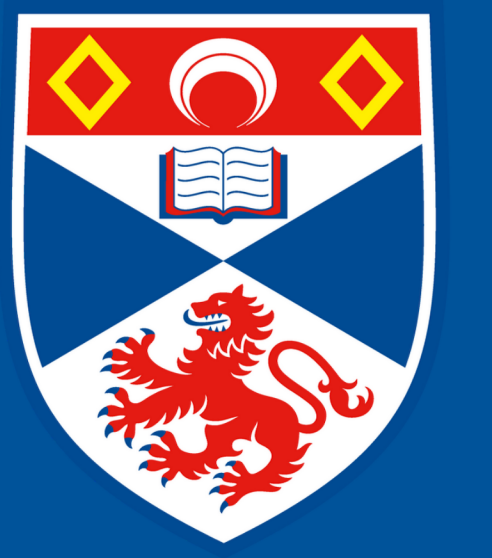


Identifying active galactic nuclei for the SPHEREx space observatory



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SPHEREx Space Observatory

In 2025, NASA will launch the SPHEREx satellite ref [1], a Spectro-Photometer sky survey satellite. SPHEREx will observe most frequent in the region of the celestial poles, thus making it suited for studying active galactic nuclei (AGN) in North Celestial Cap (NCC) using Reverberation Mapping ref [2].

