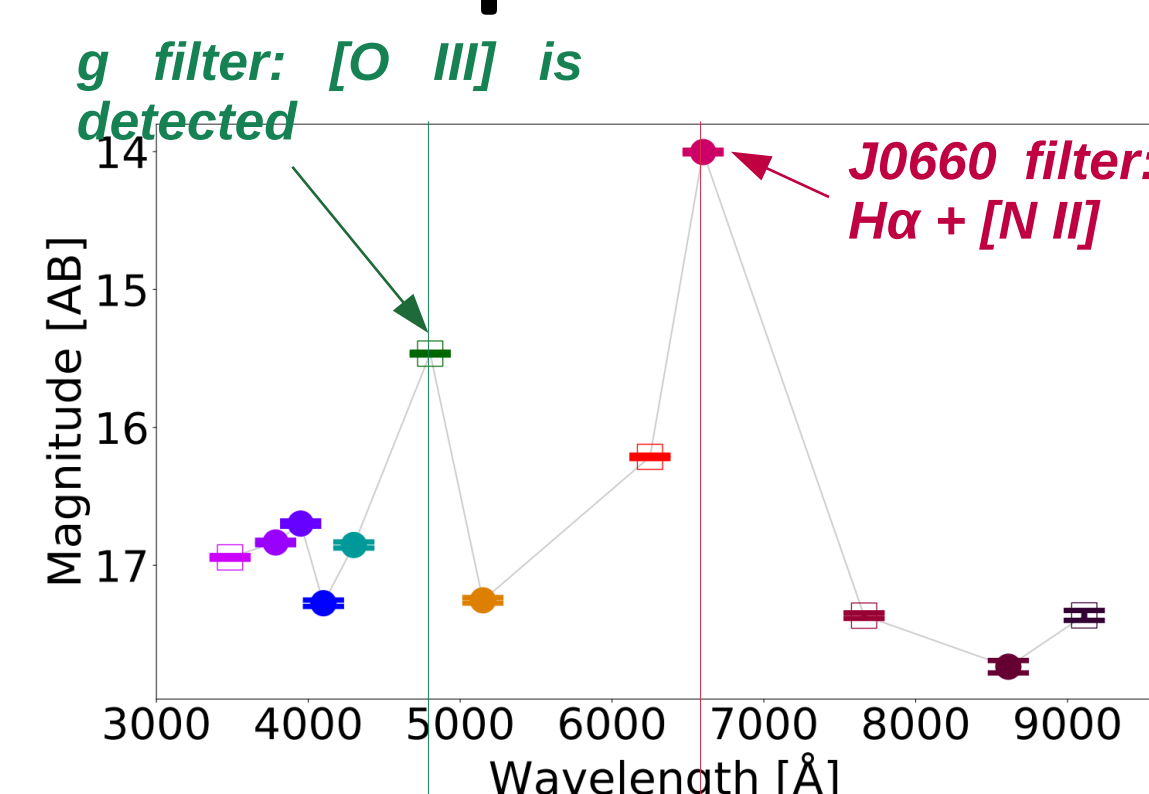


The distribution of the planetary nebulae from the literature (green circles) in the Magellanic Clouds can be seen in the figure. The large gray squares indicate the S-PLUS fields that cover both the Large and Small Magellanic Clouds. Almost all the PNe are within the S-PLUS fields.

