GPS1(GAIA-PANSTARRS1-SDSS) PROPER MOTIONS

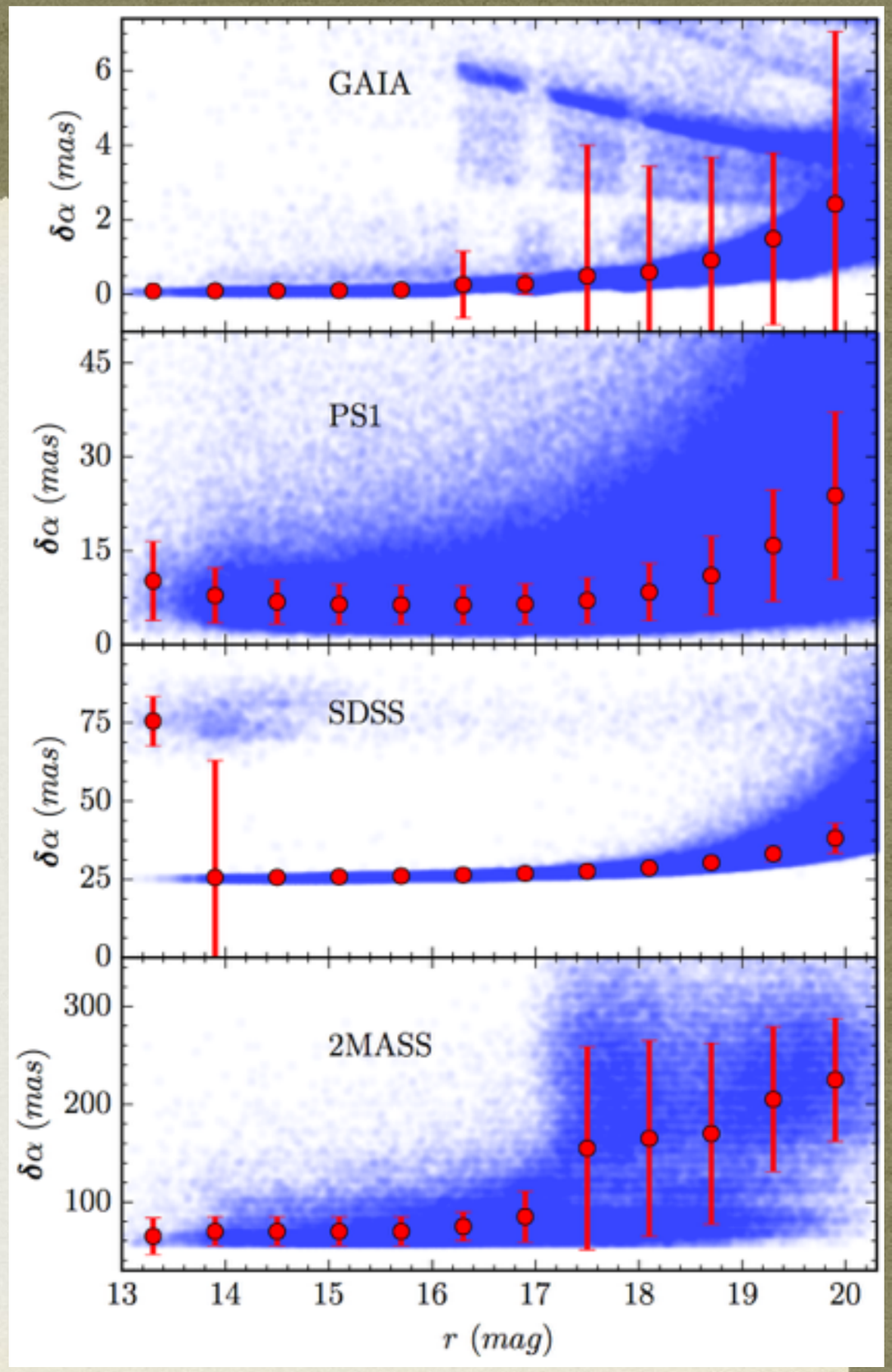
Haijun Tian (MPIA & CTGU)

Collaborators: Branimir Sesar, Hans-Walter Rix, Chao Liu, etc.

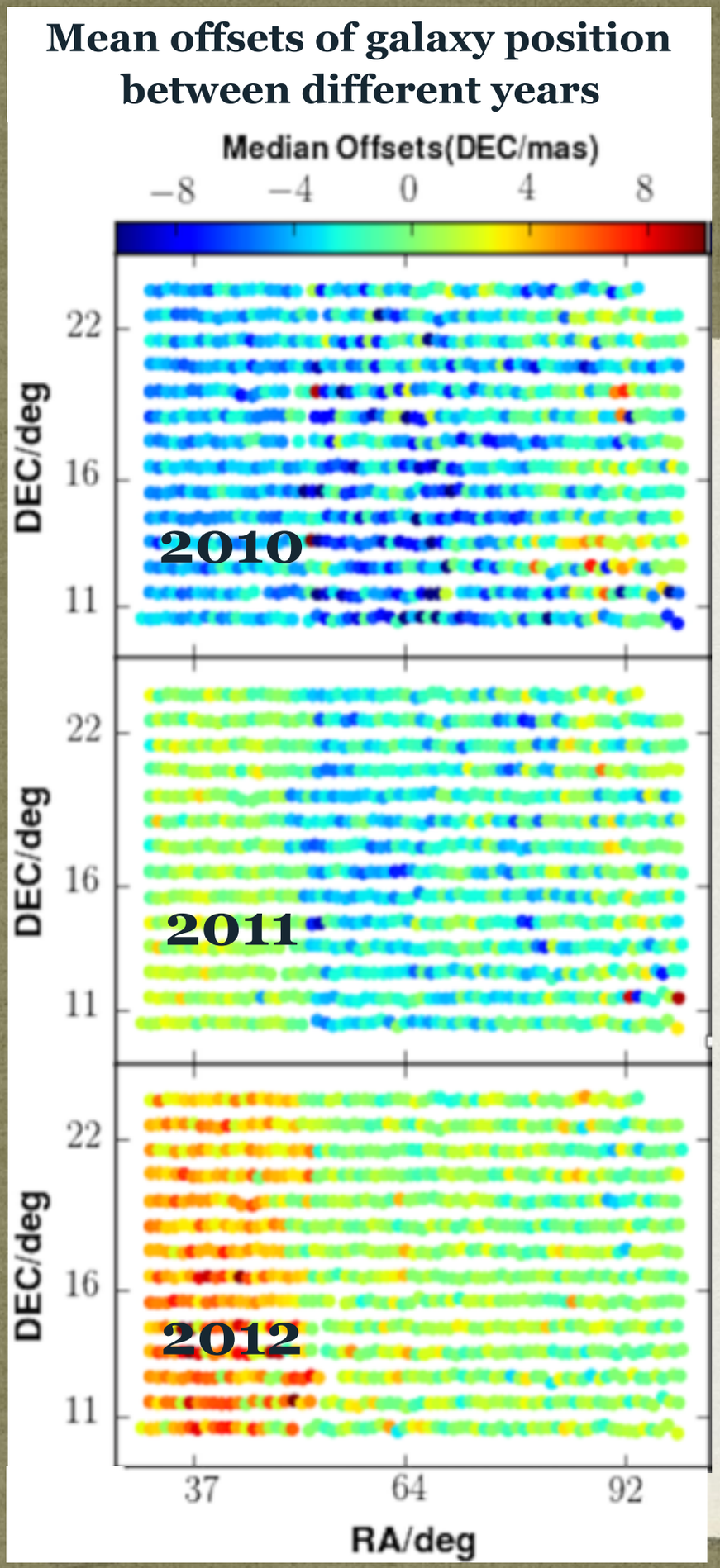
2017-02-18

DATA

- Data for the proper motions
  - GAIA (1-year, <2mas)
  - PS1 (>4 years, ~10mas)
  - SDSS (~10 years ago, ~25 mas)
  - 2MASS (~10 years ago, ~100 mas)