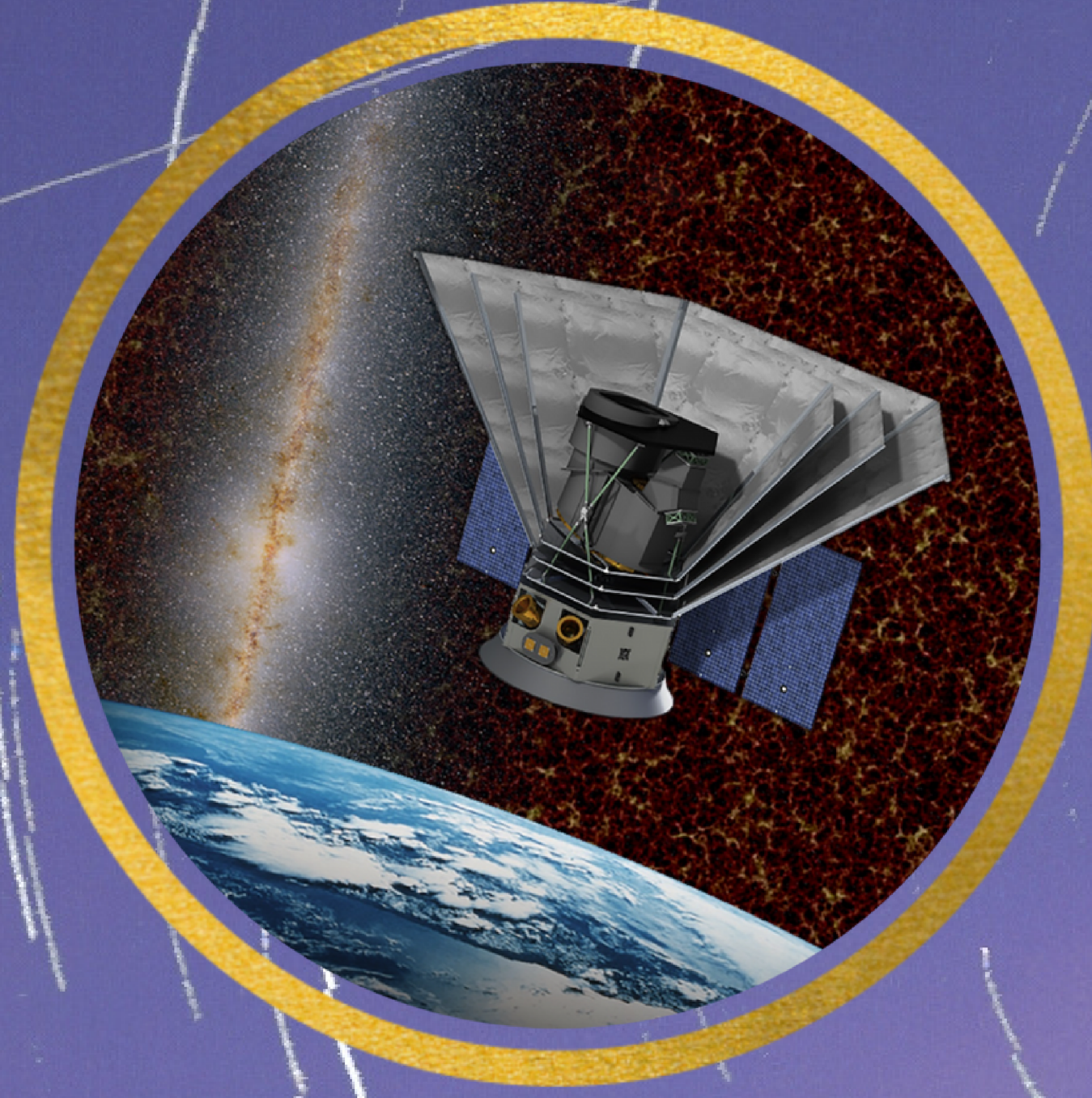


Figure 1 (Above): Illustration of the SPHEREx satellite
Courtesy of NASA/JPL-Caltech

Where are we looking?

The NCC is a region of sky 10° radii from the north celestial pole. Figure 2 shows where the NCC is in the northern hemisphere.

