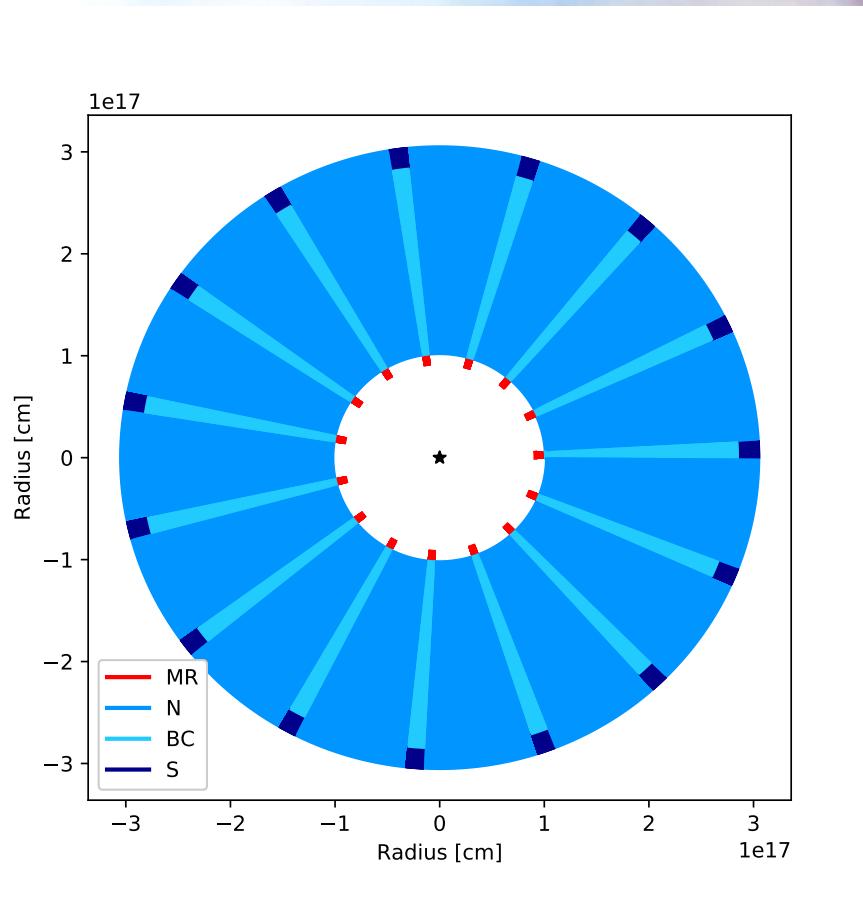


Topological equivalence



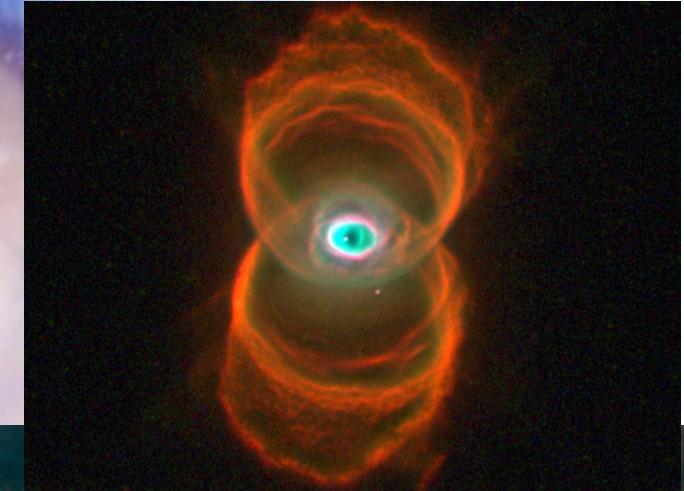
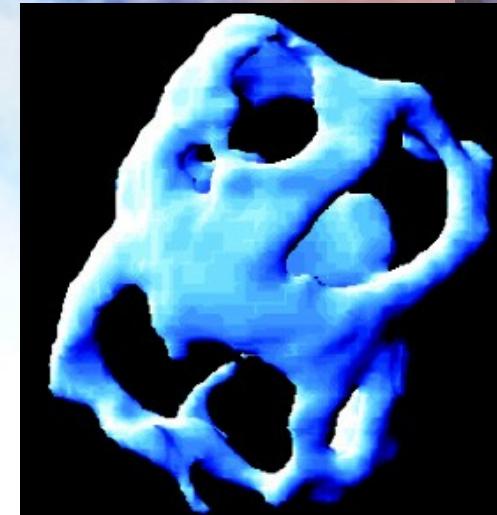
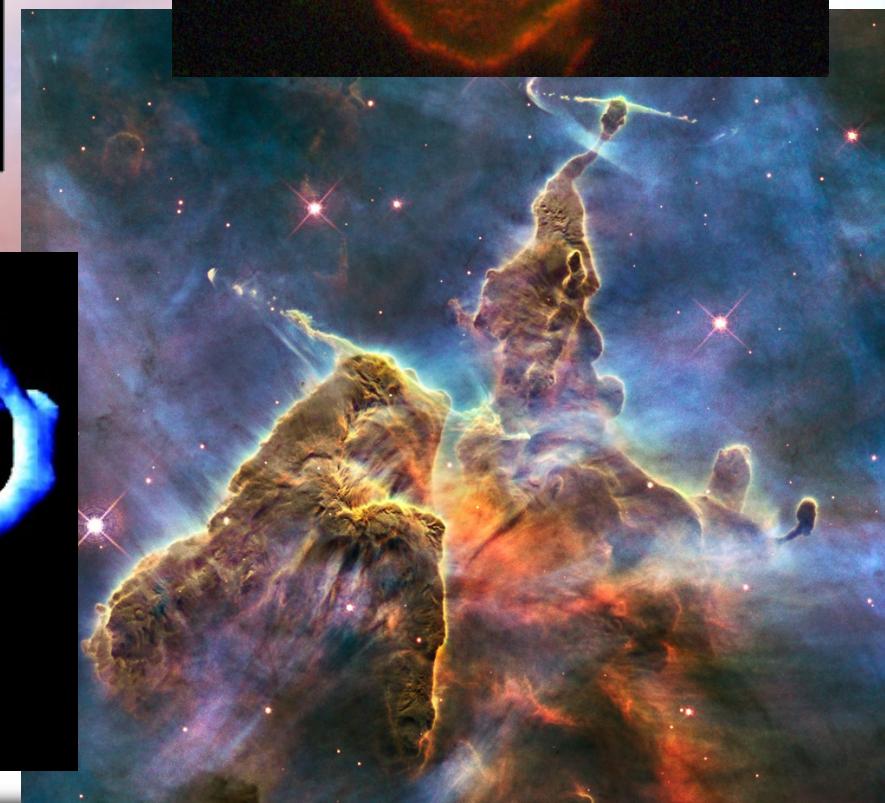
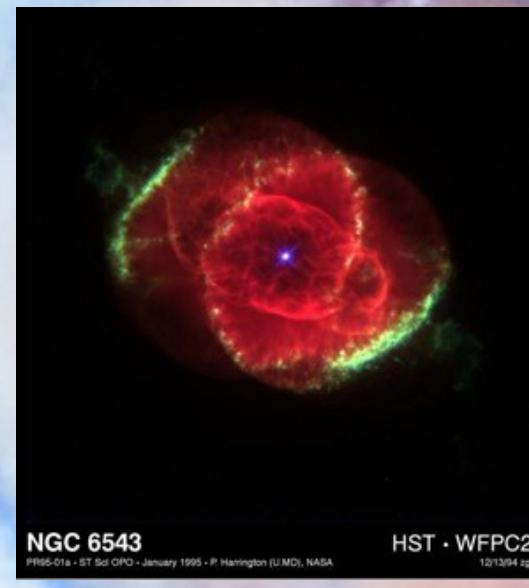
- Gómez-Llanos & Morisset, MNRAS, soon ;-)
- Object with 2 components of different metallicities: H-poor regions and « solar » regions.
- There is also a « shadow » when the ionization is not anymore from central source.
- This complex model is obtained by running only 3 Cloudy models and combining the line intensities.

Why 3D ?

