UKIDSS GPS update

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UKIDSS IV   31 May 2012

Outline

1) Science Goals

2) Progress on observations and data releases

3) Science Results

Science Goals

- A Legacy Science database and atlas
  - 1 billion stars in the northern and equatorial plane at $|b|<5°$.
- Star formation on a large scale
  - New young clusters; large increase in number of known YSOs; propagation of star formation across Giant Molecular Clouds and behind spiral arms.
- Galactic structure and history
  - Edge of the Galactic disc; structure of the Galactic bar; old clusters
- Characterising the Galactic X-ray population
- Detection of rare objects

Milky Way Surveys coming of age

Optical: IPHAS and UVEX (north) and VPHAS+ (south) u,g,r,i,Hα

Near IR: UKIDSS GPS (northern/equatorial) and VISTA VVV (southern, smaller but synoptic)

Near-mid-far IR: *Spitzer* GLIMPSE I, II and 3D (l = 295 to 65°) 3-8 um
MSX, 0<l<360°, |b|<5°, ~20" resolution 4-21 um
WISE all sky, ~6" resolution 3-23 um
Warm *Spitzer* GLIMPSE360, l=65-295°, |b|<3° 3-5 um
Warm *Spitzer* Deep GLIMPSE, 0<l<360° 3-5 um

Spitzer MIPSGAL. (24-70 um), covers GLIMPSEI-II regions 24, 70 um
Akari all sky coverage at 9, 50, 100, 150 um.

Submm: HERSCHEL Hi-Gal, 0<l<360 at |b|<1° 50-500 um
JCMT/SCUBA-2. JPS l=? |b|<1° 450, 850 um
SASSy l,b=? 850 um

Radio: CORNISH 5 GHz VLA survey, GLIMPSE-North region.
CORNISH-south 5 GHz ATCA survey.
MMB: Methanol Maser Survey at Parkes
BOLOCAM GPS mm survey (10<l<90°, |b|<0.5°)

X-ray and Gamma ray: INTEGRAL, |b|<5°, complete. Swift, *Fermi*, all sky.
ROSAT all sky.
XMM, CHANDRA – smaller surveys.

GPS Observations

- JHK imaging in photometric conditions. Typical seeing 0.8” at K.

  All 3 bands observed within a 20 minute period.

  Integration times are 80s, 80s, 40s at JHK.
  2x2 microstepping is used to improve resolution, giving 0.2” pixels.