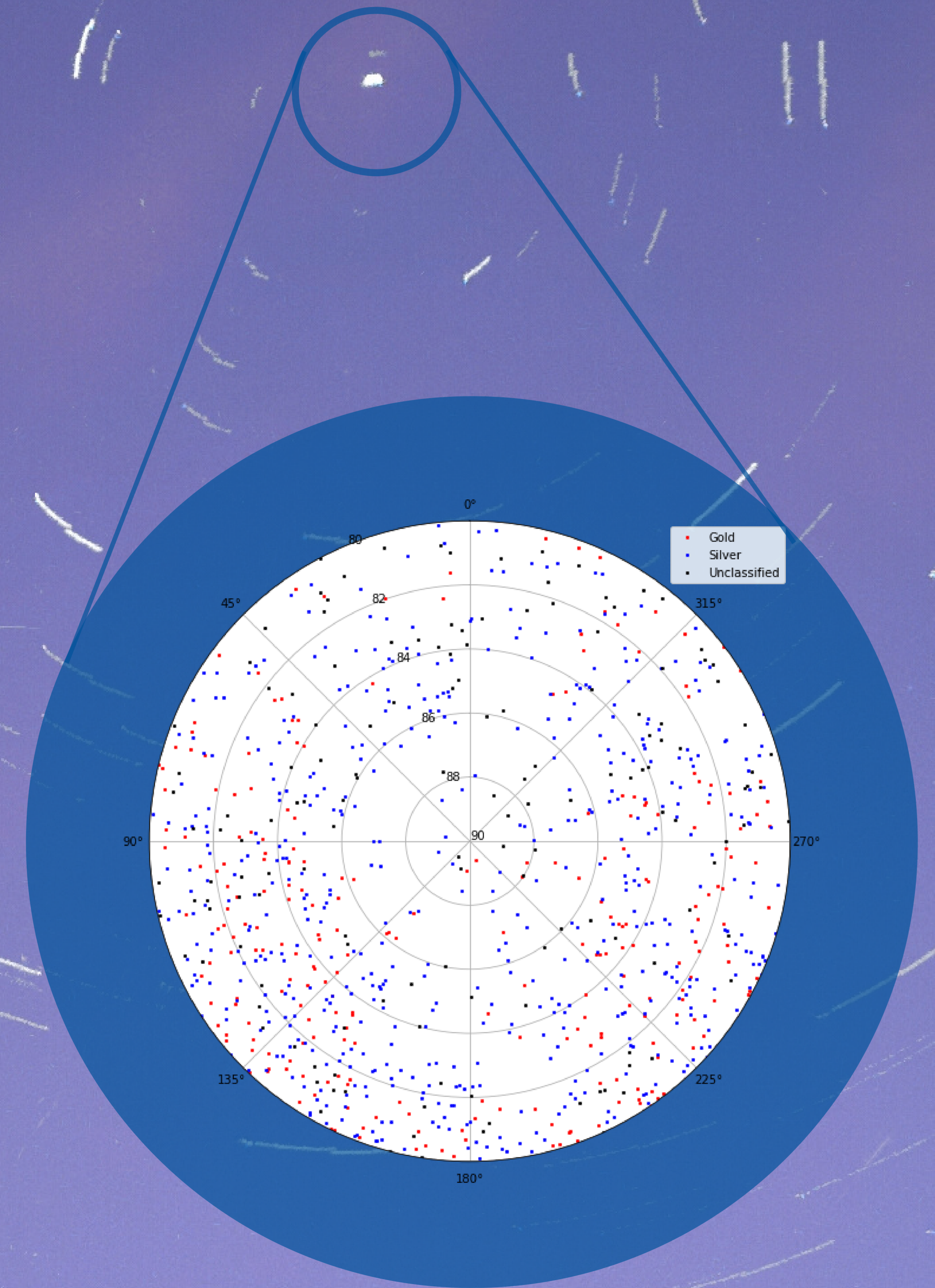


Figure 2 (Above): All candidates plotted on the NCC with different classification

Why the North Celestial Cap?

The NCC is a poorly covered region by many modern surveys. This study identifies AGN candidates for further verification by the Las Cumbres Observatory (LCO) using spectroscopy.

North Celestial Cap Catalogue

The North Celestial Cap Catalogue (NCC-CAT) consists of 914 AGN candidates brighter than 19 magnitude in Pan-STARRS1 G Mean Aperture magnitude. This ensures that all candidates are observable by SPHEREx and LCO, the latter being a ground-based observatory.

All sources exhibit astrometric and photometric properties indicative of AGNs, and each source has been cross-matched with at least one external AGN/QSO catalogue.

A Boolean credit scoring and scorecard system are used to help view and rank each candidate into different tiers, as seen in Figure 2. Each scorecard shows the candidate's basic information, images from DSS, Gaia DR3 lightcurves, and Gaia BP/RP spectrum where available

