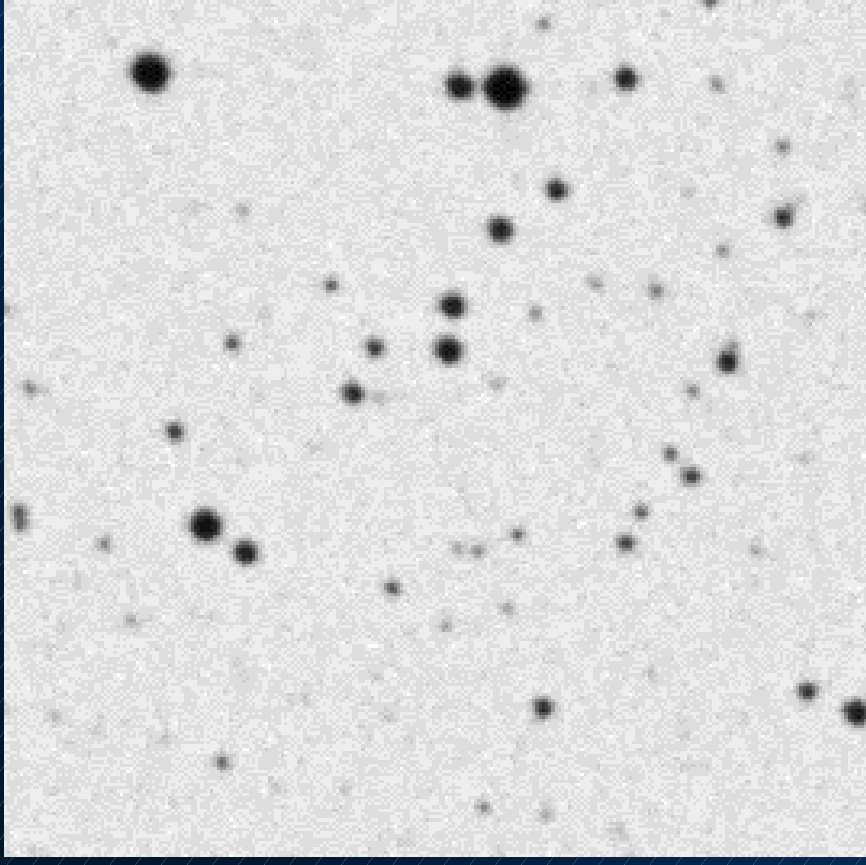


Proper motion surveys in the infrared



Centroiding accuracy

Following: King, 1983, PASP, 95, 163
Irwin, 1985, MNRAS, 214, 575

$$\sigma_x / a \sim \sigma_I / I$$

where:

a is the (well-sampled) image scale size (\sim pixel size)

x is either co-ordinate

I is the intensity

\Rightarrow a 5-sigma detection will have centroid accuracy of
one fifth of a pixel, etc.

Panoramic (near) infrared surveys currently available

Legacy (first epoch) :

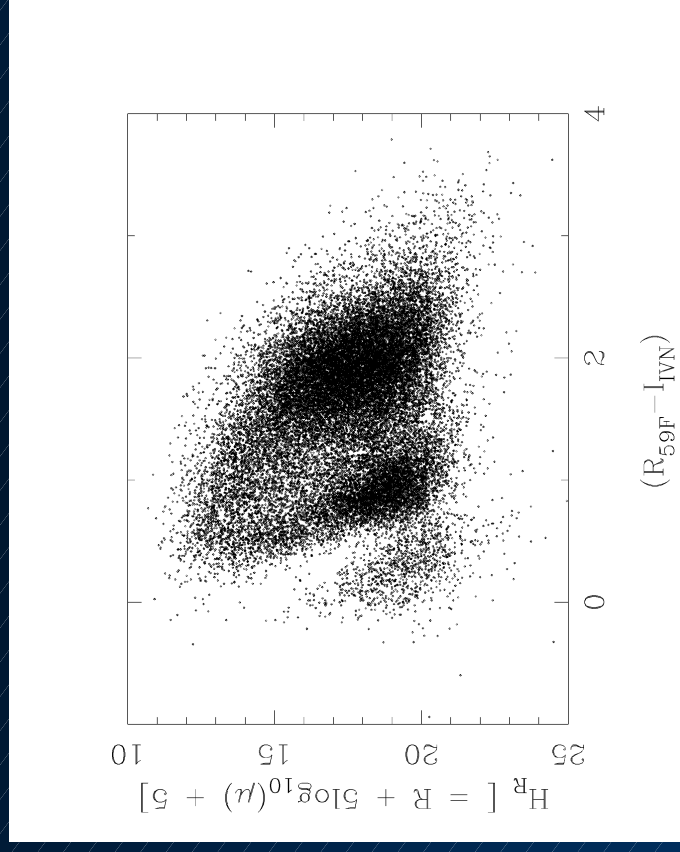
- Schmidt photographic digitised sky surveys:
 - I ~ 18.5
 - USNO-B, GSC-II, SuperCOSMOS Sky Survey (SSS)

Recent (second epoch):

- Two-micron all-sky survey (2MASS):
 - J~15.8 ; H~15.1 ; K~14.3
- Deep near-infrared southern sky survey (DENIS):
 - I~18.5 ; J~16.5; K~14.0
- Sloan Digital Sky Survey:
 - i~21.3 ; z~20.5

⇒ all provide relative astrometry to ~0.1 arcsec,
and hence a combined pm accuracy ~10 mas/yr

Proper motion as an indicator of absolute luminosity



Following Hertzprung:

$$M = m - 5 \log_{10} d + 5$$

$$\mu = v_T / 4.74d$$

$$\therefore M = m + 5 \log_{10} \mu + 5 + c$$

⇒ 5-sigma proper motions are required for clear population separation in reduced proper motion.

