Blue Horizontal Branch Stars in Pan-STARRS

John J Vickers
Eva K Grebel
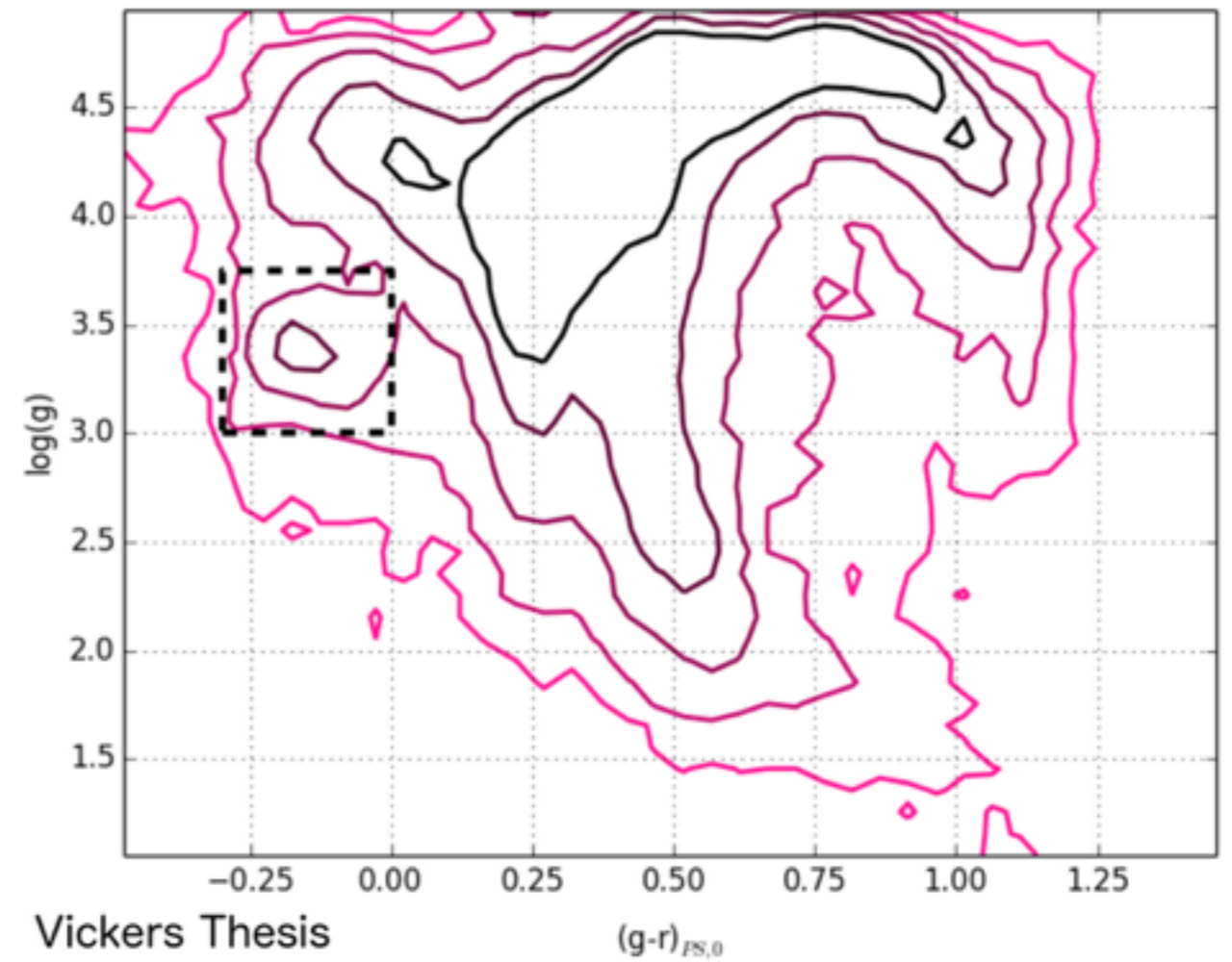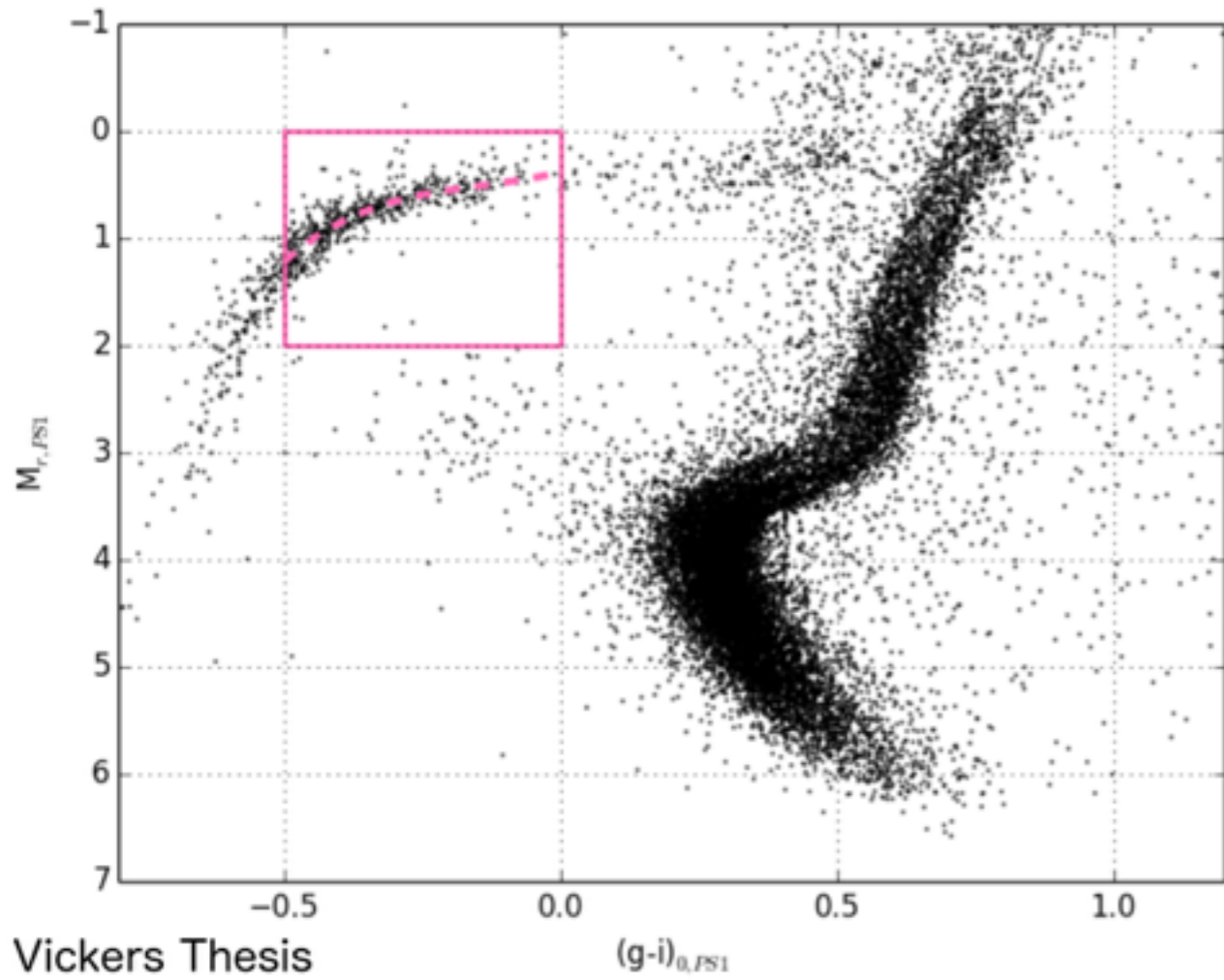Avon P Huxor [See Poster Here]

