

VST ATLAS QUASAR SURVEY

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CENTRE FOR EXTRAGALACTIC ASTRONOMY



VST ATLAS SURVEY

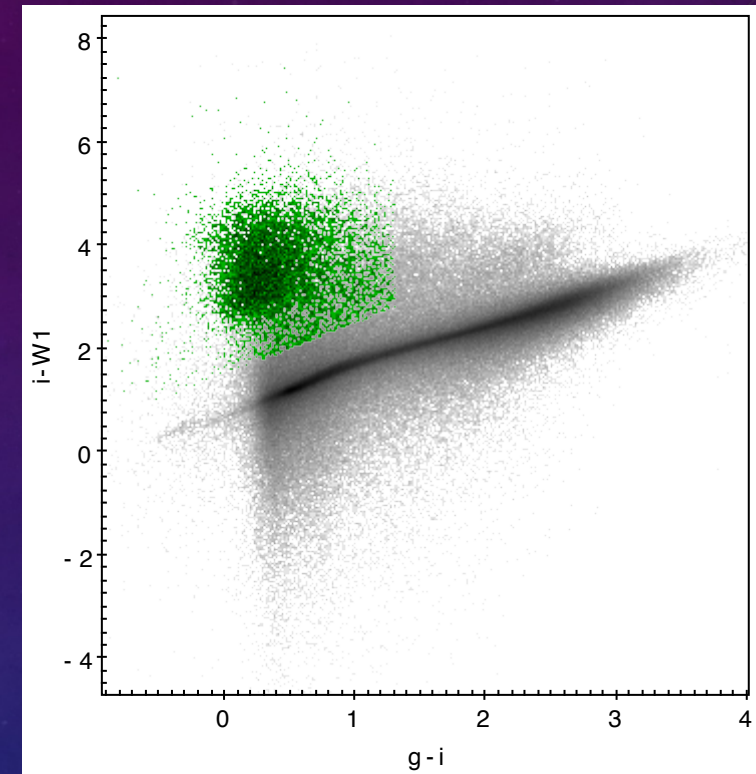
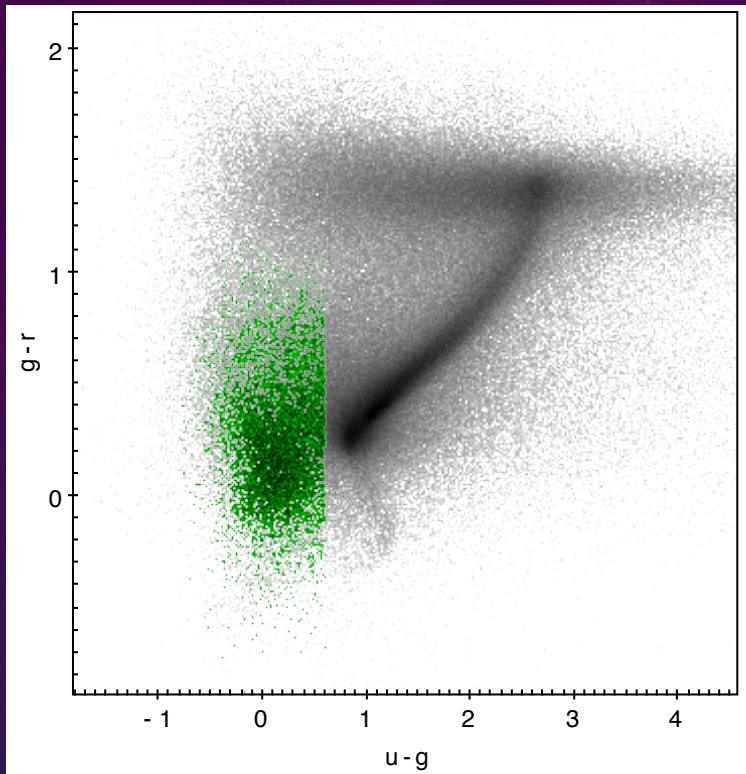
- VLT Survey Telescope (VST) is a telescope located in northern Chile with a 2.6 meter aperture
- $1^\circ \times 1^\circ$ field of view with the OmegaCAM instrument (16k \times 16k pixel CCD)
- Survey imaging $\approx 4700 \text{ deg}^2$ of the Southern sky in the optical *ugriz* bands to similar depths as SDSS
- Using forced photometry of the *u*-band to positions in the *g*-band to look for UV excess
- Overlapping VHS, AllWISE, and NEOWISE
- Aimed at supporting the 4MOST Cosmology Redshift Quasar and eROSITA X-ray AGN Surveys

