The Local Group with LSST

Rodrigo Ibata
Observatoire Astronomique de Strasbourg
and
Nicolas Martin, Benoit Famaey, Ariane Lançon,
Pierre Ocvirk, Olivier Bienaymé, Christian Boily

image credit: J.-C. Cuillandre

What LSST buys us
(for Local Group science)

- Deep detections of candidate point sources
- Photometric measurements for Euclid point sources
- Variability
- Proper motion of faint point sources

Its hard to think of some area of study of the Local Group and its constituents that won't be transformed by LSST!

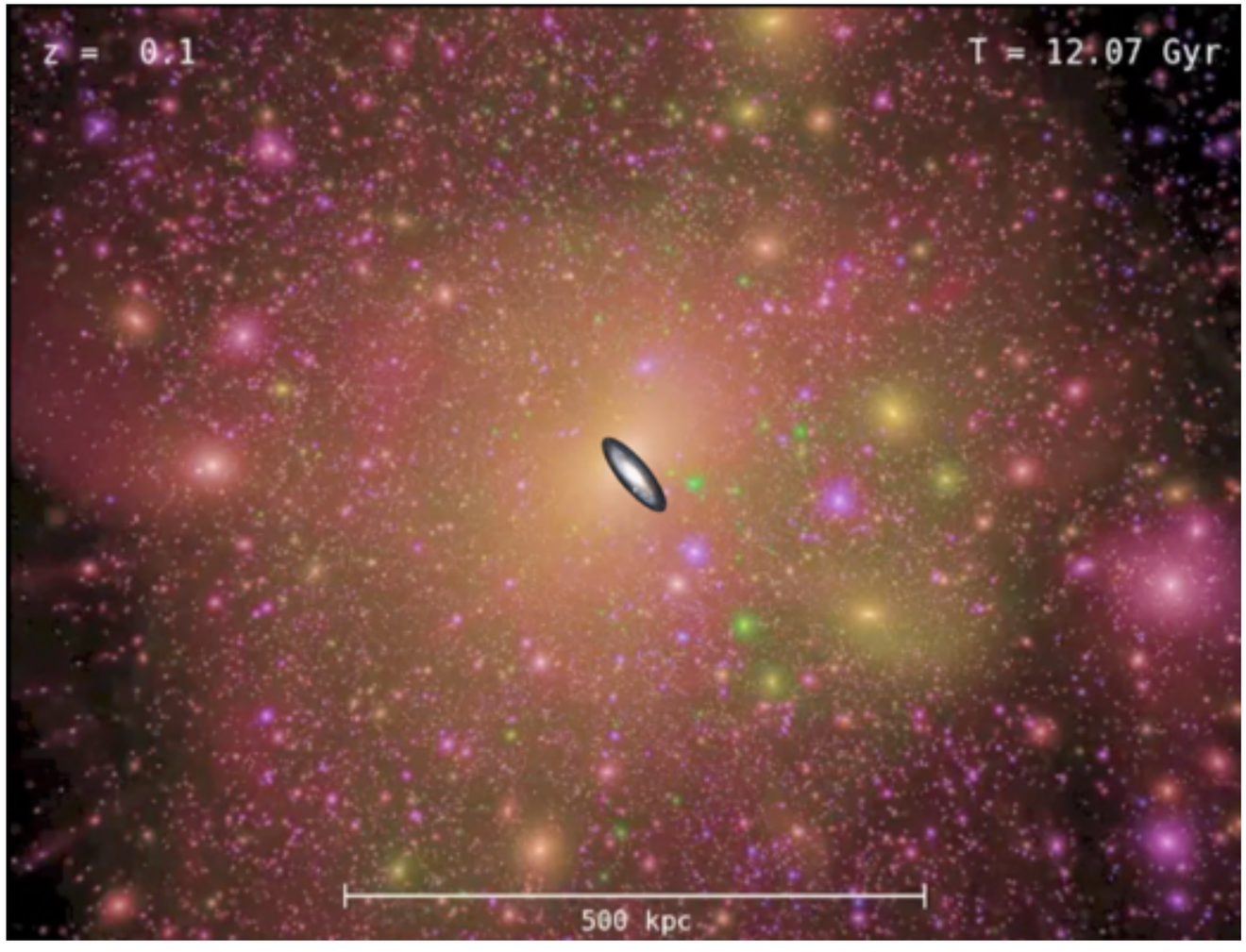
Dark Matter in the Local Group

DM subhalos:
central prediction of LCDM

Do subhalos exist?

How do baryonic processes transform the subhalos?

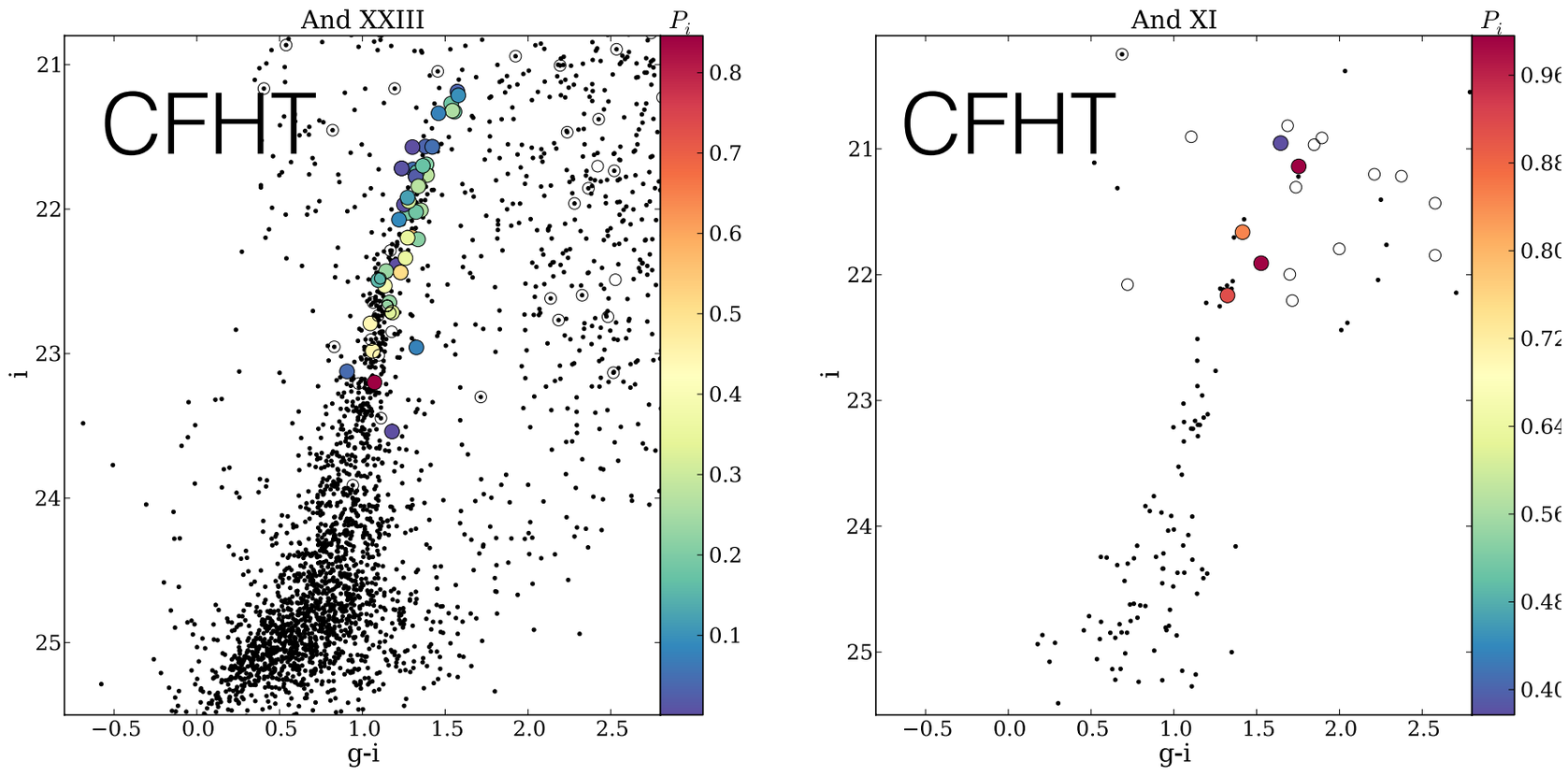
Effect of feedback?
effect of tides?



Can very dark satellites be detected on the edge of the LG?