Astrometry

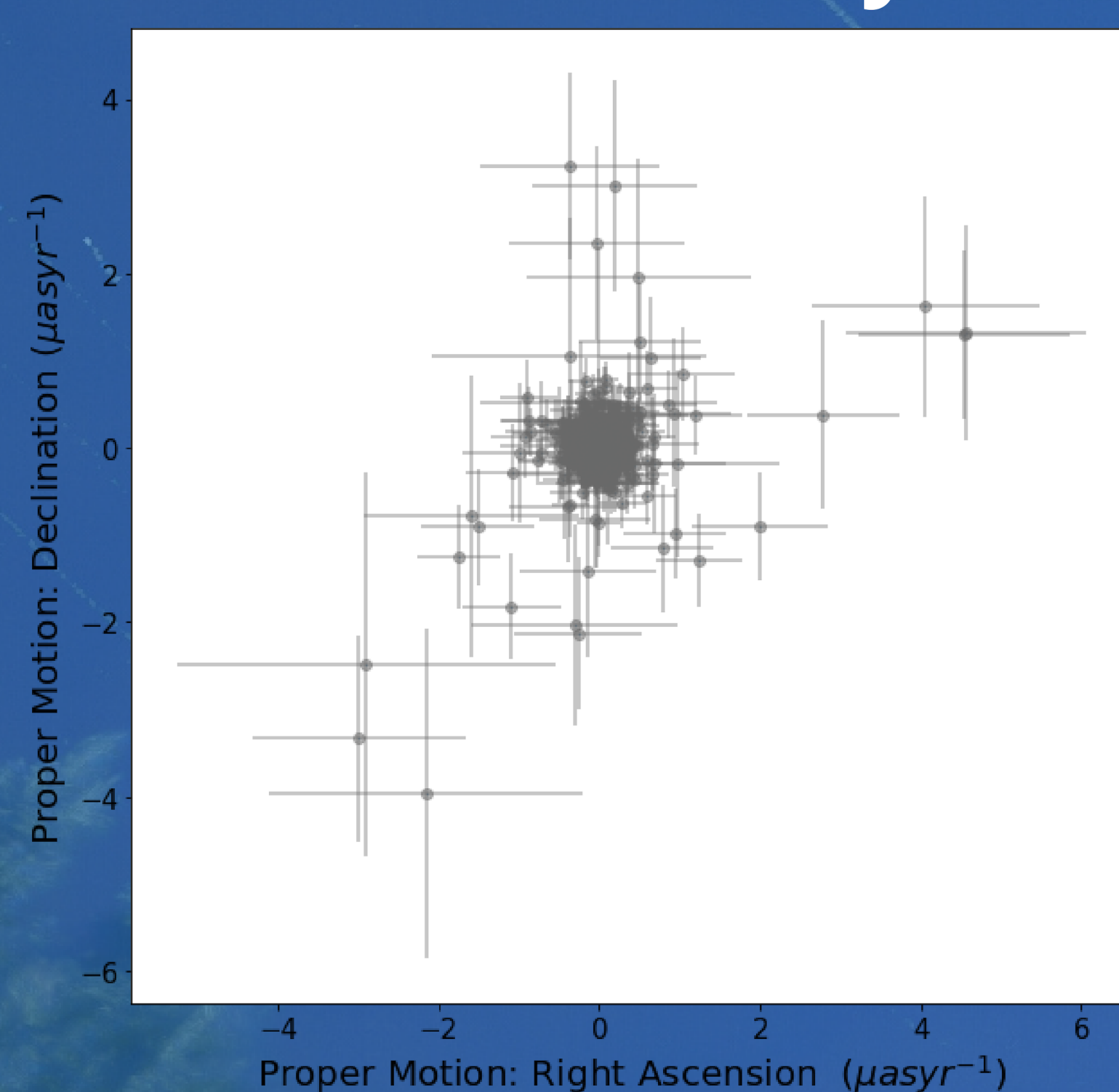


Figure 3: NCC-CAT Candidates' proper motion. Most sources are clustered around the centre with small errors as we expect of extragalactic sources. Few candidates exhibit large proper motion and error. These are resolved sources ref [3].