  5 sigma depths in uncrowded fields

  J=19.8

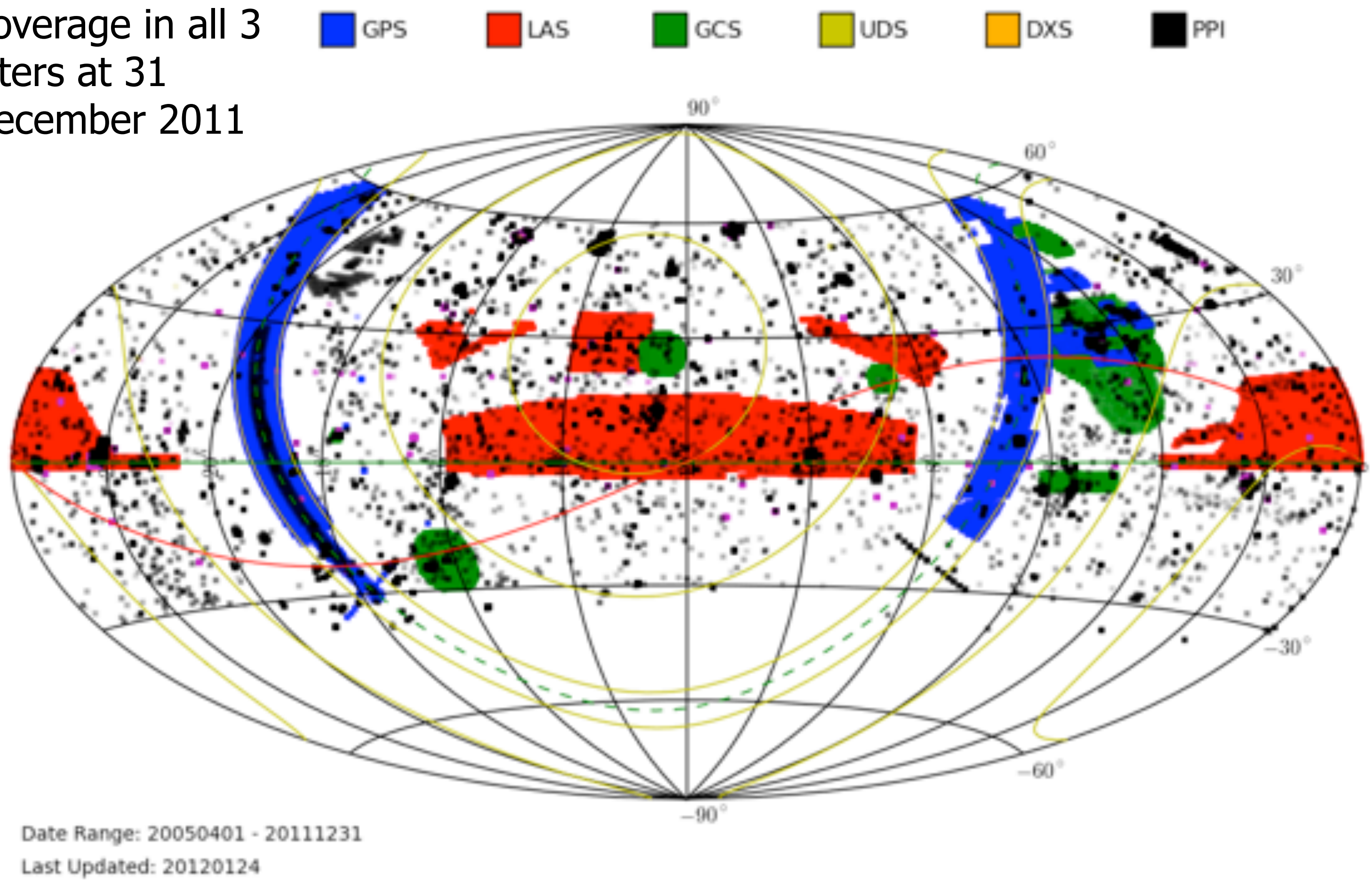
  H=19.0

  K=18.1

- 2nd epoch imaging at K for proper motions and variability
  - Thin cirrus conditions are allowed

Progress: observations

Coverage in all 3 filters at 31 December 2011



Progress: observations

JHK observations are complete: 1845 sq. deg in the plane

- some mopping up of fields that failed quality control is desired
- this takes only a few hours of UKIRT time.

2nd epoch K band: 62% complete (1140 sq deg.)

68% in the summer fields

56% in the winter fields

- we would like to finish the remaining 38%
- this takes ~25 hrs per year in 2012 & 2013 in thin cirrus time

Progress: releases and calibration

- Current release is DR8 (51% of survey, 700 million sources).
  - Benefits from improved photometric calibration
    - update to the extinction term in the 2MASS – UKIRT photometric transformation
    - updated aperture corrections (important in very crowded fields)
    - minor update to selection of 2MASS calibrators in each field
  - Overlap analysis is very encouraging.
    - ~90% of adjacent fields have calibrations consistent to within 0.03 mag.
    - <0.1% of adjacent arrays differ by >0.1 mag.

- Next release is likely to be DR10, adding data from 10A,10B,11A & 11B.
  - Will benefit from improved quality control using the SQL database
  - A search for fields with large mean(Apermag1-Apermag3) finds a lot of the fields with the channel edge problem or lost guiding
  - Colour-based searches may also help

- PSF photometry is needed for the final release.

