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**Introduction**

For decades, the physical parameters necessary for high (1.5E4 K) electron temperature (Te) galactic narrow line region gas clouds has remained unexplained[citations, showing the decades]. To model these clouds in the narrow line region, we typically assume some photoionization source, such as the accretion disk around a central supermassive black hole in active galactic nuclei (AGN), or stellar radiation in star forming galaxies. This photoionization will go through the gas cloud, and we measure spectra from this cloud. We can assume reasonable ranges for parameters of the cloud such as ionization parameter, metallicity, hydrogen density, grain content etc. from previous literature. We can input these conditions into a computer program called CLOUDY that will output emission lines for a galaxy with the given input characteristics. [whats the typical way of modeling narrow line regions, assume some ionizing continuum, accretion disk etc and then it does through the cloud, assume u, hden, z, etc., then introduce cloudy and mappings code][show realistic ranges in parameters, those predict common temps, show evidence][setup history of it, go in order from shudder and osterbrock 1981 dig through 4363 and high te, dopita w shocks, K&S 1997, groves 2004, r14, zLH]. [typical electron temps, osterbrock ferland,] Our research focuses on this temperature problem in narrow line region (NLR) emitting Active Galactic Nuclei (AGN) [move farther down]. As Zhang, Liang and Hammer (2013) mention, there has been no clear explanation of the temperature problem, and most attempts to explain it have relied on unrealistic combinations of parameters. Komossa & Schulz (1997) attempted to solve this problem by increasing density, but their density values caused inconsistencies in other measurements, specifically OI values. Richardson et al. (2014) investigated the possibility that the temperature problem is actually a density problem causing false readings in the temperature sensitive line ratios, but determined that this was not actually the case.

Our research uses data from the Sloan Digital Sky Survey as well as constraints on galaxy types established in Kewley et al. to separate our data set by galaxy type. Interestingly, our data set contains no LINERs. Shock-wave heating is a possible heating mechanism, but LINERs are shocked AGN, so because we have no LINERs, we do not explore shocks.

We plot our SDSS data set on a collection of diagnostic diagrams in order to categorize them by characteristic conditions and type. The most popular and useful of these is the BPT Diagram, presented by Baldwin, Phillips and Terlevich in 1981. The BPT Diagram is a log[OIII] λ5007/Hβ vs. log[NII] λ6584/Hα plot that conveniently separates AGN from Star Forming (SF) galaxies, composites, and ambiguous objects, all of which are contained in our data set. log[OIII] λ5007/Hβ is a hydrogen density and ionization sensitive line ratio, and log[NII] λ6584/Hα is primarily sensitive to ionization. We used this log[NII] λ6584/Hα ratio again when we separate our galaxies by temperature, in a log[OIII] λ5007/4363 vs. log[NII] λ6584/Hα plot. This neatly categorizes our galaxies by their temperature, as 5007/4363 is a temperature sensitive emission line ratio. The high temperature outliers in our data set are apparent in this temperature plot, and we use it to compare with our simulations and check the temperature of our simulations. By comparing different iterations of simulations with these plots of our data set we are able to see the effects of changing different parameters, which helps us decide how to adjust our simulations. These plots also ensure that we are using realistic values of our parameters, and likely observed conditions, by showing us whether our simulations match our data.

ZLH find the high Te Seyfert 2 show low metallicity Fig 7

LINERs and composites show Te “far too high to be explained by only stellar photoionization”

Some strong [O III] λ4363 emission Seyfert 2 galaxies with Te > 15 000 K can be fitted with dusty AGN model grids at low metallicity (i.e. Z/Z ∼ 1).

**References**

BPT

Kewley

Cloudy

SDSS

Richardson 2014

Komossa & Schulz

Zhang, Liang Hammer