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 //
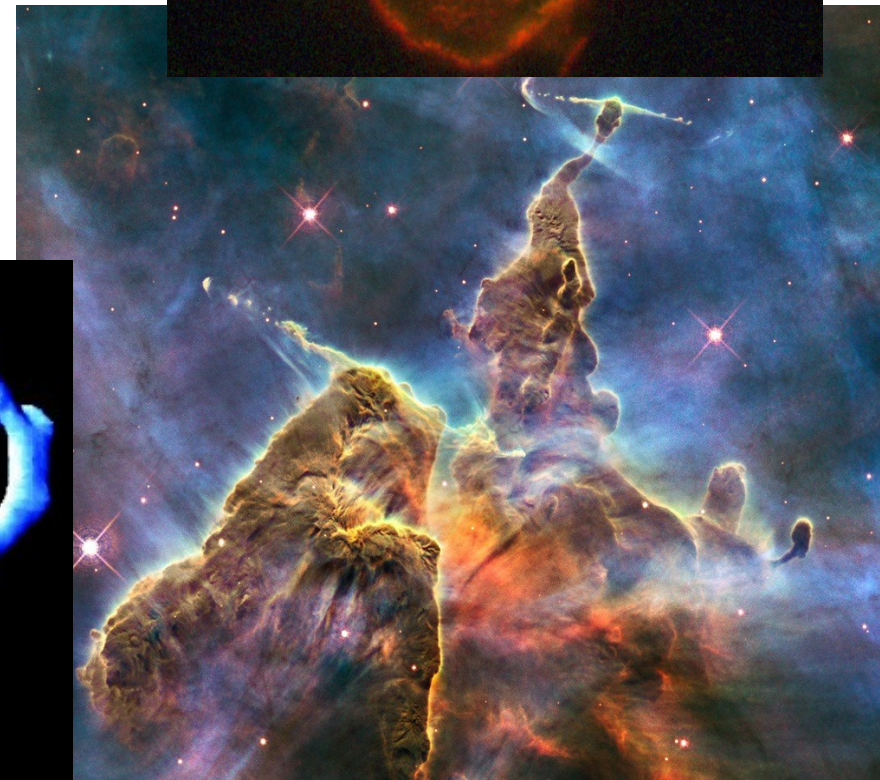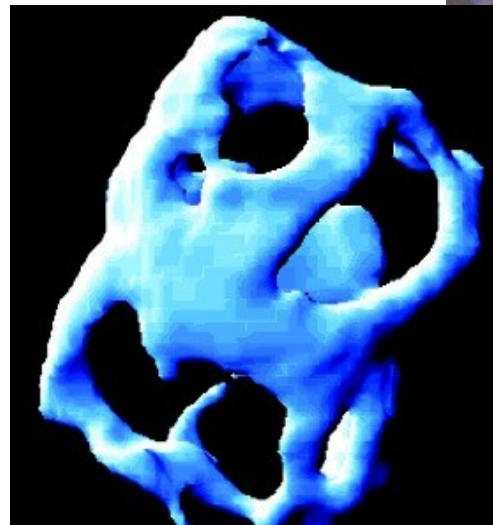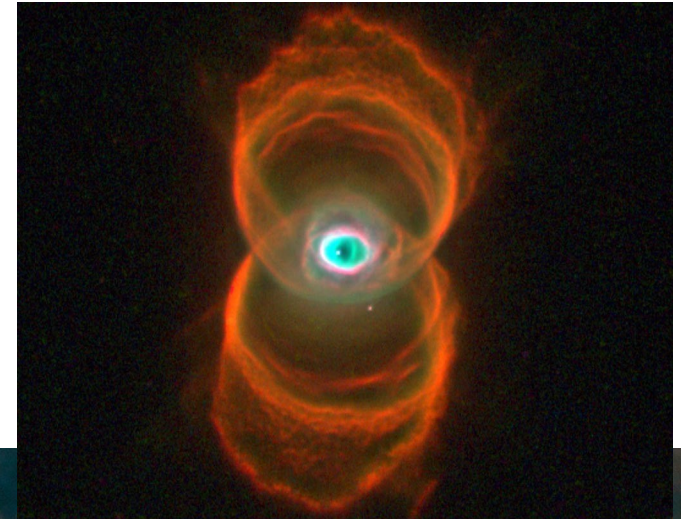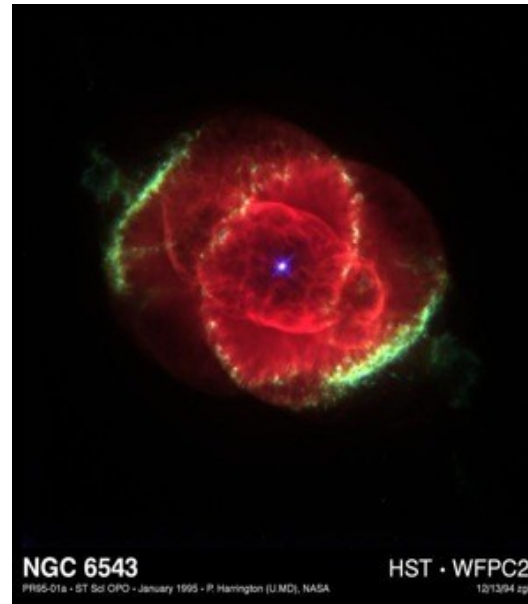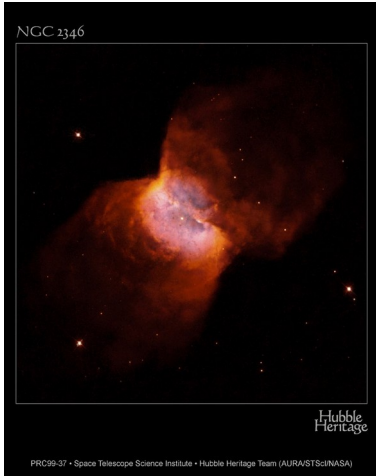
Aperture effects