Science Results

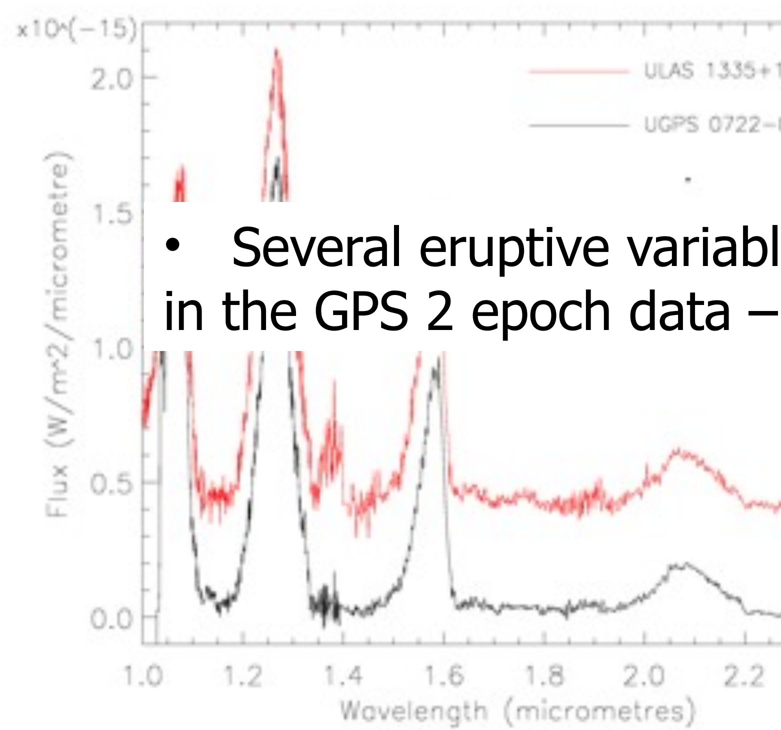
- The Legacy database is being used, increasingly by US astronomers as well as Europeans. DR7 is world public.
  - The GPS group paper (Lucas et al.2008) has 79 citations, 19 in 2012.

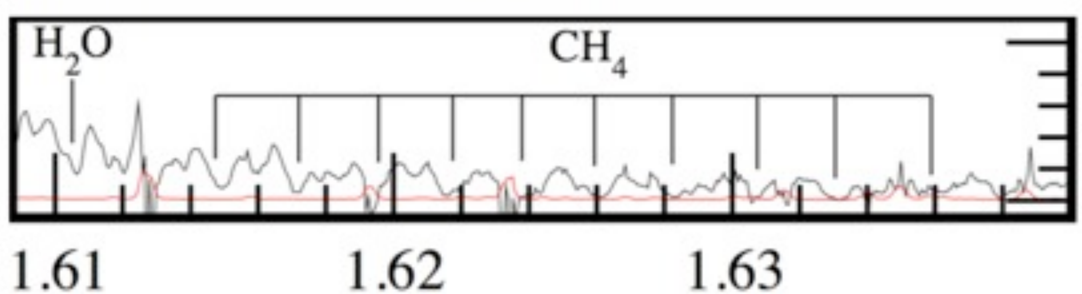
2012 papers

- 1 Ioannidis & Froebrich, D. 2012, MNRAS, 421, 3257. UWISH2 H_2 + GPS work
- 2 Foster, et al.2012, ApJ in press. Extinction-based distances to dark clouds
- 3 Hussman et al.2012, A&A, 540, A57. Quintuplet cluster study
- 4 Solin et al.2012, A&A in press. New GPS clusters from DR7
- 5 Kargaltsev et al.2012, ApJ, 748, 31. A new magnetar from Swift (IR upper limit).
- 6 Scholz, A., 2012, MNRAS, 420, 1495. Variability of T Tauri stars in the GCS and GPS
- 7 Verbeek K., et al.2010, MNRAS,420, 1115. UVEX UV excess sources, including a GPS cross match
- 8 Mottram & Brunt, 2012, MNRAS, 420, 10. A cluster of outflows in the Vulpecula Rift
- 9 Wright et al.2012, ApJL, 746, L21. Photoevaporating proplyd-like objects in Cygnus OB2
- 10 Longmore et al.2012, ApJ, 746, 117. G0.253 + 0.016: A molecular cloud progenitor of an Arches-like cluster
- 11 Palau et al.2012, MNRAS in press. A proto-brown dwarf search in Taurus (GPS+GCS).

