HII regions are formed from gaseous clumps ionized by young, hot OB stars. Characterized by strong recombination or collisional emission lines, Tracers of different feedback mechanisms.

**SITELLE/CFHT Observations of the Filamentary Nebula of NGC 1275 with High-Resolution Observations (Vigneron; in prep)**

**Beyond the BPT Diagram: A Machine Learning Approach to Galactic Emission-Line Region Classification (Rhea; submitted)**

**Emission-Line Region Classification (Rhea; submitted)**

**“Revealing the Nature and Kinematics of the Filamentary Nebula of NGC 1275 with High-Resolution Observations (Vigneron; in prep)”**

**A Machine Learning Approach to Integral Field Unit Spectroscopy Observations: III. HII Region LineRatios**

In this third installment, we develop a framework using a convolutional neural network trained on synthetic spectra to determine the number of line-of-sight components present in the SN3 filter (656–683nm) spectral range of SITELLE. We compare this methodology to standard practice using Bayesian Inference. Our results demonstrate that a neural network approach returns more accurate results and uses less computational resources over a range of spectral resolutions.

Furthermore, we apply the network to SITELLE observations of the merging galaxy system NGC2207/IC2163. We find that the closest interacting sector and the central regions of the galaxies are best characterized by two line-of-sight components while the outskirts and spiral arms are well-constrained by a single component. Determining the number of resolvable components is crucial in disentangling different galactic components in merging systems and properly extracting their respective kinematics.

**A Machine Learning Approach to Integral Field Unit Spectroscopy Observations: II. HII Region LineRatios**

In this paper we develop an artificial neural network to estimate the line ratios of strong emission-line present in the SN1; SN2, and SN3 filters of SITELLE. Residual analysis of the network on the test set reveals the network’s ability to apply tight constraints to the line ratios. We validated this network’s efficiency by constructing an activation map, checking the [N II] doublet fixed ratio, and applying a standard k-fold cross-correlation. Additionally, we apply the network to SITELLE observation of M33; the residuals between the algorithm’s estimates and values calculated using standard fitting methods show general agreement. Moreover, the neural network reduces the computational costs by two orders of magnitude. The neural network can also excel at predictions in the low signal-to-noise regime.

**A Machine Learning Approach to Integral Field Unit Spectroscopy Observations: I. HII Region Kinematics**

We present a method that uses Convolution Neural Networks (CNN) for estimating emission line parameters in optical spectra obtained with SITELLE as part of the SIGNALS large program. Our algorithm is trained and tested on synthetic data representing typical emission spectra. Once trained, the algorithm was tested on real SITELLE observations in the SIGNALS program of one of the South West fields of M33. The CNN recovers the ionization parameters with an accuracy better than 5 km s\(^{-1}\) in regions with a signal-to-noise ratio greater than 15 over the H\(\alpha\) line. More importantly, our CNN method reduces calculation time by over an order of magnitude on the spectral cube with native spatial resolution when compared with standard fitting procedures.

**A Machine Learning Approach to Integral Field Unit Spectroscopy Observations: Preliminary**

This study lays the groundwork for future work on using Convolutional Neural Networks to estimate line ratios in SITELLE spectra. Once trained, the algorithm will be applied to real SITELLE observations in the SIGNALS program. Our algorithm is trained and tested on synthetic data representing typical emission spectra. Our results demonstrate that a neural network approach returns more accurate results and uses less computational resources over a range of spectral resolutions. Furthermore, we apply the network to SITELLE observations of the merging galaxy system NGC2207/IC2163. We find that the closest interacting sector and the central regions of the galaxies are best characterized by two line-of-sight components while the outskirts and spiral arms are well-constrained by a single component. Determining the number of resolvable components is crucial in disentangling different galactic components in merging systems and properly extracting their respective kinematics.

**Machine Learning Approach to Integral Field Unit Spectroscopy Observations: SITELLE Filter SN3 (657–685 nm), SN2 (48–520 nm), & SN1 (367–385 nm)**

SITELLE Filter SN3 (657–685 nm), SN2 (48–520 nm), & SN1 (367–385 nm) spectral range of SITELLE. We compare this methodology to standard practice using Bayesian Inference. Our results demonstrate that a neural network approach returns more accurate results and uses less computational resources over a range of spectral resolutions. Furthermore, we apply the network to SITELLE observations of the merging galaxy system NGC2207/IC2163. We find that the closest interacting sector and the central regions of the galaxies are best characterized by two line-of-sight components while the outskirts and spiral arms are well-constrained by a single component. Determining the number of resolvable components is crucial in disentangling different galactic components in merging systems and properly extracting their respective kinematics.