Blue Horizontal Branch Stars
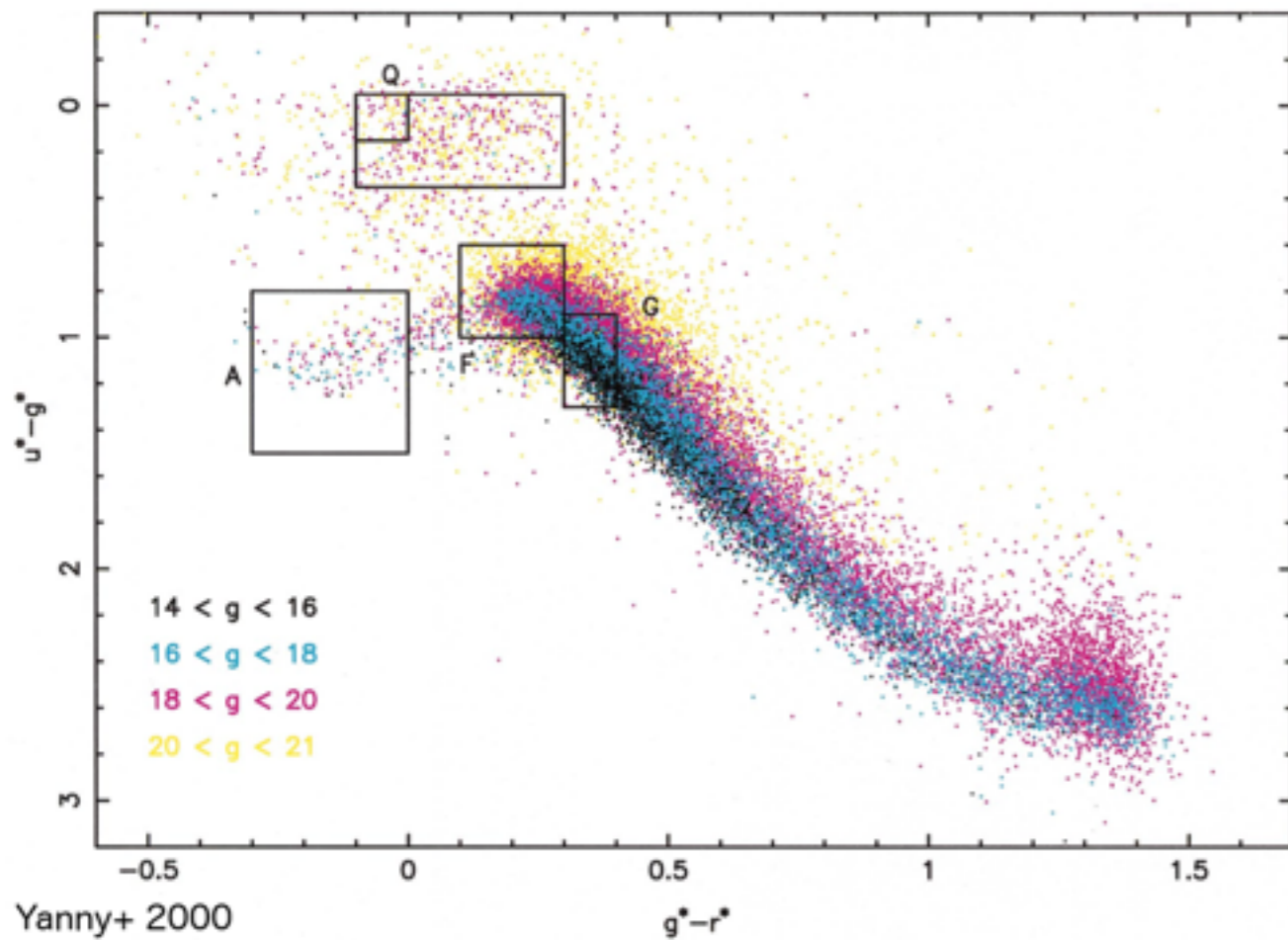

Vickers Thesis

$(g-i)_{0,PS1}$

Vickers Thesis
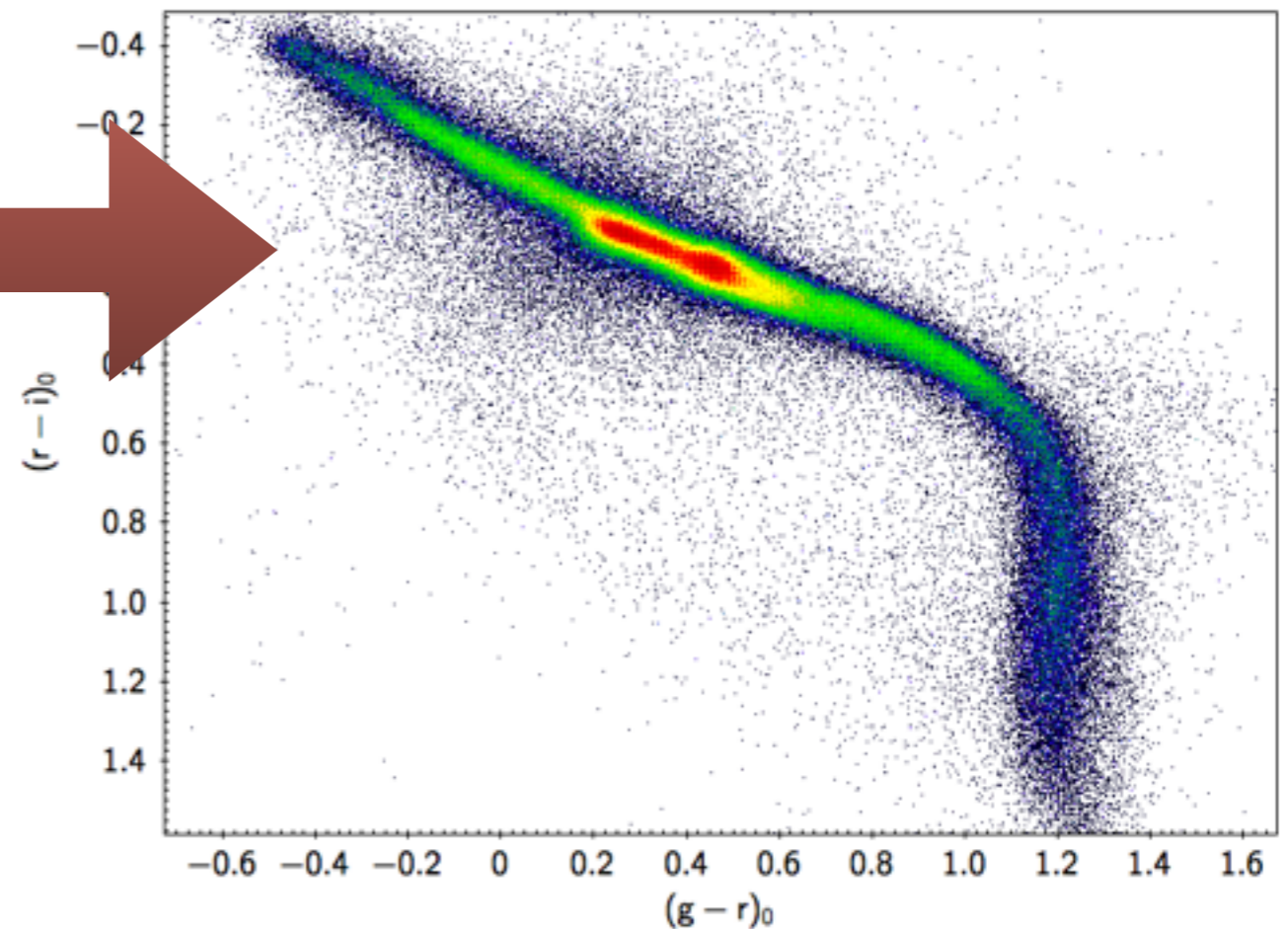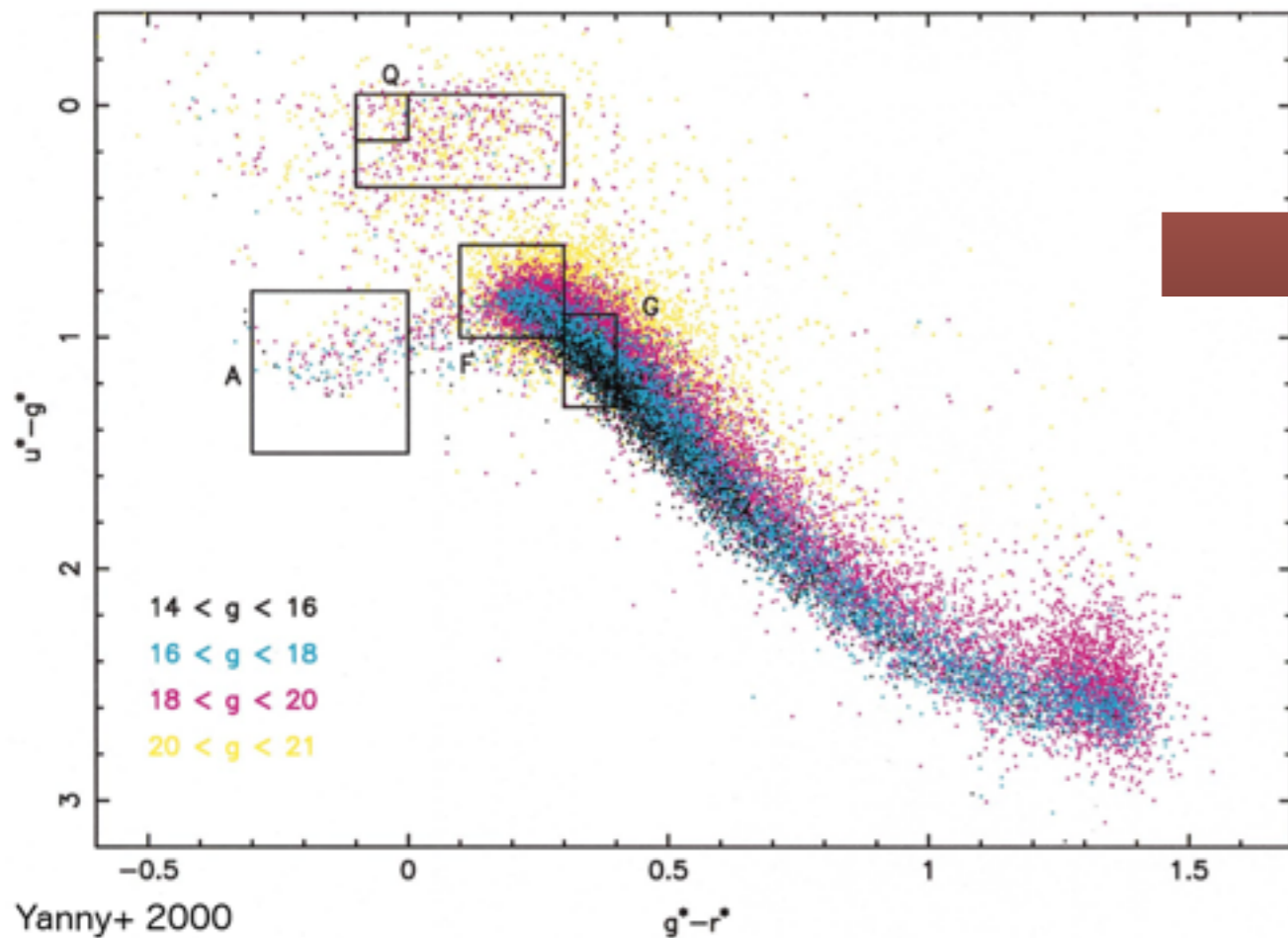
$(g-r)_{PS,0}$

Stellar Color Locus

- Stars lie on a ribbon-like surface in color space.

  - SDSS (u,g,r)
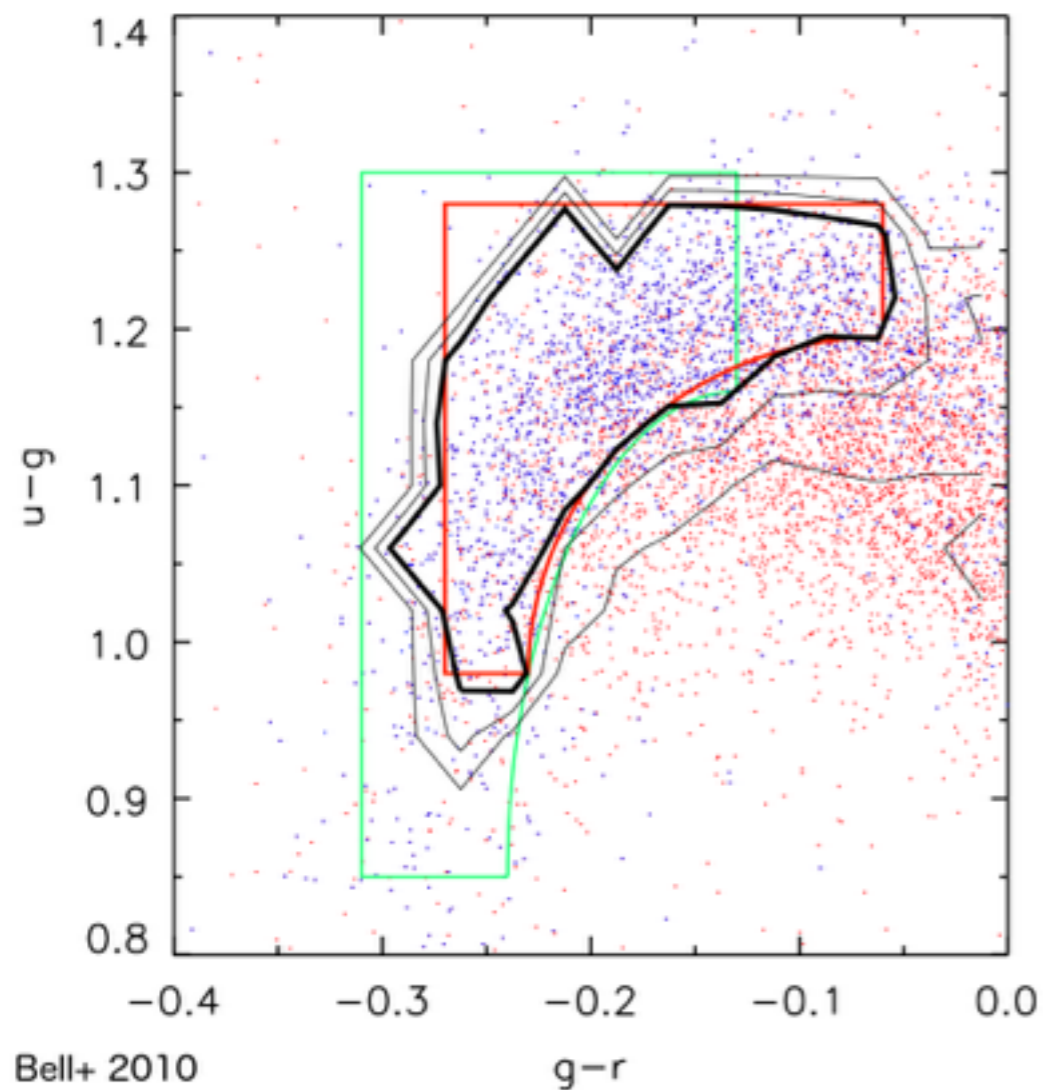

Yanny+ 2000

Stellar Color Locus

- Stars lie on a ribbon-like surface in color space.