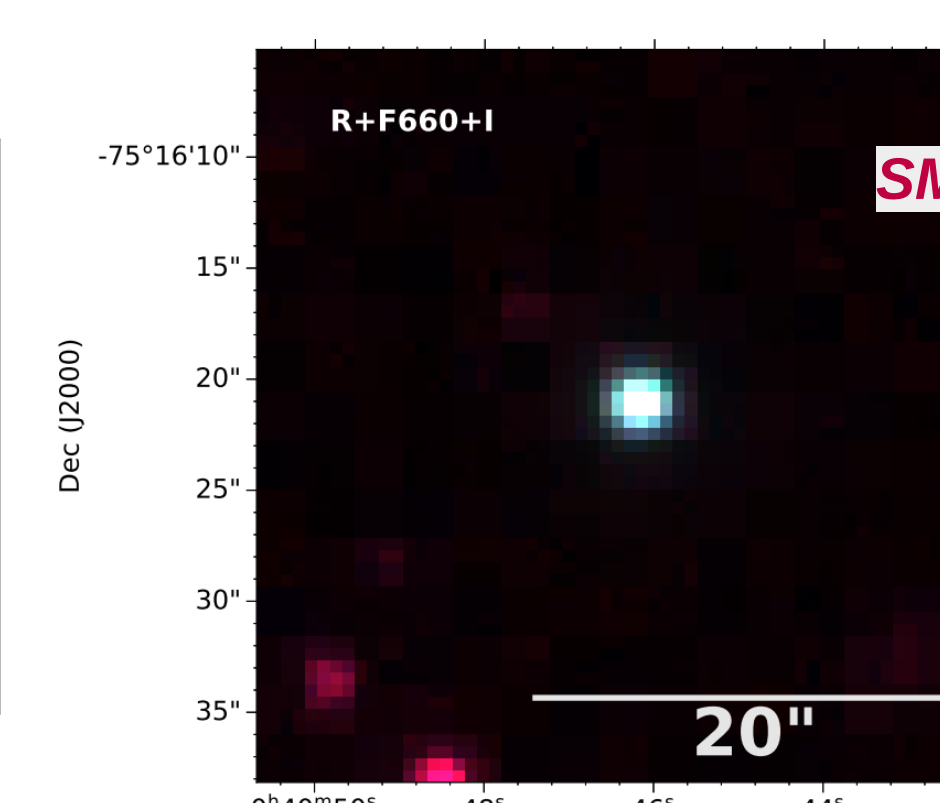
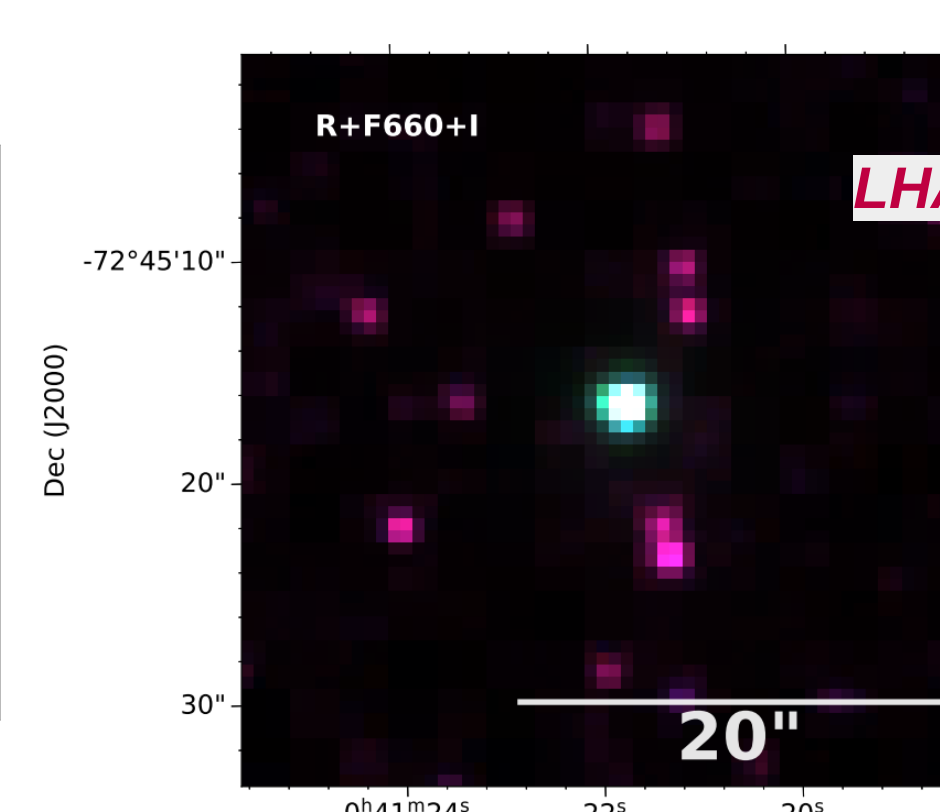