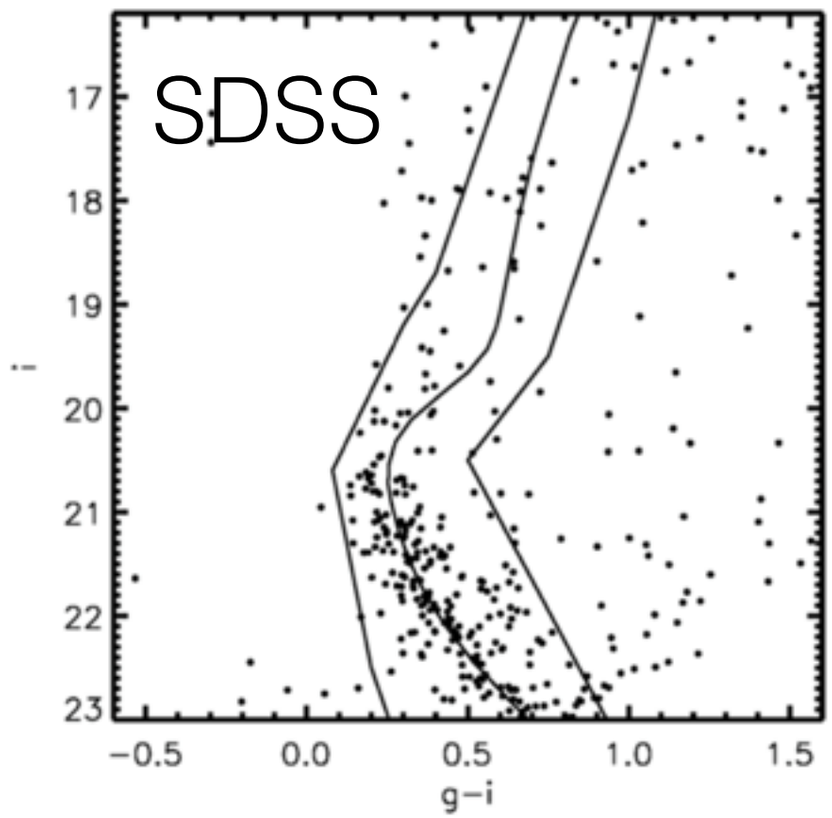
Examples:
Andromeda & Milky Way dSphs

And 23 &11 @ 800kpc



Collins+(2013a)

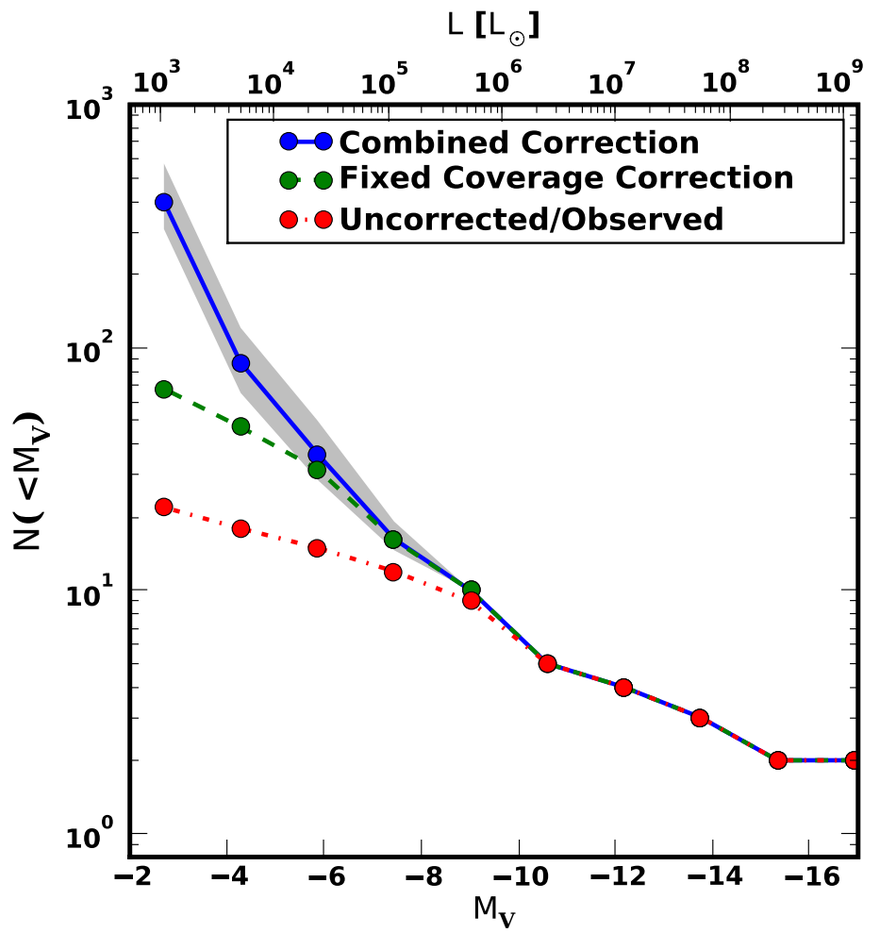
Segue 1 @ 23kpc



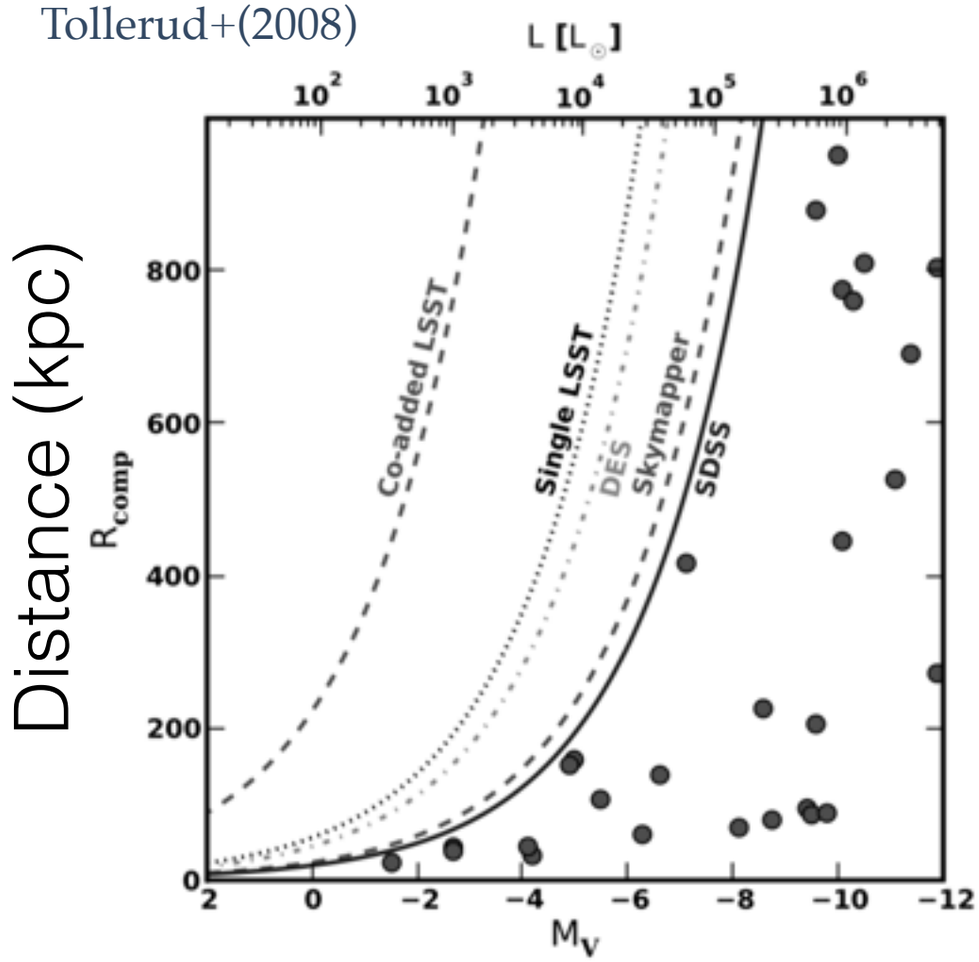
Niederste-Ostholt (2009)

dSphs with LSST

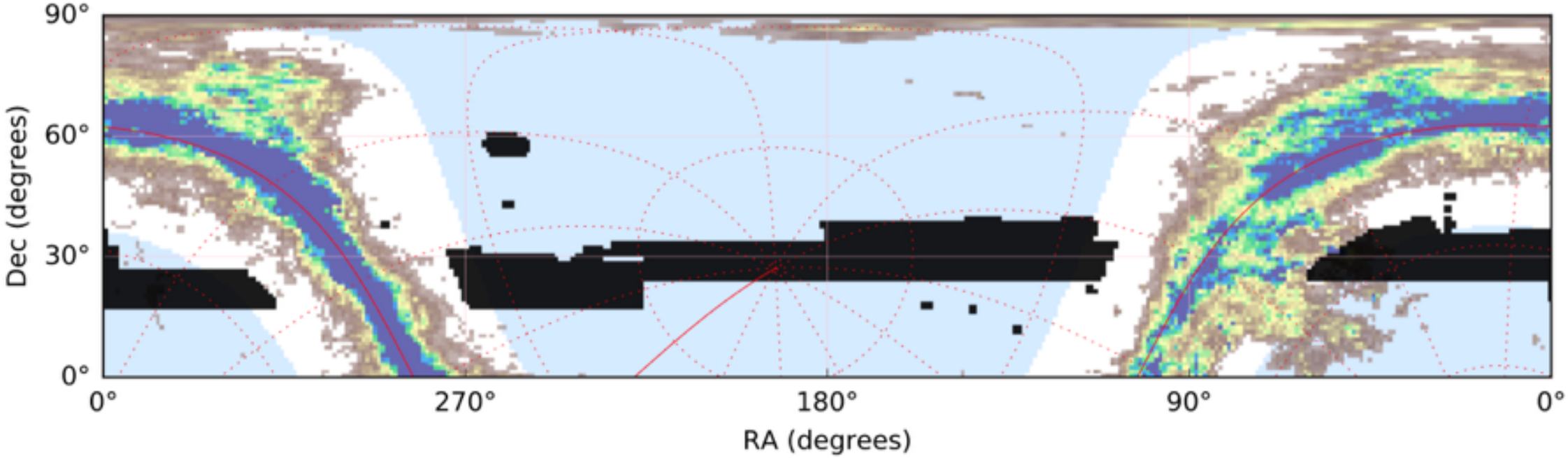
- Faintest, lowest mass galaxies we can detect
- Allow us to probe dark matter on small scales (few 100s pc)
- They flirt with controversy:
  Missing?
  Cusped or cored?
  Universal?
  Too big to fail?
- Finding all LG satellites (down to say Mv~-2) would be a big step towards fully understanding dark matter subhalos, and their role in galaxy formation.



