CTA200H boot camp project for Paras Sharma

Antoine Marchal has created a lot of software associated with ROHSA. So have previous students. You will have access to and benefit from this. However, as a basic introduction to HI spectra, below are a number of exercises to introduce and provide a foundation. We will be able to consult and suggest a timetable.

1. Download the cube for the designated field (IVC G86 is good for this exercise) from the GHIGLS web site: www.cita.utoronto.ca/GHIGLS. Look at the previewer on that page.

2. Load the cube.

3. Extract one spectrum for a single pixel. Plot it. Make sure that it has both low and intermediate velocity gas (2 main peaks). Otherwise, find another that does! (here, something like a cube previewer might help (please consult)).

4. Compute the first three (velocity) moments. Express the first integral in units of HI column density.

5. Like 4, but first divide the spectrum into two sensible velocity ranges for which the moments make more sense.

6. Measure the noise from the “end channels."

7. Using a least-squares curve fitter (from a python library), simultaneously fit two Gaussians (+ a continuum level if you think it is needed), one for each velocity range. Plot the fitted curve and the residual spectrum (data - model). Compare the analytical results available from the fitted Gaussian to the numbers in 5.

8. Understand (derive) the relation between the dispersion of the Gaussian and the FWHM. Express the FWHM of the Gaussian in units of kinetic temperature rather than km/s. The gas is atomic hydrogen.

9. Extract a small section of the cube, say 20 by 20 pixels across the face. Compute and plot the average spectrum.

10. What is the noise in the average spectrum compared to the noise in a single spectrum?

11. Repeat 6 and 7 for the average spectrum.

12. Use ROHSA to decompose the spectra across this small region. Use 2 or more components as needed.

13. Visualize the ROHSA output using the standard plotting tools (e.g., in the sample ROHSA notebook).