ALLWISE AND NEOWISE SURVEYS

- Using the publicly available All-Sky Source Catalogue from NASA's Wide-field Infrared Survey explorer (WISE) and data from the on-going NEOWISE survey
- We create bandmerged $u+g$, riz catalogues and include infrared information from the W1 and W2 bands
- We compare AllWISE and NEOWISE as NEOWISE has more complete and deeper coverage in the W1 and W2 bands
- We further compare AllWISE and NEOWISE with our UVX selections

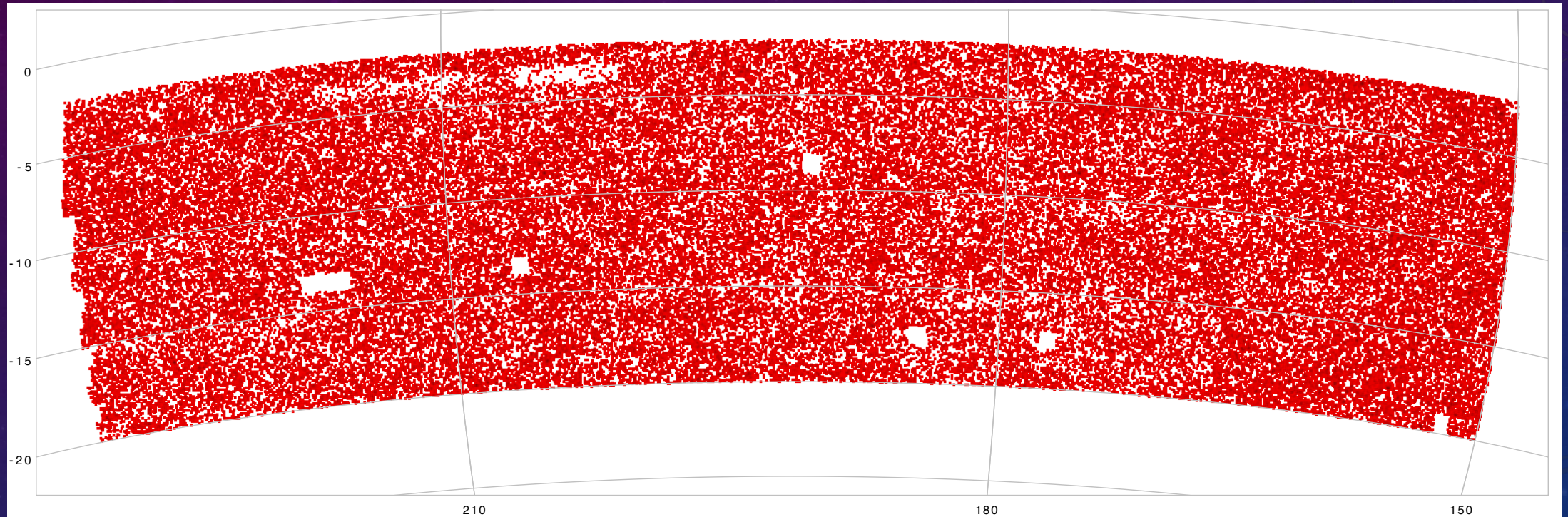
QSO SELECTION CRITERIA

- Following the Chehade et al. ('16) 2QDES pilot survey, we made the following *ugriz* magnitude and infrared colour cuts:
 - *ugriz*:
 - $-0.8 \leq u - g \leq 0.6$
 - $-1.25 \leq g - r \leq 1.25$
 - $r - i \geq 0.38 - (g - r)$
 - Optical and mid-IR:
 - $i - W1 \geq (g - i) + 1.5$
 - $-1 \leq g - i \leq 1.3$
 - $i - W1 \leq 8$
 - $(W1 - W2) > 0.4 \ \& \ g < 19.5$
 - $(W1 - W2) > -0.4g + 8.2 \ \& \ g > 19.5$
- To minimize stellar contamination in *g*, we went to $g < 21.5$ in AllWISE and $g < 22.5$ in NEOWISE
- Covers a redshift range of $0.5 < z < 2.3$