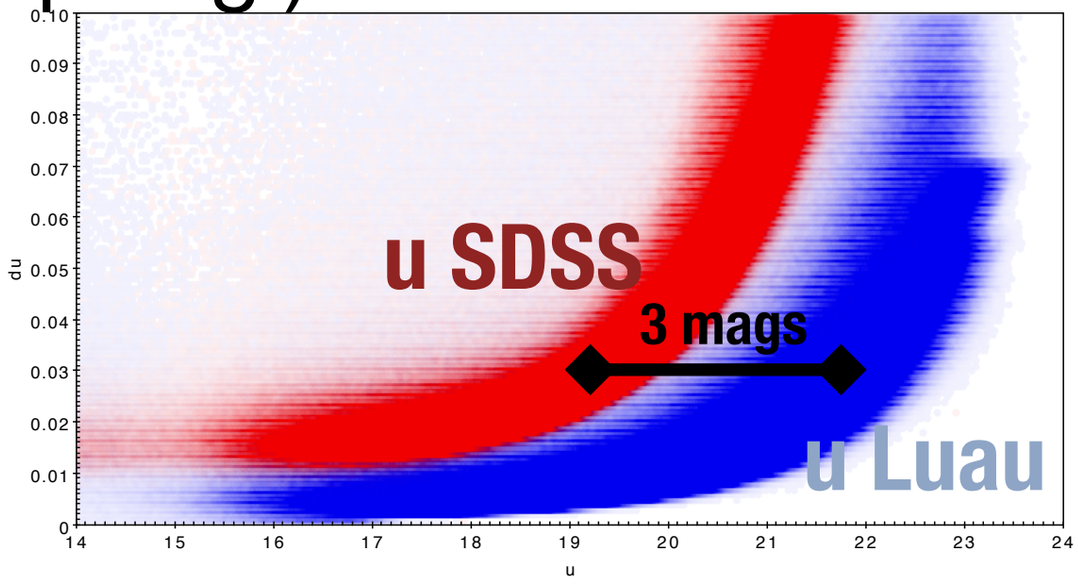
Tollerud+(2008)



Canada-France Imaging Survey (CFIS)

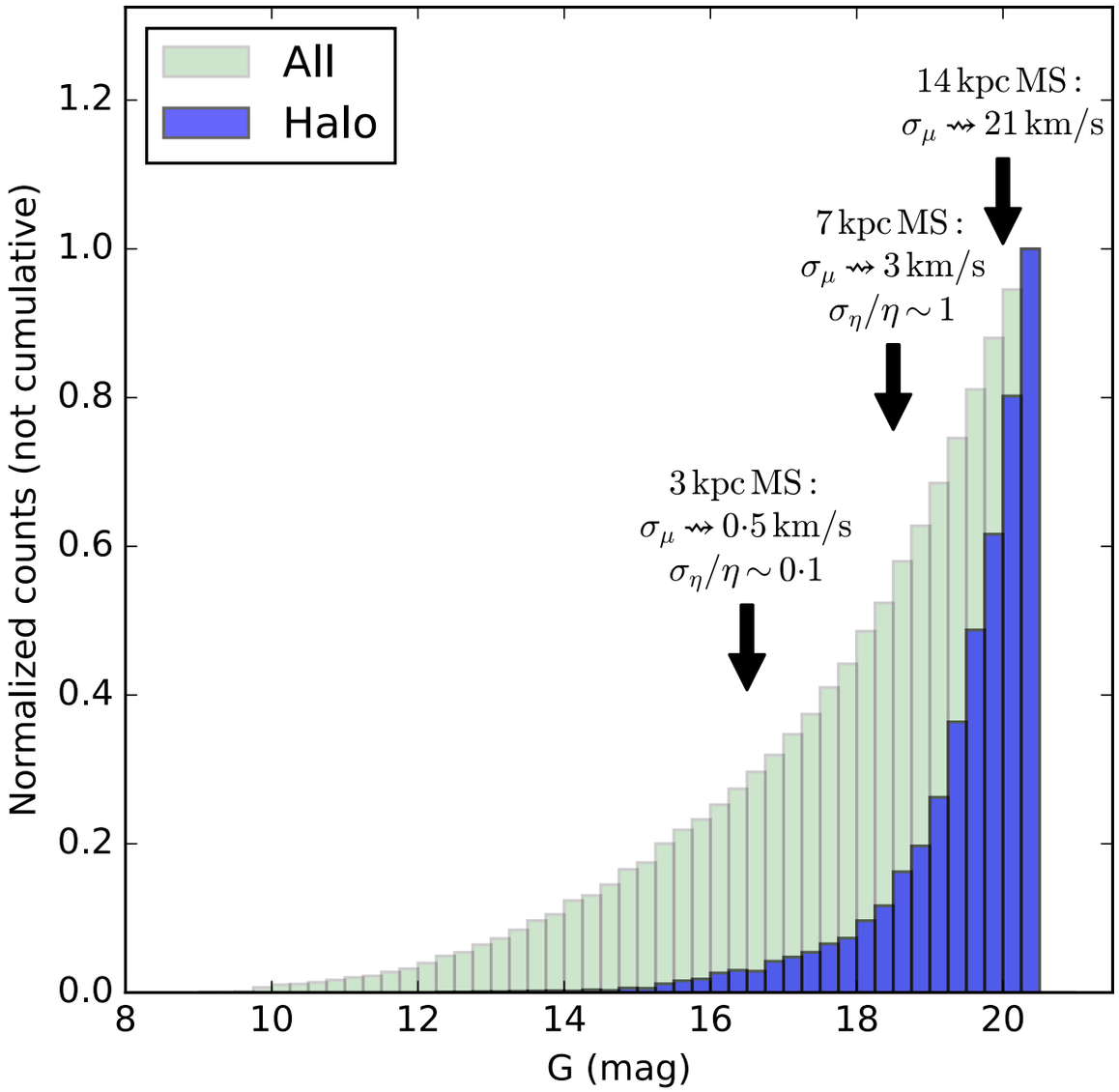


- ~2500 sq. degrees / 10000 sq. degrees
- 240 sec (480 sec over 1000 sq. deg.)
- 0.3 x 10^{13} pixels
- 9.8 million sources
- ~3 mags gained wrt SDSS-u

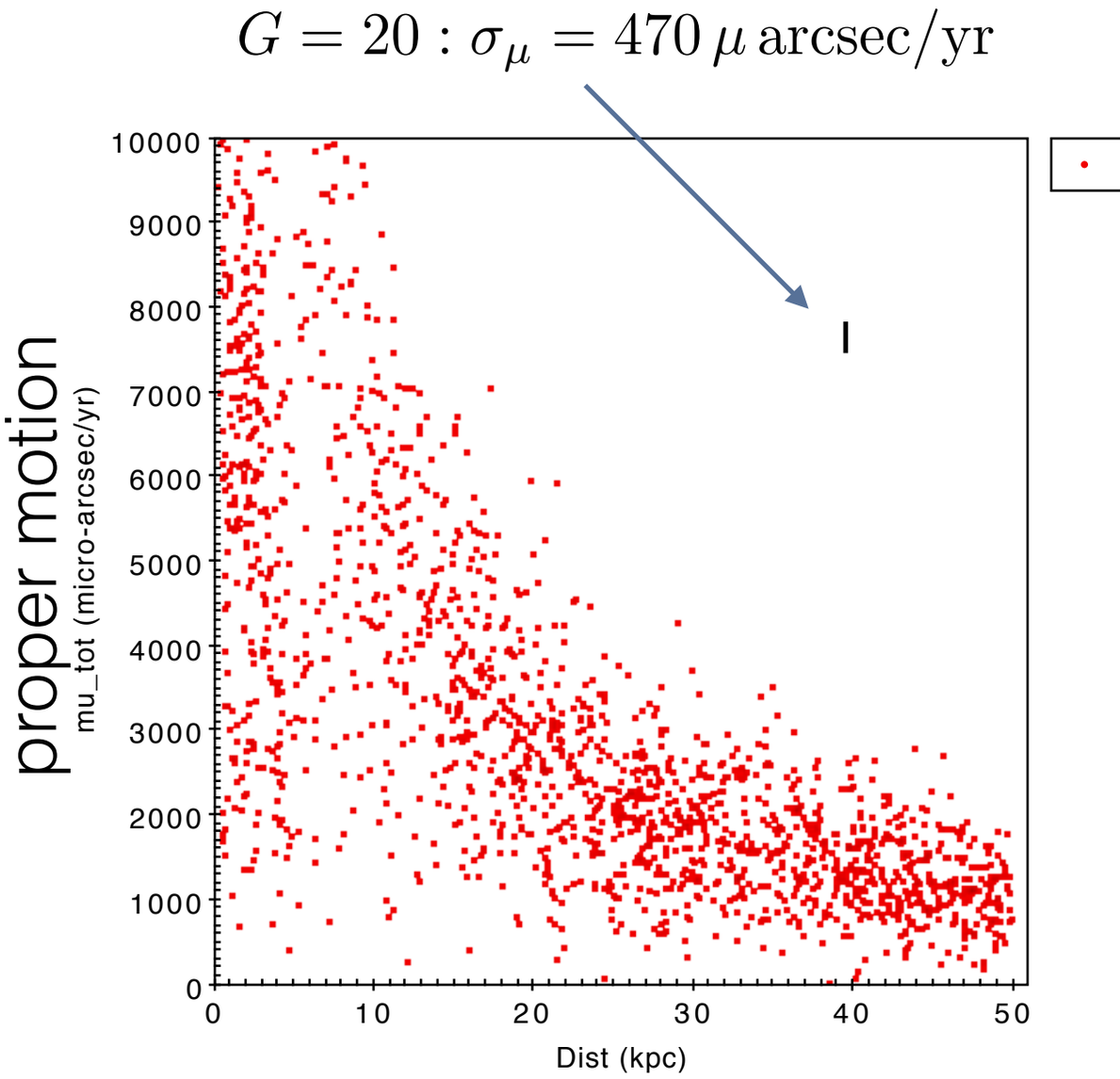


Halo science lies at the faint end of Gaia

Besançon model prediction 100 sq deg @ b=60 deg:



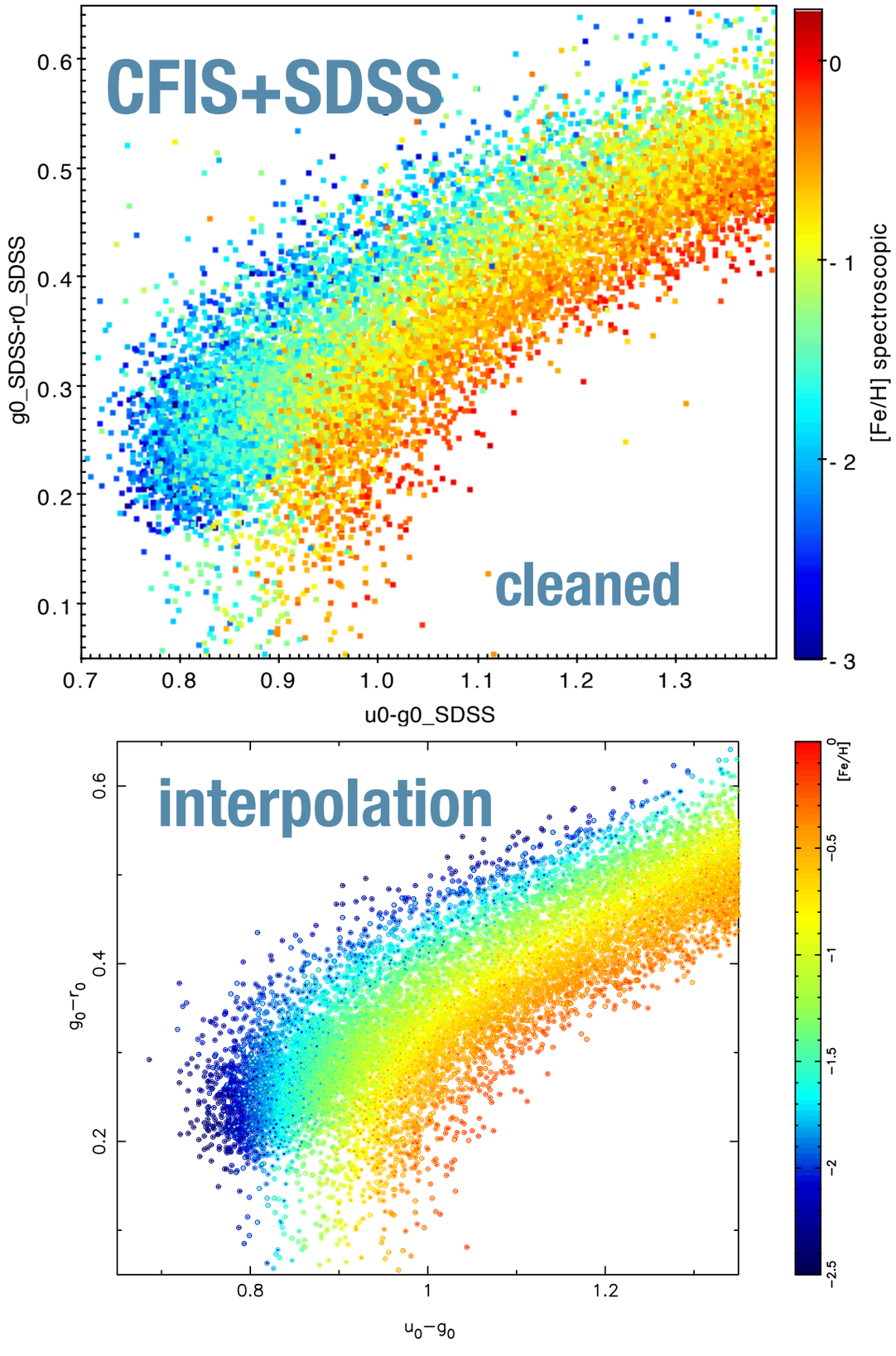
where Gaia has no parallaxes, no RVs, and poor spectrophotometry