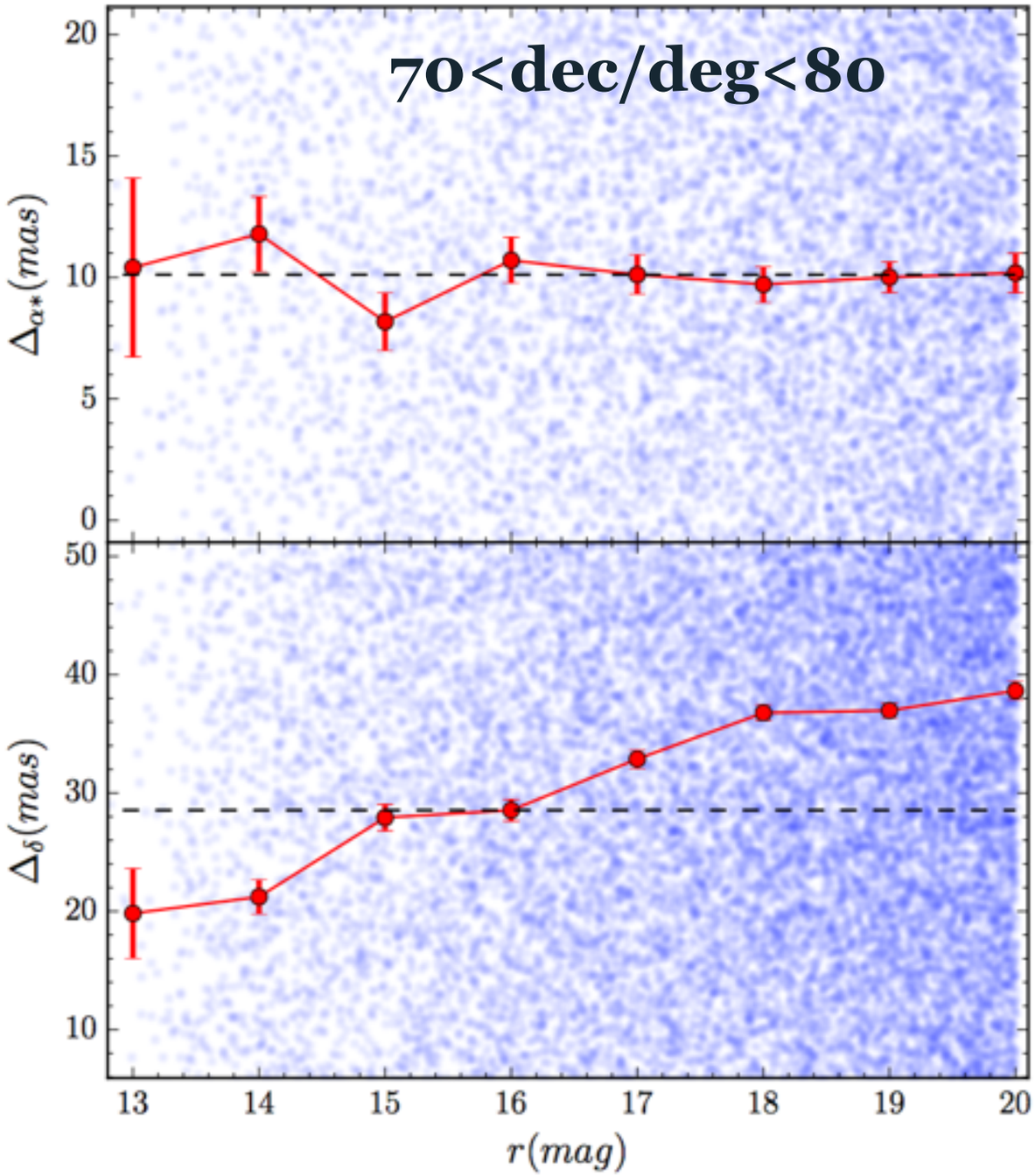
X-CALIBRATION

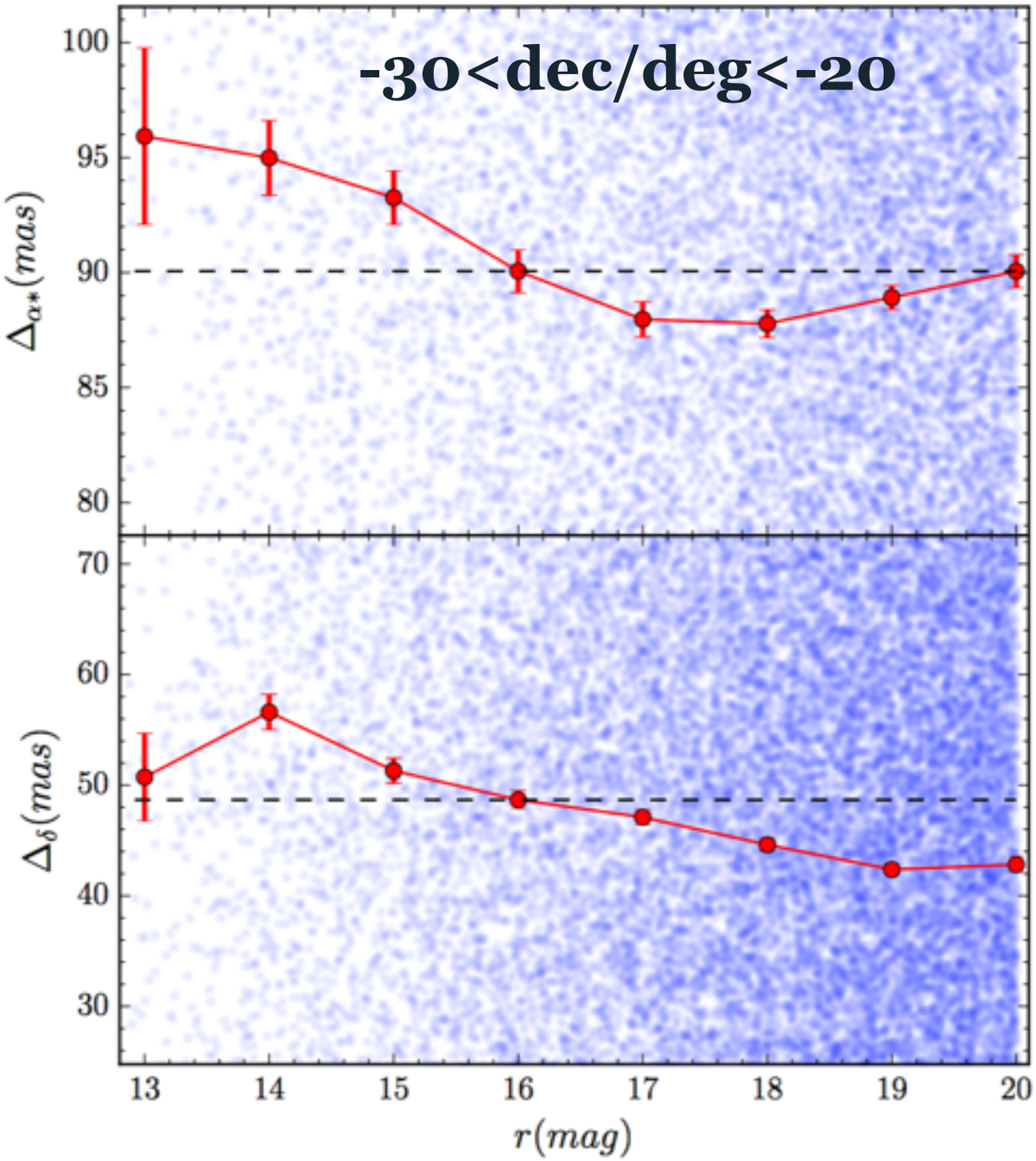


- How to cross-calibrate stars in the different surveys?

- The space-dependent offsets (Galaxies **NOT** move!)