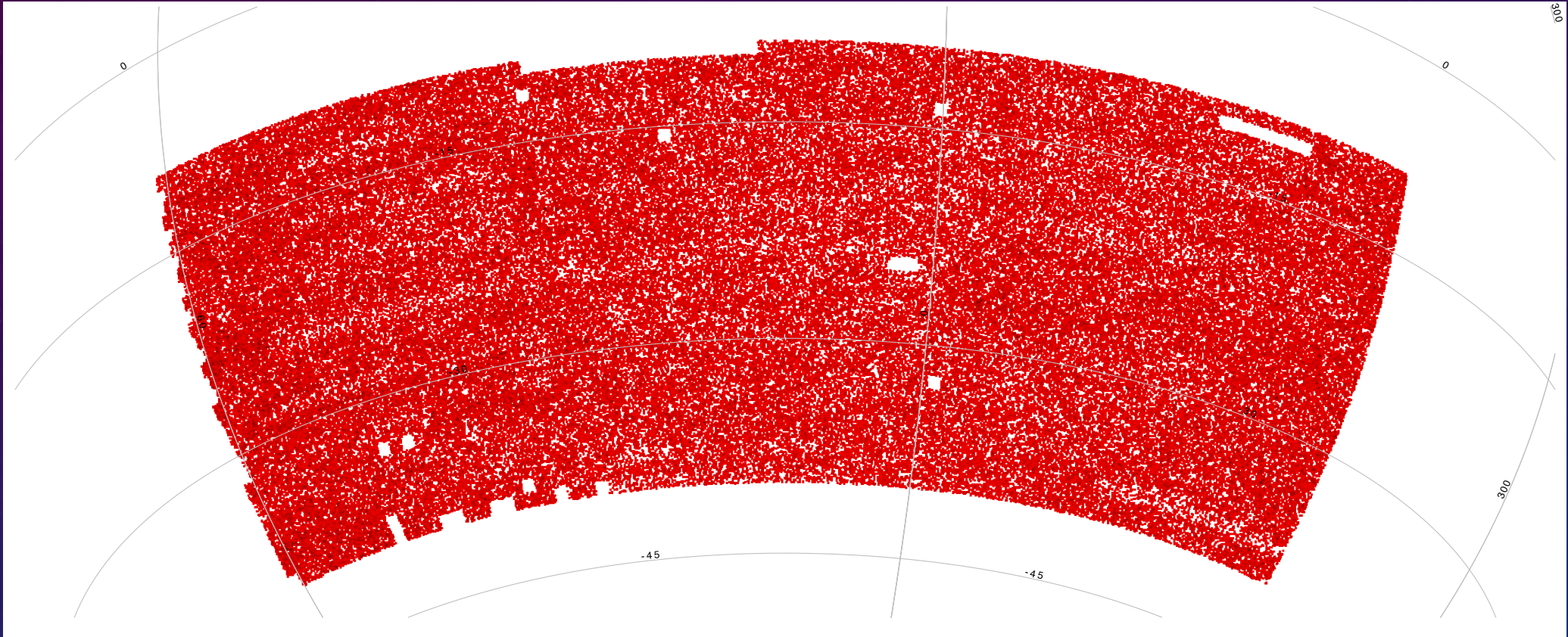
- Cuts made to maximize completeness of sample and minimize contamination
- We can see the stellar locus in gray and our quasar candidates in green
- $ugri$ cuts help cut down contamination of stars in the sample
- $giW1$ shows a clearly identifiable stellar locus and helps constrain contamination from galaxies