SuperCOSMOS Sky Survey

<http://www-wfau.roe.ac.uk/ssss>

Bookmarks Location: <http://www-wfau.roe.ac.uk/ssss/> What's New!

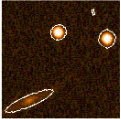
SuperCOSMOS Sky Surveys (SSS)

These pages provide on-line access to the digitised data derived from SuperCOSMOS scans of photographic Schmidt survey plates.


Users can extract images (pixel data) up to 15 arcmin across and/or object catalogues covering up to 100 sq. degrees. The data cover three wavebands (BRI), with one colour (R) represented at two epochs.

First-time visitors are encouraged to read the [Introduction](#) and relevant pages under [Documentation](#).

The [examples page](#) is a good starting point if you're unfamiliar with astronomical coordinates and explains how to extract images of some interesting objects.



(a) small-area image extraction example



(b) two-epoch catalogue generation example

[Home](#) | [Intro](#) | [Get an Image](#) | [Get a Catalogue](#) | [Coverage](#) | [Documentation](#) | [History](#) | [Links](#)

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WFAU IFA ROE

SuperCOSMOS Science Archive

The SuperCOSMOS Science archive holds the object catalogue data extracted from scans of photographic Schmidt survey plates.

At around 2.5 terabytes in size, the database contains 3.7 billion individual object detections which are merged into over 1 billion multi-colour, multi-epoch sources and covers the southern celestial hemisphere (dec < +3.0) in three wavebands (BRI), with one colour (R) represented at two epochs.



Access to the data has previously been made available through the [SuperCOSMOS Sky Survey](#) pages. The SSA is based on the same underlying data but it is housed in a relational database (Microsoft SQL Server 2000). This platform allows users more power and control over how they can access the data.

A short description of the SSA database structure and content is given in the [Data Overview](#), for full details see the [Schema Browser](#).

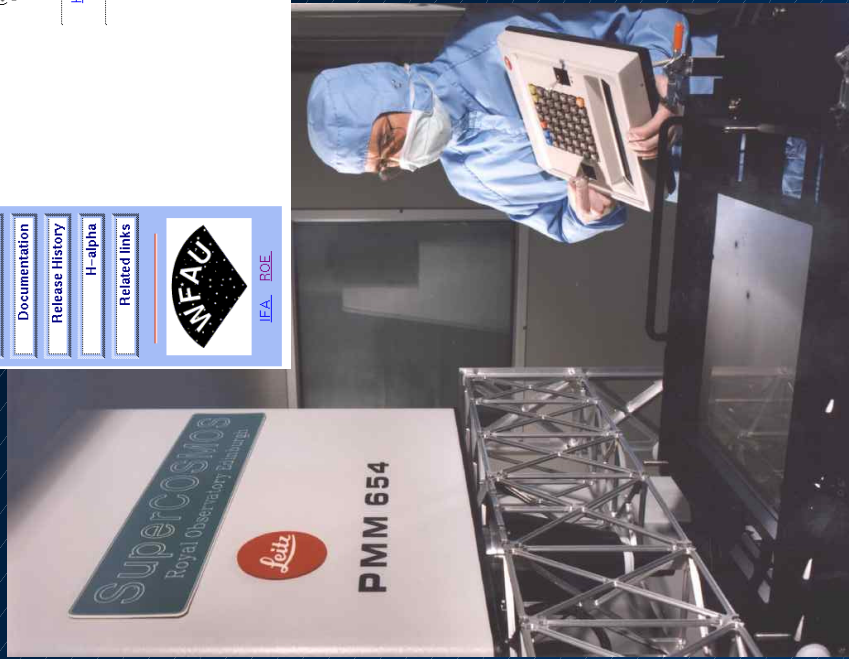
Users wishing to access the data should first read the general introductory notes under [Data Access](#).

Home | [Overview](#) | [Browser](#) | [Access](#) | [Cookbook](#) | [Links](#) | [Credits](#)

SSA Home
Data Overview
Schema browser
Data access
Radial
Menu query
Freeform SQL
CrossID
Cookbook
Personal SSA
Q&A
Release History
Links
Credits