- Color = dominating emission line.

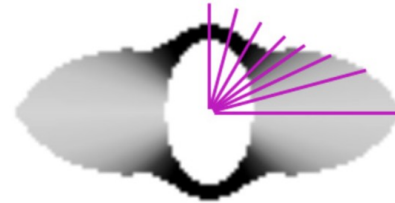- Position : different line ratios.

Velocity field

Astron
&
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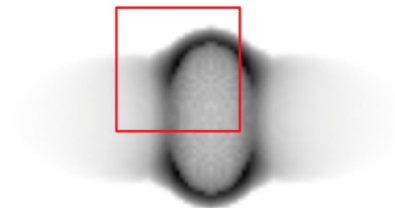### 3D pyCloudy modelling of bipolar planetary nebulae: Evidence for fast fading of the lobes[*]

K. Gesicki[1], A. A. Zijlstra[2], and C. Morisset[3]

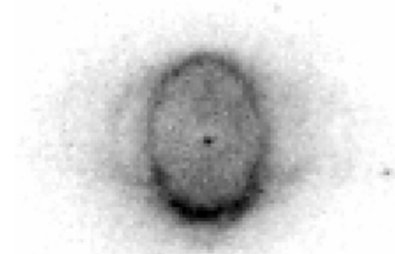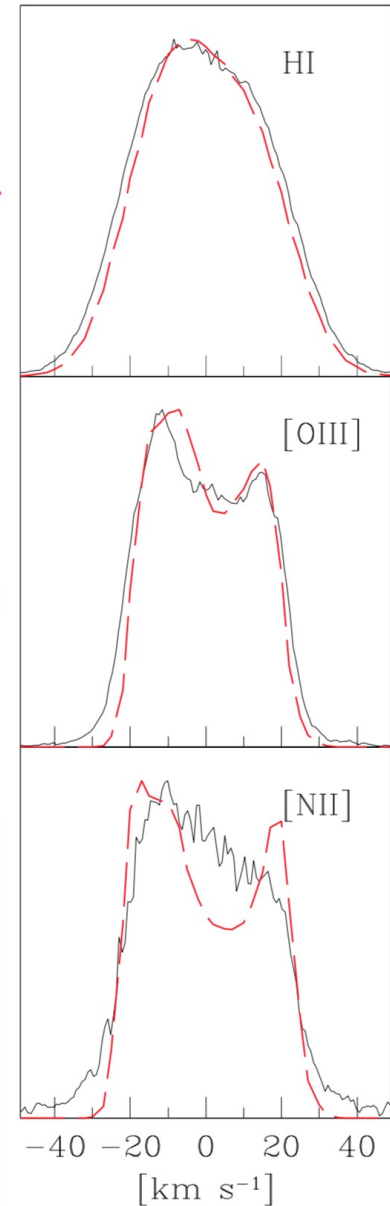pyCloudy