  - SDSS (u,g,r)   PS1 (g,r,i)
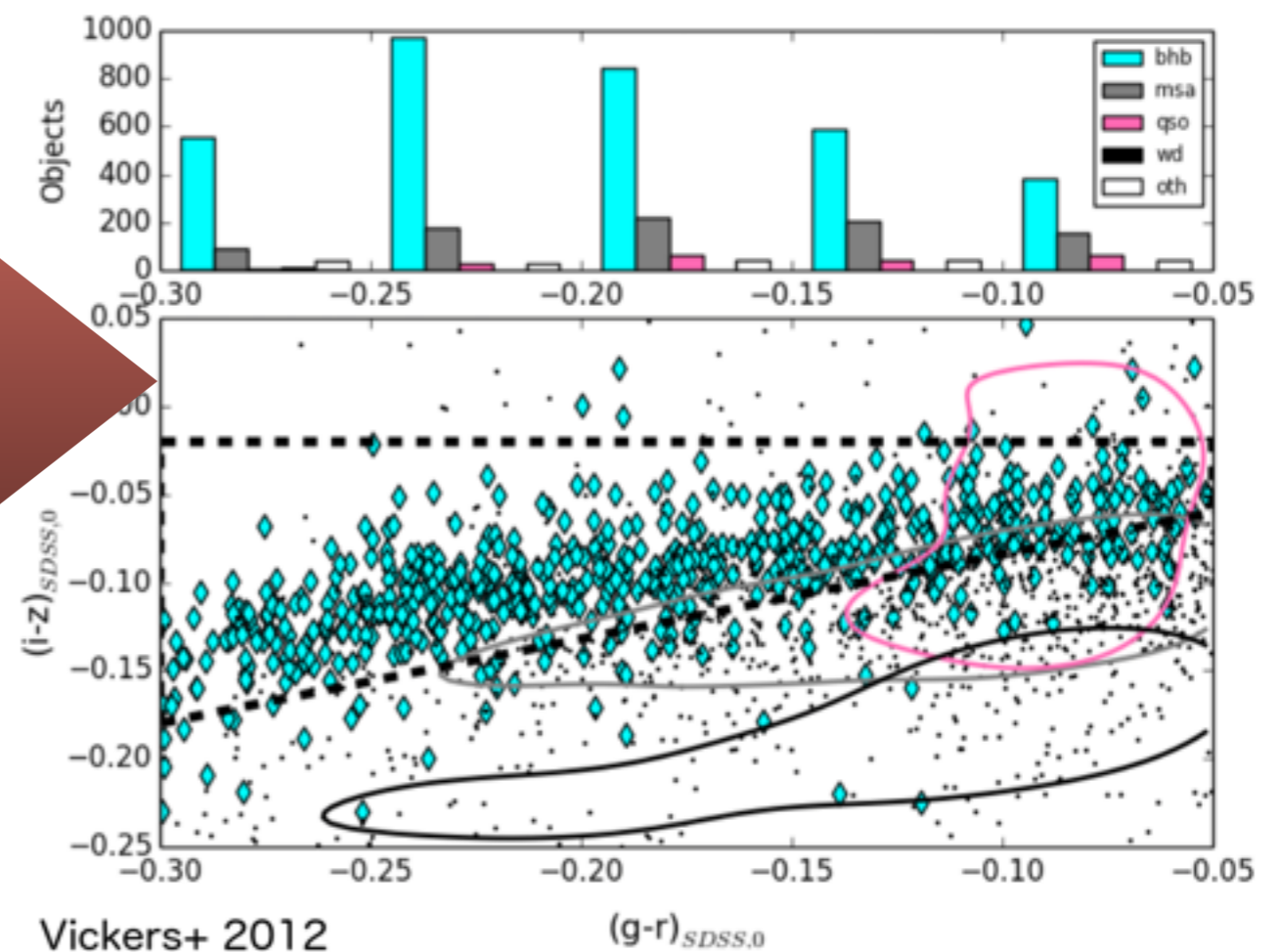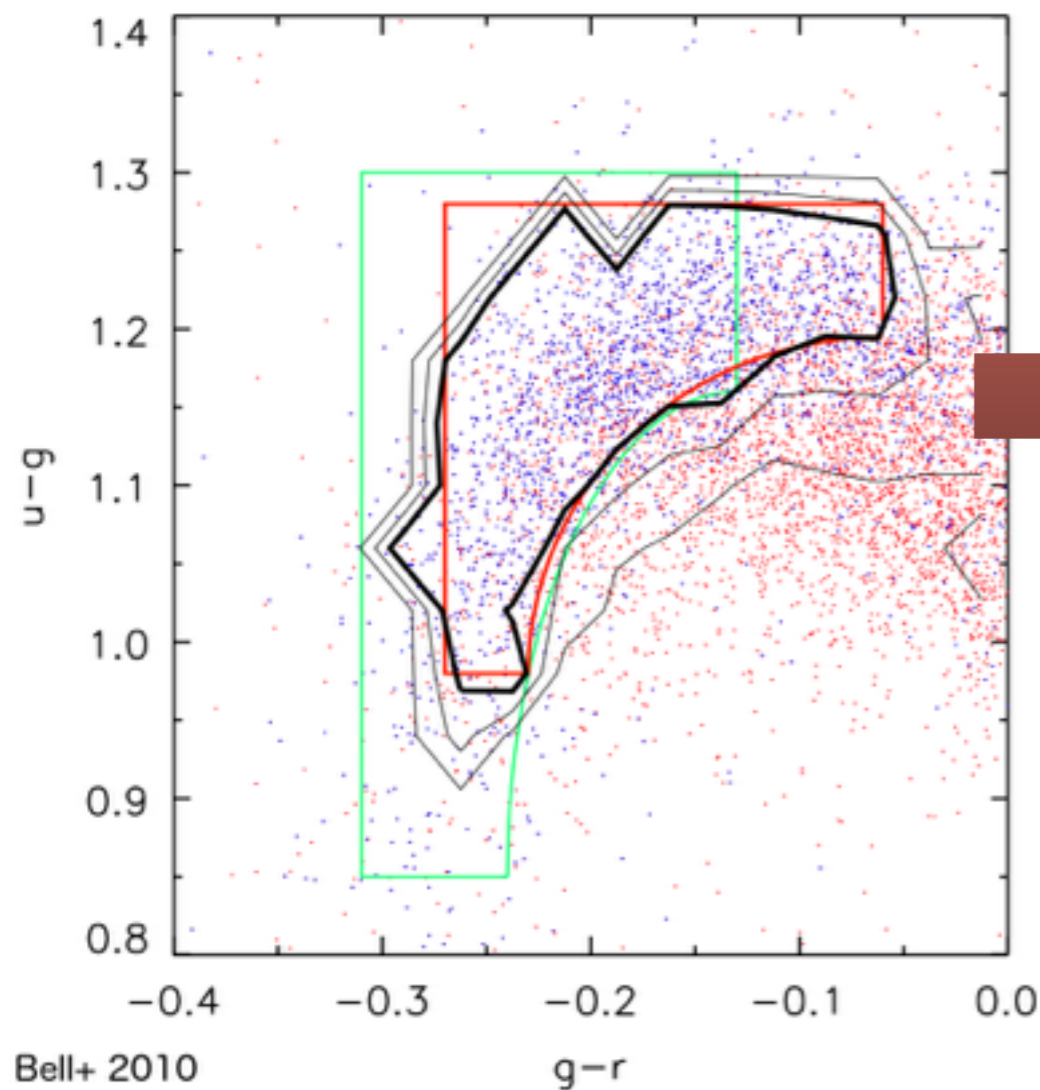

Yanny+ 2000

Surface Gravity Splits A Giants and Dwarfs in Color

- u_{SDSS} is a good separator because of the Balmer Break
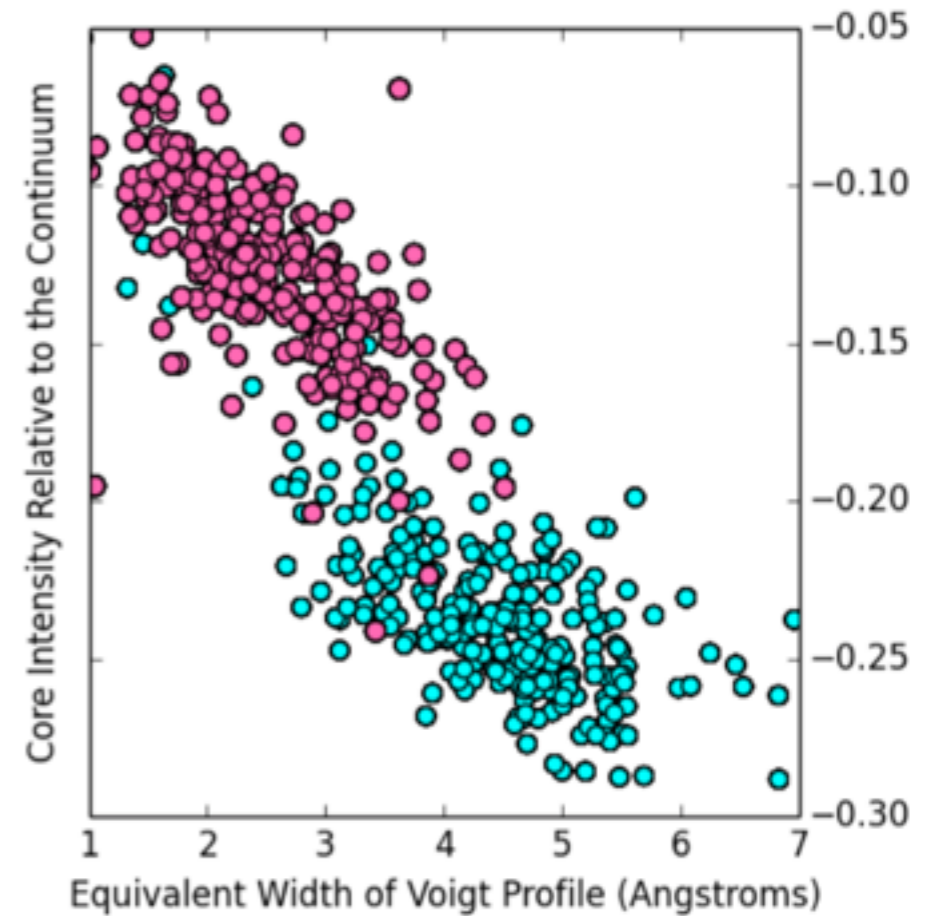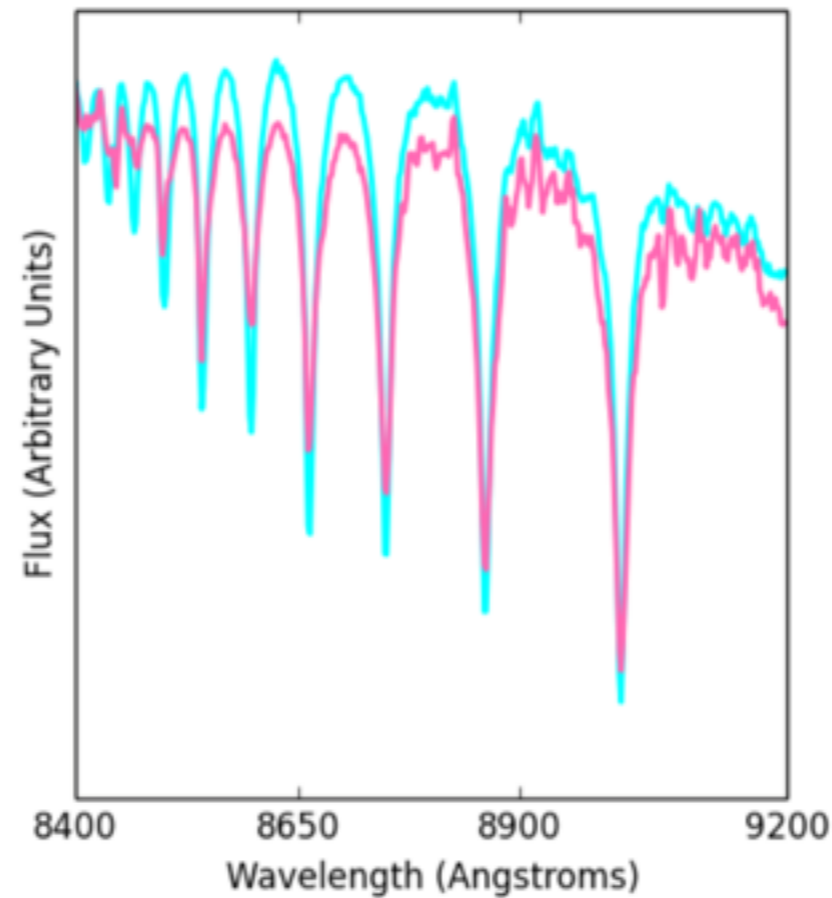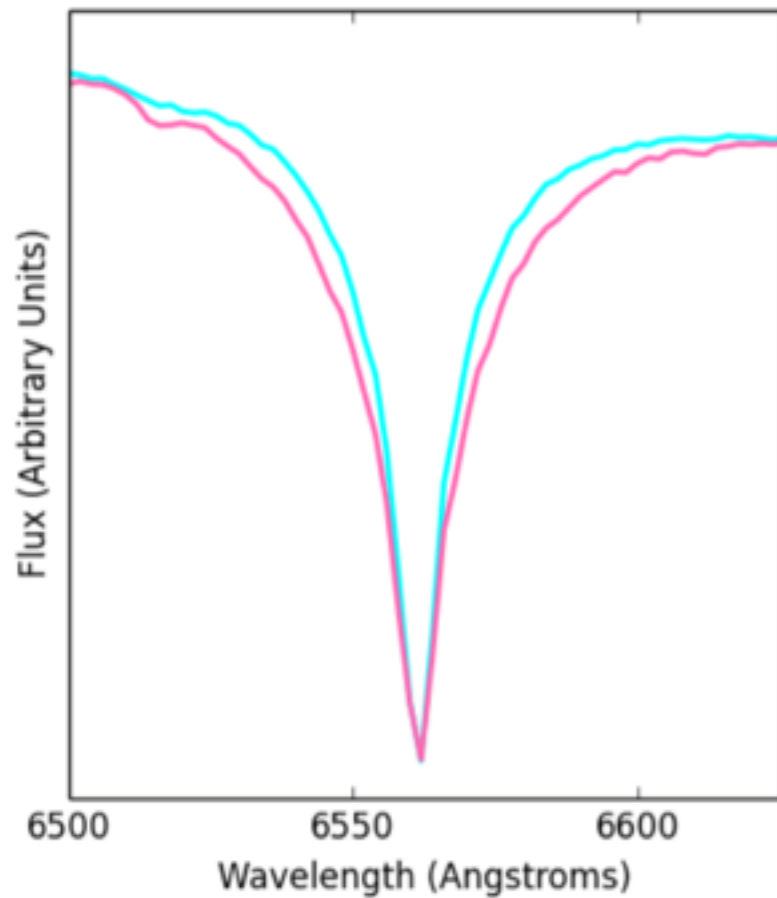