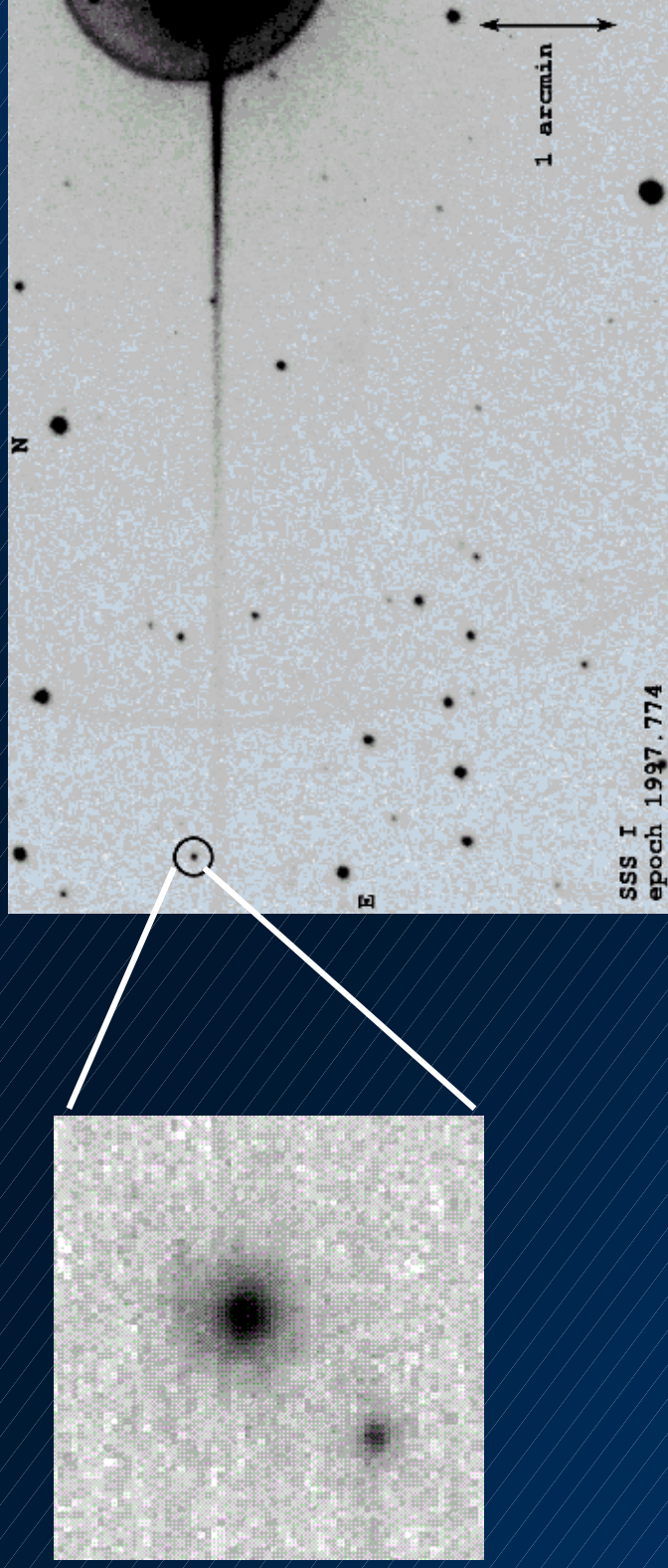
IFA ROE



<http://surveys.roe.ac.uk/ssa>

e.g. Scholz et al., 2003, A&A, 398, L29

- SSS and 2MASS
- common proper motion T dwarf companion to Epsilon Indi



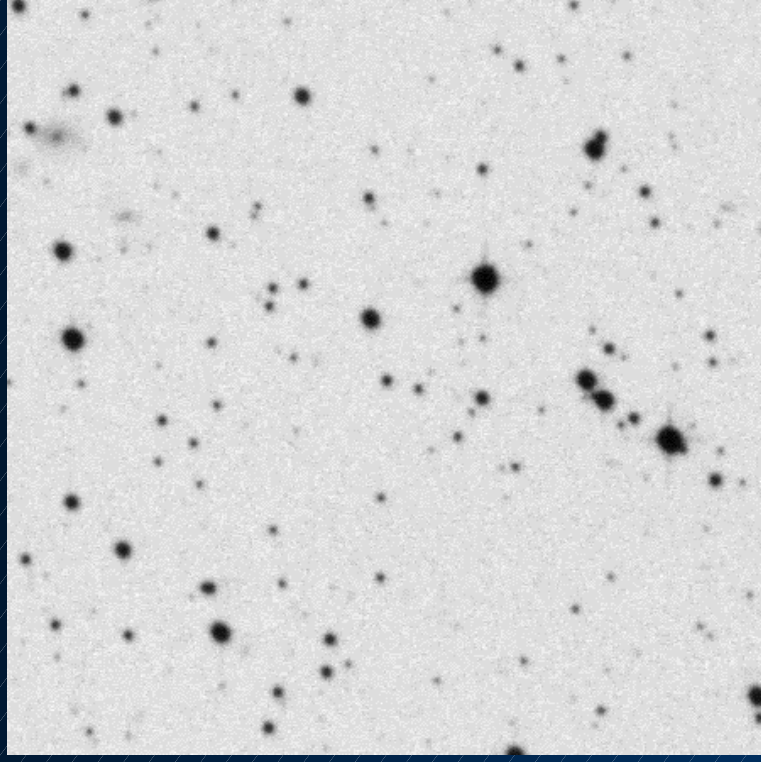
- McCaughrean et al., 2004, A&A, 413, 1029 : T1 / T6 binary !
- work being extended/completed by Scholz, Lodieu, et al.

Southern hemisphere Infrared Proper motion survey (SIPS)