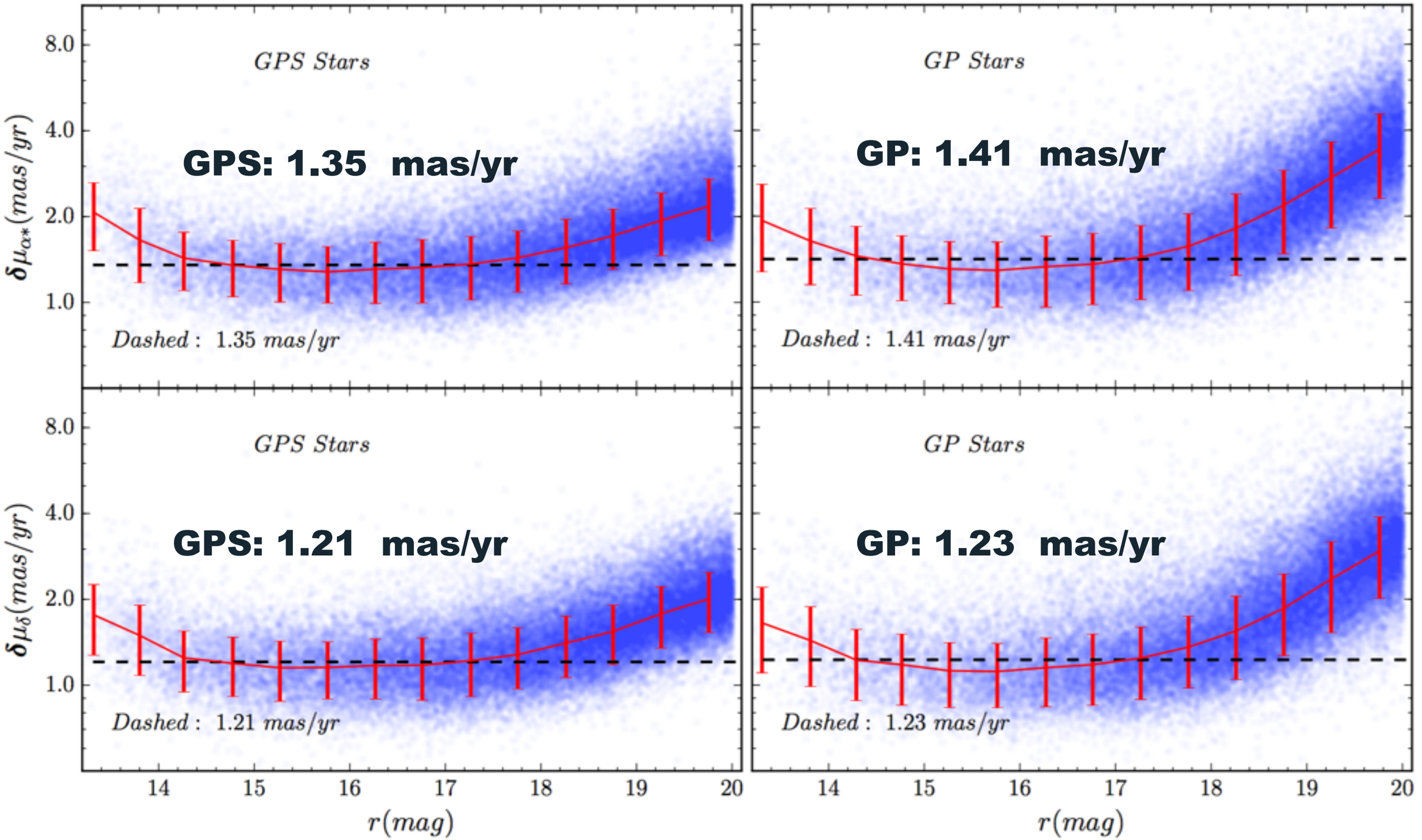
X-CALIBRATION



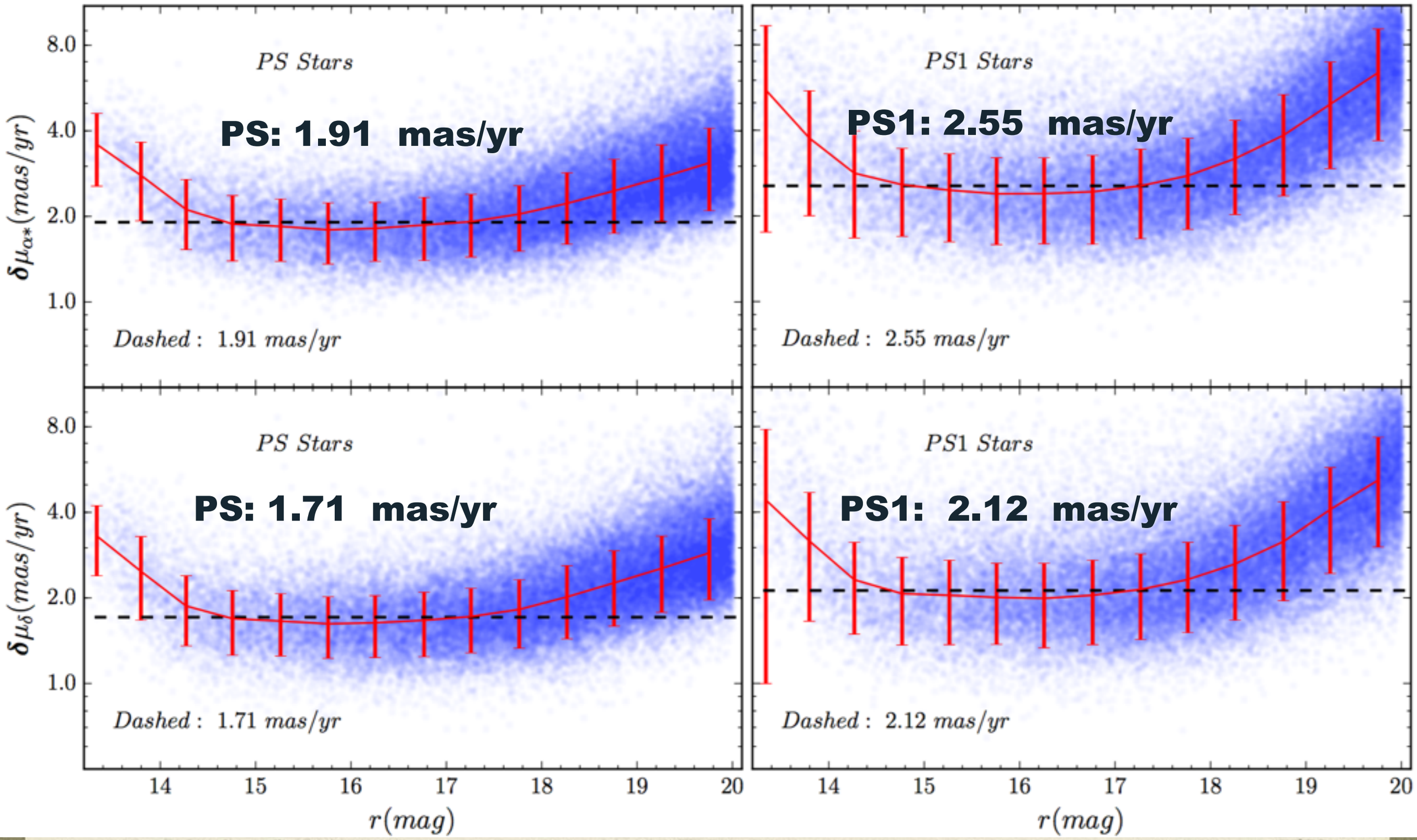


- The magnitude- and latitude-dependent offsets (Gaia)

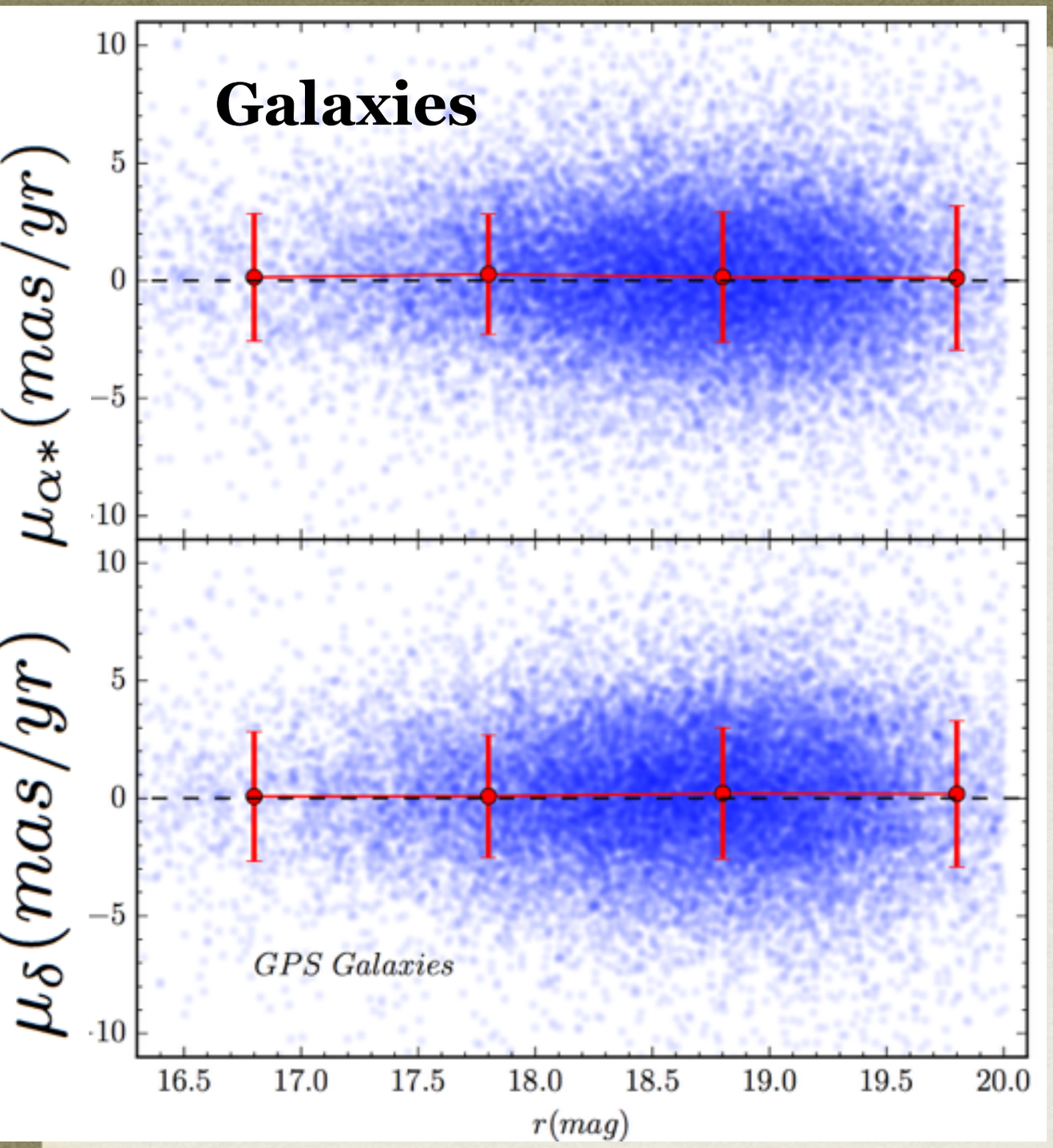
RESULTS(WITH GAIA)