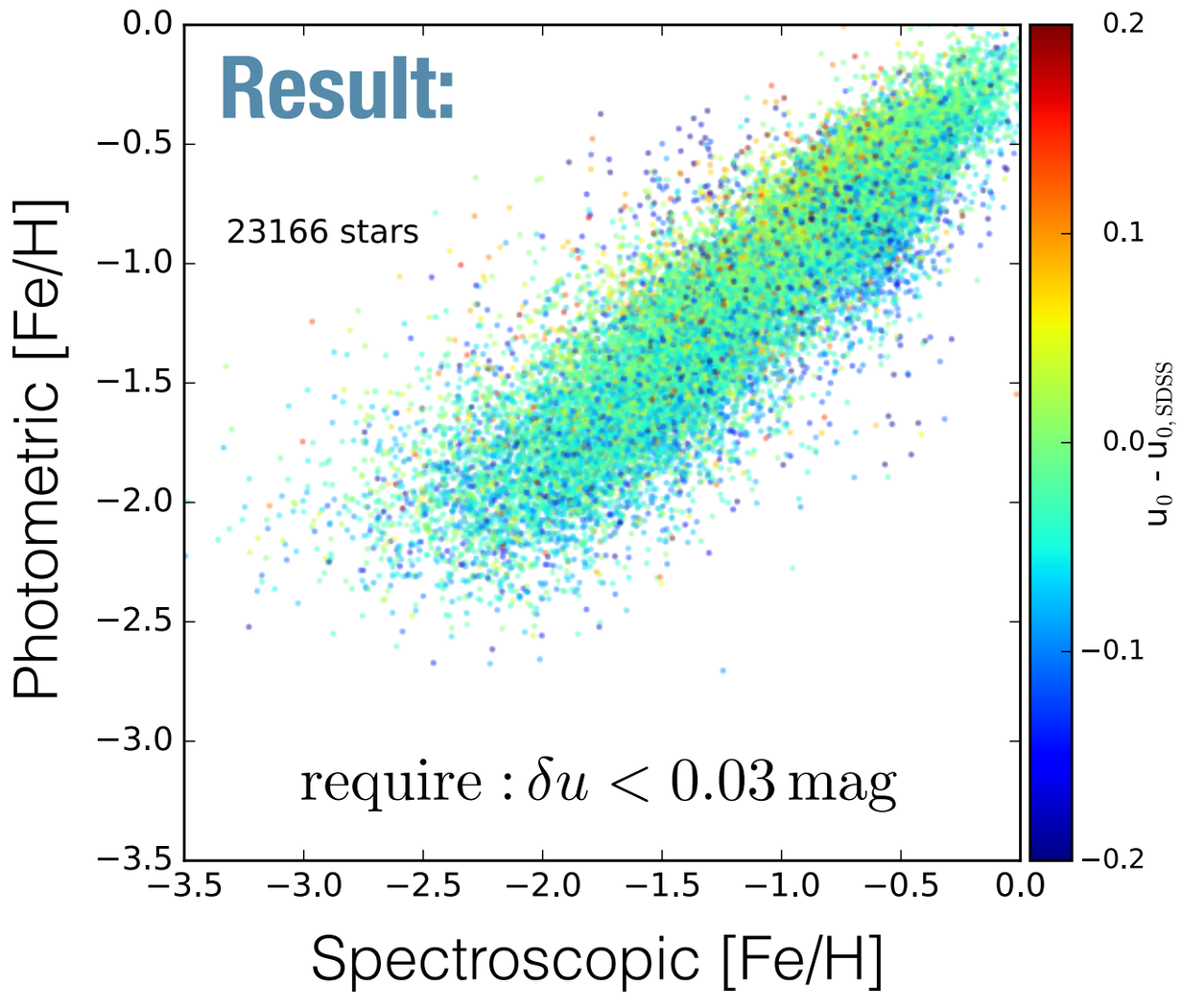


We need additional distance measurements and population discriminants

CFIS + Segue

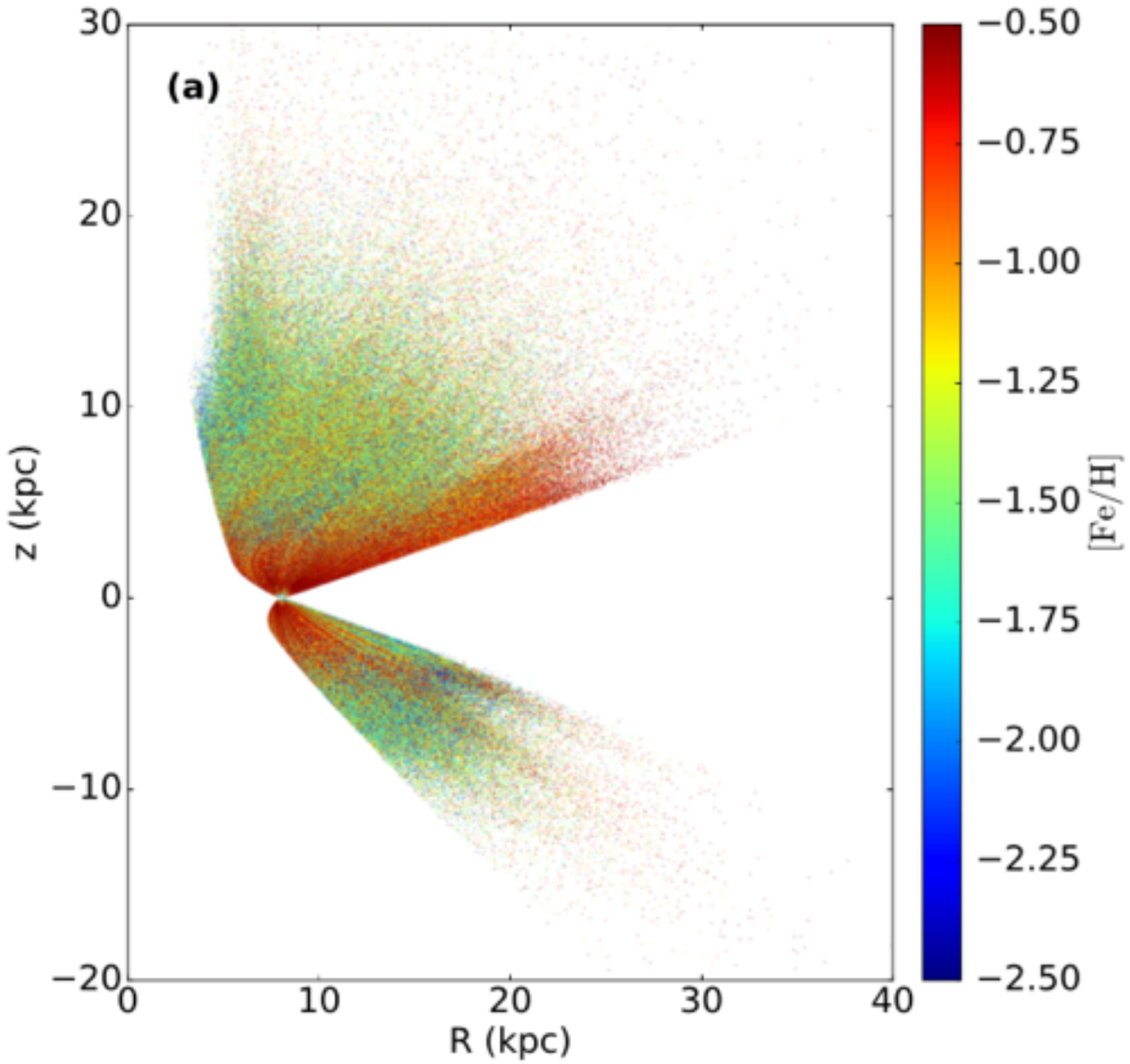
Defining photometric metallicity relation for dwarfs (following Ivezic et al. 2008)