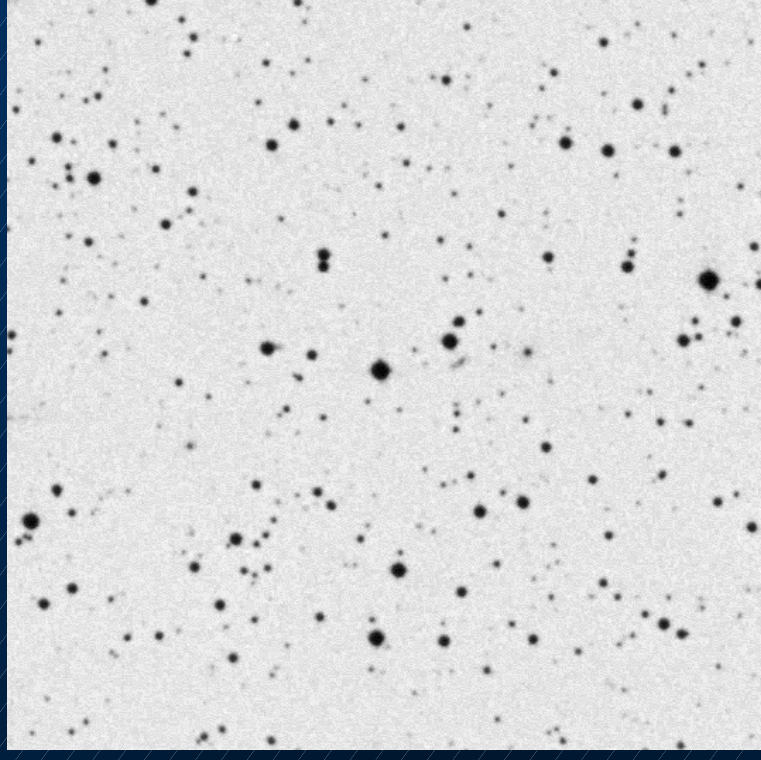
- Employing SSS I-band and 2MASS
- all sky except most crowded regions
 - Schmidt data cannot be used at low $|b|$ or M.C.s
- currently limiting $\mu > 0.5$ arcsec/yr
- extending work in progress:
 - lower proper motion limit
 - northern hemisphere
- identifying new, nearby stars

⇒ see Deacon, Hambly & Cooke, 2005, A&A 435, 363
(astro-ph / 0412127)

New high proper motion stars:

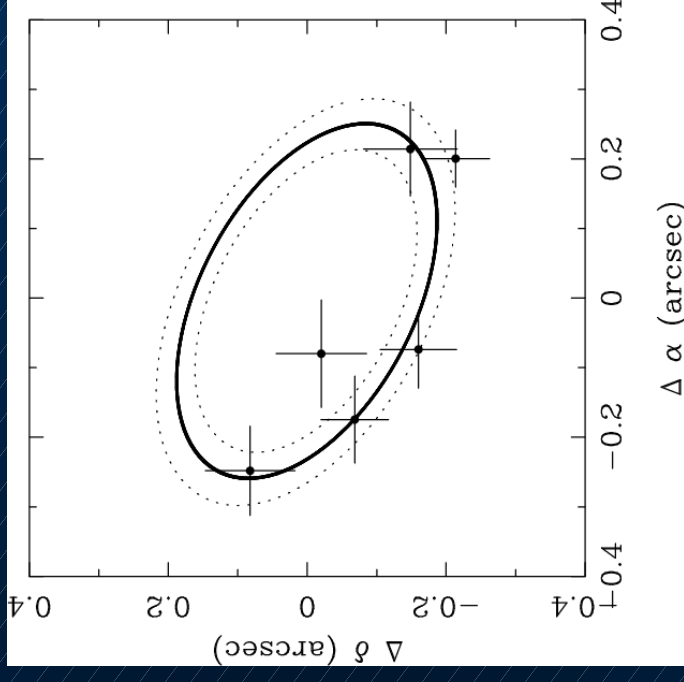
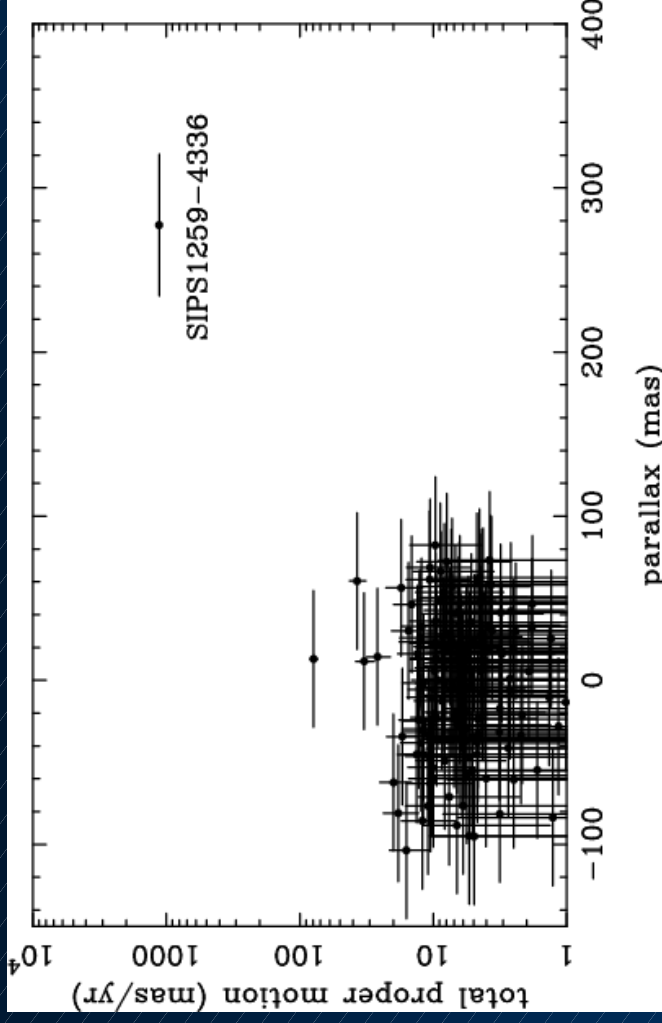


