

pyCloudy, a tool to manage Cloudy

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Christophe Morisset

- Working on HII regions, Planetary Nebulae, Wolf Rayet nebulae
- Interested in abundance determination, models of complex objects (3D, multi-phase, multi-components)
- Main developer of:
 - pyCloudy
 - PyNeb
 - 3MdB
- Interested in using Machine Learning techniques to interpolate in grids of models (Cloudy models for example)

The pyCloudy ecosystem

- Main page:

<https://sites.google.com/site/pycloudy>

- Installing via pip `install pyCloudy`

- Github repository:

<https://github.com/Morisset/pyCloudy>

- Forum:

<https://groups.google.com/forum/#!forum/pycloudy>

PyCloudy (and PyNeb)

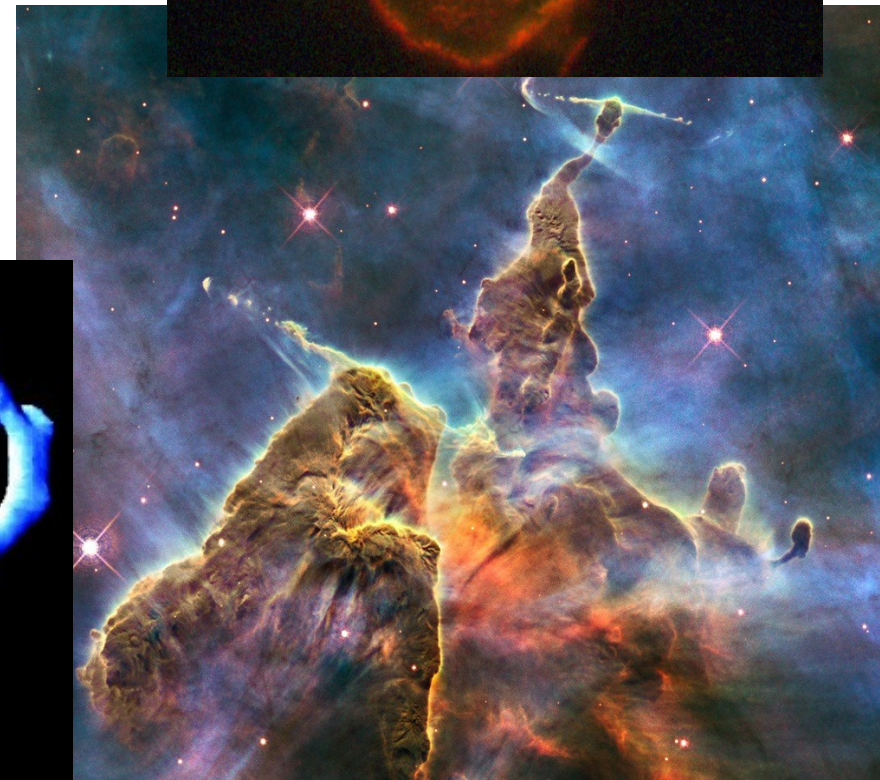
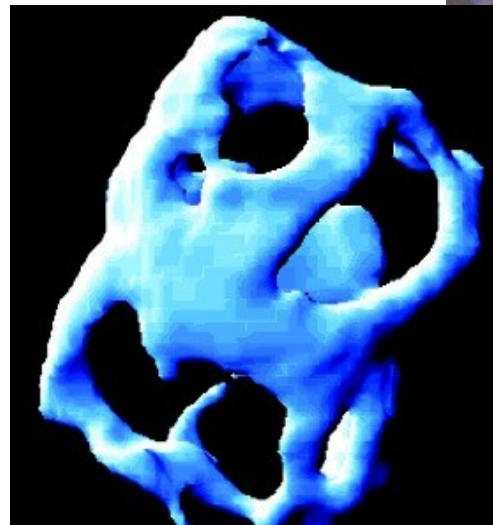
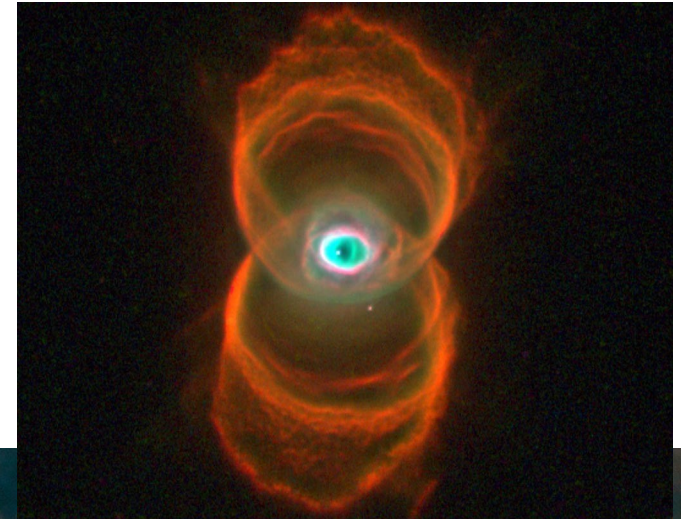
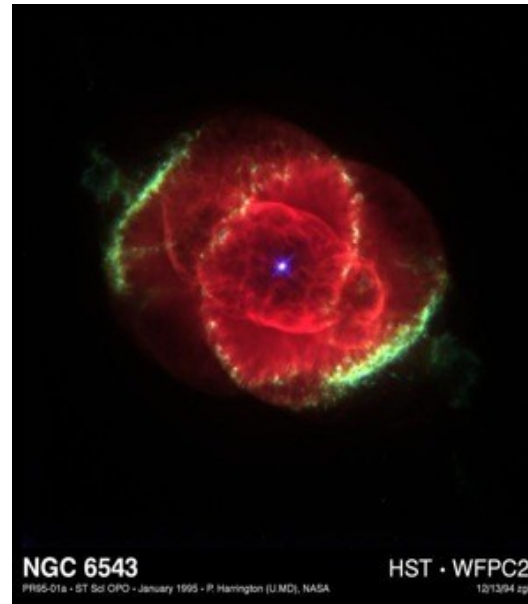
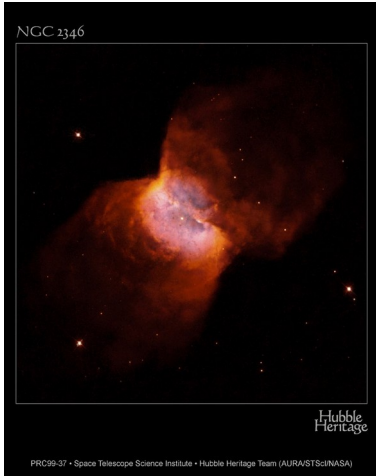
- Makes it easier to interact with Cloudy from any python script or notebook:
 - Write input file, run Cloudy, read output files from a single script
 - Easy to run grids of models (just a loop in python)
 - Make 3D models (actually pseudo-3D)
 - Allow to generate big grids of models (3MdB)
- PyNeb is another library that can be used to compute line emissivities, and determine electron temperature and densities from line ratios.