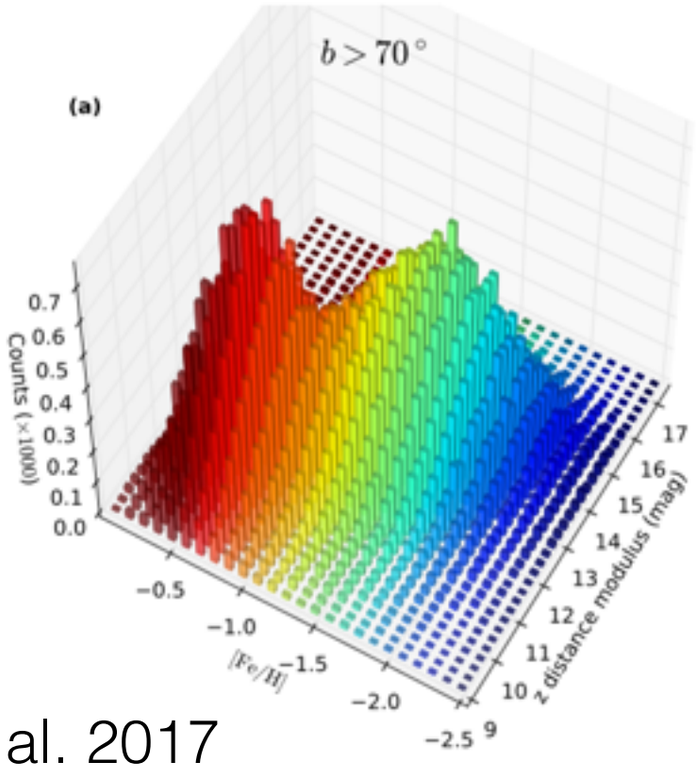




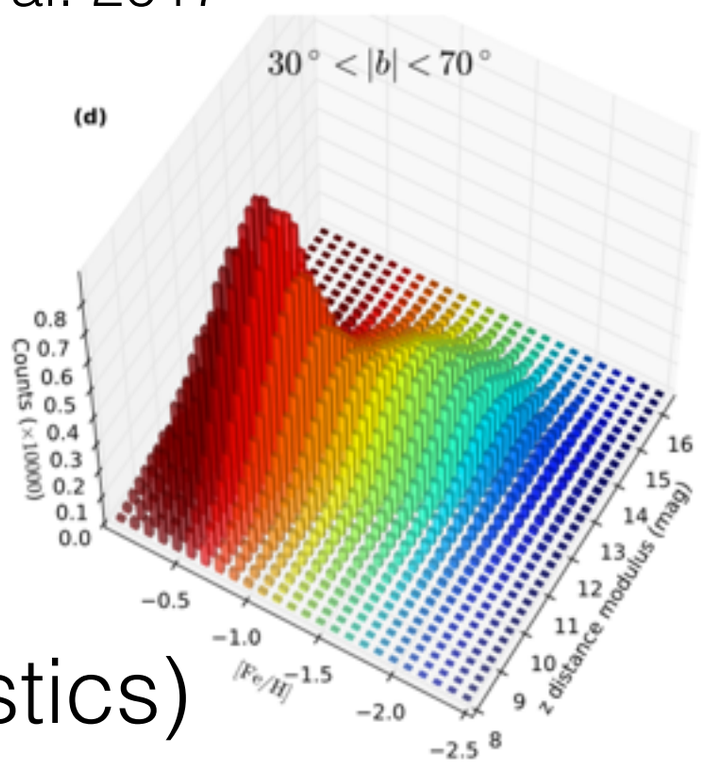
Ibata et al. 2017

CFIS: Metallicity distribution of dwarfs



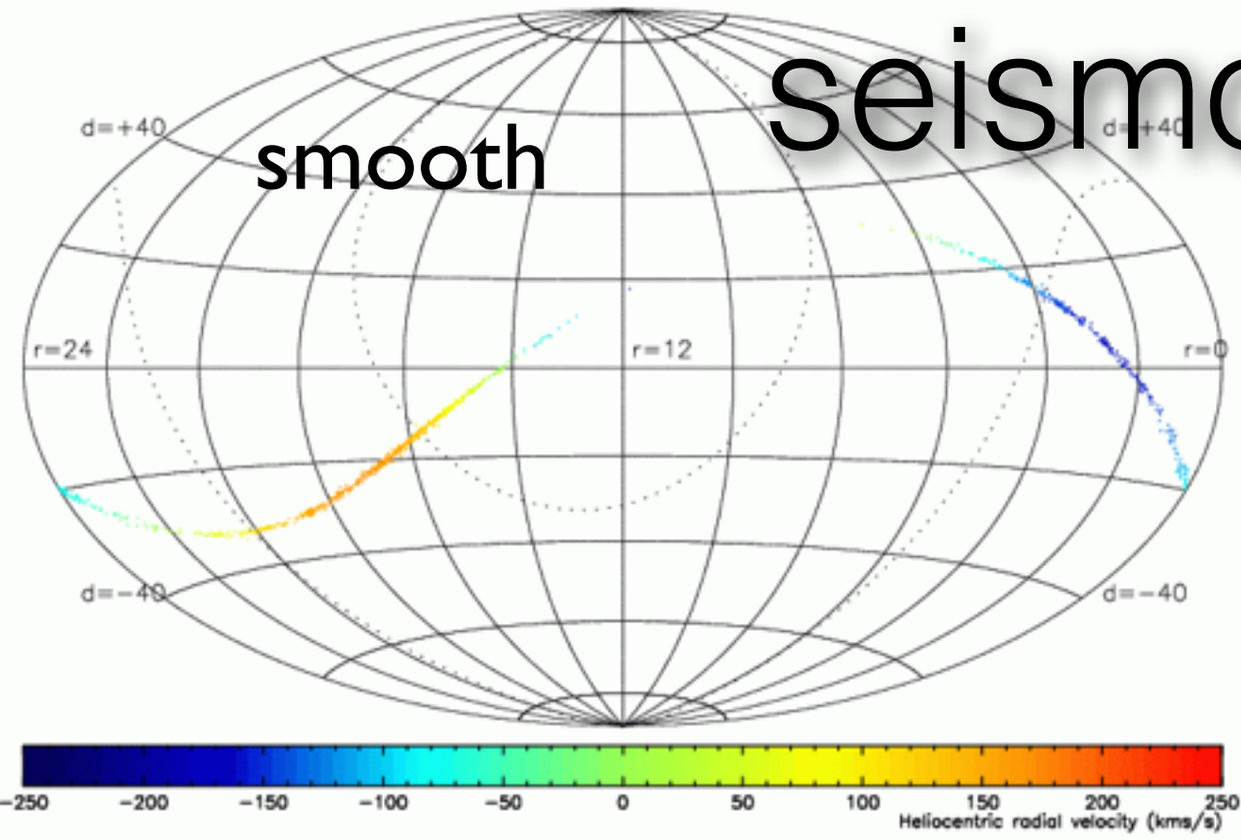


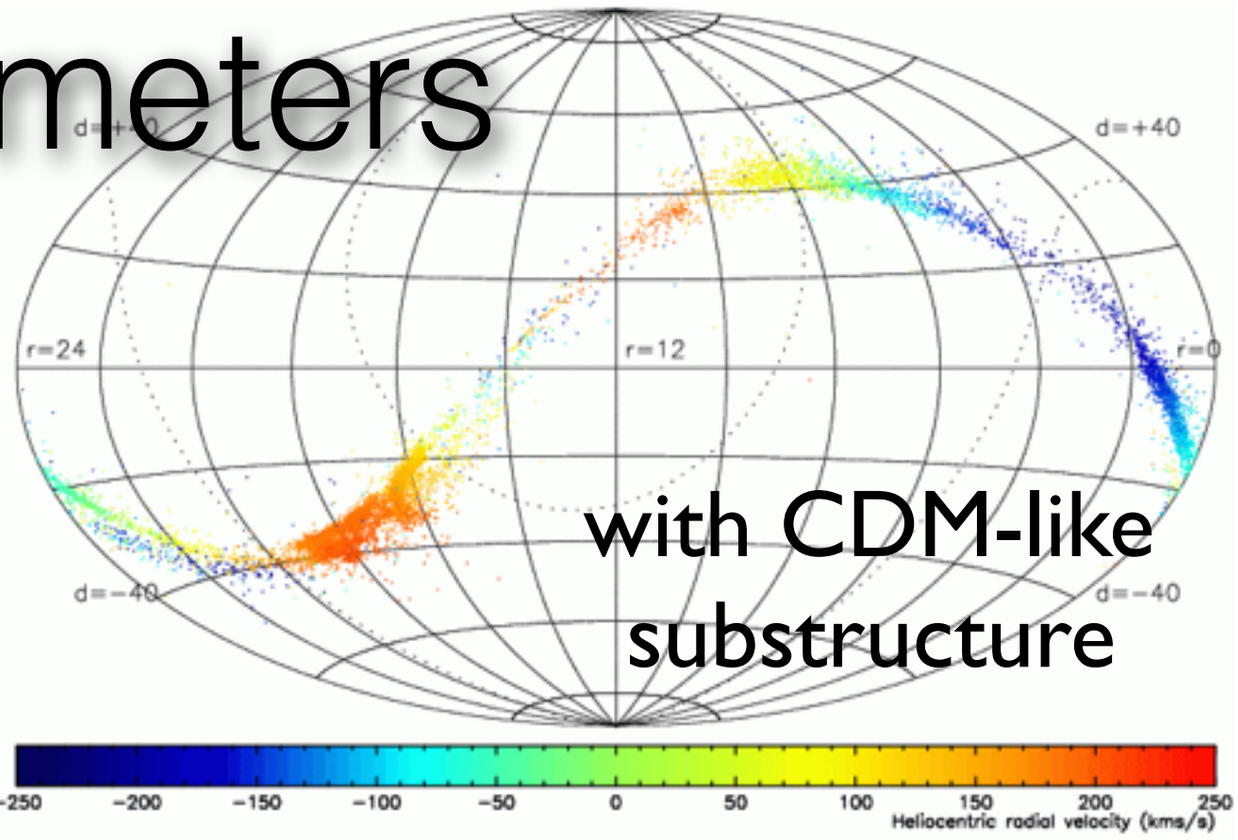
Ibata et al. 2017



LSST will go much further! (& better statistics)

Stellar streams as seismometers





Ibata, Lewis, Irwin, Quinn (2002) ; Johnston et al. (2002) ; Dalal & Kochanek (2002)

Or probes of exotic dark matter (Kesden & Kamionkowski 2006)

Stellar streams are probably the only reliable way we have to probe the small-scale substructure of Galactic dark matter.

Also probably best way to probe large-scale properties of Galactic dark matter

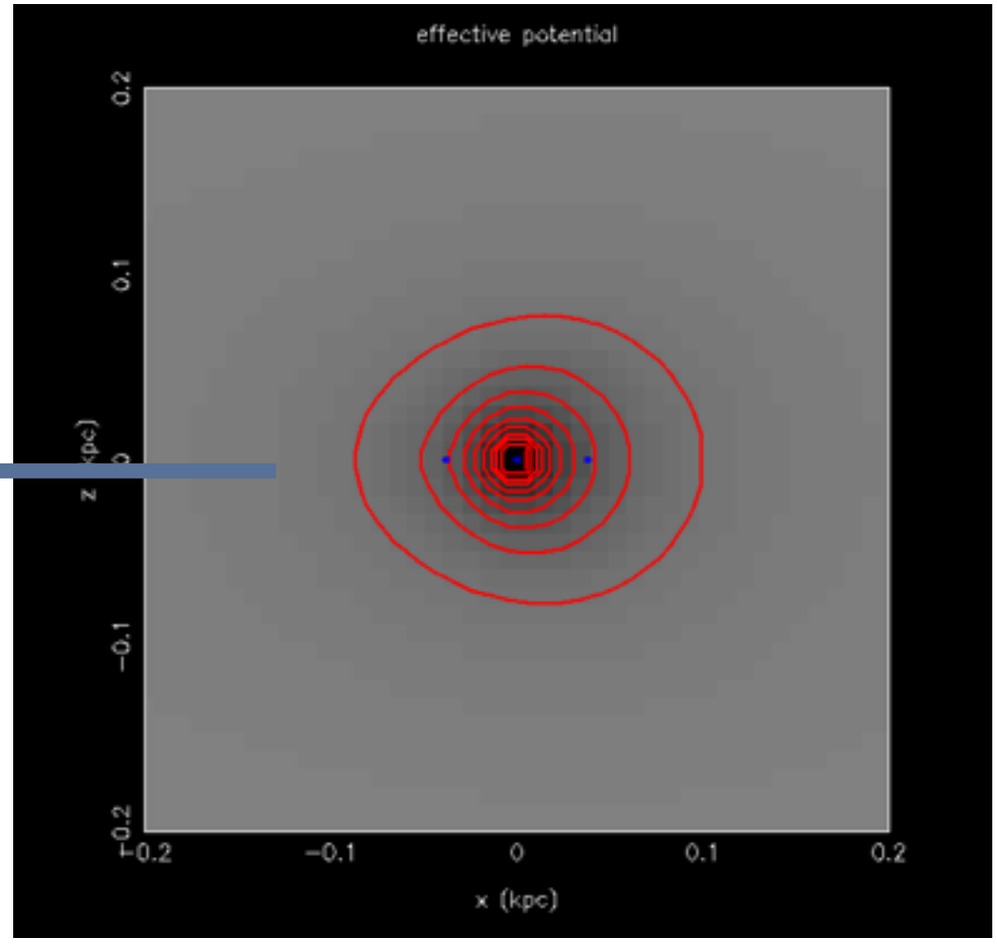
Globular clusters and satellite streams in alternative gravities

- “External Field” effect in MOND gives rise to asymmetric potentials around satellites.

- Superfluid DM?

- Influence on dynamics of streams

- In principle testable!