Bell+ 2010

Surface Gravity Splits A Giants and Dwarfs in Color

- u_{SDSS} is a good separator because of the Balmer break

- z_{PS1} is a good separator because of the Paschen break

Bell+ 2010

Vickers+ 2012

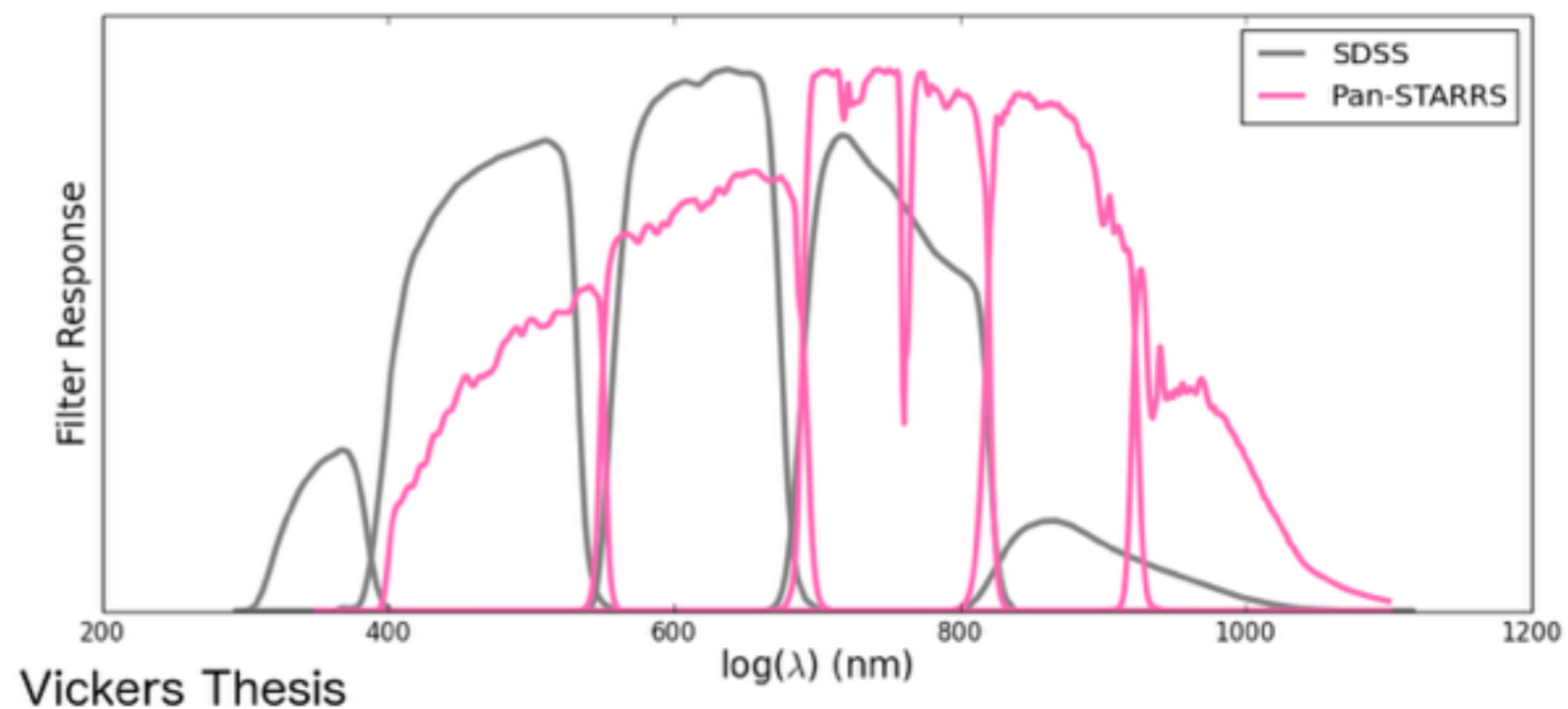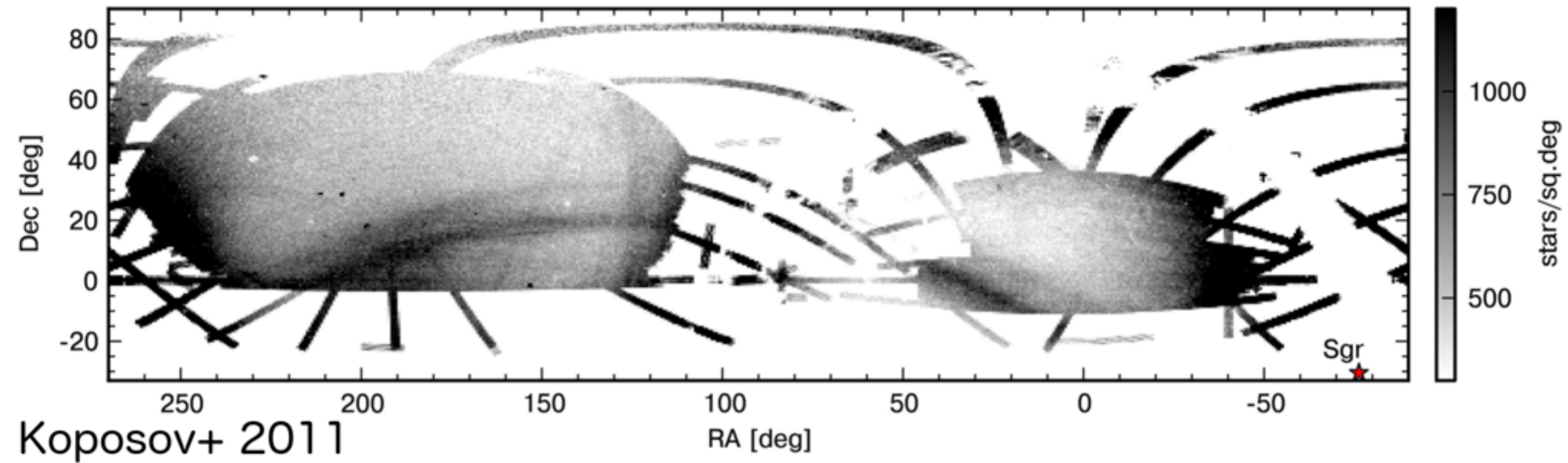# Visual of the Paschen Break

Vickers+ 2012

$$\frac{1}{\lambda_{\text{vac}}} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Pan-STARRS Data

- 1.8 meter Ritchey-Chretien Reflector

- 1.4 Gpx Camera

- 3° Field of View
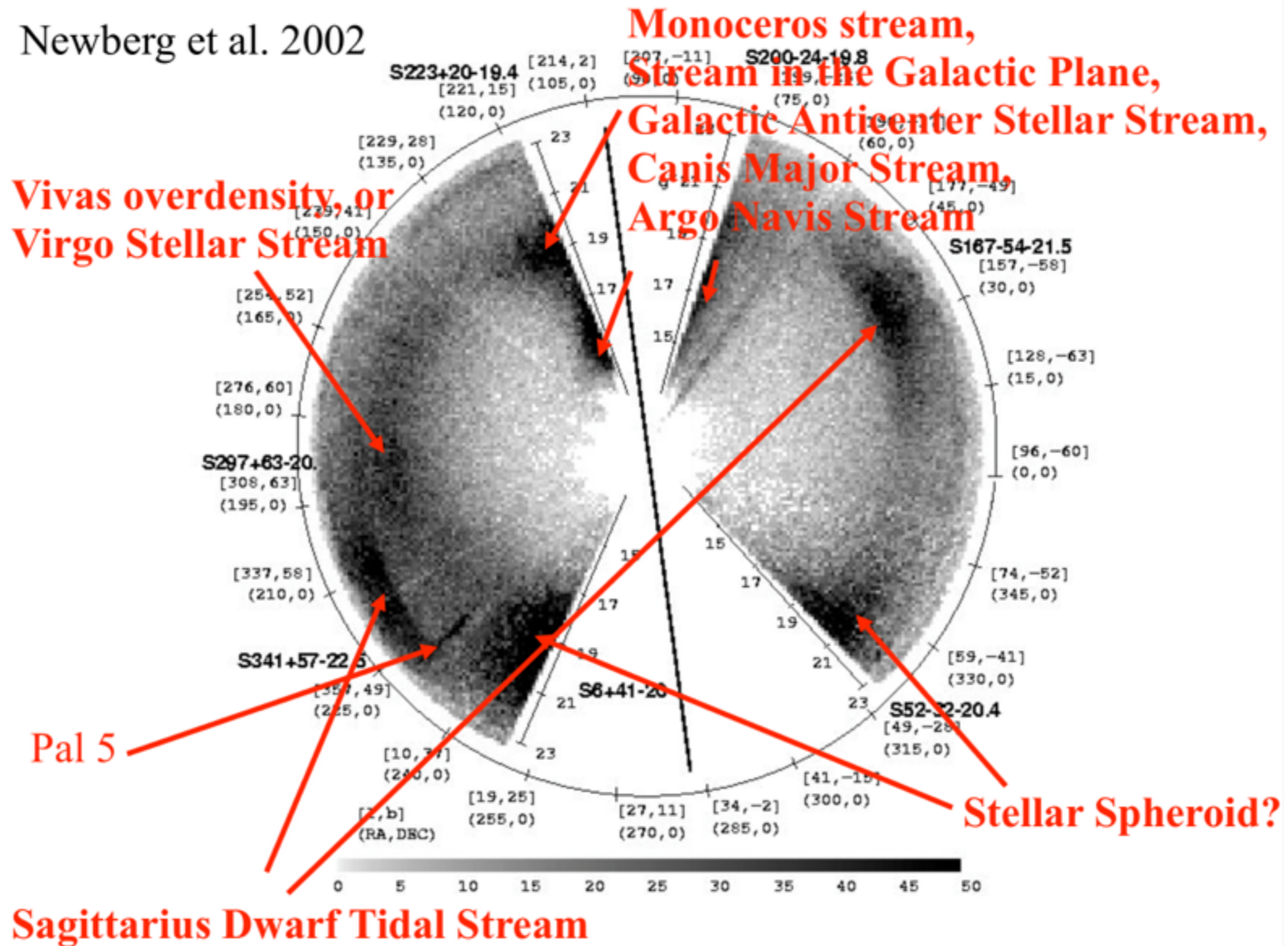
- Six Photometric Filters

- Time Resolved

ps1sc.org

SDSS
Pan-STARRS

Filter Response

200   400   600   800   1000   1200

$\log(\lambda)$ (nm)

Vickers Thesis

Substructure in the Halo

Koposov+ 2011

Substructure in the Halo

Newberg et al. 2002

Monoceros stream,
Stream in the Galactic Plane,
Galactic Anticenter Stellar Stream,
Canis Major Stream,
Argo Navis Stream