Past science highlights (1. Rare objects)

- Detection of a very cool, very nearby brown dwarf, UGPS 0722-0540 (Lucas et al.2010, MNRAS, 408, L56)
  - Was the coolest known brown dwarf at the time (~520 K, type T9/T10).
  - Still the nearest brown dwarf primary (4.12 pc)
  - At J=16.5, it is bright enough for medium resolution spectroscopy of





- Several eruptive variable Young Stellar Objects have been detected in the GPS 2 epoch data – update by Carlos Contreras tomorrow.

Galactic structure)

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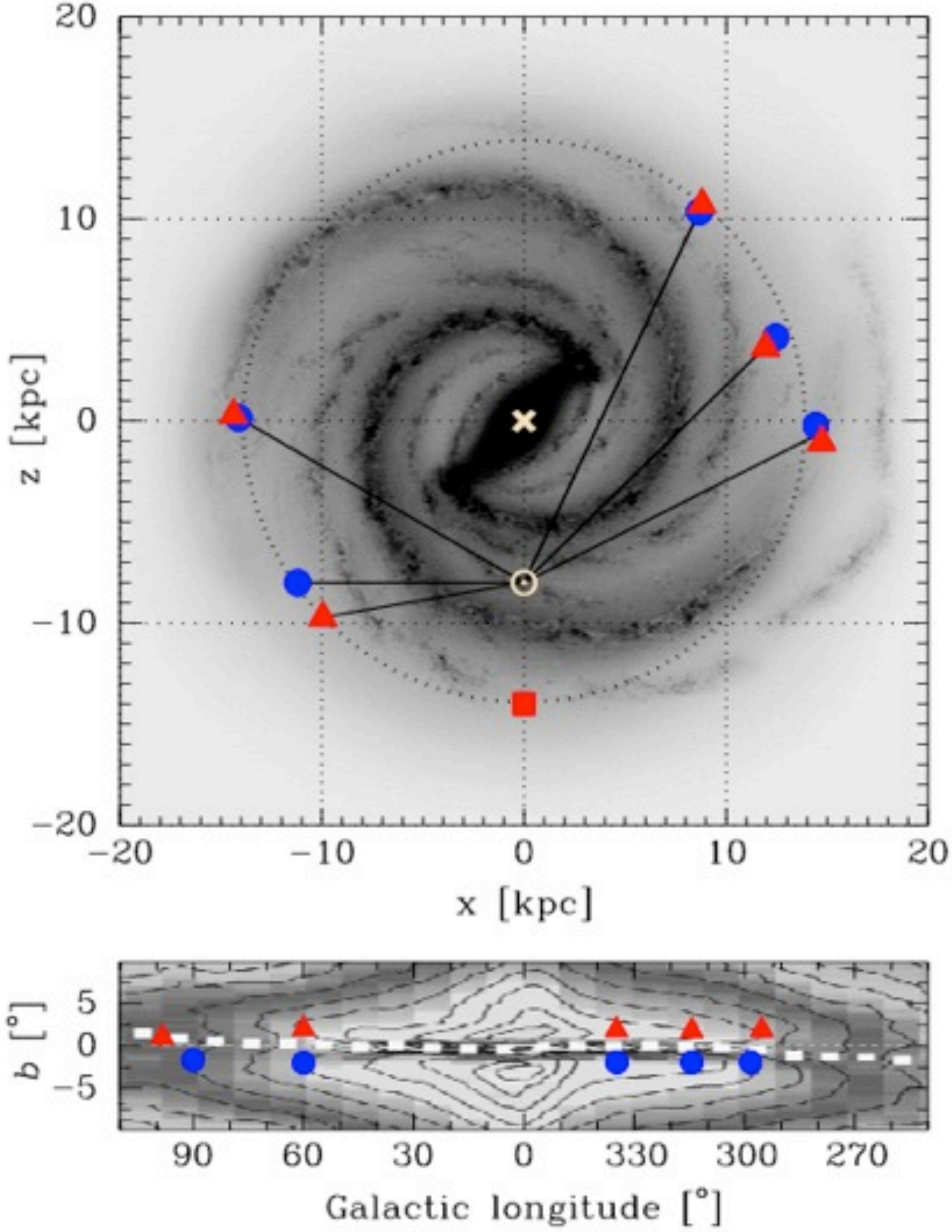
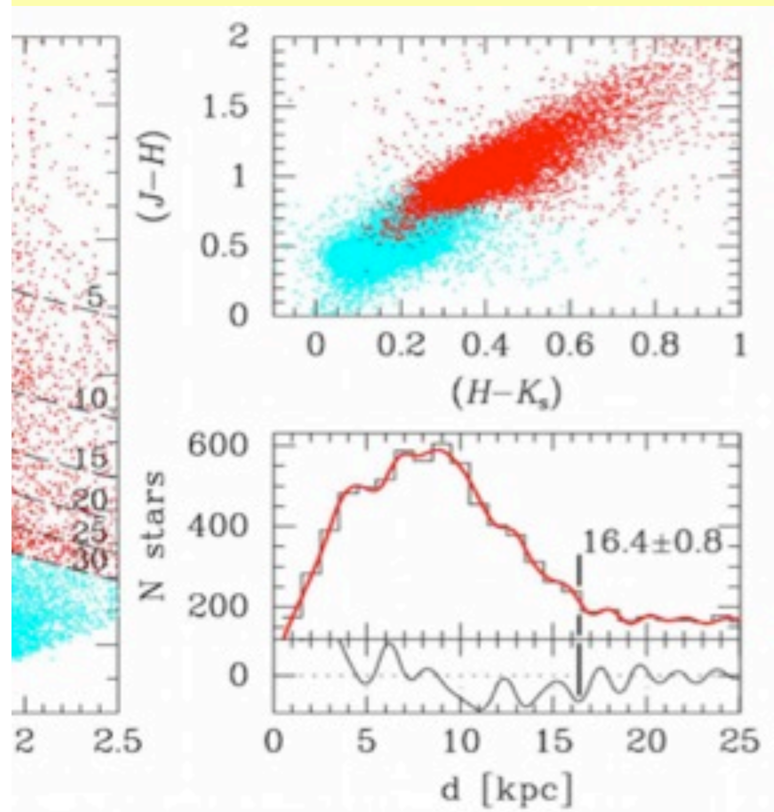
-/- 0.5 kpc, as traced by
d 4.