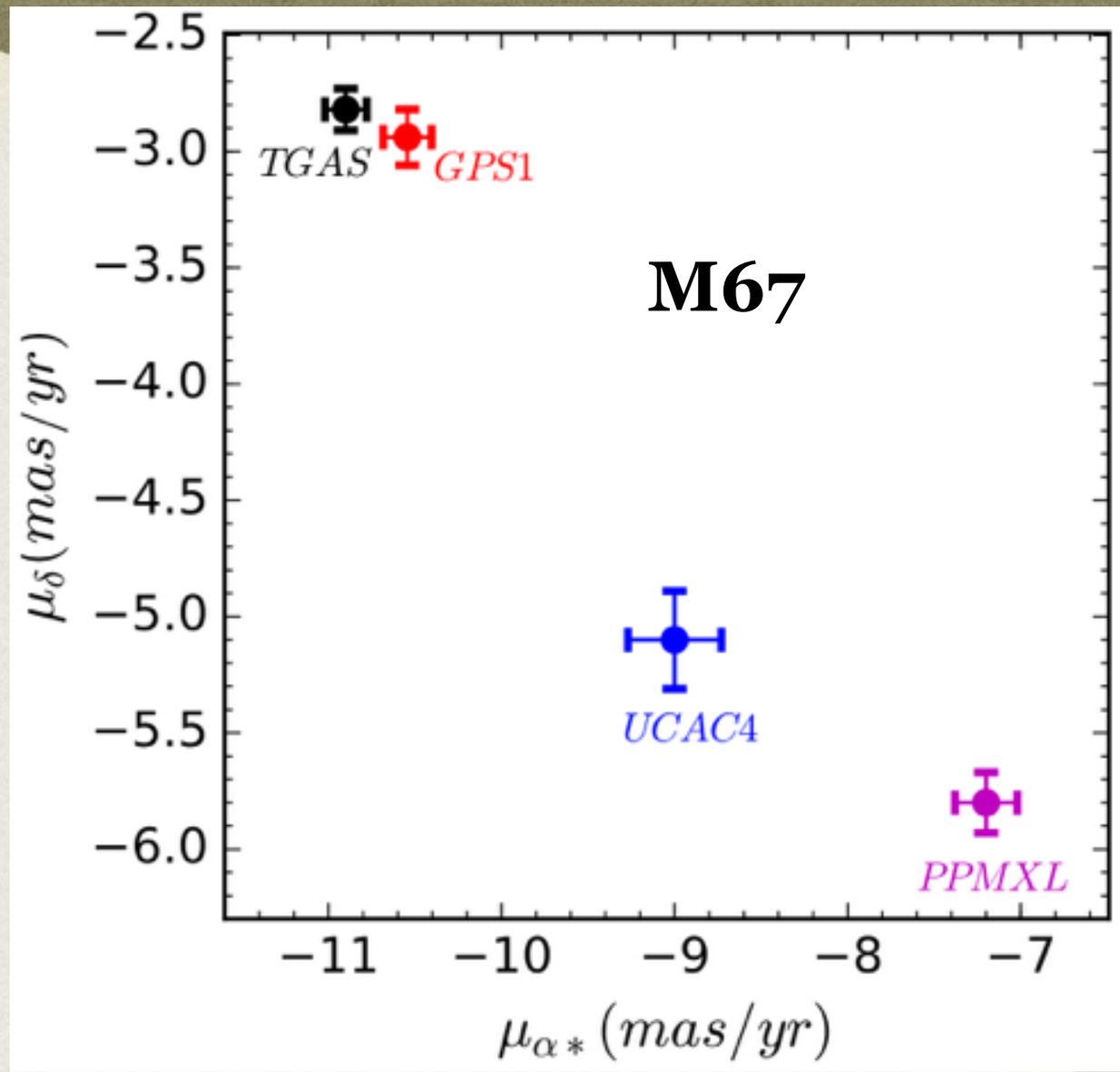


RESULTS(WITHOUT GAIA)



VALIDATION





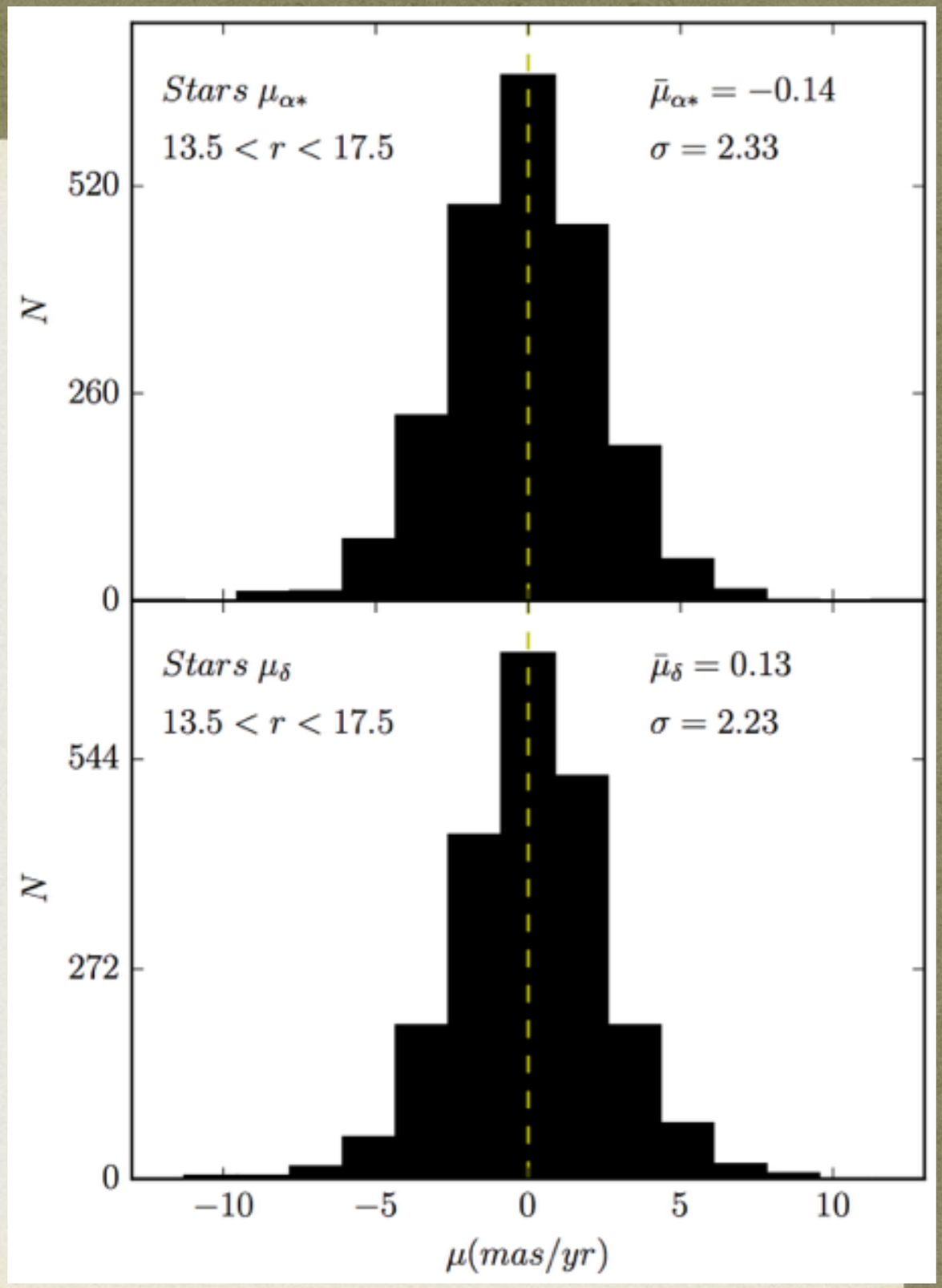
The systematic error <0.3 mas/yr (~10x better than PPMXL, UCAC4)

VALIDATION (DISTANT STARS)

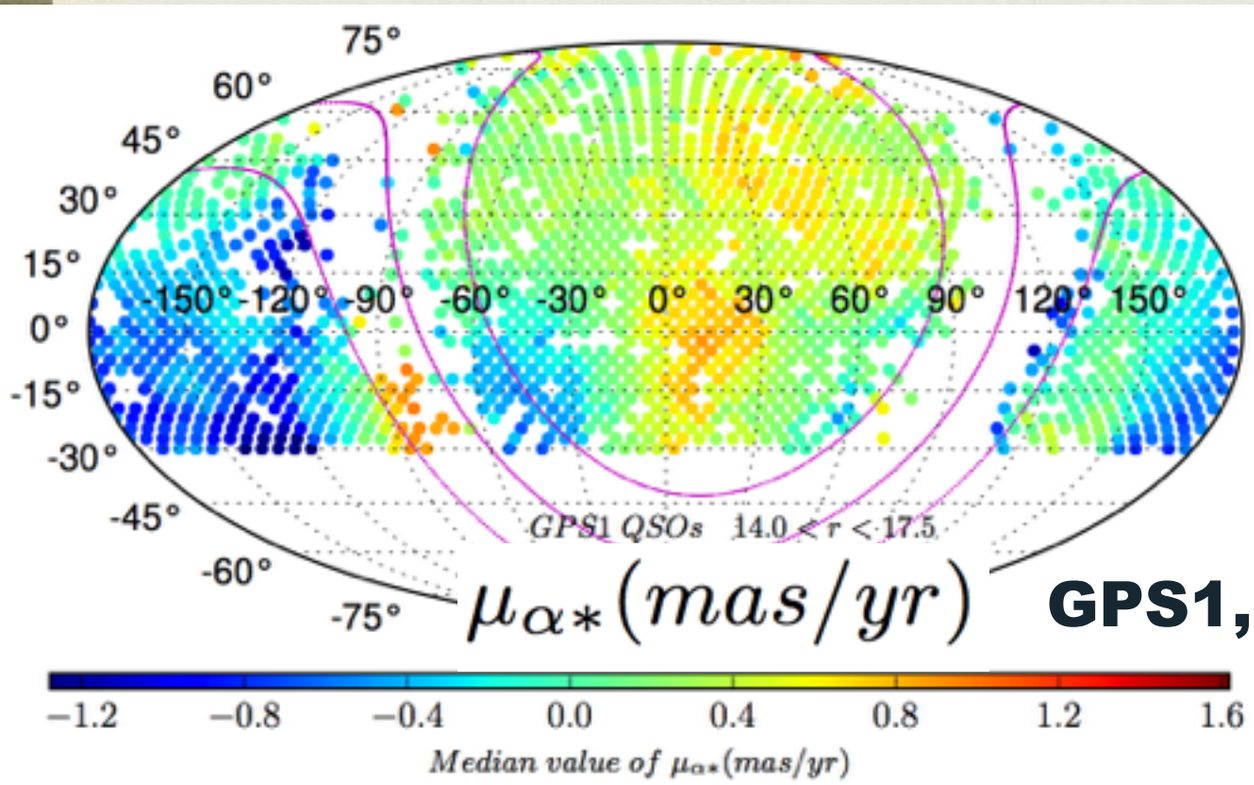
~2200 BHB (Xue + 2008) and Giant stars (Xue + 2014) (d>20kpc, 13.5<r<17.5)