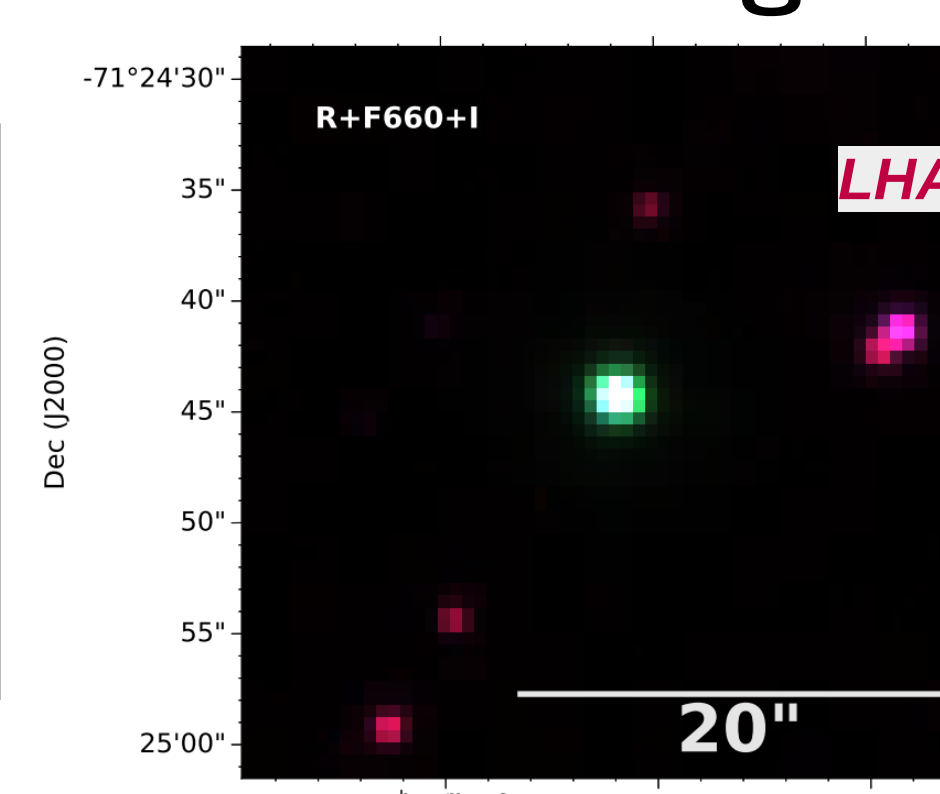
## Extracting $H\alpha$ flux from photometric data