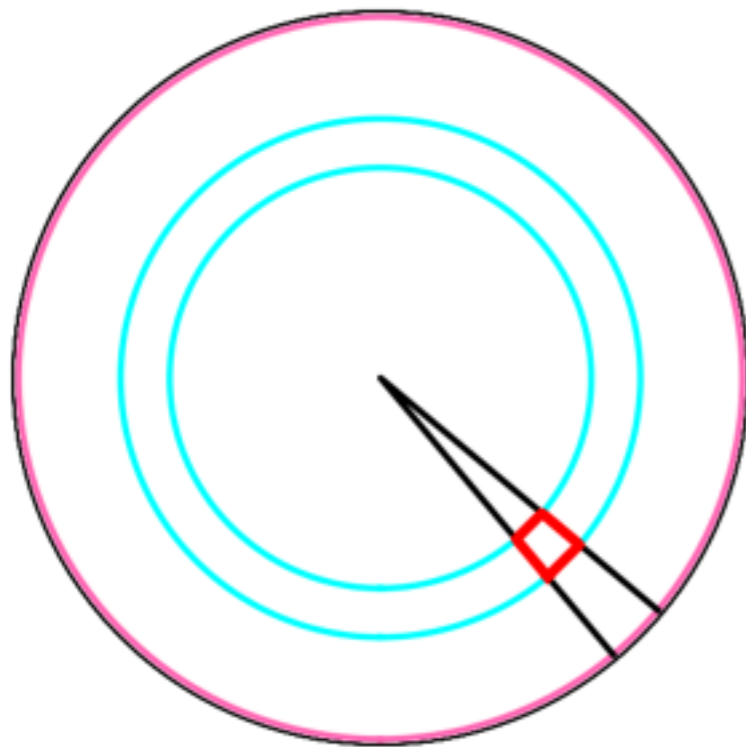Vivas overdensity, or
Virgo Stellar Stream

Pal 5

Stellar Spheroid?
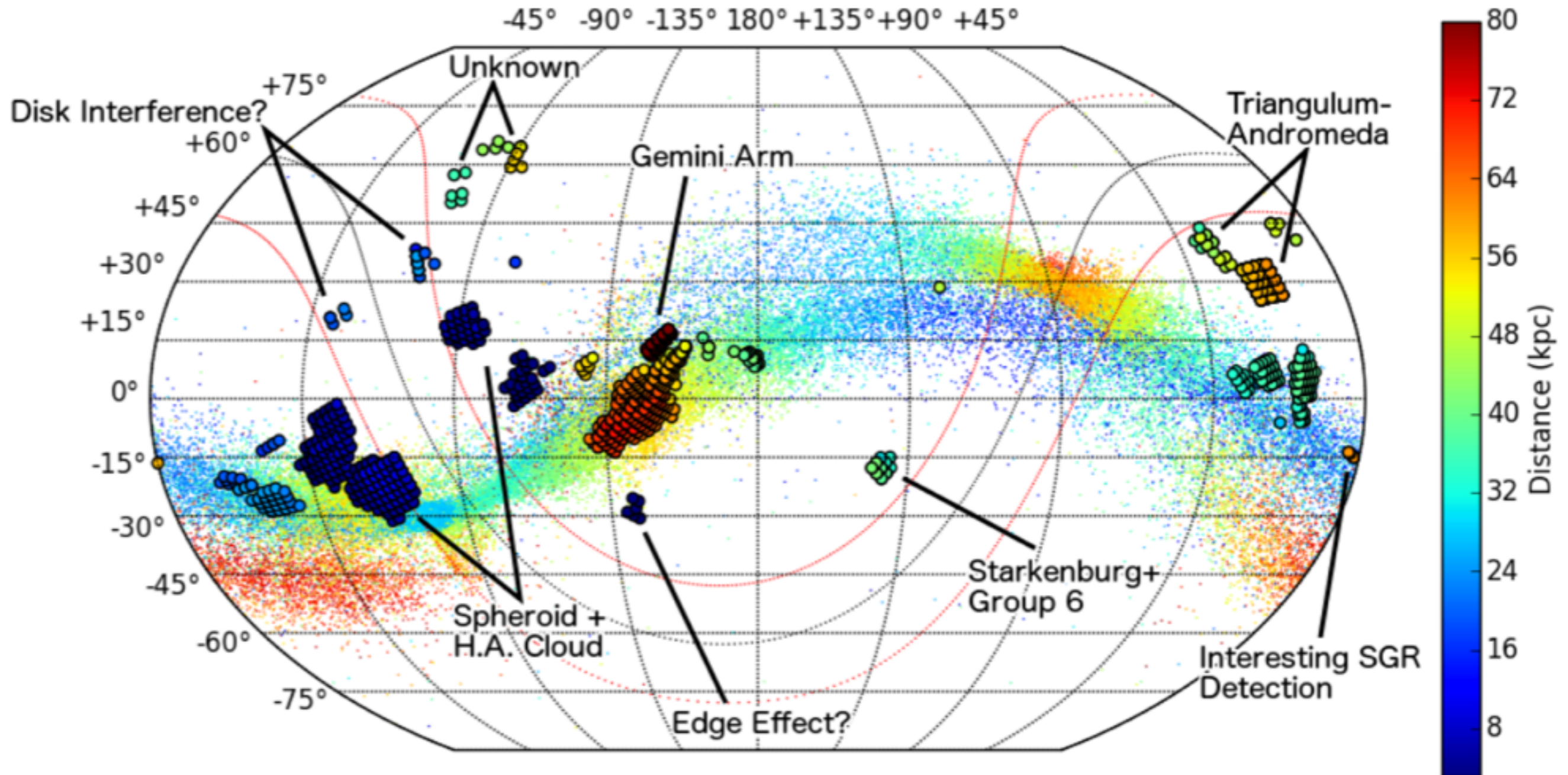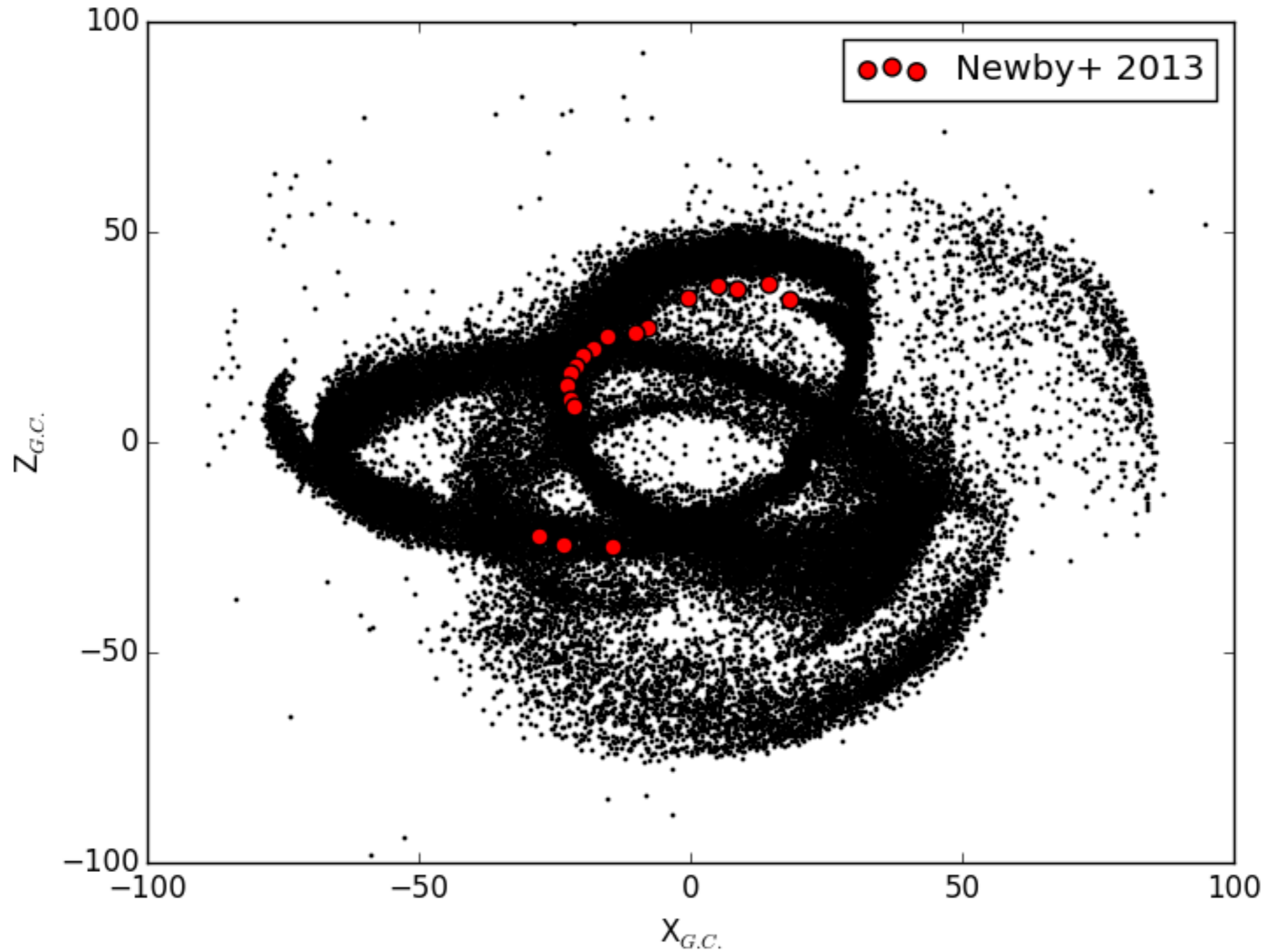
Sagittarius Dwarf Tidal Stream

Search Strategy for Pan-STARRS

- Compare ratio of stars at a certain distance in a pencil beam to the ratio of stars at that distance in a ring at the same latitude.
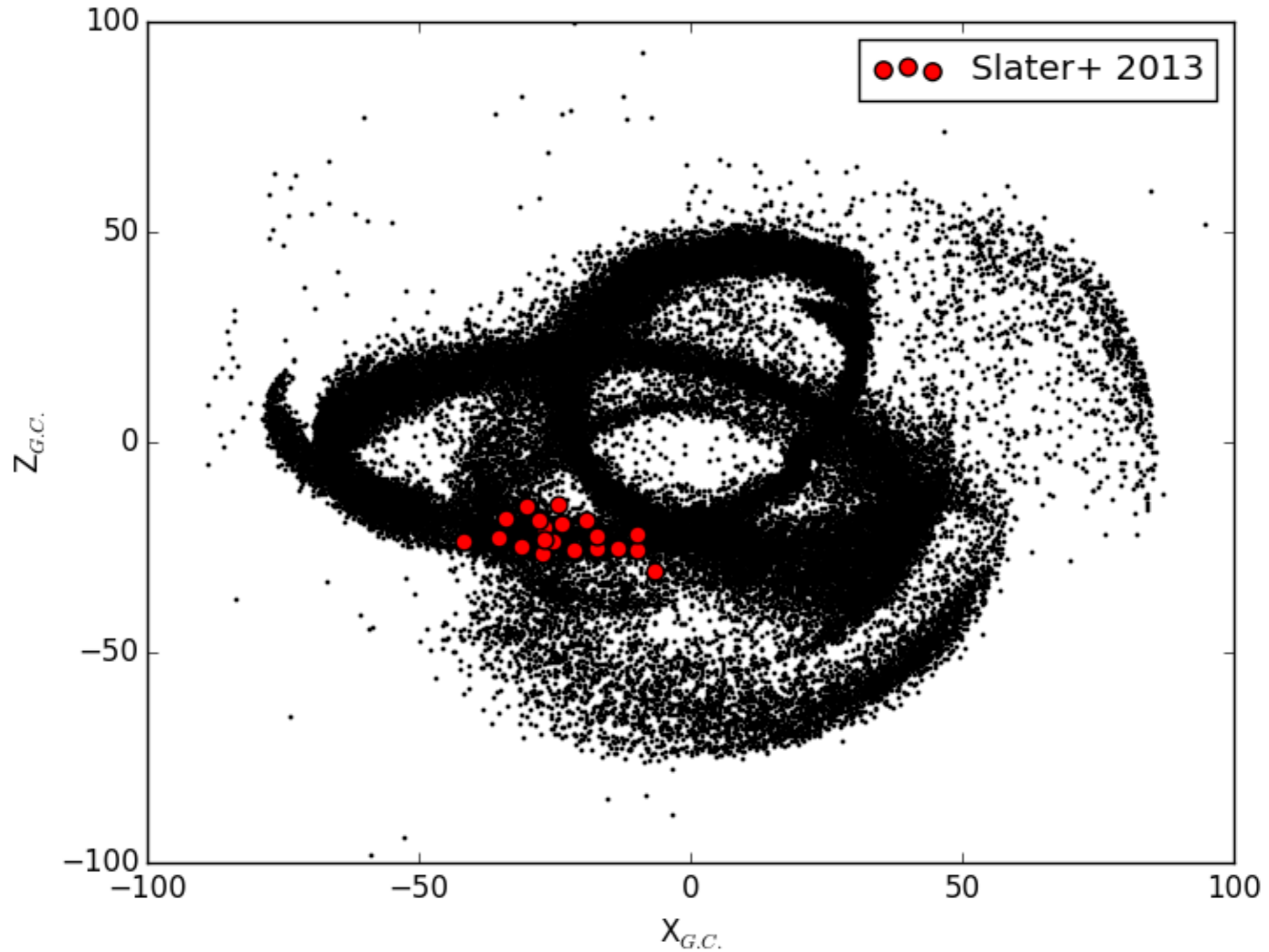