$$(U_\odot, V_\odot, W_\odot) = (9.58, 10.52, 7.01)\,\mathrm{kms}^{-1}$$

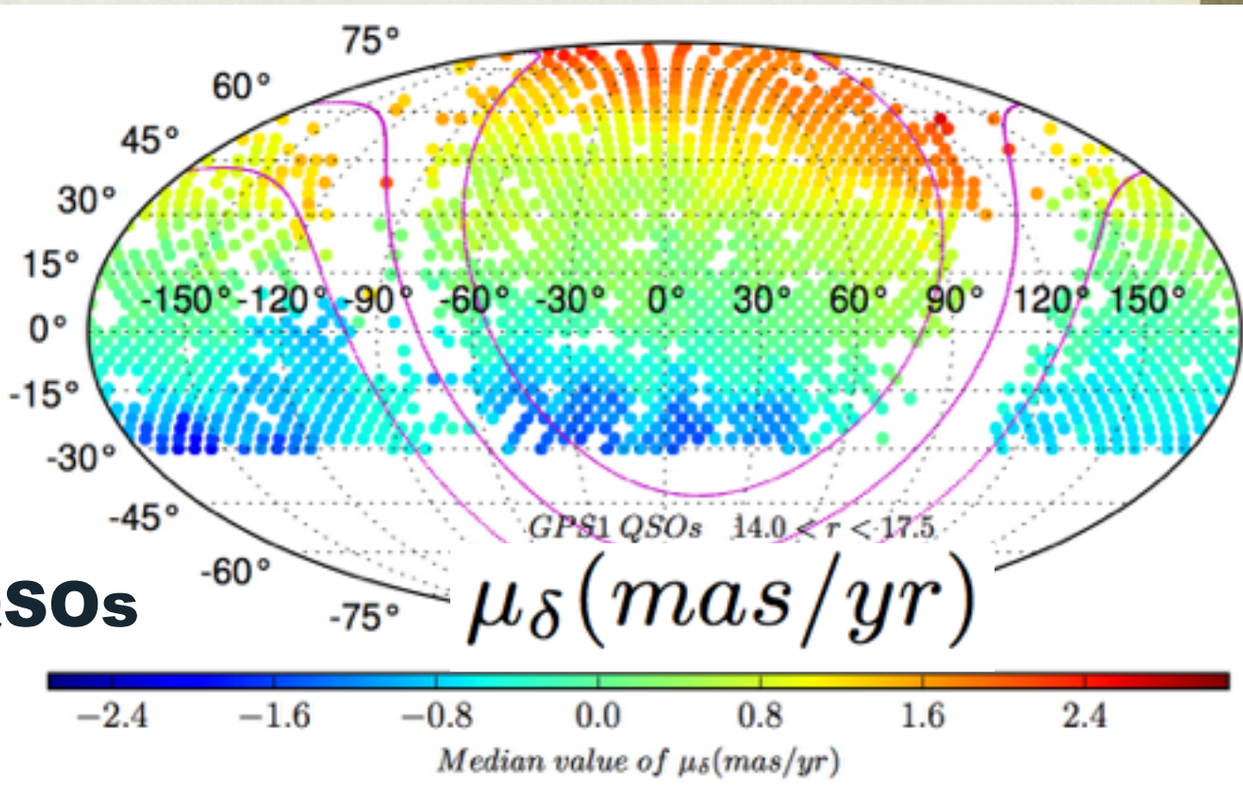
(Tian et al. 2015)



PERFORMANCE ON QSOS



GPS1, QSOs



Significant differential chromatic refraction (DCR) impact on QSOs

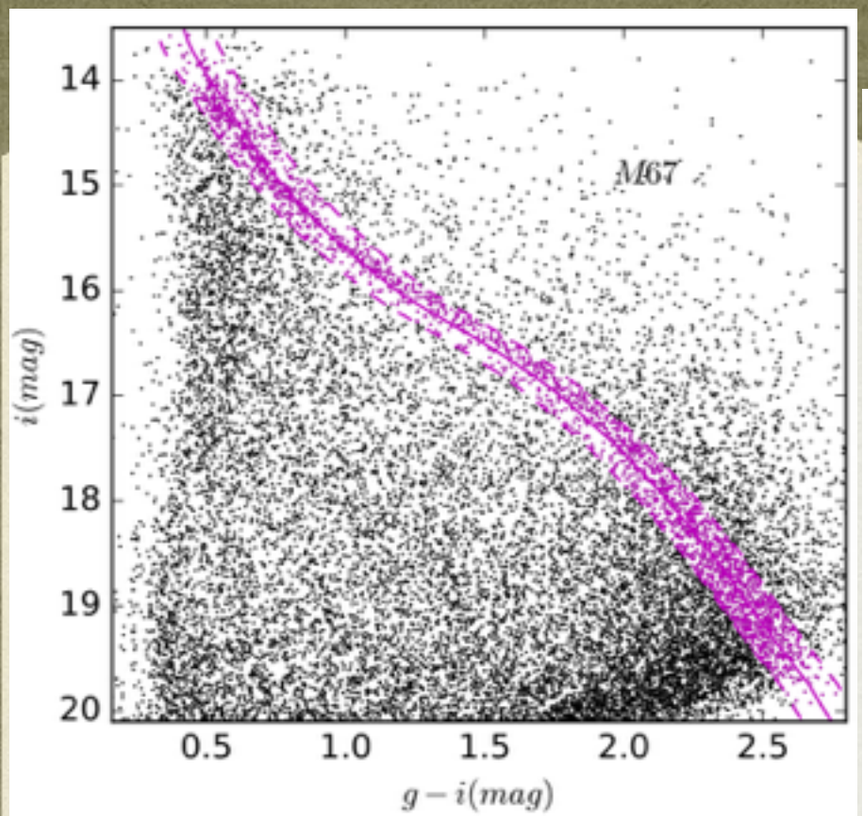
CONCLUSION

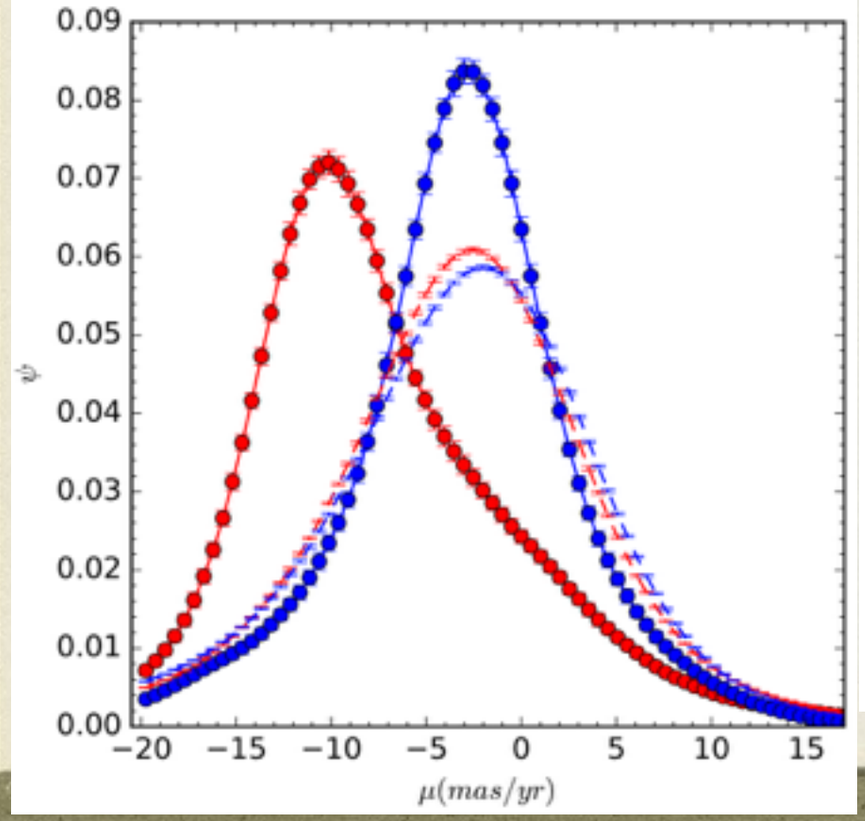
- With Gaia+PS1+SDSS, we construct a proper motion catalog (GPS1) for ~350 million stars across 3/4 sky region, down to mr<20.