The  $H\alpha$  flux for the Magellanic Cloud planetary nebulae observed by S-PLUS was extracted using two broad-band filters (r and i) and one narrow-band filter (J0660), according to Equation 3 of Vilella-Rojo et al. (2015). Below are the  $H\alpha$  maps for some planetary nebulae, along with their respective S-PLUS photospectra and false color images based on the r, J0660, and i filters:

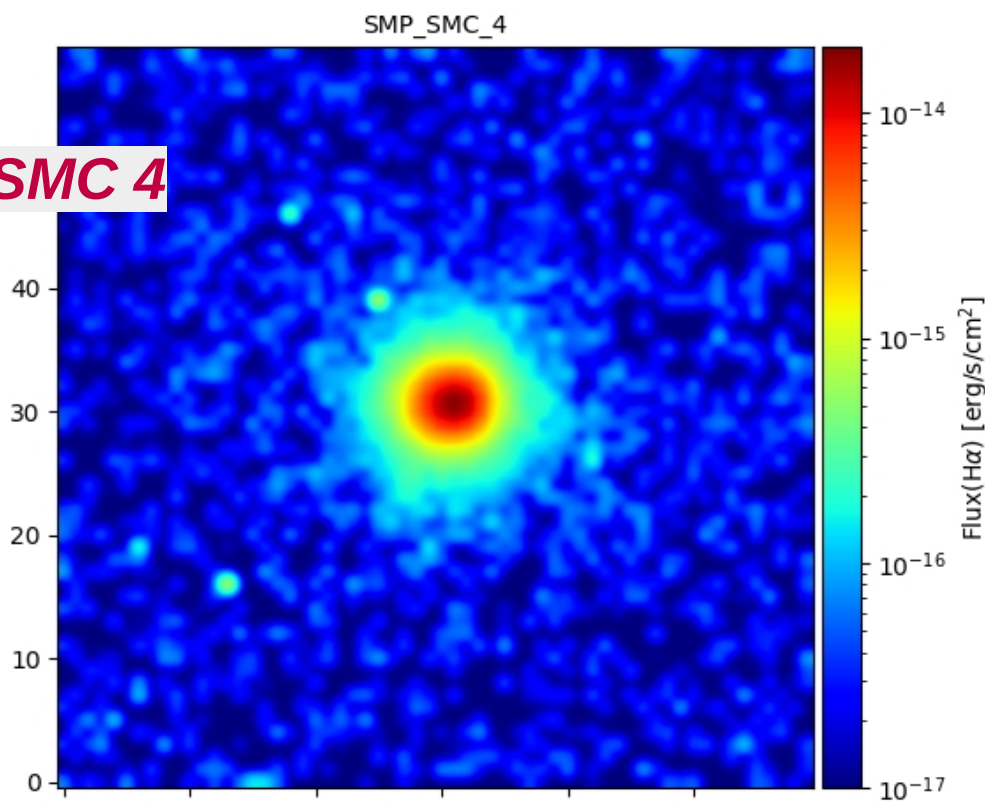
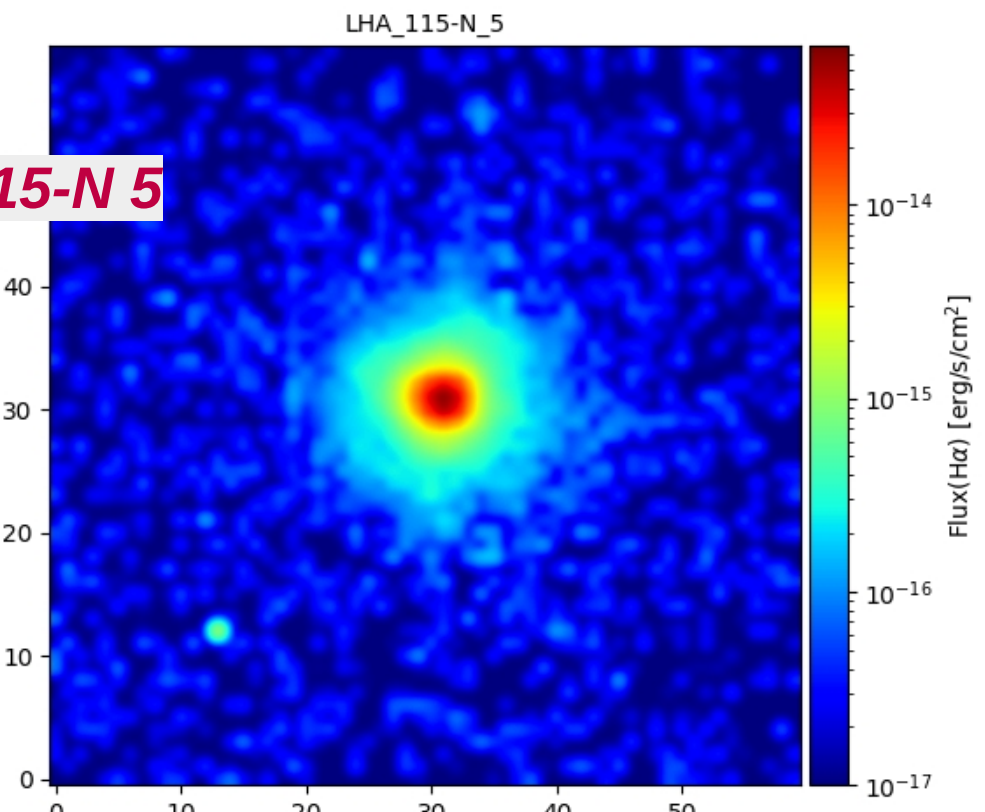
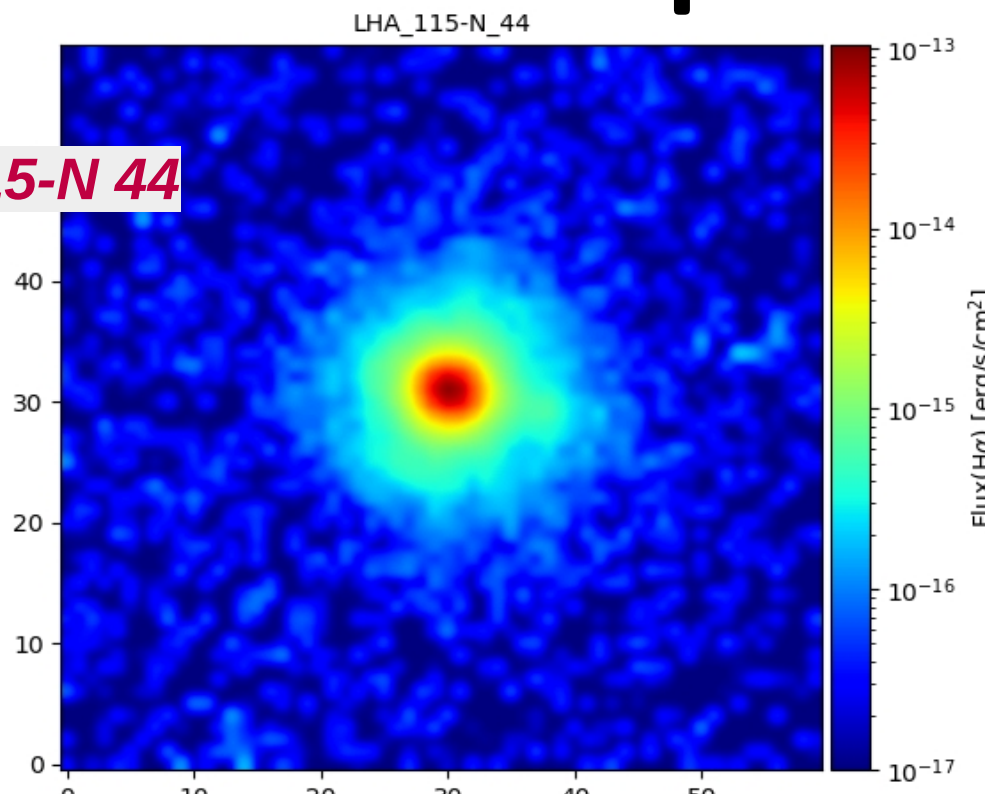
## Photospectra



## RGB image



## $H\alpha$ flux map



In the  $H\alpha$  images, it is possible to perceive external and extensive shells of weak  $H\alpha$  emission.

## Final remarks and next steps

We present reliable  $H\alpha$  fluxes for MC PNe measured from S-PLUS images. With these fluxes, we will estimate the hydrogen density of the ionized gas, the temperature of the central star, as well as analyze the structures of the nebulae.

## References

Mendes de Oliveira C. et al. 2019, MNRAS, 489, 241  
Vilella-Rojo, G. et al. 2015, A&A, 580, A47

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