Photometry

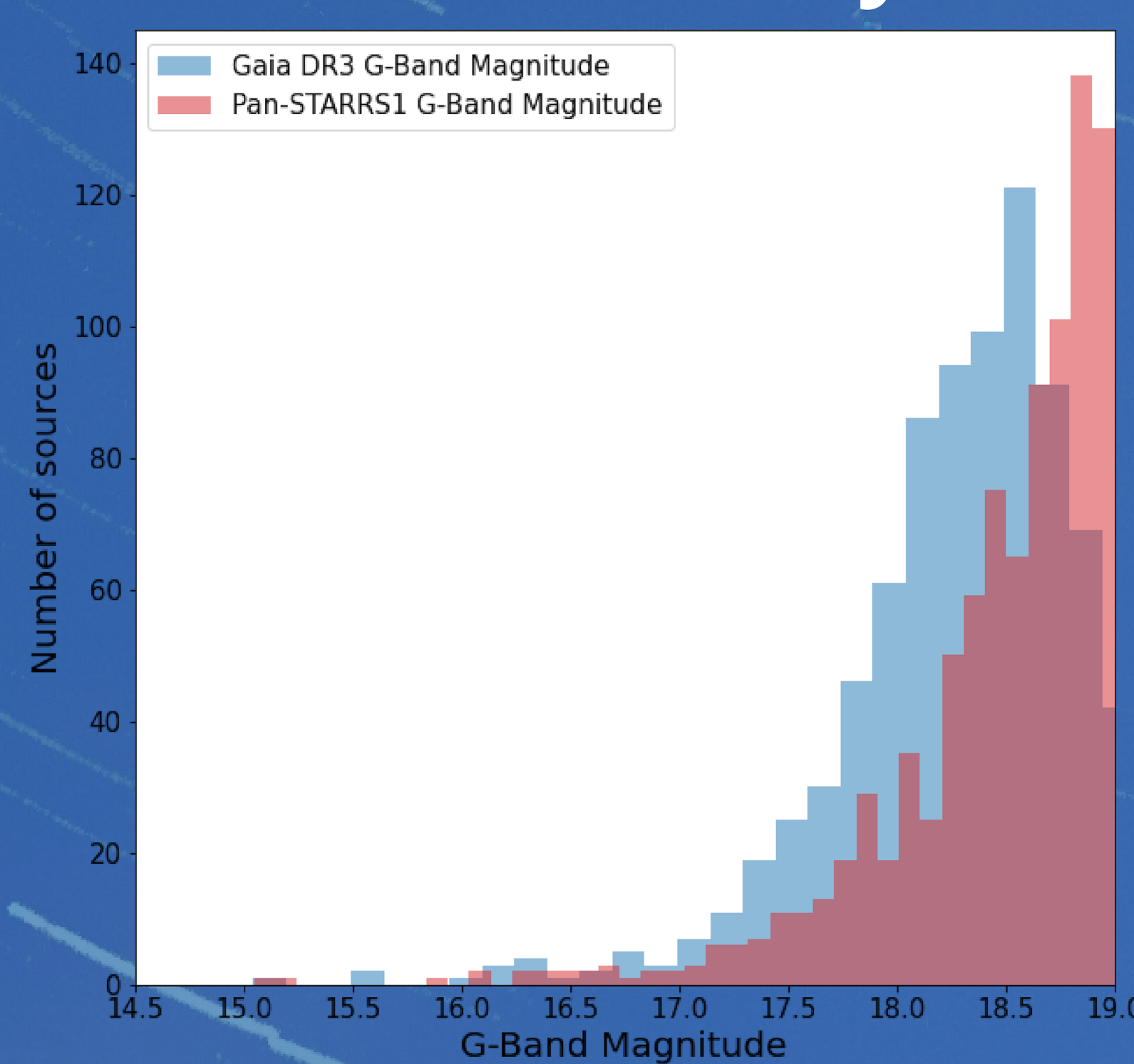


Figure 4: NCC-CAT Candidates' magnitude histogram, showing the magnitude distribution from Gaia and Pan-STARRS1 photometry. 76 candidates are brighter than 18 magnitude in Pan-STARRS1 photometry.