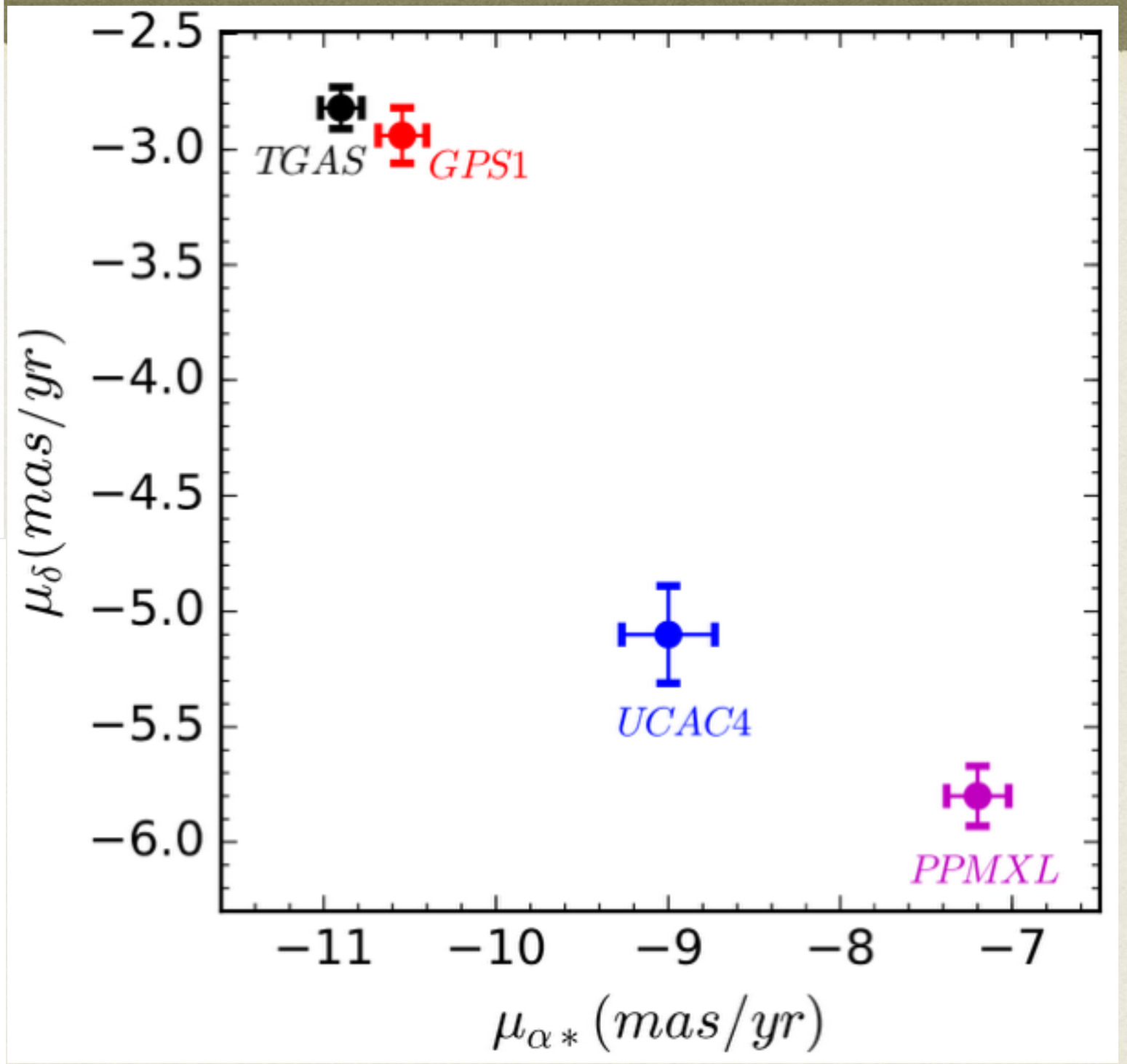
- The characteristic systematic error <0.3 mas/yr (~10x better than PPMXL, UCAC4), the precision ~1.5 mas/yr. (~4x better than PPMXL, UCAC4)

- GPS1 & LAMOST will be the best catalog for the Milk Way research before Gaia DR2 (2018.04)

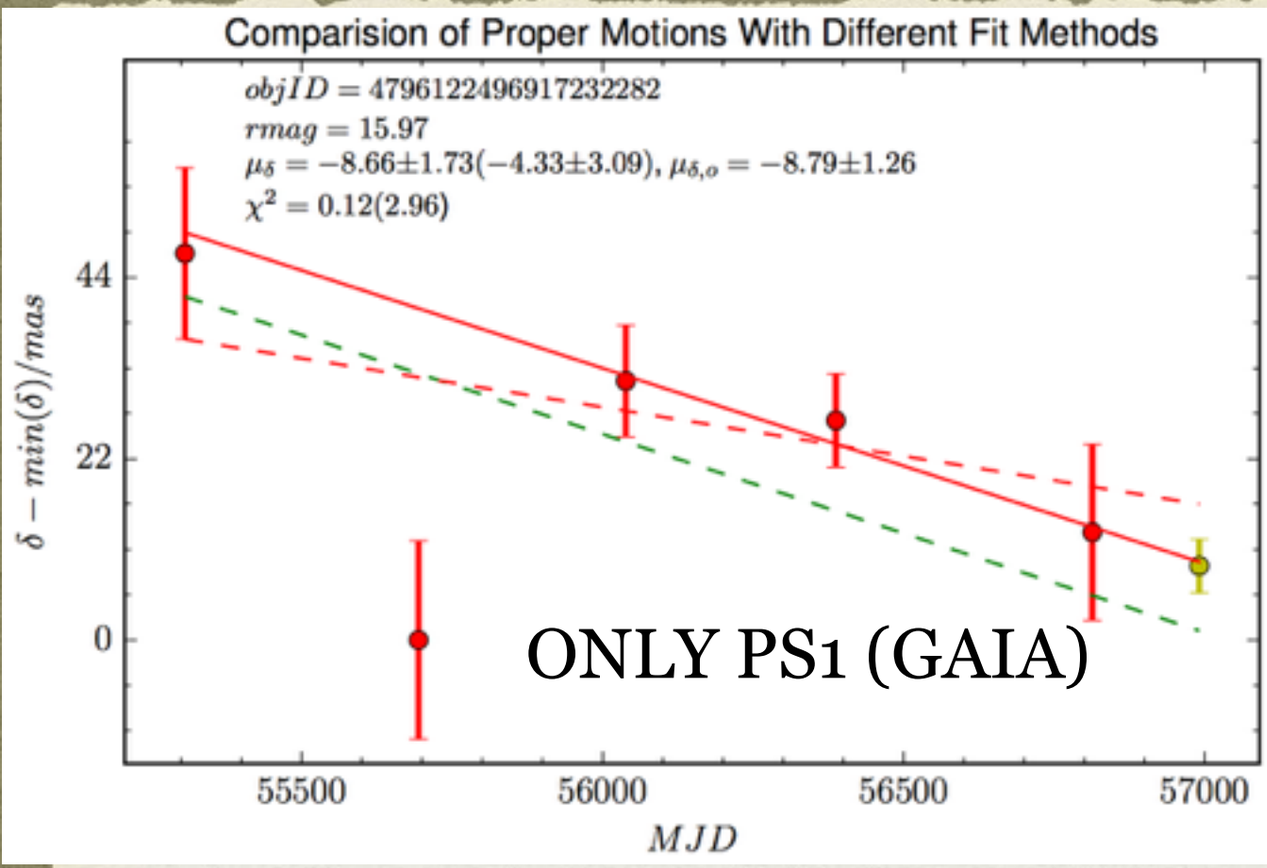
VALIDATION (OPEN CLUSTER)