Ongoing science (1. Clusters)

Why study clusters?

Star formation

1) Measure variations in the IMF at low mass, e.g. η Cha cluster (Lyo et al.2006)

2) Measure the Cluster Luminosity Function

3) Search for Young Massive Clusters – rare but important

4) Cluster structure as clues to
   i) Initial conditions of cluster formation (Allison, Goodwin et al.2009, 2010)
   ii) the cluster evaporation process

5) Cluster location within Giant Molecular Clouds
   probe propagation of star formation across GMCs, in combination with tracers of imminent star formation (**dense clumps, methanol masers**)

Why study clusters?

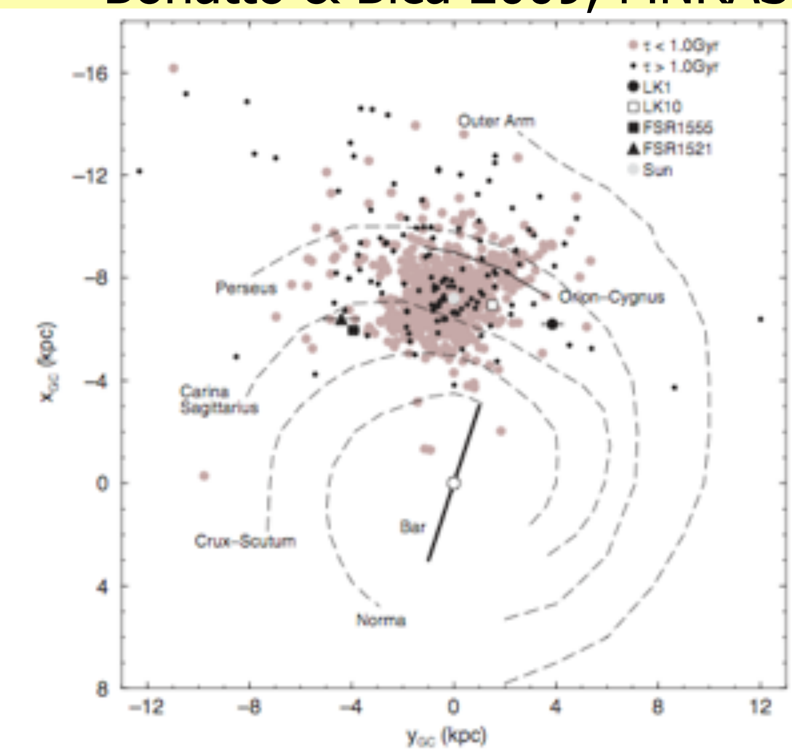
<u>Galactic structure</u>

- PMS clusters – trace spiral arms and structure within arms
- Main sequence clusters

  Another probe of the edge of the Galactic disc

  Old metal poor clusters are rare. They provide clues to the origin of the Galactic disc.

