Abstract:

Seyfert 2 galaxies do not have observable broad line emission (BEL) from their broad line regions (BLR). However, spectropolarimetric observations of Seyfert 2 galaxies reveal BLR features in the polarized light. I propose a spectropolarimetric reverberation mapping campaign of selected Seyfert 2 galaxies, in order to determine time lags, and better understand the BLR geometry and kinematics of this type of galaxy.

Background and Motivation:

Active Galactic Nuclei (AGN) are a particular area of interest in extragalactic astronomy. These supermassive black holes at the center of galaxies are believed to be essential to the formation and evolution of the galaxy. Despite the importance of these objects to understanding galactic evolution, there are still many unanswered questions about them.

Reverberation mapping has proven essential to helping us begin to answer some of these questions. Reverberation mapping is looking at the time lag between broad emission lines (BEL) and the ionizing continuum, in order to determine the size of the broad line region (BLR): the area of the dusty torus where we see broad emission lines. (**check this**). The time lag allows us to calculate the black hole mass using (**insert equation**), and velocity resolved time lags obtained from high fidelity reverberation mapping allow us to determine characteristics of the BLR geometry and kinematics. My experience with reverberation mapping and the Monitoring AGN with Hbeta Asymmetry (MAHA) project during the 2019 University of Wyoming REU gives me particular insight into this method of measuring and characterizing AGN (Du et al. 2018).

The downside of reverberation mapping however, is that it is only a useful method for AGN that have observable BELs. Seyfert 2 galaxies, for example, do not exhibit BEL from their BLR, making it so that we cannot use reverberation mapping to examine these galaxies. However, spectropolarimetric observations of Seyfert 2 galaxies, can reveal "hidden" Seyfert 1-like broad lines, (Du et al. 2017) allowing us to do the same reverberation mapping determination of AGN features that we can do with reverberation mapping of Seyfert 1 galaxies. This allows us to begin to understand and characterize the geometry and kinematics of Seyfert 2 broad line regions (**why do we expect them to also have BLR?**)—an important and necessary step forward in understanding and characterizing AGNs (**support—why is this important and necessary?**) I propose a reverberation mapping campaign using spectropolarimetric observations of Seyfert 2 galaxies, in order to determine time lags and better understand their BLR geometry and kinematics.

*note that it is possible to obtain bh mass from other methods with Seyfert2 eg. the Du 2017 paper. But we want the possibility of velocity resolved time lags in order to study the geometry and kinematics of BLR even further.

Methods:

We will begin by determining a target list of Seyfert 2 galaxies that are good candidates for spectropolarimetric observations (**what makes a good candidate?**). We will favor objects with short time lags, as that reduces the amount of data necessary to produce a high fidelity data set. We also want bright targets in order to achieve a sufficiently high S/N with observation times

of less than ~1 hour. This is especially important as sufficiently high S/N is difficult to achieve in spectropolarimetry, and the brighter the target, the easier it is to obtain a high S/N.
We will need consistent access to a telescope that has a spectropolarimeter in order to conduct this campaign. *INSERT STUFF ABOUT WHERE I COULD GET THIS ACCESS

I propose an initial year-long spectropolarimetric reverberation mapping campaign. We will obtain spectropolarimetric data consistently over this time frame. We will reduce and analyze our data in the accepted ways, (**do I need to talk about the reduction process? I probably need to talk about the analysis process**).

Anticipated Results

From this reverberation mapping campaign we will obtain the first time lag measurements for our target list of Seyfert 2 galaxies. From this we can calculate the black hole mass and compare against other methods. Assuming a high fidelity data set, we will also be able to obtain velocity resolved time lags, allowing us to further characterize our target list's BLR geometries and kinematics. We will be able to compare our results to those obtained for Seyfert 1 galaxies, in order to further understand the differences between these types of galaxies.

Proposed Timeline: (**how long can my timeline be? Can I assume a 2-3 year campaign? Also, I probably need a plan for when I am going to publish**)

Year 1: Determine target list and begin observation campaign.
Year 2: Continue observation campaign and data reduction and analysis
Year 3: Continue data reduction and analysis and produce velocity resolved time lags.
Determine geometry and kinematic characteristics of the BLR of our target list.
Compare to reverberation mapped Seyfert 1 galaxies.

References:

Du, P., Wang, J., Zhang, Z. 2017. APJ Letters.
Du, P., Brotherton, M.S., Wang, K., et al. 2018. APJ.
(**I can probably insert more references. Is that necessary? Most likely**).