Colour

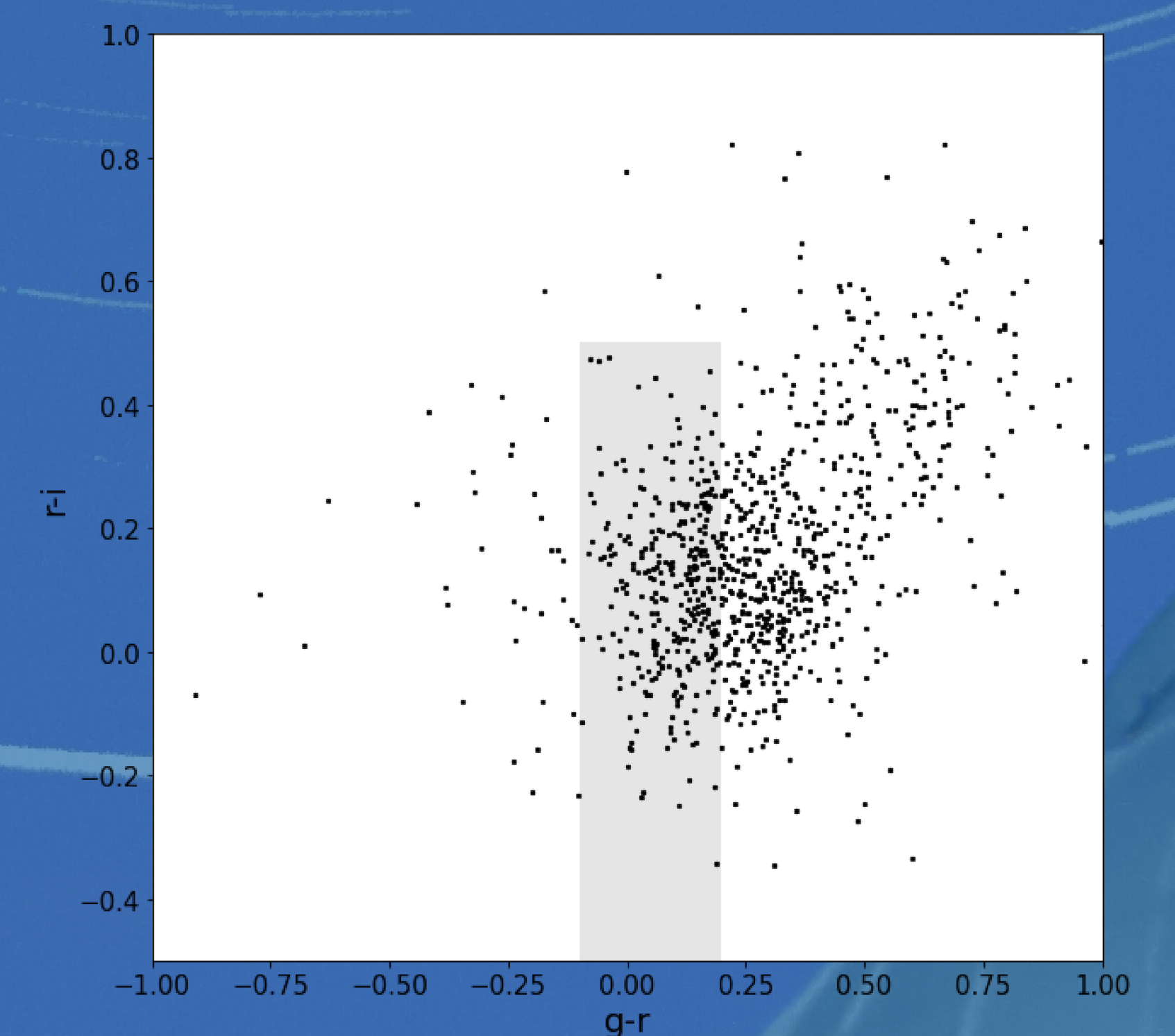


Figure 5: Colour-colour diagram of NCC-CAT candidates. Sources located in the grey region of the diagram are considered low redshift AGNs ref [4]. 497 Candidates are flagged as low redshift AGN.

Summary

With the soon launch of the SPHEREx satellite, AGNs in the NCC must be identified before the mission. Reverberation mapping allows us to measure the mass of the supermassive black hole at the centre of the AGN. This study identifies 914 AGN candidates in the NCC using archival sky survey databases. The catalogue is produced utilising a cross-matching technique to match sources from different databases and look for sources with AGN properties. A crediting system is implemented to rank the candidate into tiers, and scorecards are made for individual candidates for ease of viewing each candidates.

Acknowledgements

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References

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- Background Image: Star Trail around the North Celestial Pole behind the JGT: Supakorn Juengsophonvitavas