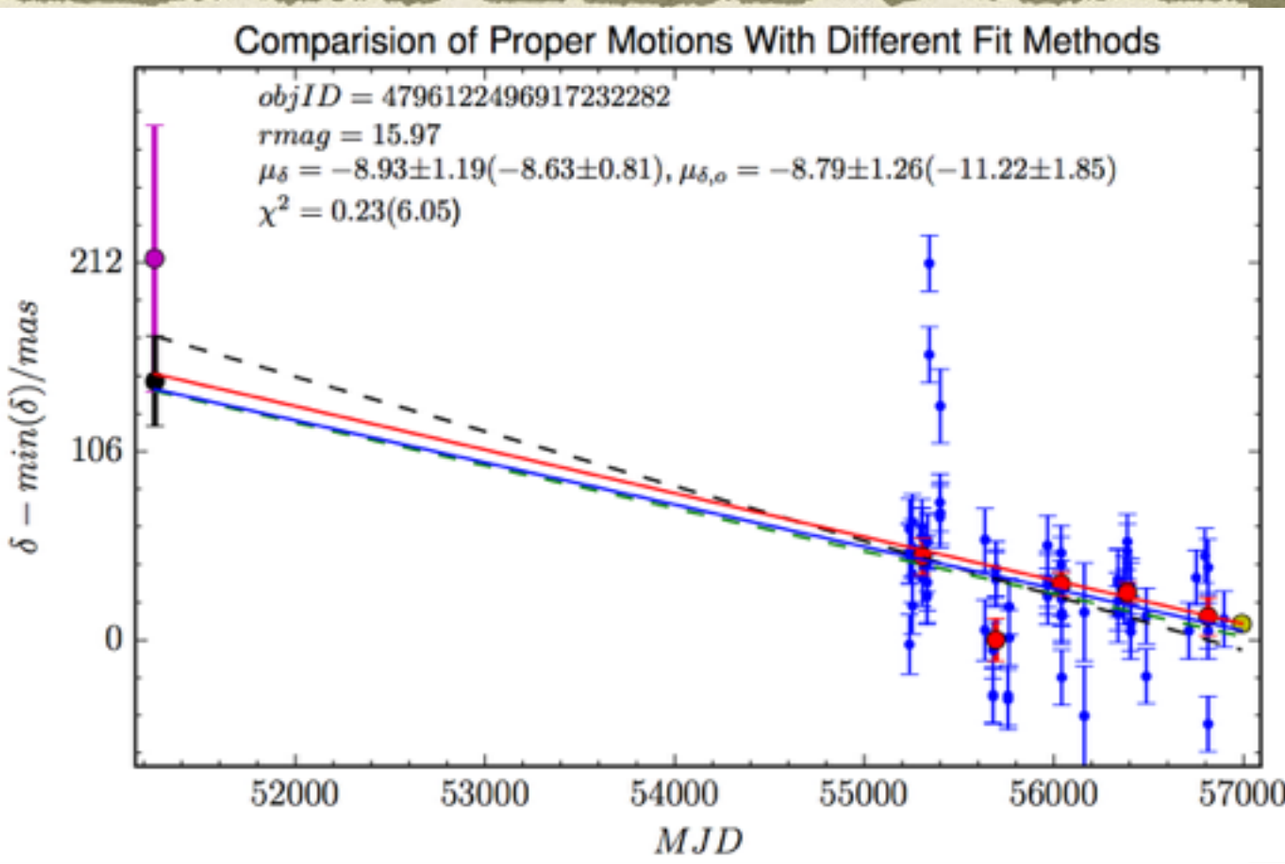






PROPER MOTION FIT (A TYPICAL EXAMPLE)



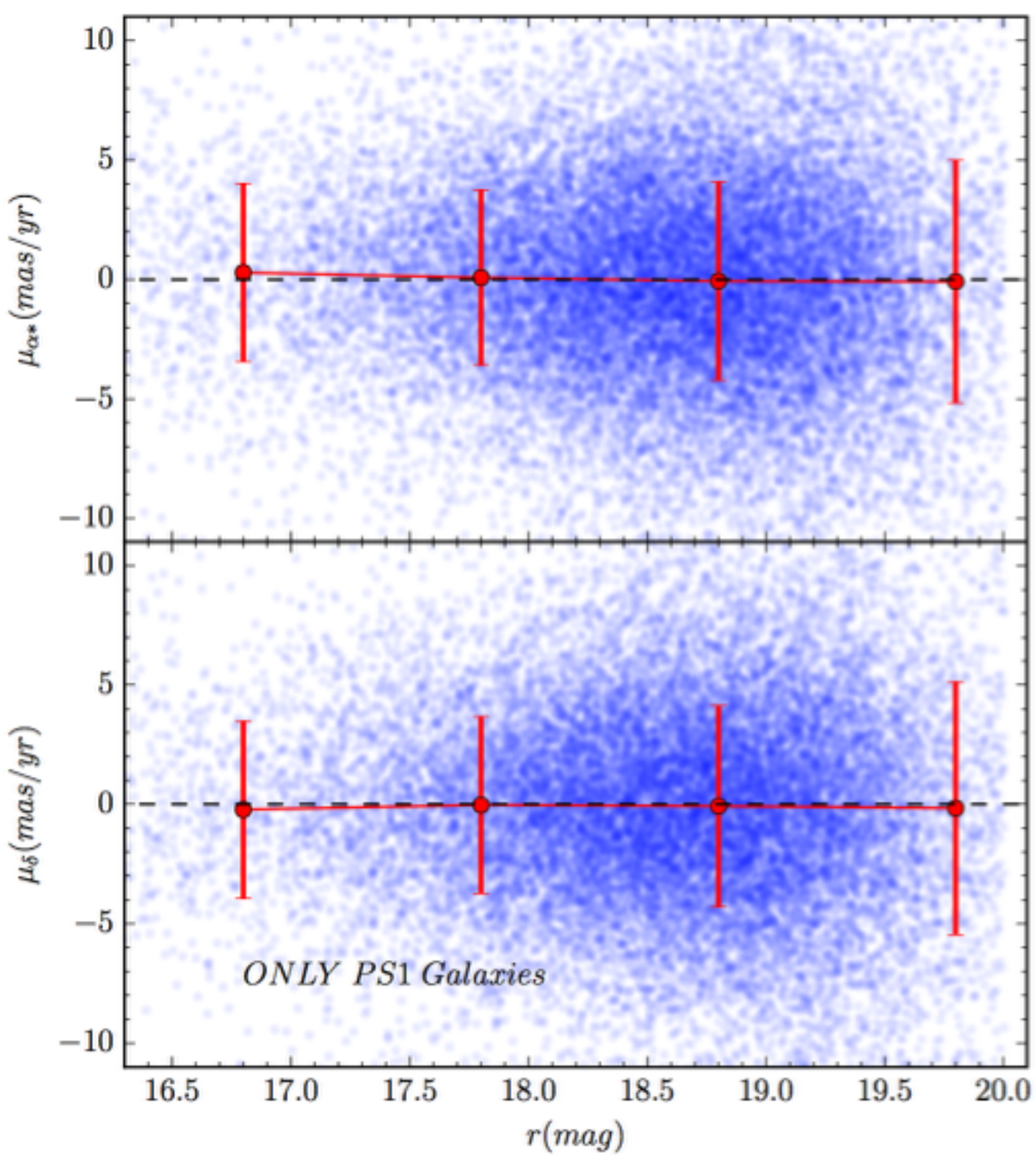


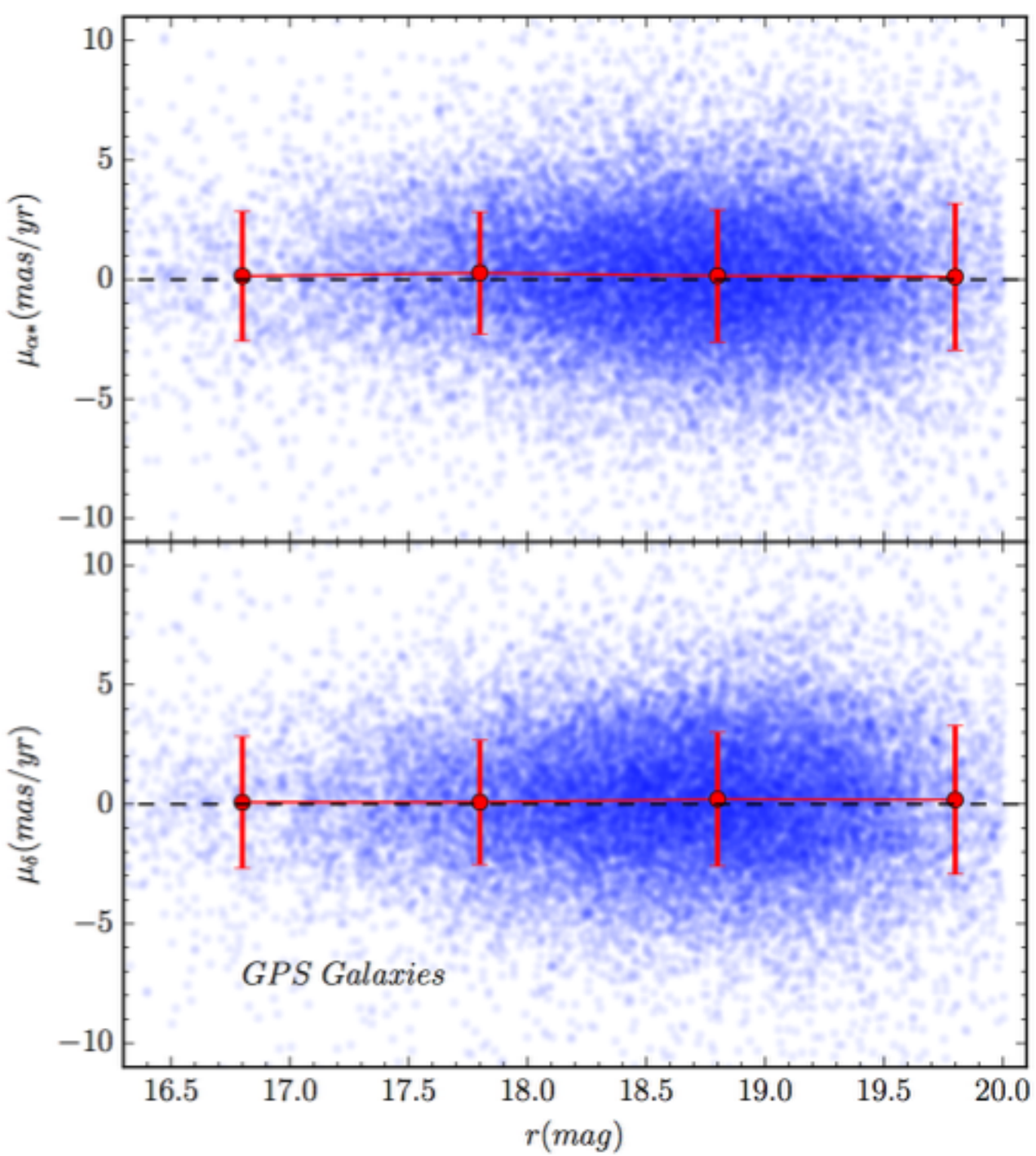
- red points (Season-AVG PS1)
- yellow point (Gaia)
- blue points (individual PS1)
- pink point (2MASS)
- black point (SDSS)