Why 3D ?

- As we all know, PN are spherical, and HII regions plan parallels :-)



Not O nor //



Aperture effects



- Color = dominating emission line.
- Position : different line ratios.

Velocity field

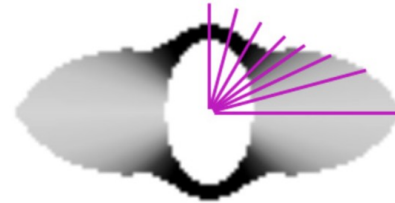
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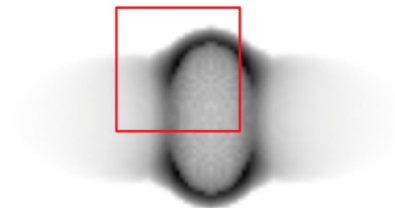
3D pyCloudy modelling of bipolar planetary nebulae: Evidence for fast fading of the lobes[★]

K. Gesicki¹, A. A. Zijlstra², and C. Morisset³

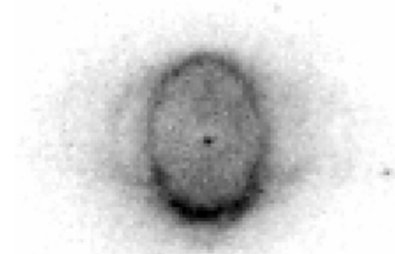
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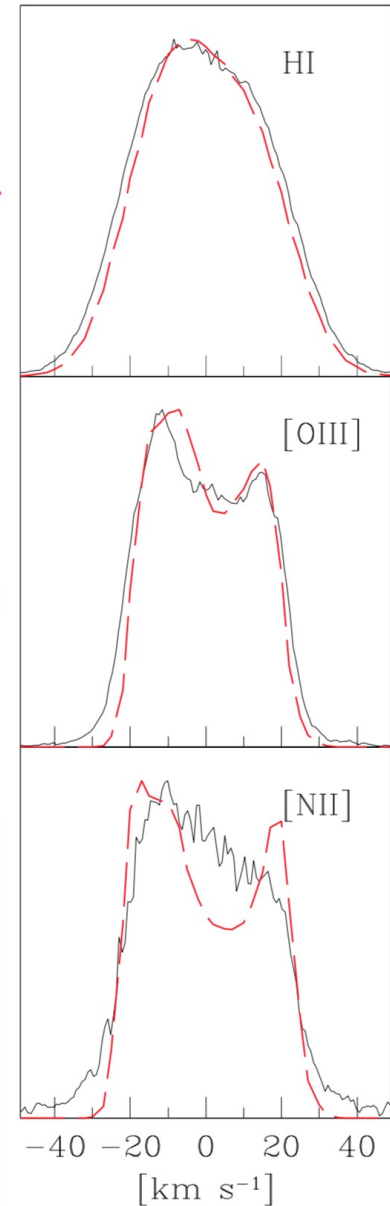
pyCloudy
density and 1D models