SIPS 1259 - 4336



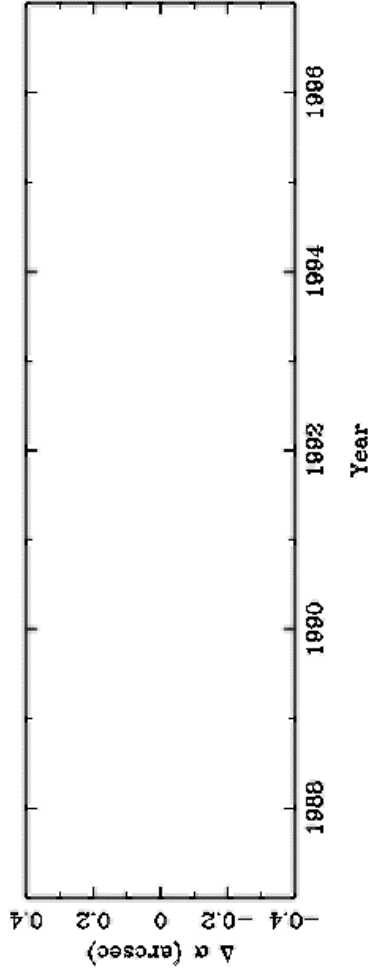
SIPS 1910 - 4132

SIPS 1259 parallax / proper motion

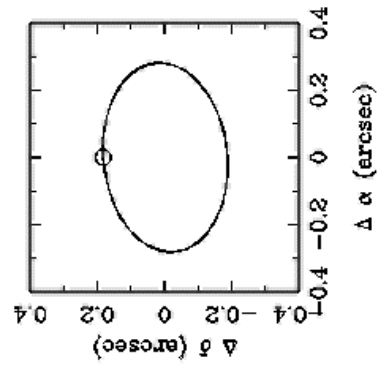
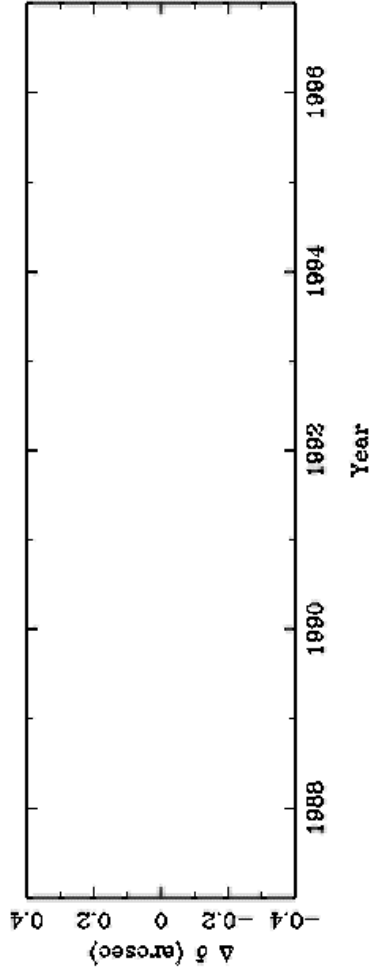


- **parallax = 276 +/- 41 mas**
- **$d = 3.6 +/- 0.5$ pc**

(a)

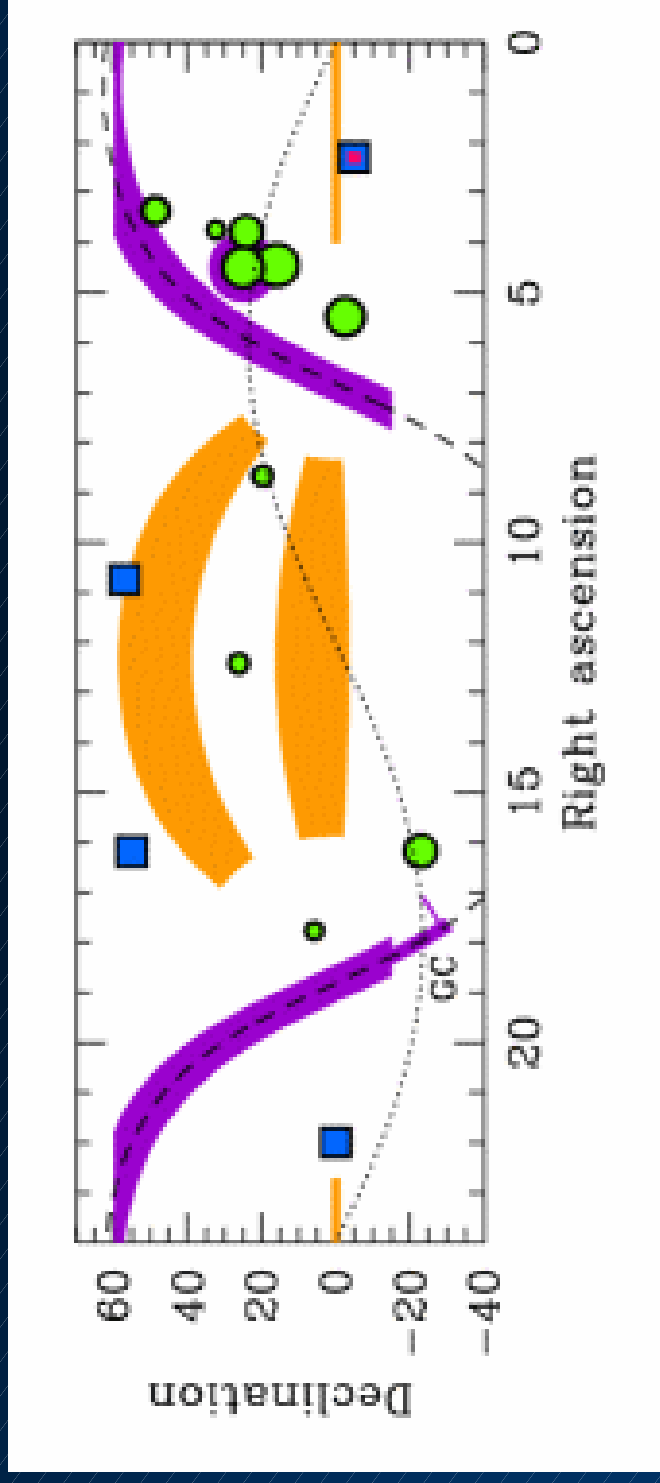


(b)