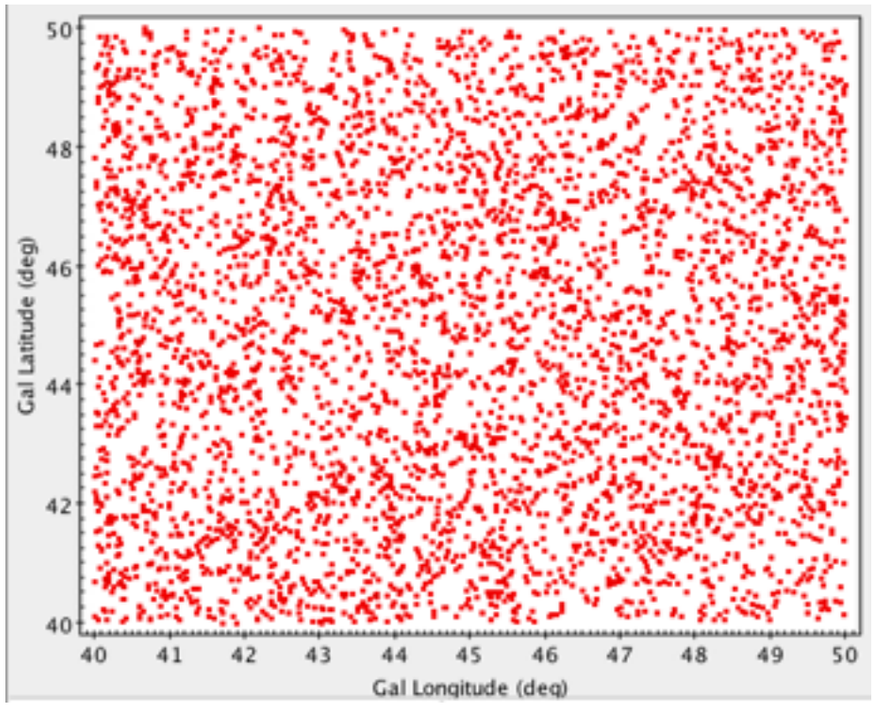


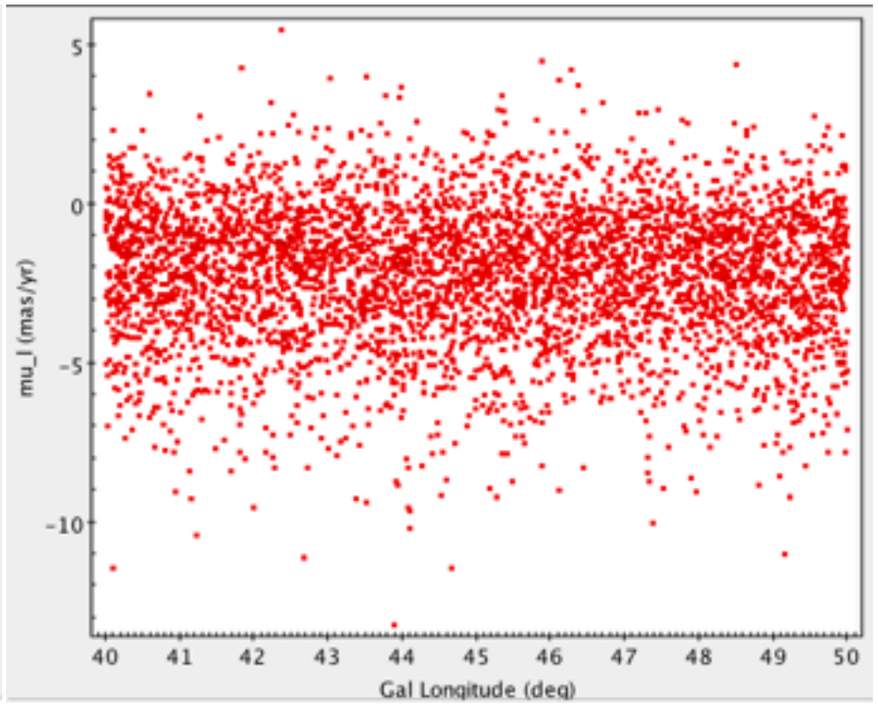
to host

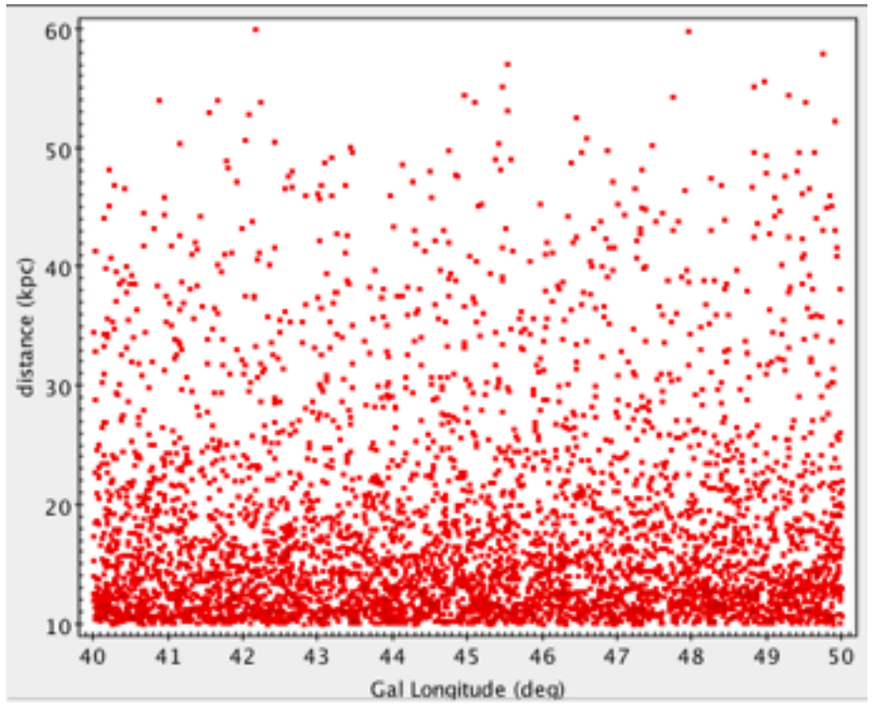
with
Guillaume Thomas
Benoit Famaey

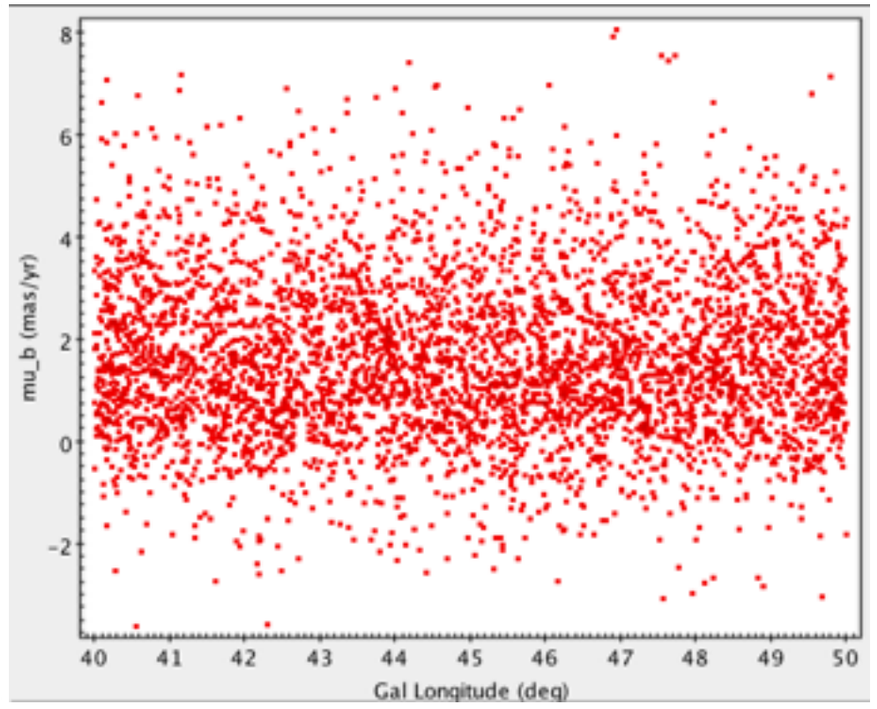
Getting ready to find streams with CFIS (or LSST)+Gaia