NGC – ALLWISE MATCHED QSO CANDIDATES



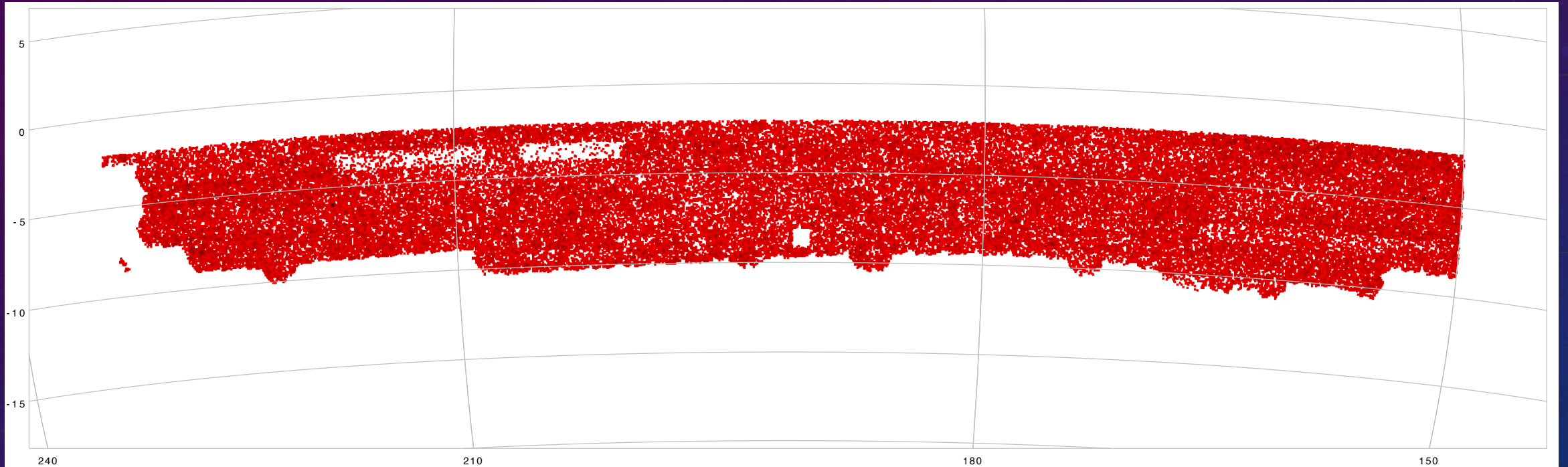
- 71,128 qso candidates
- ~ 46.5 qso candidates per square degree

SGC – ALLWISE MATCHED QSO CANDIDATES



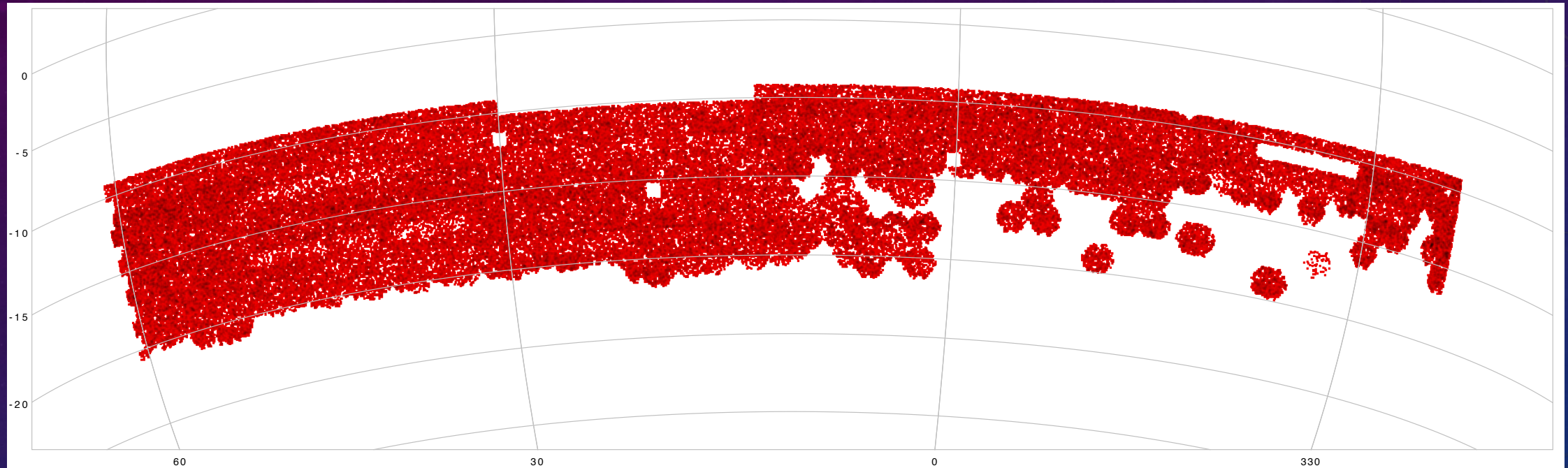
- 133,604 qso candidates
- ~ 44.4 qso candidates per square degree