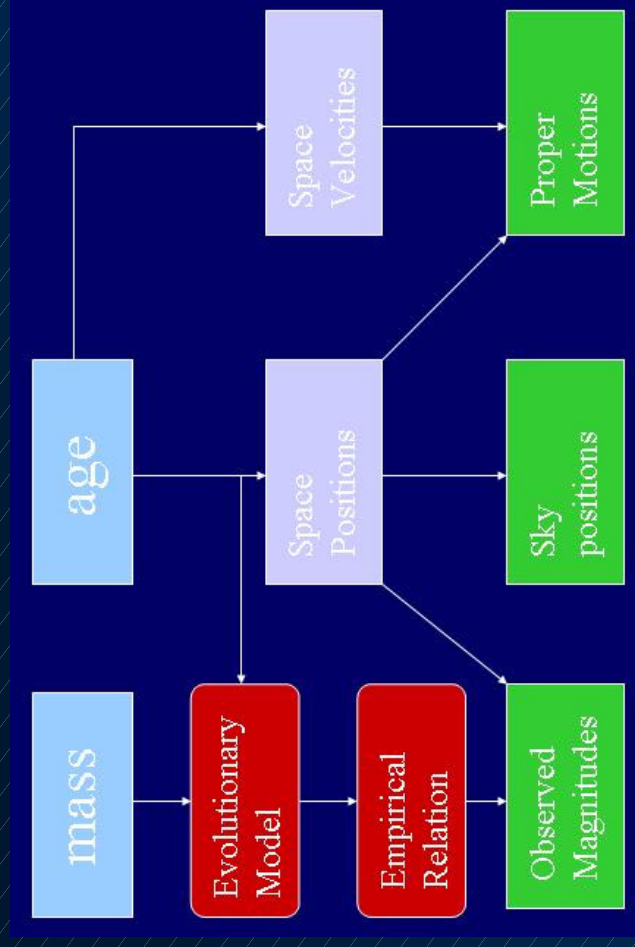
The new generation of IR surveys

- United Kingdom Infrared Deep Sky Survey (UKIDSS) Large Area Survey:
 - up to 4000 sq. degrees over ~ 5 yr
 - $Y \sim 20.5$; $J \sim 19.7$; $H \sim 18.8$; $K \sim 18.4$
 - *with J at two epochs!*



Simulated populations

- Assumed mass and age distributions
 - MF: power law & log-normal ($\log M_c = -1.1$; width = 0.79)
 - BR: exponential; characteristic timescale τ

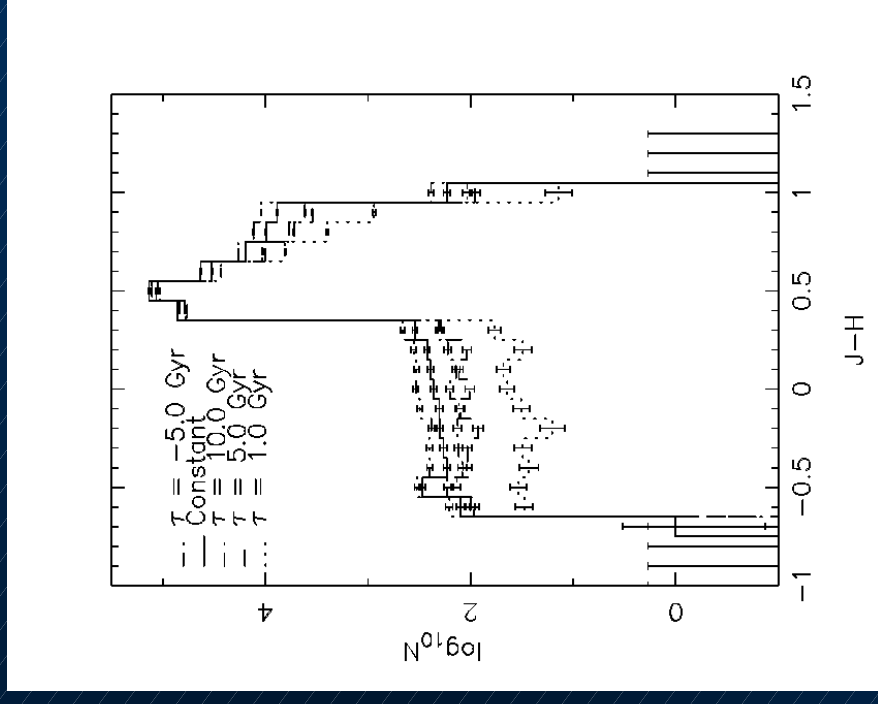
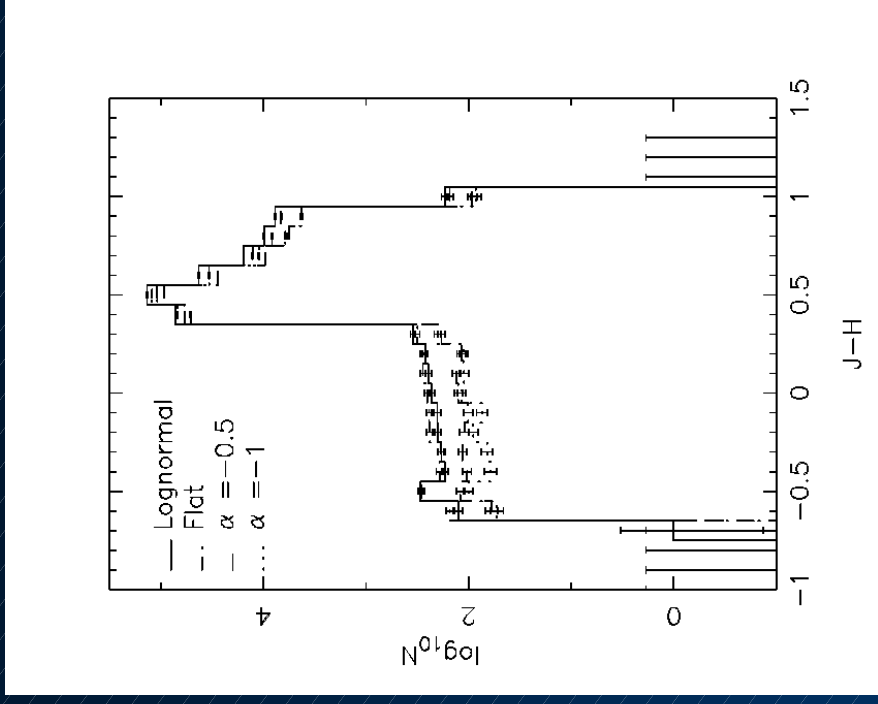


