

Identifying active galactic nuclei for the SPHEREx space mission.

The proposal aims to catalogue potential active galactic nuclei candidates in the north celestial cap in preparation for NASA's SPHEREx space telescope mission using archival sky survey data.

Active galactic nuclei (AGN) play a significant role in understanding extragalactic astronomy and the universe's evolution. Although we cannot directly observe the supermassive black hole at the centre, from our understanding of the Unified Model of AGN, we could determine the mass of the black hole by studying the constituent parts using reverberation mapping ([Bradley Peterson 2004](#)). However, due to the distance of these AGN, it is challenging to observe them using ground-based observatories due to the air mass and long observing time ([Keith Horne 2004](#)). In 2025, NASA's SPHEREx mission, a sky survey satellite, will enable us to study the various structures of the AGN in detail due to the wide range of wavelength coverage of its instrument as well as having multiple passes during its mission lifetime ([Olivier Dore 2016](#)). As such, this will overcome the limitation presented above.

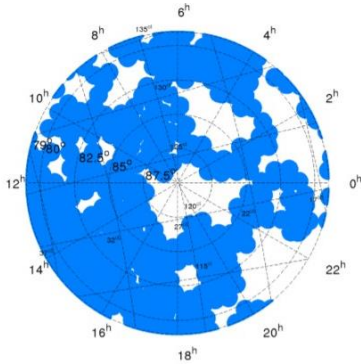


Fig 1: NCC Survey from merged GALEX and WISE data. Data $\sim 5^\circ$ around the pole is still lacking. ([Evgeny Gorbikov et al. 2014](#))

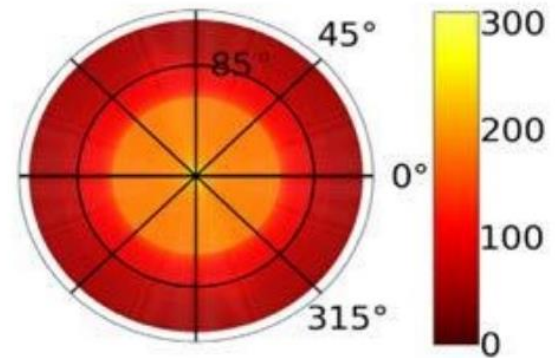


Fig 2: Expected number of times SPHEREx field of view passes through the celestial cap. ([Dore et al. 2018](#))

In spite of this, we are currently lacking a catalogue of AGN in the north celestial cap (NCC) region, as seen in Figure 1. Although SPHEREx can only survey the sky four times during its two-year mission period, its low earth orbit allows it to monitor the celestial cap frequently as shown in Figure 2. Therefore, it is crucial that we catalogue potential AGN well prior to the launch to utilise the mission fully. Unfortunately, verifying AGN requires complex techniques such as spectroscopy or comparing radio signals from optical counterparts, which are not feasible for every object; as such, it would be more practical to conduct these techniques on likely candidates, judging from their astrometric and photometric properties. Using publicly available archival sky survey data from past observation missions. We can construct a catalogue of potential AGN by cross-referencing specific features from different mission's datasets. By data mining, we can use these features to filter out the most likely candidates with characteristics similar to observed AGNs. Furthermore, we hope to perform statistical analysis on the data in hope of further refining the catalogue accuracy.

The success of this project will allow astrophysicists to refine the catalogue further and lay a strong foundation for the SPHEREx mission. The project proposed will make use of the publicly available archival datasets in order to accomplish the following primary objectives:

1. Create a catalogue of potential AGN candidates ~ 5 degrees around the NCC region by cross-referencing their data with different datasets.
2. Verify the catalogue with any known AGN in the region as a metric for the catalogue's accuracy.

In order to achieve the science goals, I will:

1. develop an algorithm using PYTHON to overcome the querying size limitations in the archival dataset;
2. cross-reference and remove data points that do not exhibit characteristics of AGN using the combined data set;
3. refine and reduce the catalogue using statistical methods to increase the likelihood of these candidates being AGN.

This project will be conducted by Supakorn (Nikko) Juengsophonvitavas and supervised by Juan Hernández Santisteban over a minimum period of six weeks during the summer break.