Vickers Thesis
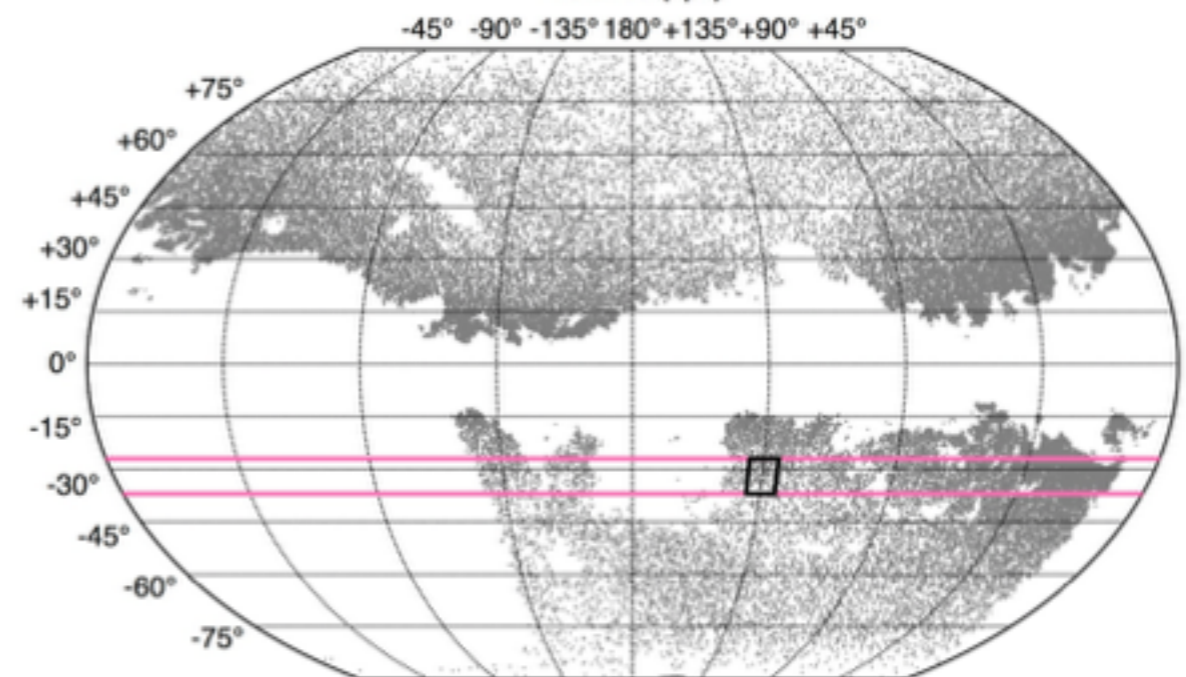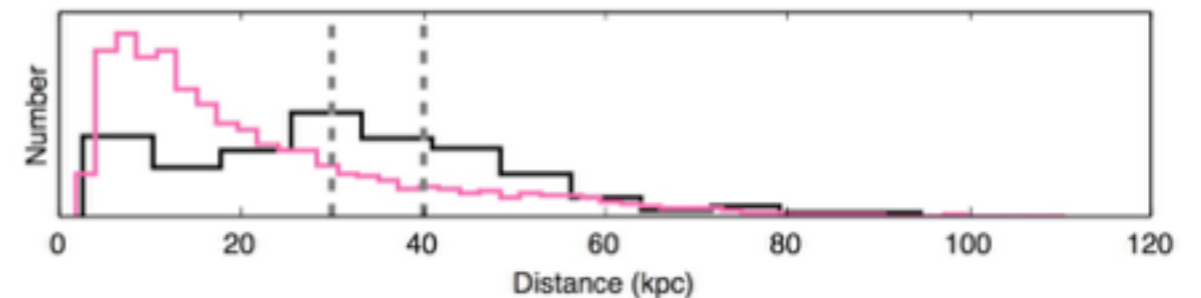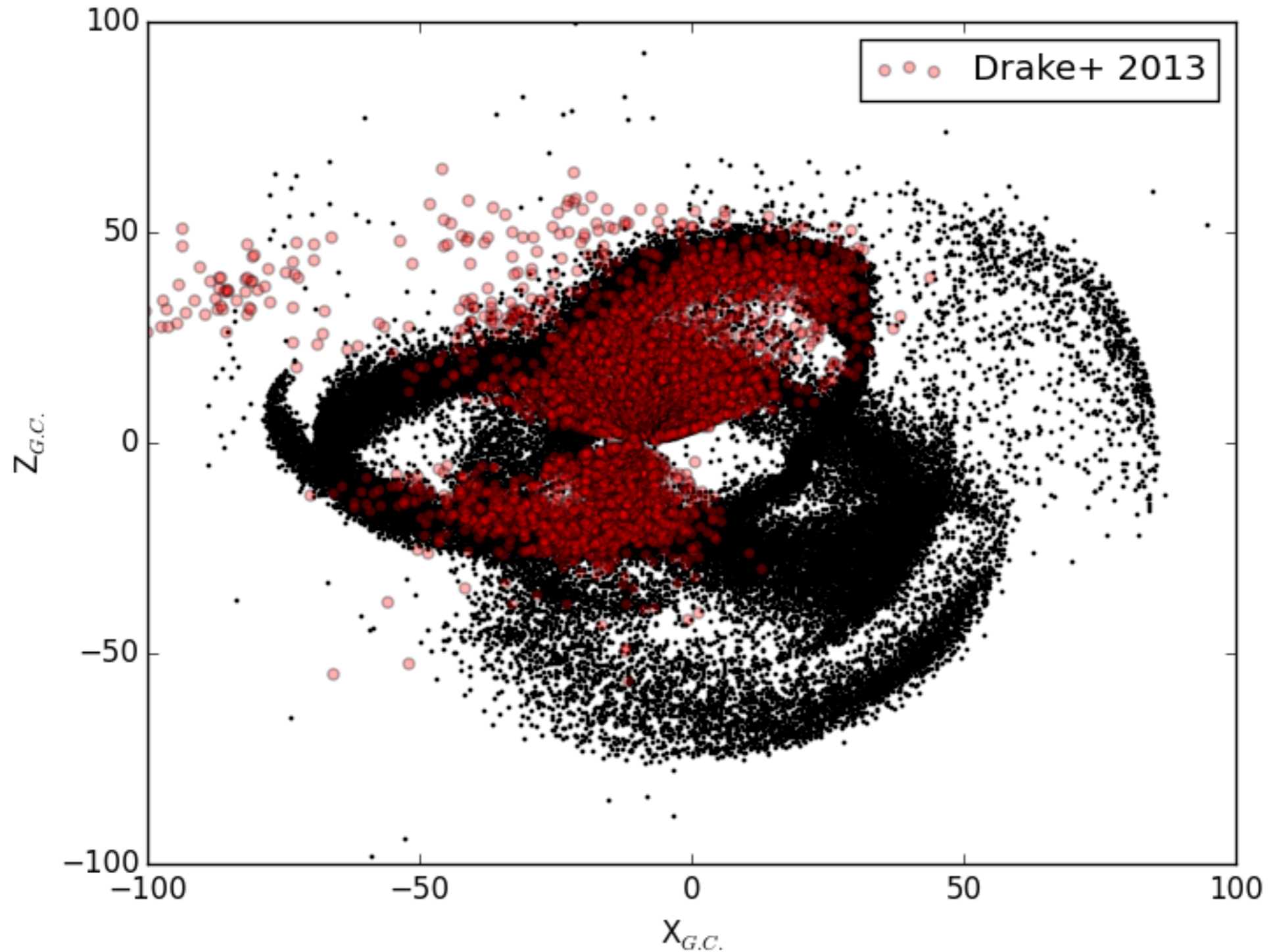
Findings

Vickers Thesis
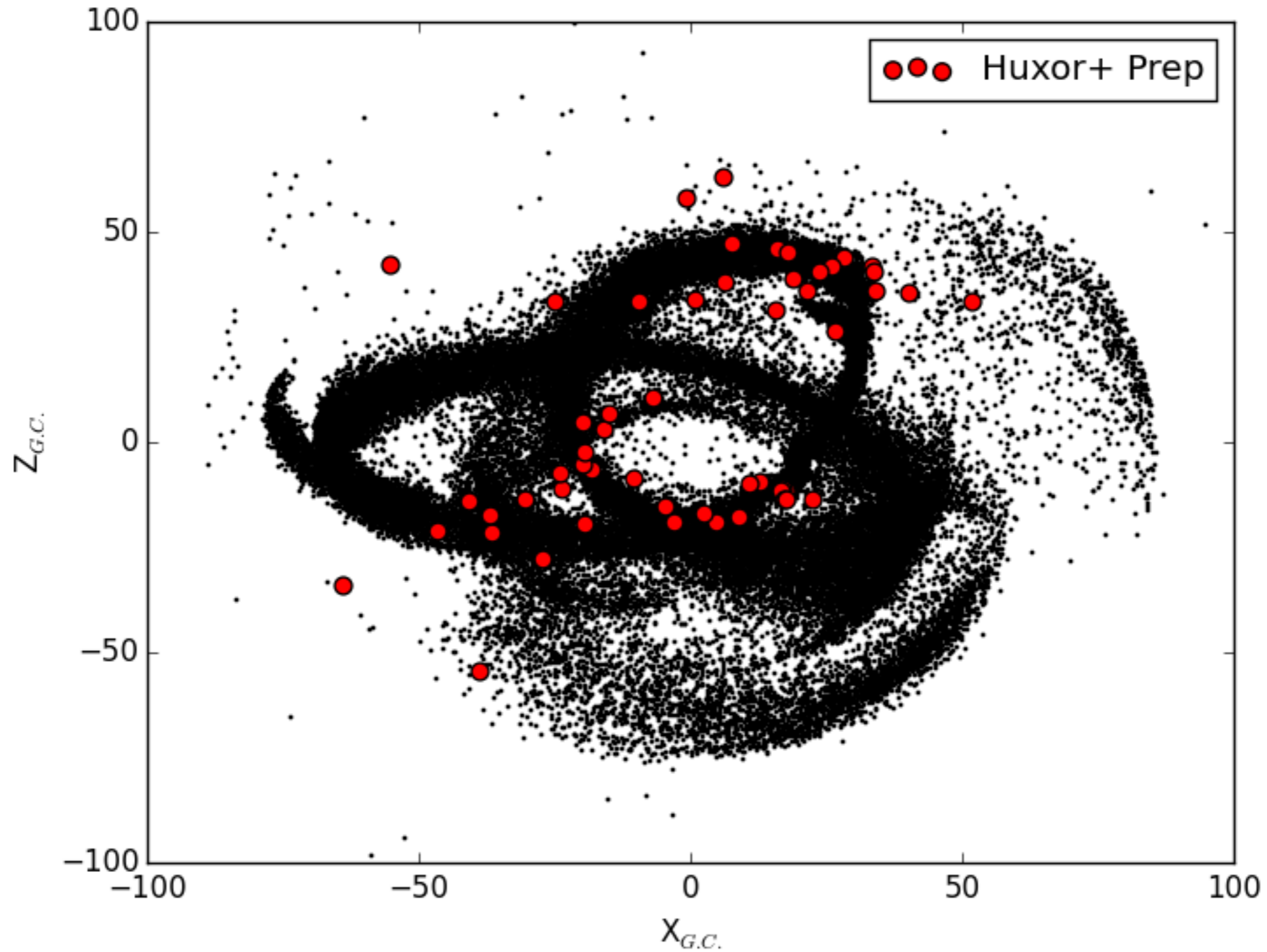
Comparison With Other Studies (Newby+ 2013)
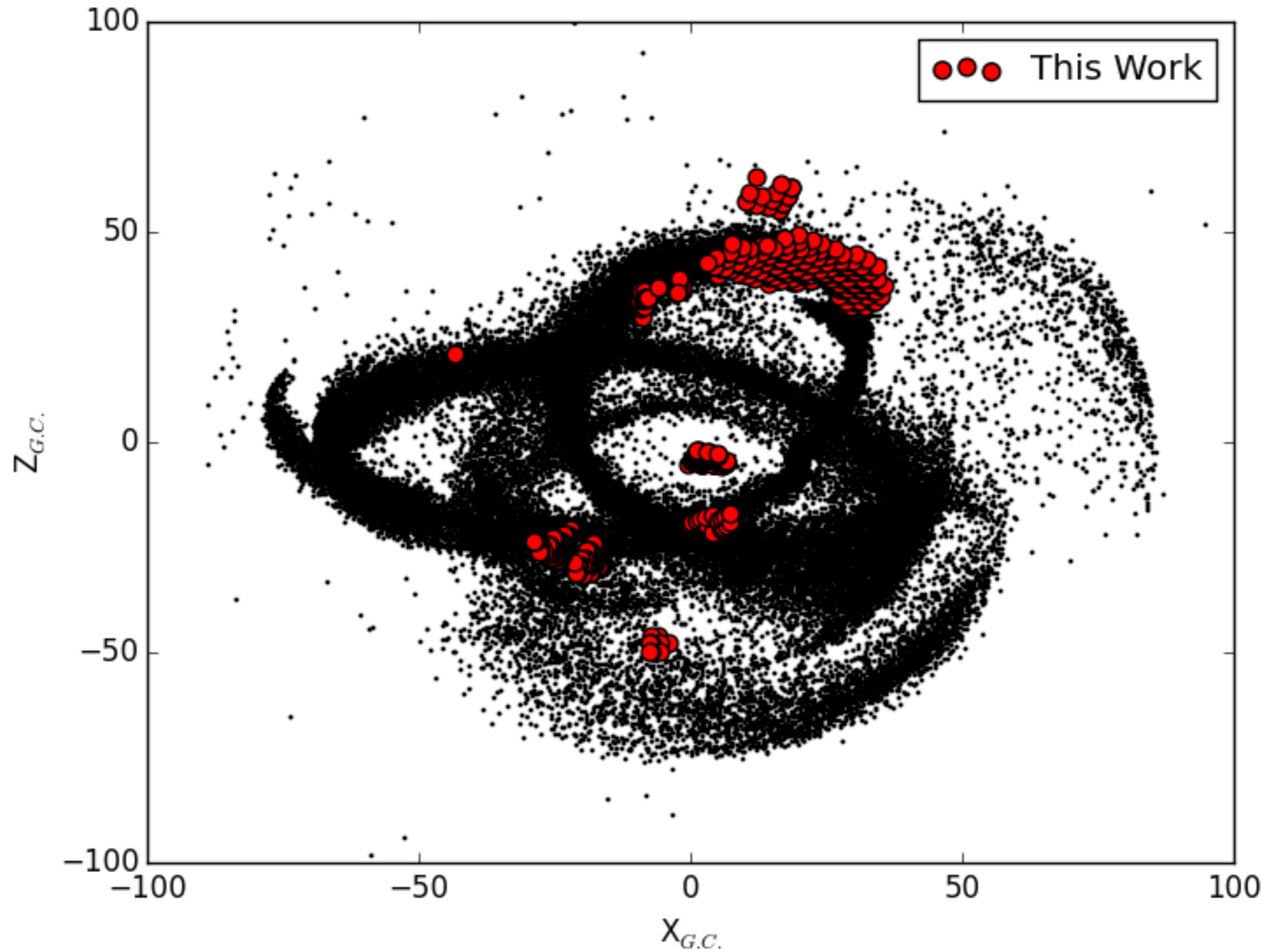
Comparison With Other Studies (Slater+ 2013)