- Disk scale height and velocity dispersions modelled as increasing with age; also model photometric errors

⇒ some preliminary results follow

Distributions in (J-H) colour

- constant birth rate, varying the mass function



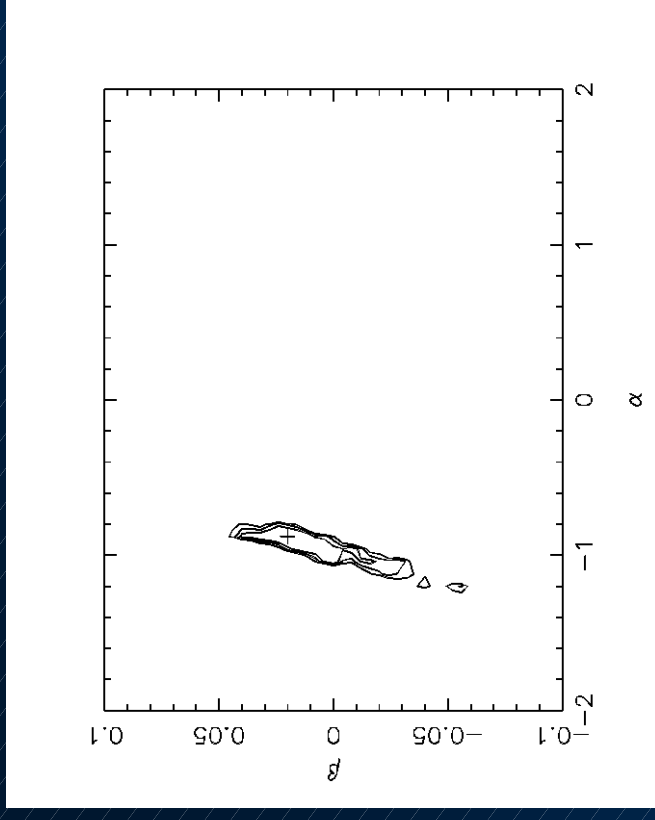
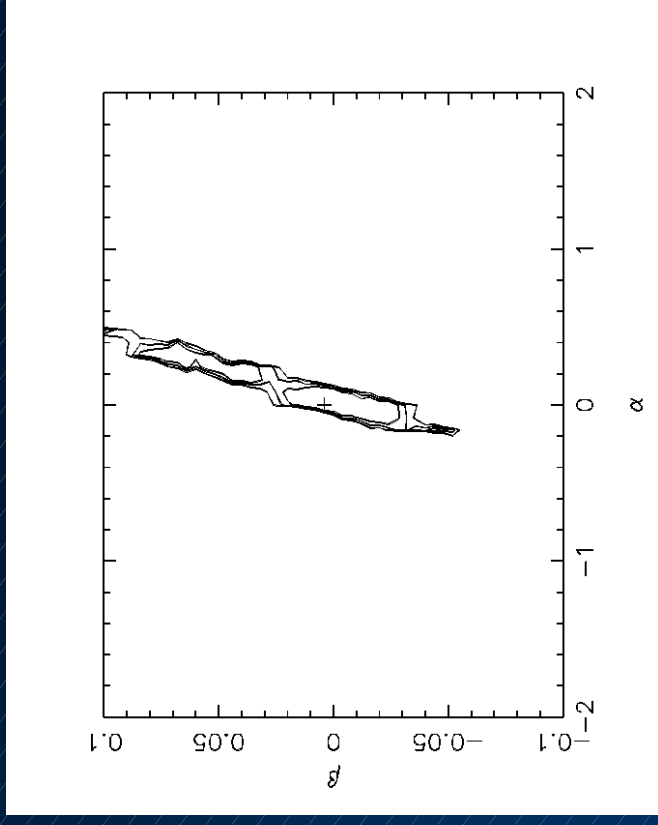
- constant mass function varying the birth rate

Constraining the birth rate and MF

Using a grid of simulated (J-H) distributions; compare a single model realisation (incl. errors) against the grid