pyCloudy
H α image and applied slit



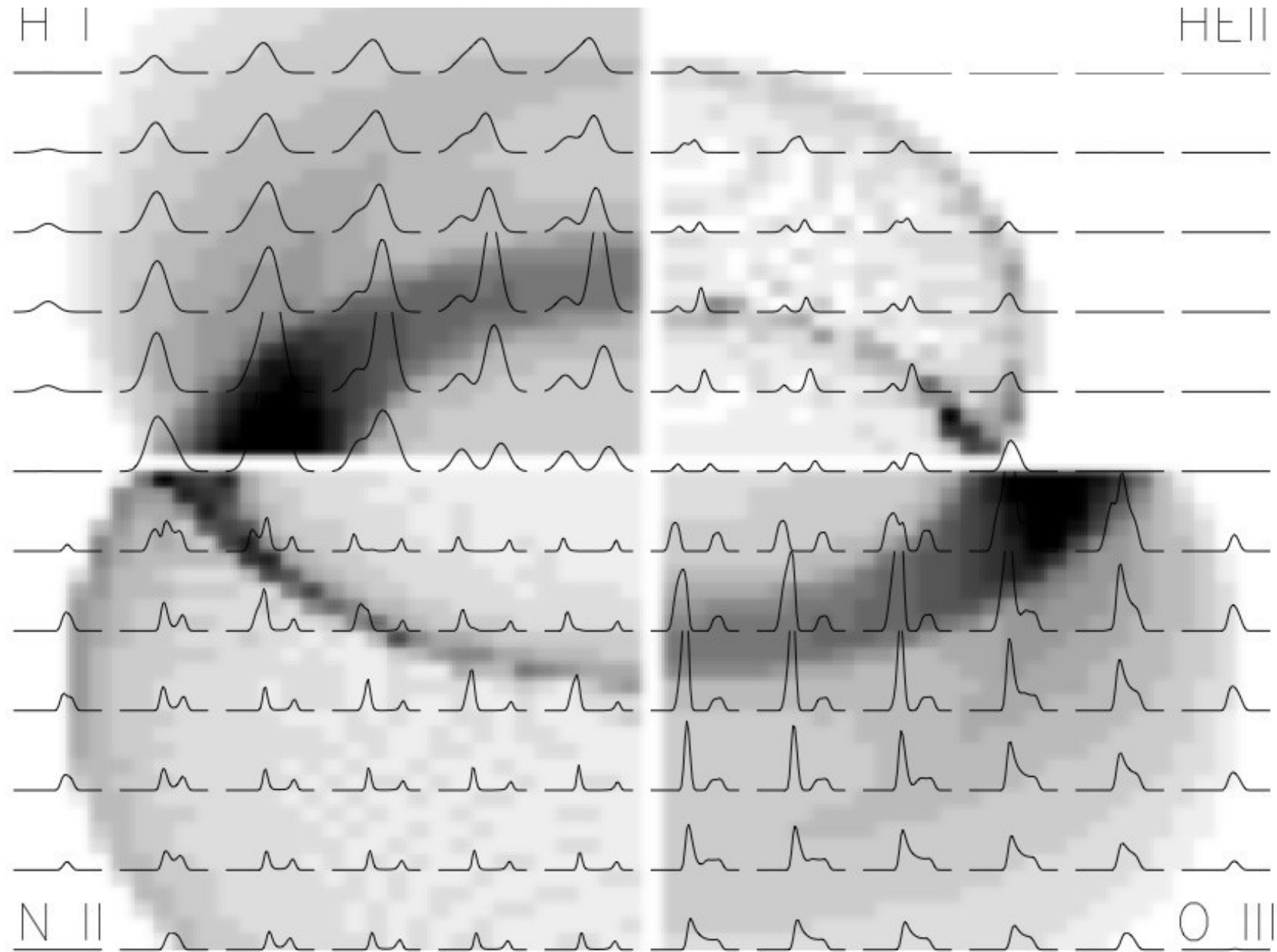
HST H α image



MODELLING OF ASYMMETRIC NEBULAE. II. LINE PROFILES

Revista Mexicana de Astronomía y Astrofísica, **42**, 153–166 (2006)

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Huge grids of models

- Sometimes one needs to compute huge grids of models (from a few 10^3 to 10^7 models...).
- In this case one cannot rely on reading all the output files, it would take toooooo much time and memory (RAM and ROM).
- The solution is to store the results of the models into a database.
- This is the main idea behind 3MdB (Mexican Million Models dataBase).

3MdB

- <https://sites.google.com/site/mexicanmillionmodels/>