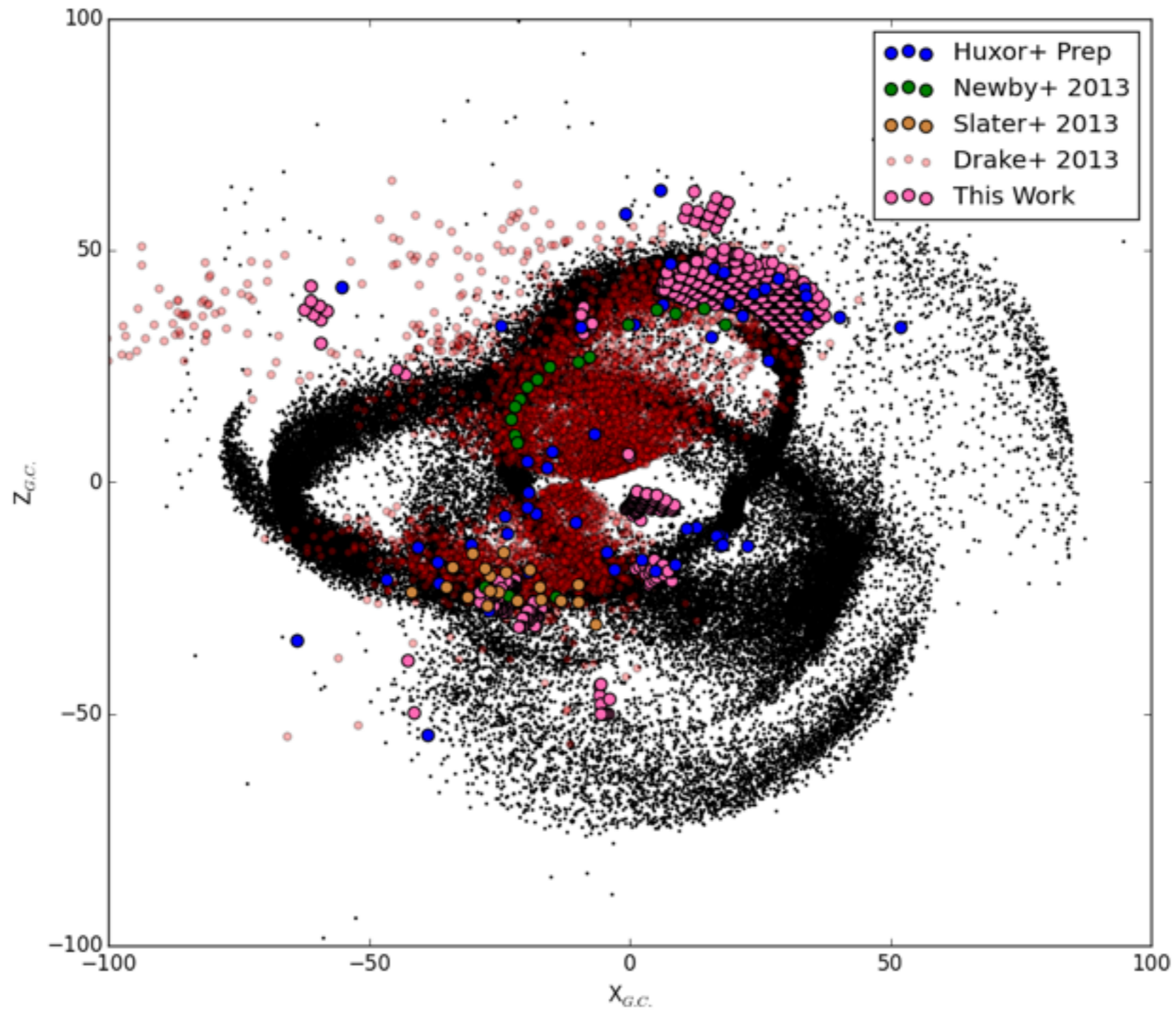# Comparison With Other Studies (Drake+ 2013)

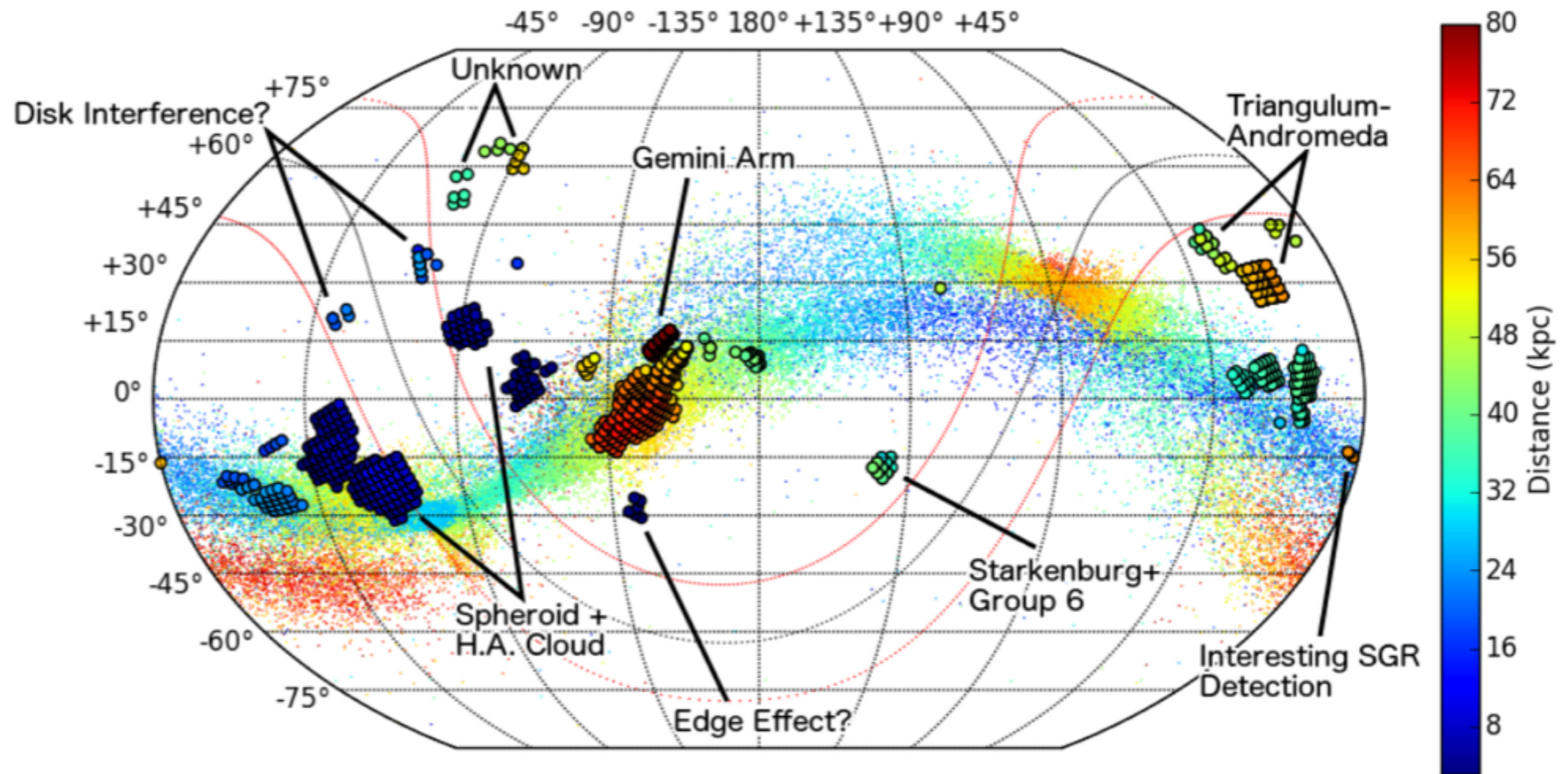# Comparison With Other Studies (Huxor+ Prep)

Comparison With Other Studies (This Work)