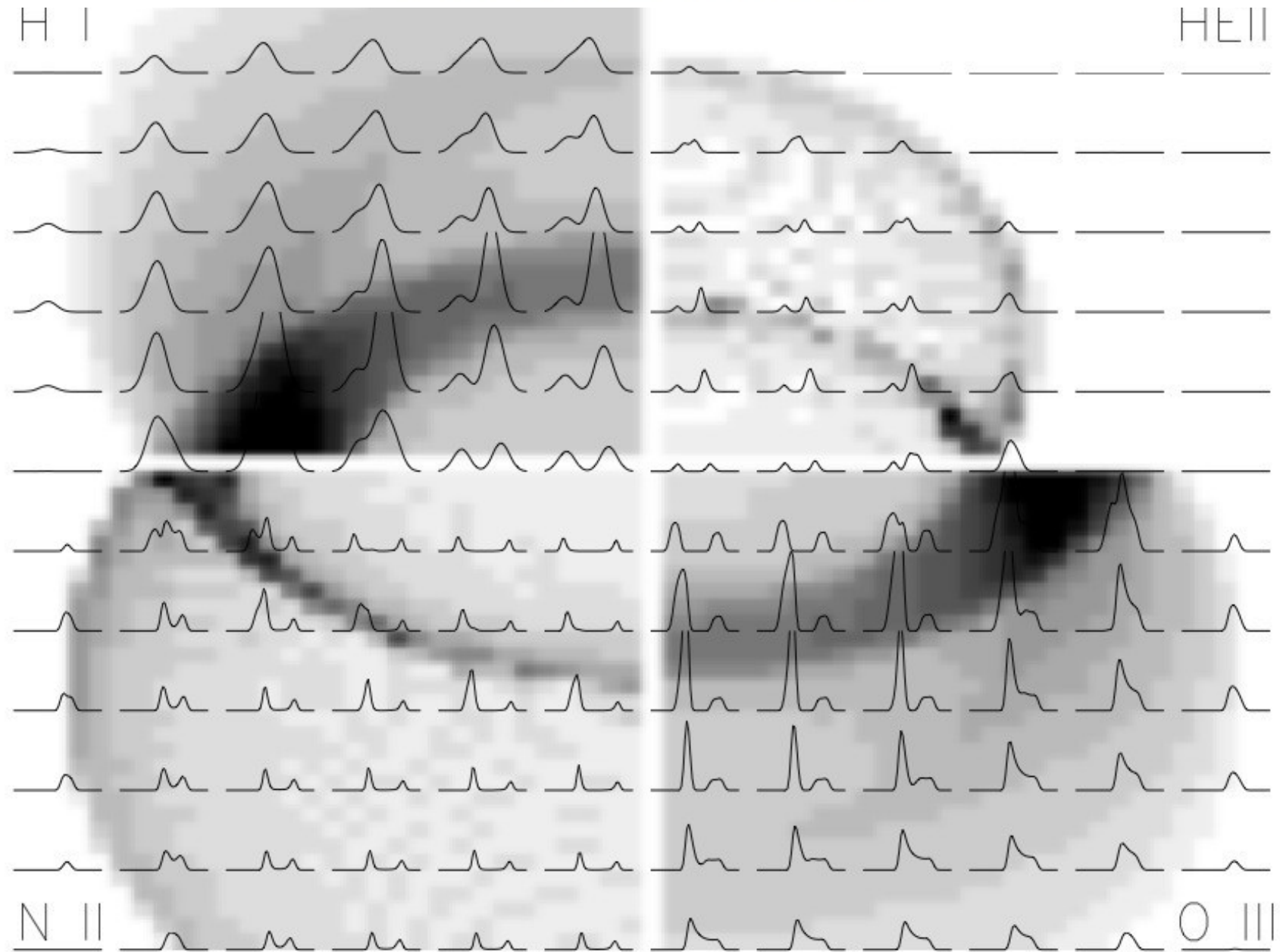density and 1D models

pyCloudy
Hα image and applied slit

HST Hα image

HI

[OIII]

[NII]

−40 −20 0 20 40

[km s^{-1}]

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MODELLING OF ASYMMETRIC NEBULAE. II. LINE PROFILES

C. Morisset[1] and G. Stasińska[2]

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 tooooo 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/