- MF: $dN/d\log m$ power-law with index $-\alpha$

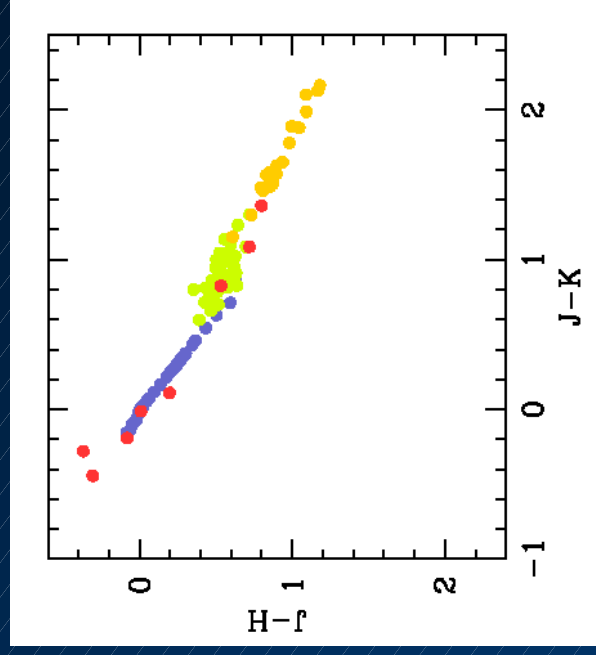
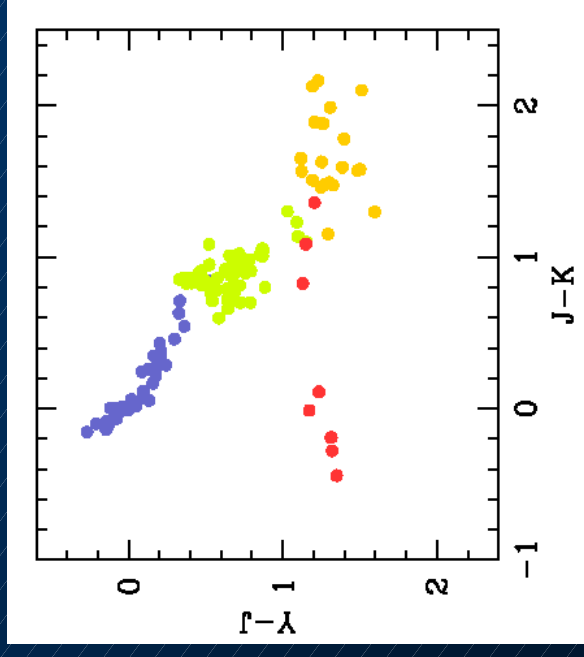
- $\alpha = 0.0$; const. BR
($\beta = 1/\tau = 0.0$)



- $\alpha = -1.0$; const. BR

Ultracool field dwarfs: the problem

- The coolest objects (e.g. “Y” dwarfs) may only be detected in a few bands (e.g. Y / J / H)
- Optical upper limits, and (weak) K upper limits, may not be sufficient to uniquely identify ultracool dwarfs

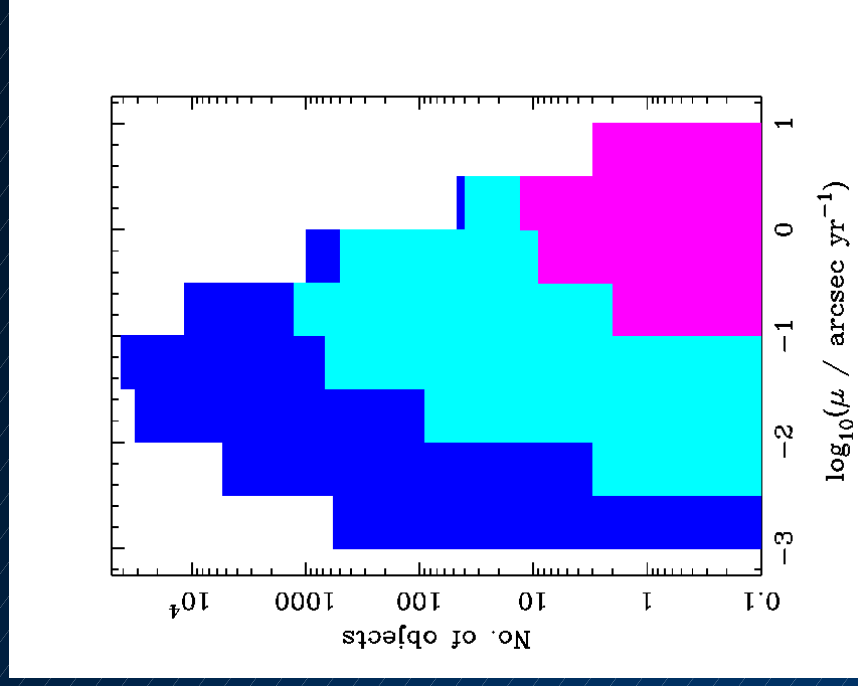


- earlier spectral types may cause significant contamination

⇒ photometric techniques alone may be insufficient to uncover the coolest objects

Distribution of proper motions

- For a UKIDSS LAS-like survey, with
 - log-normal mass function
 - constant birth rate
 - detection in K band not required for coolest objects



NOTE:

- the coolest objects are the faintest
- the faintest objects will only be observable *nearby*

⇒ *the coolest objects will all exhibit significant proper motions*

Conclusions

- Infrared proper motion surveys may be the easiest way to reliably select samples of the coolest objects
- The UKIDSS LAS should contain ~ 10s of “Y” dwarfs
- Proper motion measurements yield kinematic information also
- Modelling indicates that UKIDSS LAS will constrain ULM MF & BR.