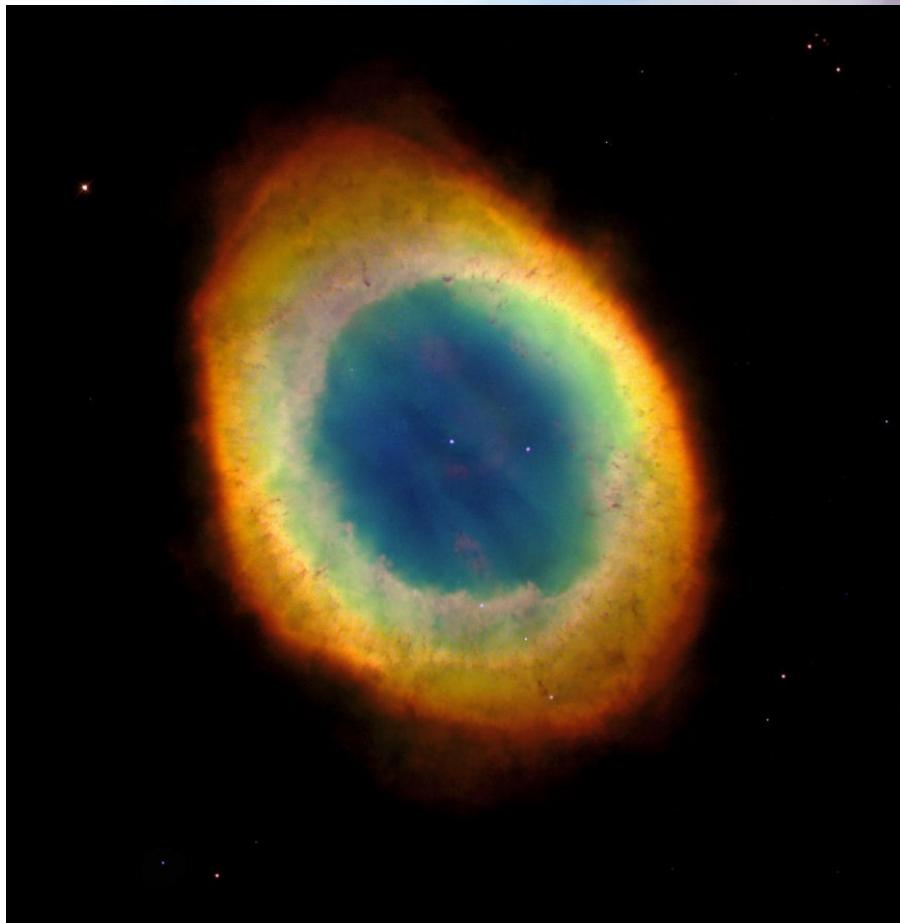
- As we all know, PN are spherical, and HII regions plan parallels :-)



Not O nor //



Aperture effects



- Color = dominating emission line.
- Position : different line ratios.
- Consequences on ICFs for example.

MOCASSIN and pyCloudy 3D

- MOCASSIN : A full 3D photoionization code, using Monte-Carlo.
- F90 MPI code, running on cluster.
- Few hours to days to run/converge a model (cluster allocation time policies).
- → need for a quick (but not so dirty) code to obtain « pseudo-3D » models
- Cloudy_3D : we're loosing the « full » 3D, but a few minutes to run:-)

PyCloudy 3D

Modelling of aspherical nebulae – I. A quick pseudo-3D photoionization code

Mon. Not. R. Astron. Soc. **360**, 499–508 (2005)