with Khyati Malhan



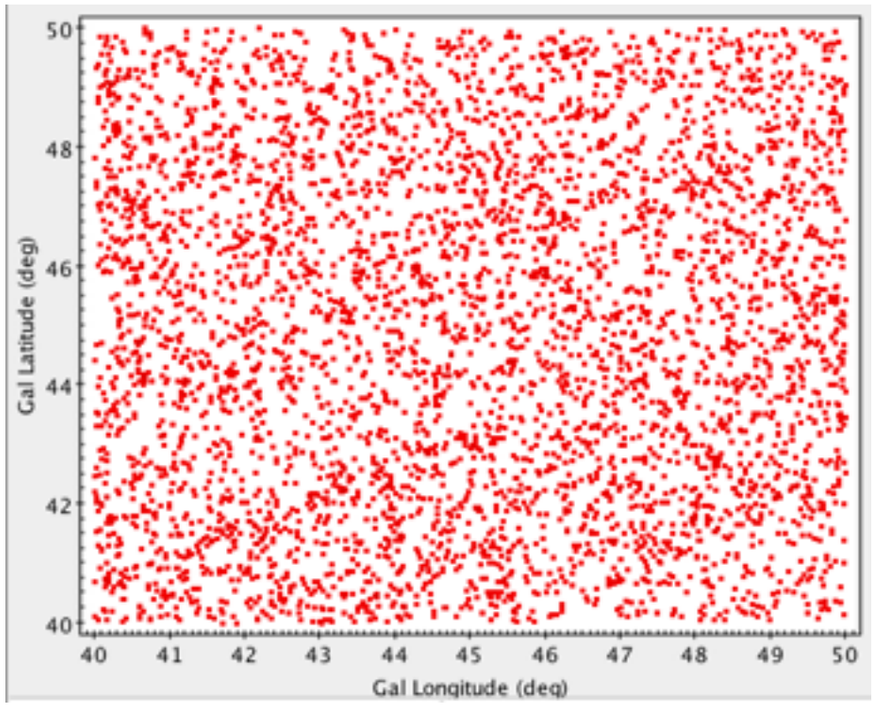


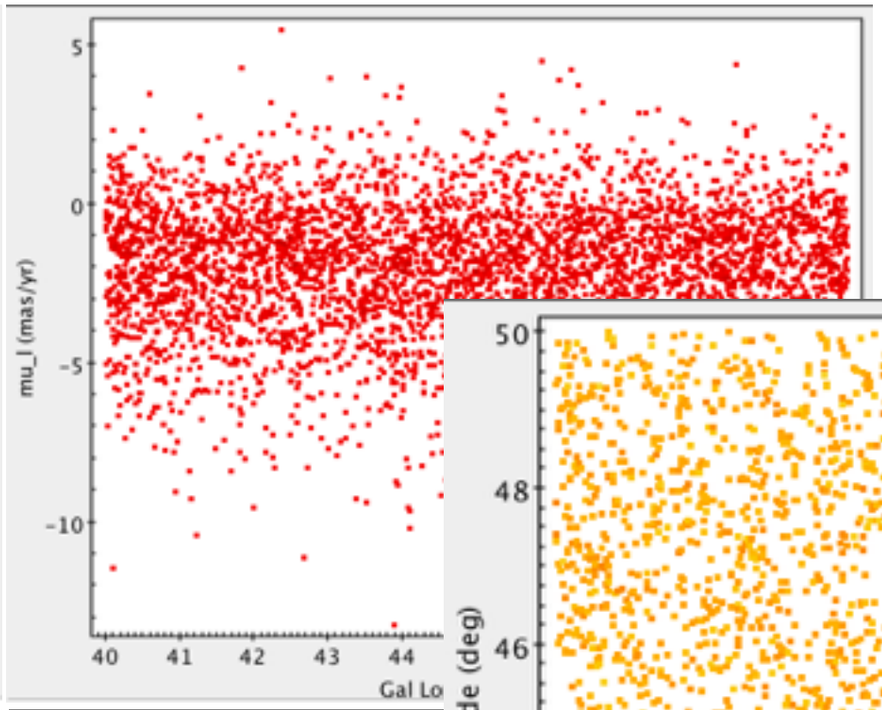


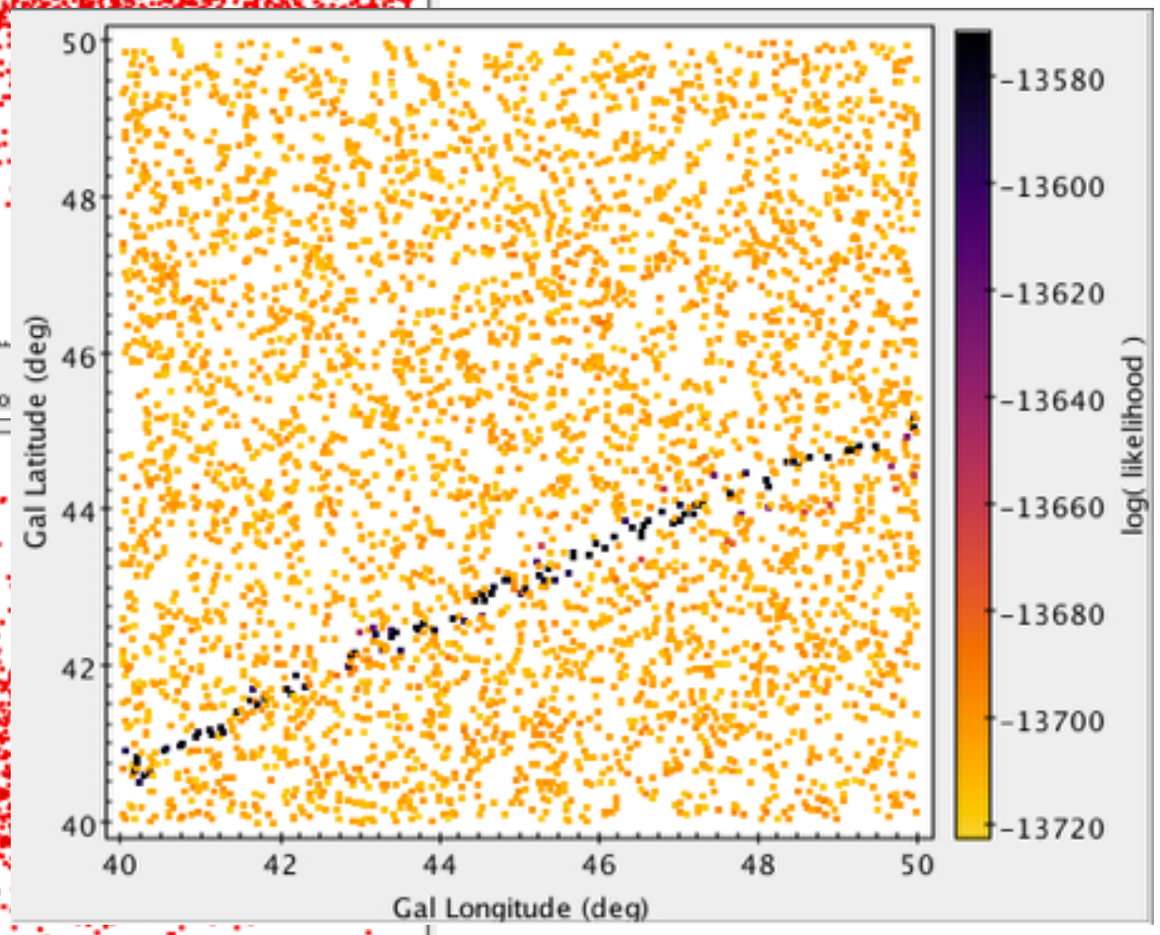


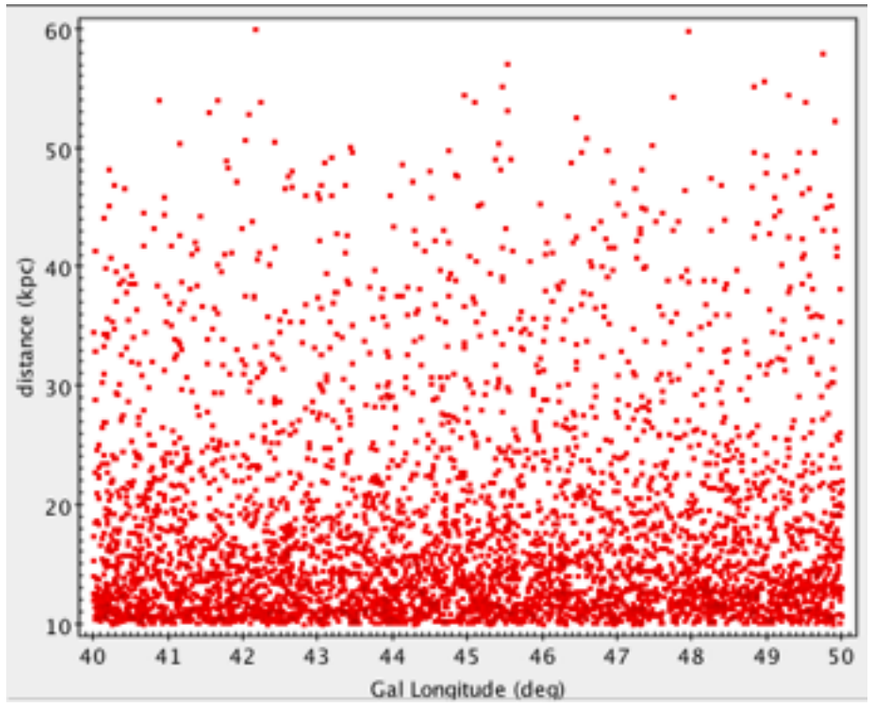
Getting ready to find streams with CFIS (or LSST)+Gaia

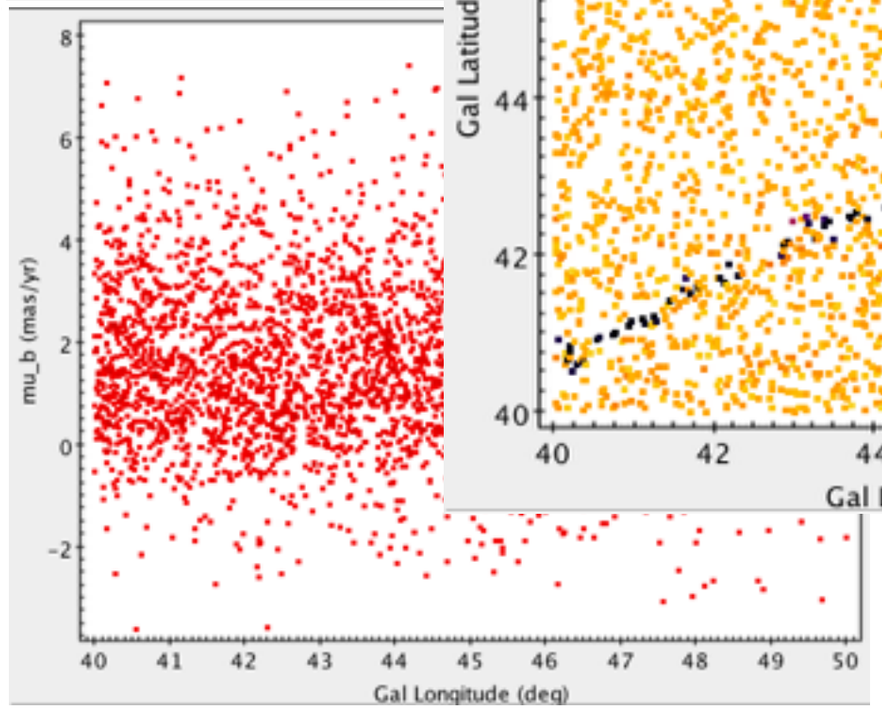
with Khyati Malhan











LSST is *really* exciting for almost everything in the Local Group!

(well, apart from Andromeda!)