The CHAOS Project uses the Multi-Object Double Spectrograph in the Large Binocular Telescope to observe star forming (HII) regions in several spiral galaxies. Measurements of temperature-sensitive upper transition emission lines, as seen in Figure 1, have been gathered from these star forming regions, which allow for temperatures – and “direct” abundances – to be measured. Spiral galaxies measured so far include M101, M51, and NGC628, and all of these galaxies show a radial metallicity and temperature gradient as can be seen in Figure 2.

Second Observation: Spiral Galaxies have metallicity gradients.

Higher in the center

Decreasing to larger radius.

Indication that the slope of the gradient may be universal (Sánchez et al. 2014).

A correlation has been found between \( T_{\text{[S III]}} \) and \( T_{\text{[O III]}} \), with significant dispersion and significant inconsistency with the photoionization models. There is general agreement between \( T_{\text{[N II]}} \), \( T_{\text{[S II]}} \), and \( T_{\text{[O II]}} \) with significant dispersion. A challenge in CHAOS has been trying to understand the significant dispersion between these lines, and what the cause is. Figure 4 shows the dispersion \( O/H \) dispersion plots for M33, and Figure 5 shows the \( O/H \) dispersion plots for M101. M101 has a much tighter dispersion plot than M33, as seen in Figure 3.

When we only have one temperature sensitive line within a star forming region, we use a photoionization relationship to predict the temperature in the other (high or low) ionization zones in that specific region. However, we were finding significant dispersions in our \( O/H \) abundance gradients, with a possible explanation being that the photoionization relationship wasn’t predicting the correct temperatures. We tested this prediction by using the high ionization line \( T_{\text{[O III]}} \) at 4363Å and cutting low ionization regions. This resulted in a drop in the dispersion down to a value consistent with observational uncertainties. Figure 5 shows the dispersion drop as the regions are cut in M33 (blue) and M101 (red).

References

2. Berg et al. 2015
3. Rosolowsky & Simon et al. 2008

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