Bonatto & Bica 2009, MNRAS



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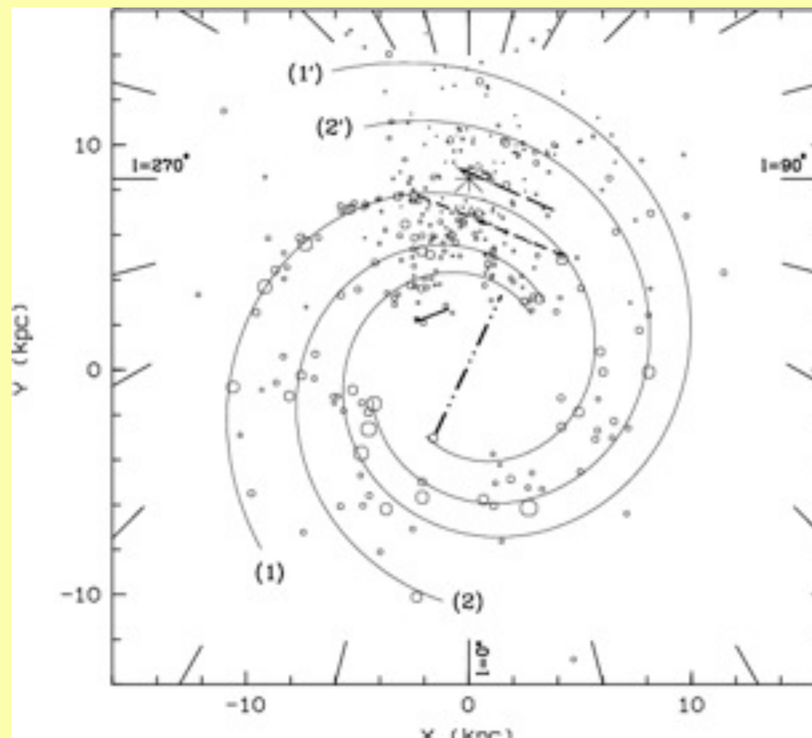
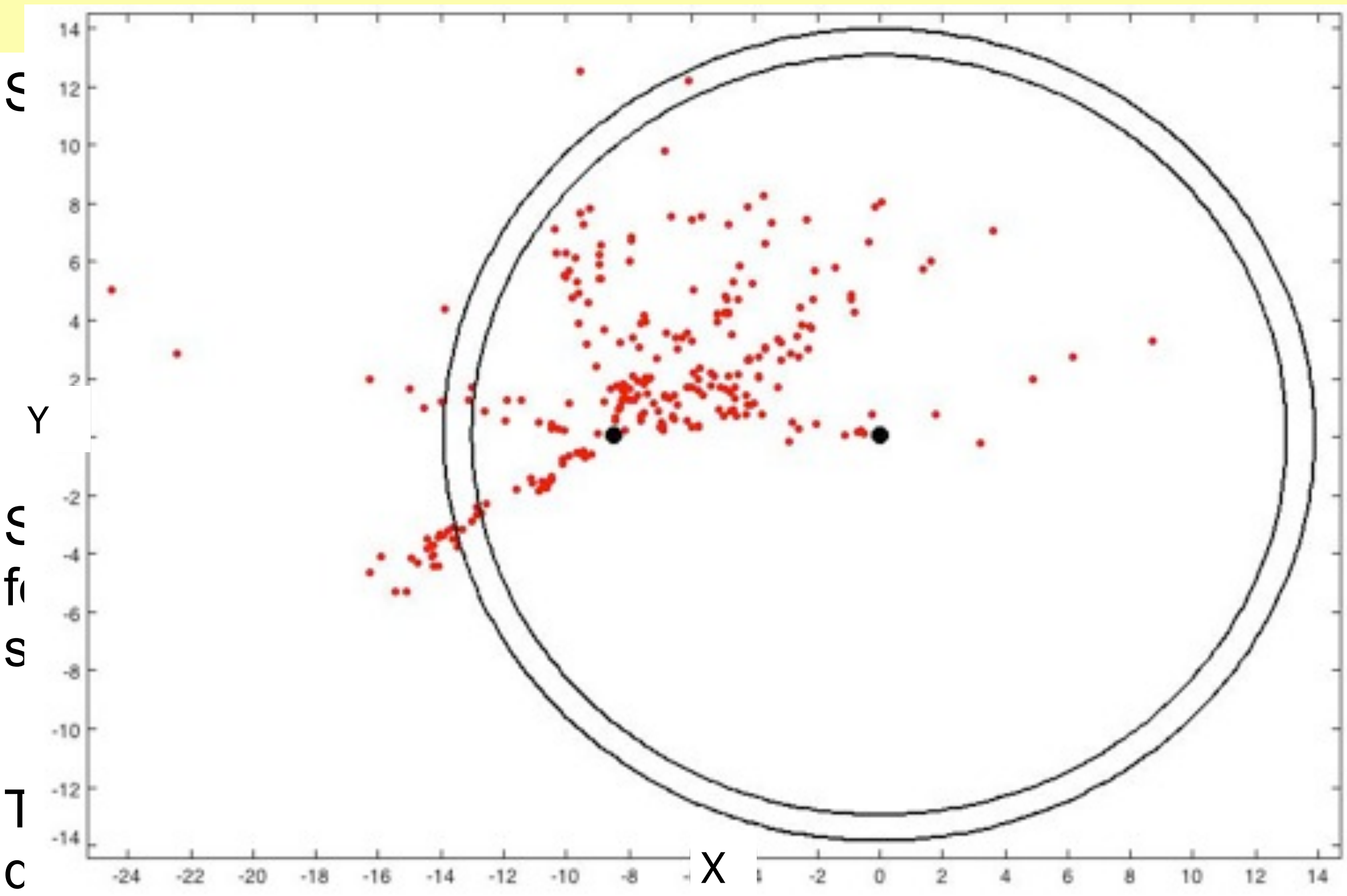


Ongoing science



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- S … of star f… ılactic s…
- T … ce c… ɔts of people, especially David Bush).

Ongoing science

- GPS+*Spitzer* GLIMPSE360 cross match to detect red objects (YSOs). Basmah Riaz's talk tomorrow.
  - Also including IPHAS optical data.
- GPS+IPHAS detection of YSOs via Halpha excess + K band excess. Geert Barentsen – work in progress.
- Variability and proper motion searches with the 2 epoch data.
  - 150 sq. deg. investigated, 1650 sq deg to go…. talk by Carlos Contreras tomorrow.
- Investigation of the extinction law
  - re-evaluation by Stead & Hoare 2009, MNRAS, 400, 731

Lots of data to exploit for many years to come!