NGC – NEOWISE MATCHED QSO CANDIDATES



- 80,752 qso candidates
- ~137 qso candidates per square degree

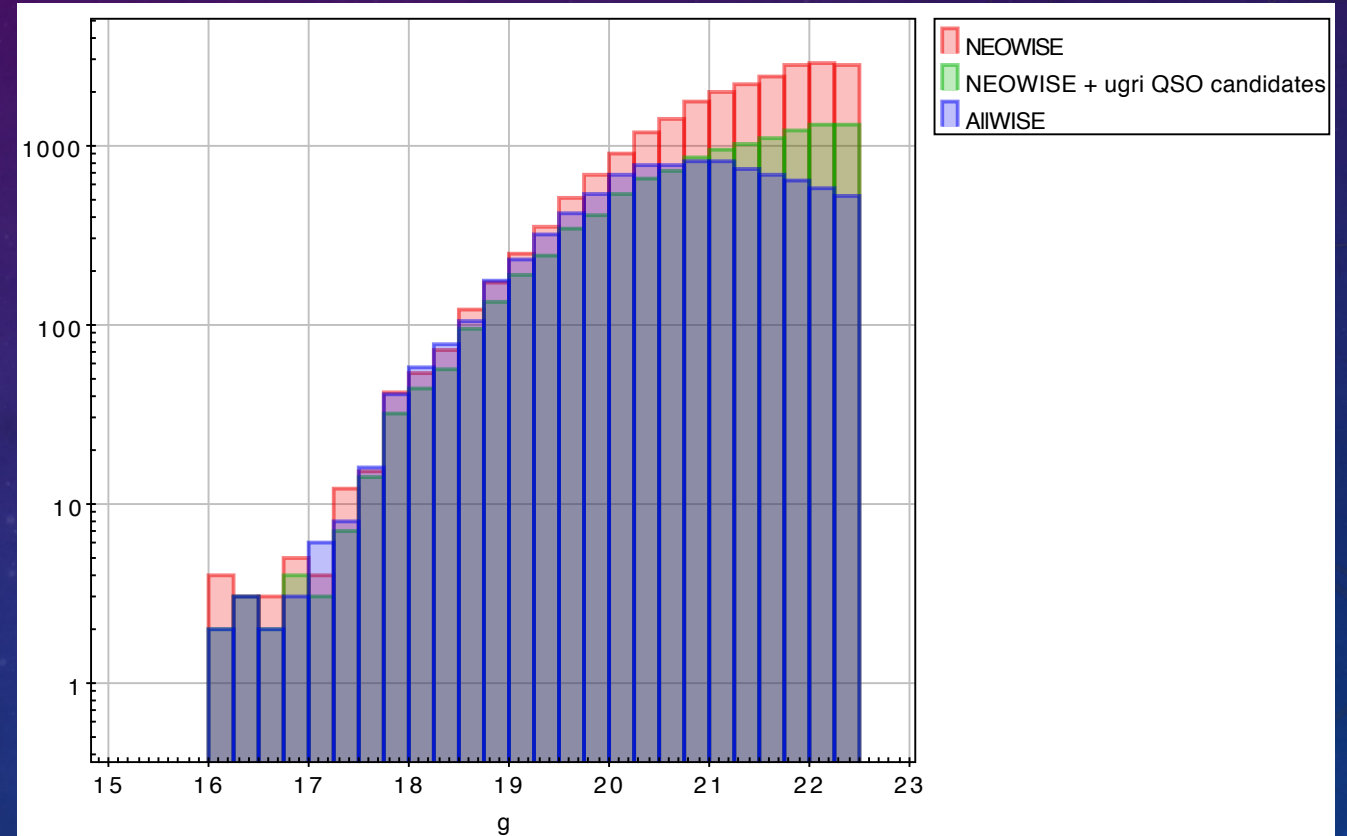
SGC – NEOWISE MATCHED QSO CANDIDATES



- 109,499 qso candidates
- ~137 qso candidates per square degree

ATLAS + NEOWISE SELECTION BENEFIT

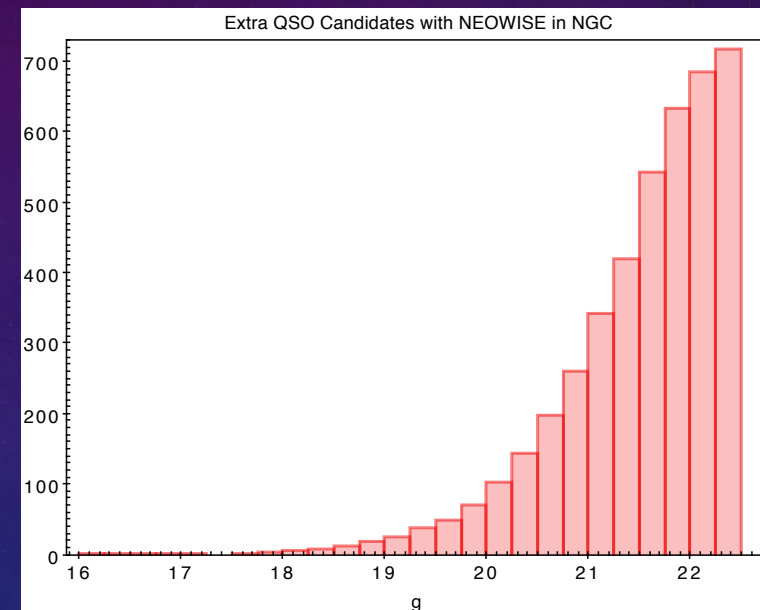
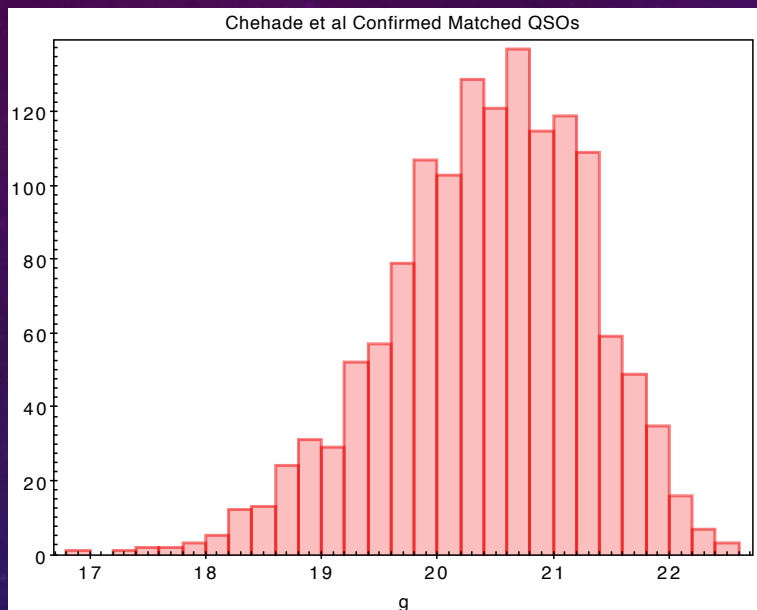
- *ugri* data from ATLAS, used to select quasar candidates based on their UVX properties, is able to significantly complement the NEOWISE selection, reaching a quasar sky density of 137 deg^2 at $g < 22.5$



EFFECTIVENESS OF QUASAR SELECTION

- Using confirmed quasars from the 2QDES survey we perform completeness and efficiency checks
- AllWISE bandmerged catalogue, with a 2QDES overlap area of 86.35 deg^2 :
 - I find ~ 60 quasar candidates per square degree
 - 66.5% completeness
 - 72% efficiency
- NEOWISE bandmerged catalogue the NGC, with a 2QDES overlap area of 81.64 deg^2 :
 - I find ~ 137.3 quasar candidates per square degree
 - 80% completeness
 - 40.2% of our added candidates are at a fainter limit than detected by 2QDES

NEOWISE-ATLAS BANDMERGED DATA



- As NEOWISE can bring us to a g -band magnitude of 22.5 we significantly increase the number of quasar candidates
- Although DESI can go deeper in grz bands, our combined UVX and mid-IR cuts give us quasar number counts and depths are comparable to the quasar density and depth achieved with DESI

CONCLUSION

- We are getting significantly better completeness and depth with NEOWISE vs AllWISE
 - Fainter in effective g-band magnitude limit - $g=22.5$
- ATLAS *ugri* complements NEOWISE, selecting bluer quasars to $g=22.5$
- Combined NEOWISE/ATLAS selections reach our target $0.5 < z < 2.3$ quasar sky density of 137 deg^2 , comparable to DESI

EXTRA/ON-GOING WORK

- Currently working on $z < 2.2$ completion in eBOSS
- Looking at the potential for $z > 2.2$ quasar selection
- Aim to publish the VST-ATLAS quasar catalogue by the Spring
- Quasar-cluster cross correlation analysis