C. Morisset,¹★ G. Stasińska² and M. Peña¹

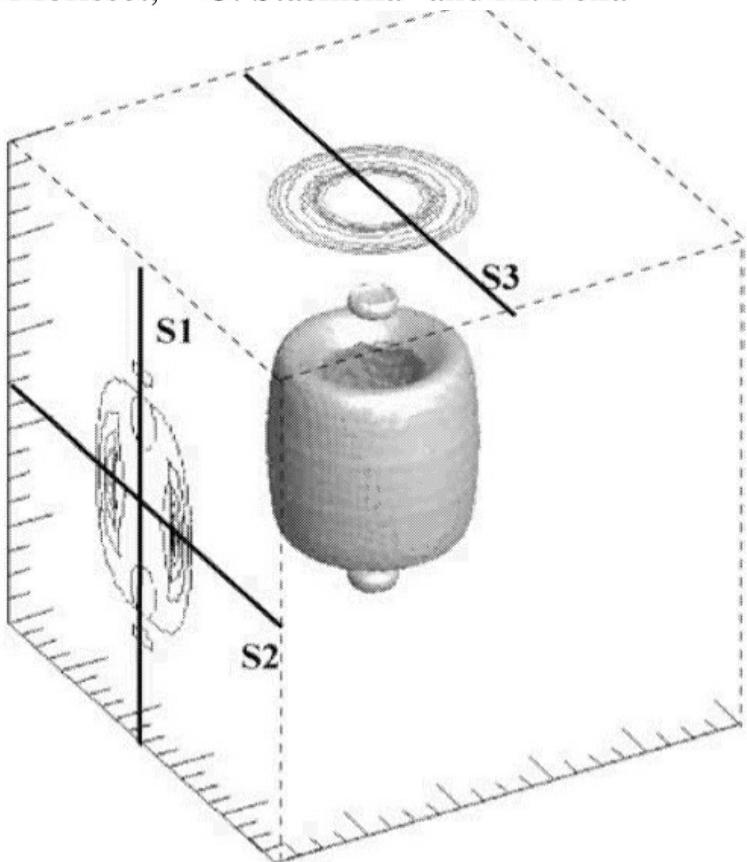
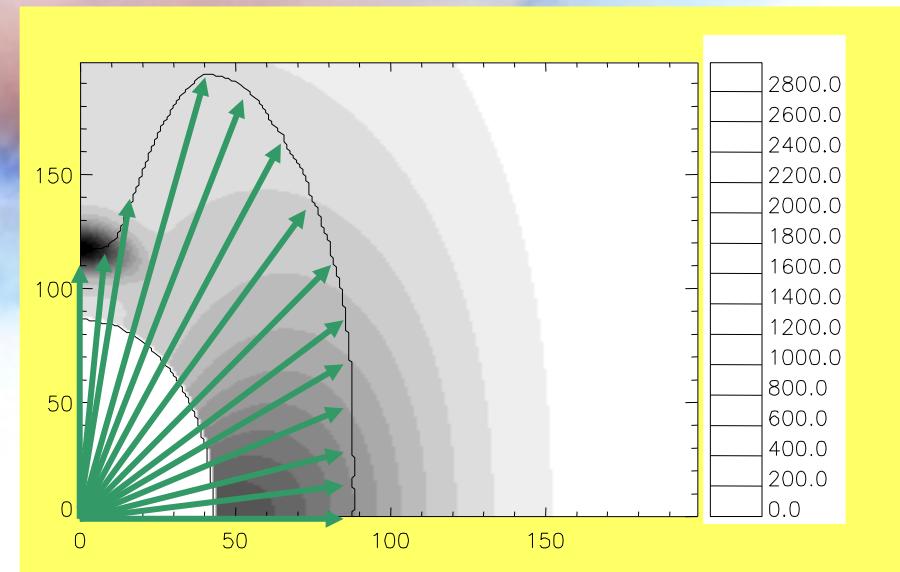


Figure 2. 3D representation of the nebula. An isodensity surface is drawn, showing the equatorial density enhancement and the two polar knots. On the faces we have represented the H β surface brightness contours for two orientations of the nebula: on the left side, for the nebula seen with the polar axis parallel to the sky; on the top, for the nebula seen pole-on. The slits used to determine parameters from emission-line ratios are indicated.

- Various runs of Cloudy (1D), corresponding to different angles.
- 3D reconstruction in a coordinate cube by interpolation between the 1D runs.



PyCloudy 3D: faster but limited ?

- pyCloudy 3D is not a « full » 3D code. It only considers radial radiation (as a combination of 1D runs).
- Limitation : when no-radial radiation dominates a process (e.g. Photoionization).
- 2 cases :
 - Shadows
 - Multiple stars

Otherwise : pseudo 3D is OK !

Most of the « complicated » morphologies are easily modeled with a simple 2- or 3-components **topologically equivalent** model.