Comparison

Findings

Vickers Thesis

- See poster of Avon Huxor for this diagram in carbon stars

Supplemental Material

Search Equations

$$\text{Cube} = \Sigma(\text{stars}) \quad \forall \quad |l_{\text{star}} - l'| < 5° \quad \wedge \quad |b_{\text{star}} - b'| < 5° \quad \wedge \quad |r_{\text{star}} - r'| < 5\text{kpc}$$

$$\text{Pencil} = \Sigma(\text{stars}) \quad \forall \quad |l_{\text{star}} - l'| < 5° \quad \wedge \quad |b_{\text{star}} - b'| < 5°$$

$$\text{Ring} = \Sigma(\text{stars}) \quad \forall \quad |l_{\text{star}} - l'| > 5° \quad \wedge \quad |b_{\text{star}} - b'| < 5° \quad \wedge \quad |r_{\text{star}} - r'| < 5\text{kpc}$$
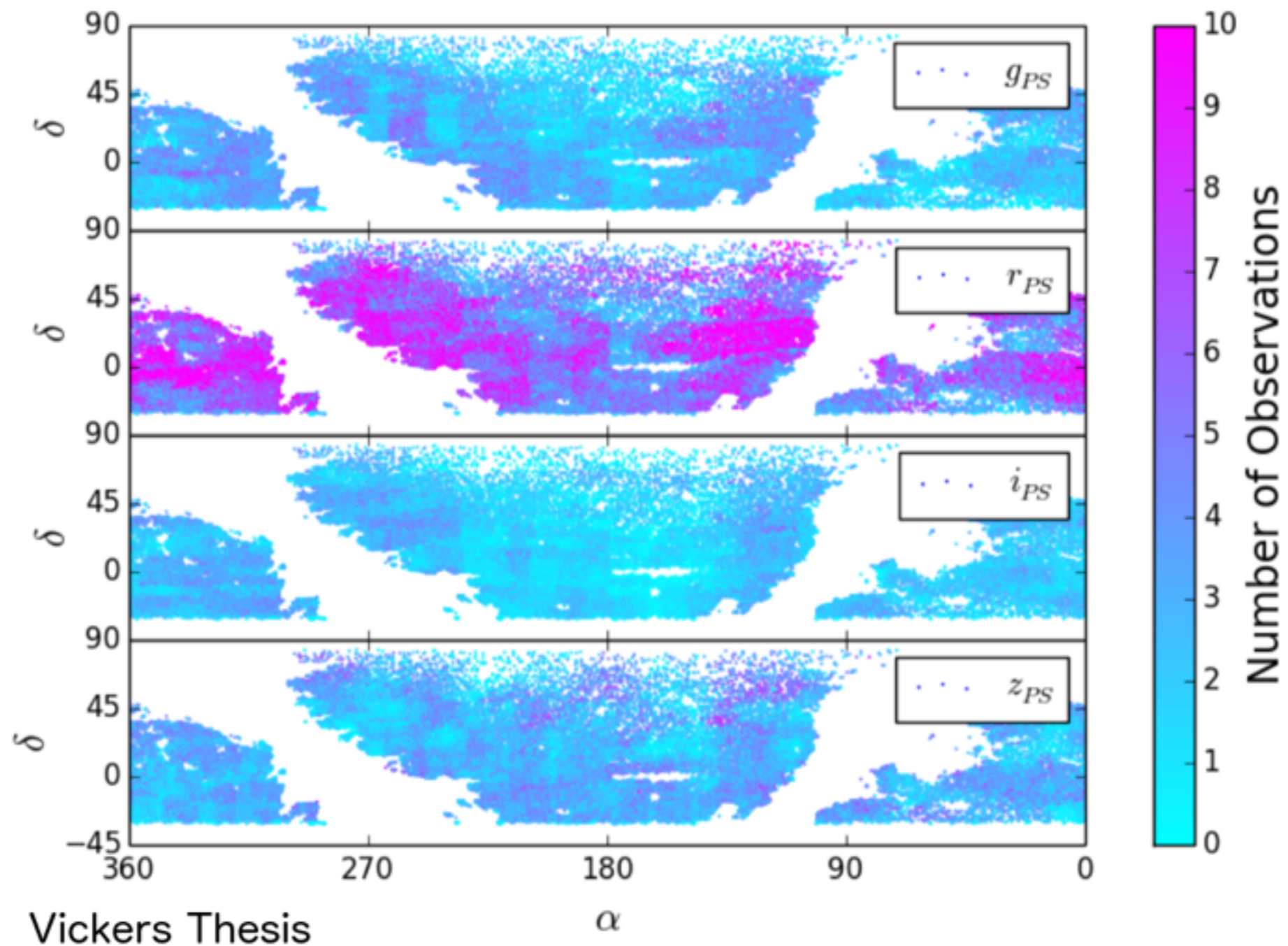
$$\text{Disk} = \Sigma(\text{stars}) \quad \forall \quad |l_{\text{star}} - l'| > 5° \quad \wedge \quad |b_{\text{star}} - b'| < 5°$$

$$\text{Cube Concentration} = \frac{\text{Cube}}{\text{Pencil}} \quad ; \quad \text{Field Concentration} = \frac{\text{Ring}}{\text{Disk}} \quad ; \quad \sigma = \frac{\sqrt{\text{Cube}^2 + \text{Ring}^2}}{\text{Pencil}}$$
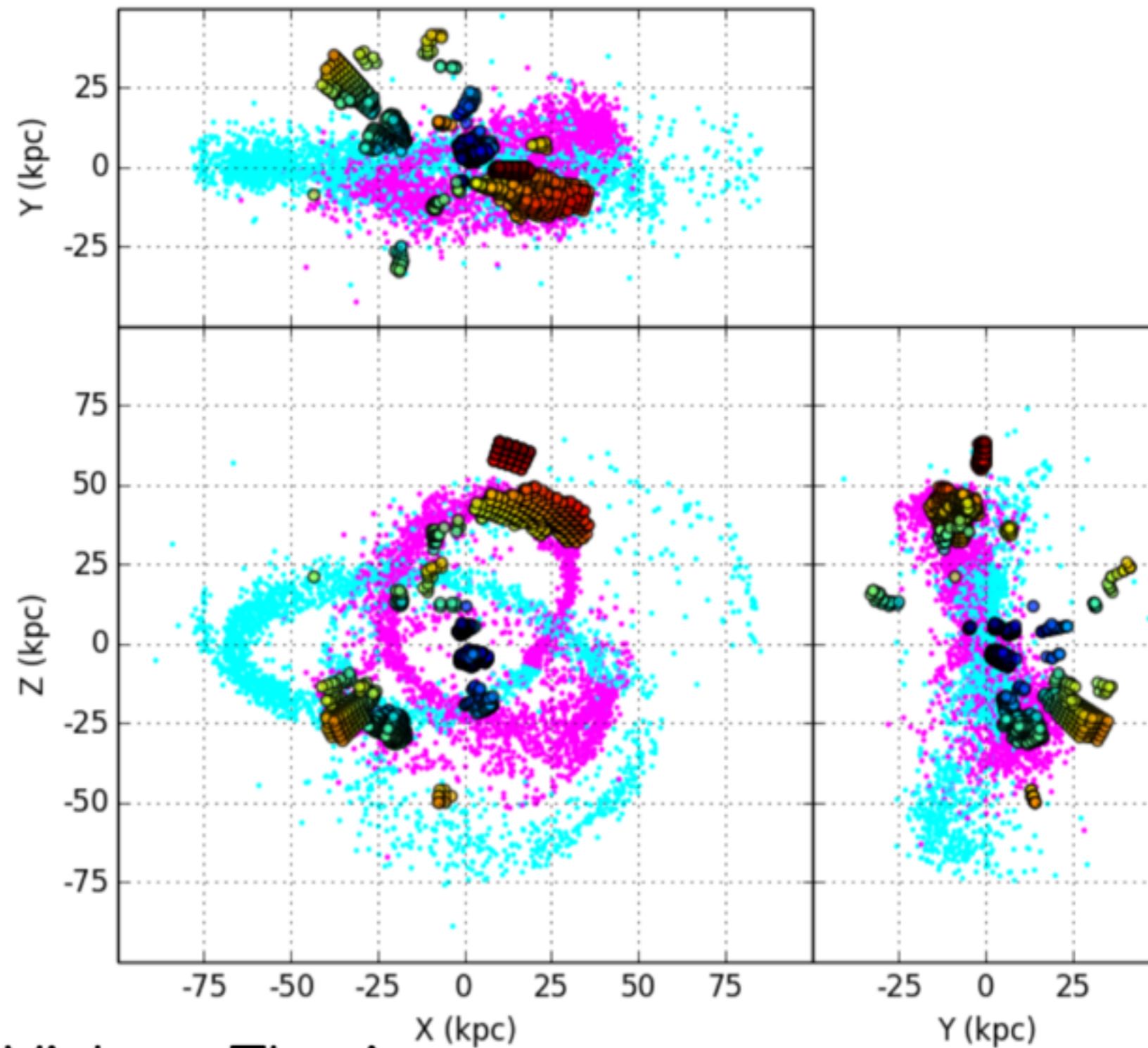
$$\text{Degree Overdensity} = \frac{\text{Cube Concentration} - \text{Field Concentration}}{\sigma}$$
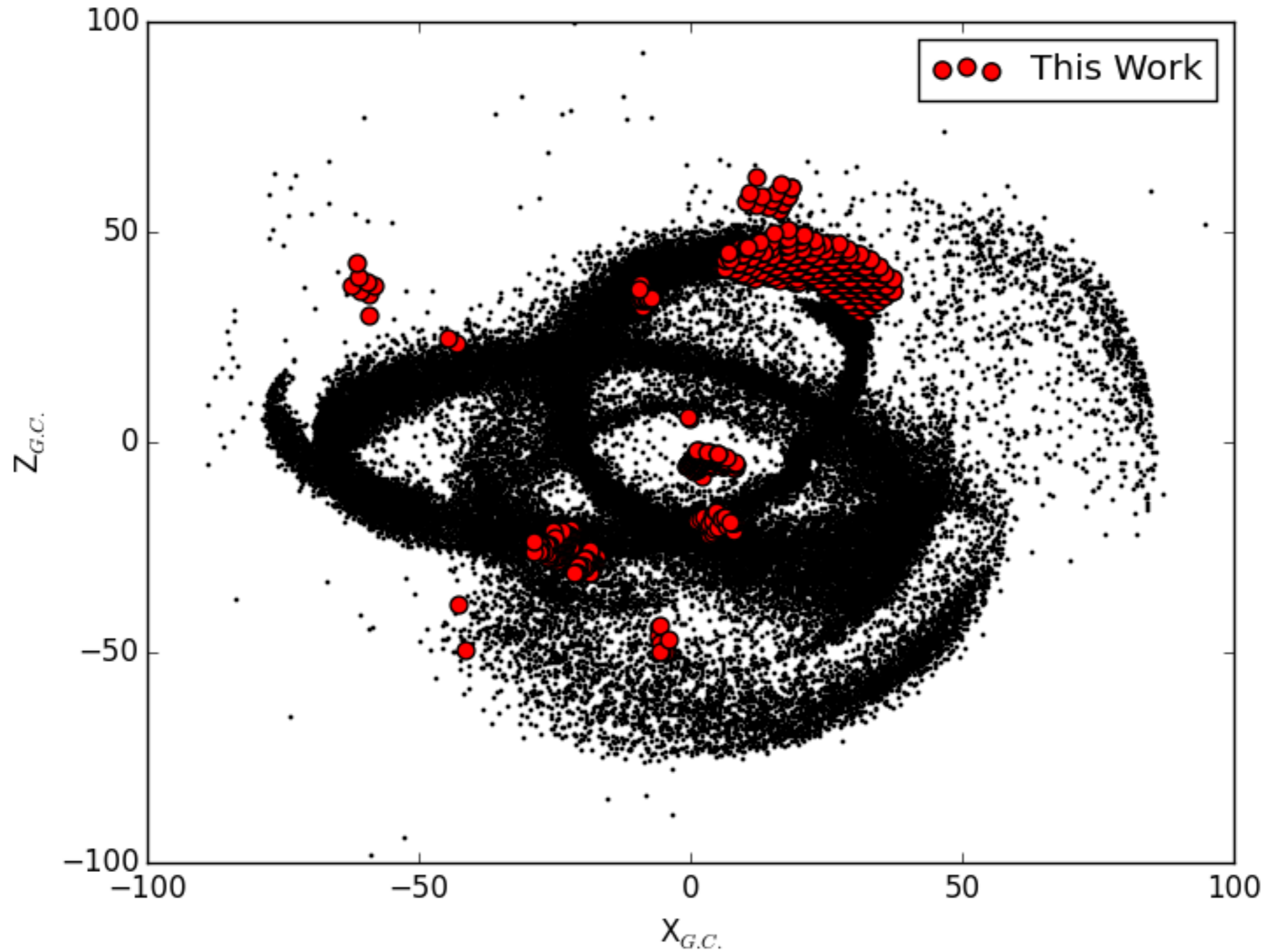
Pan-STARRS Data

- Inhomogeneous, time-resolved survey

Vickers Thesis

Findings

Vickers Thesis

Looser Color Selection

Tighter Color Selection

- W