- red line(red points, excluding 1 outlier)
- red dash line(red points, including 1 outlier)
- blue line(blue points fitting)
- black dash line(from PV3)
- green dash line(from Fritz + 2015)

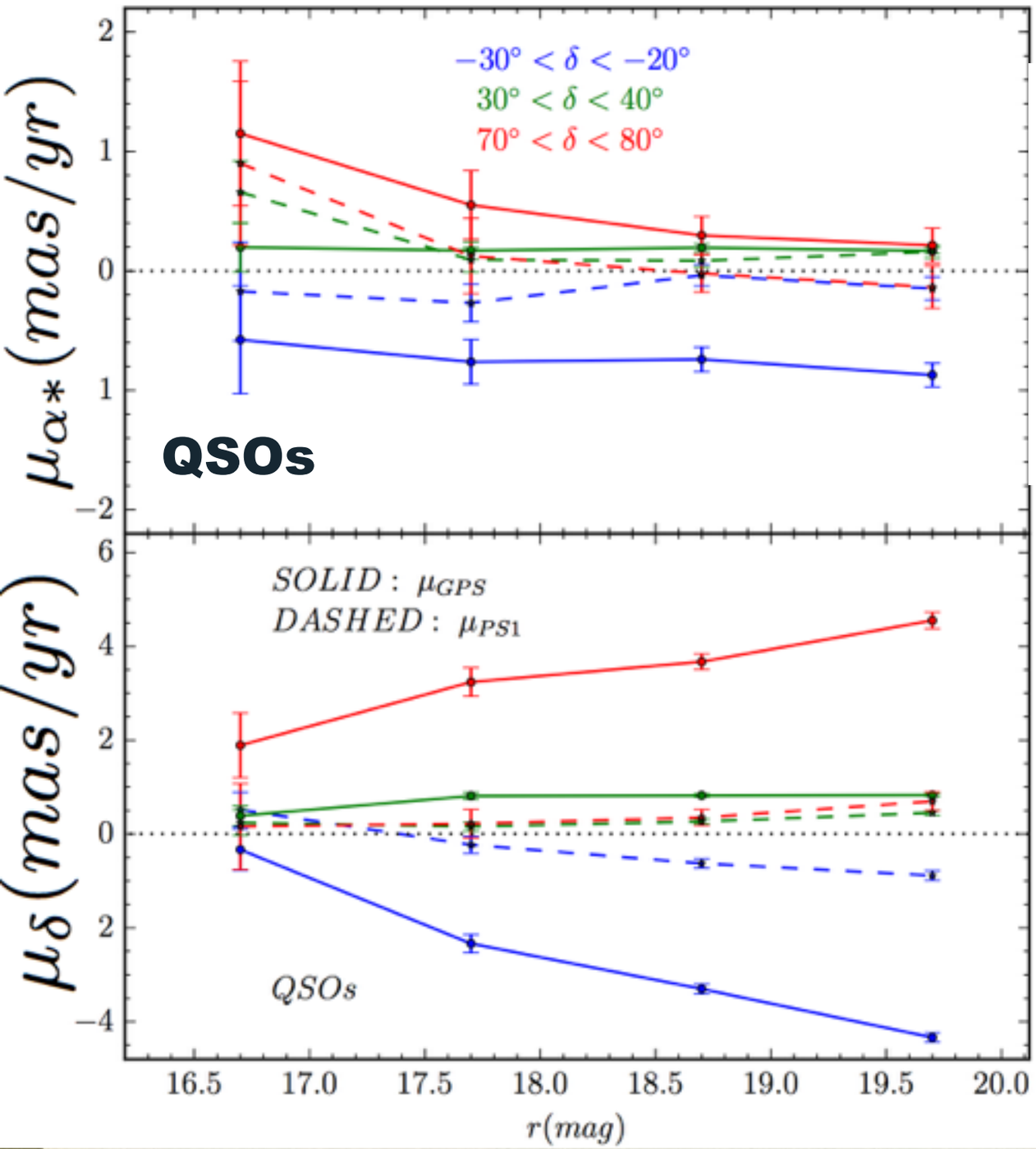
Finally, We choose the red solid fitting (MODEL INDEPENDENT).

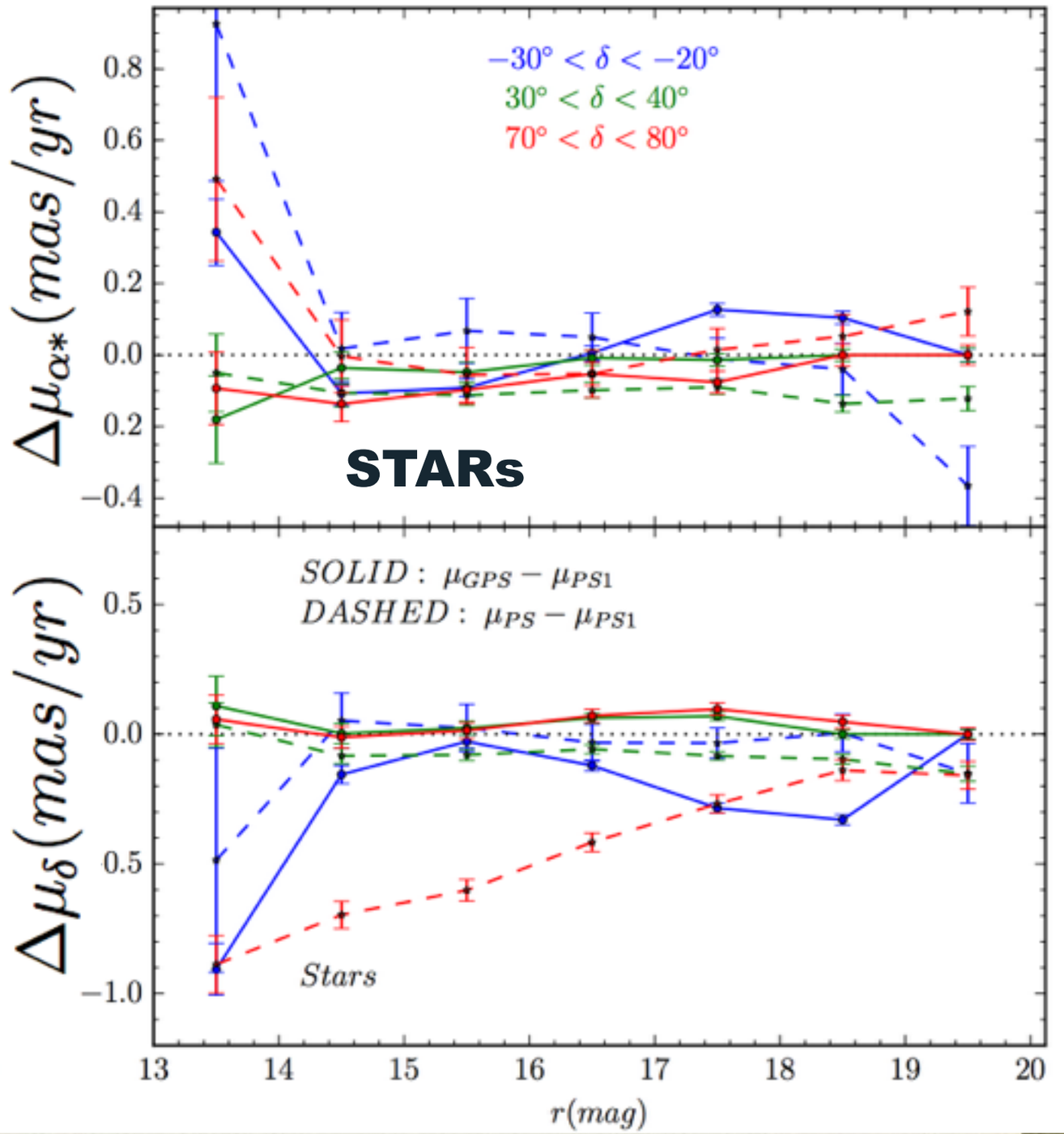
VALIDATION (GALAXIES)



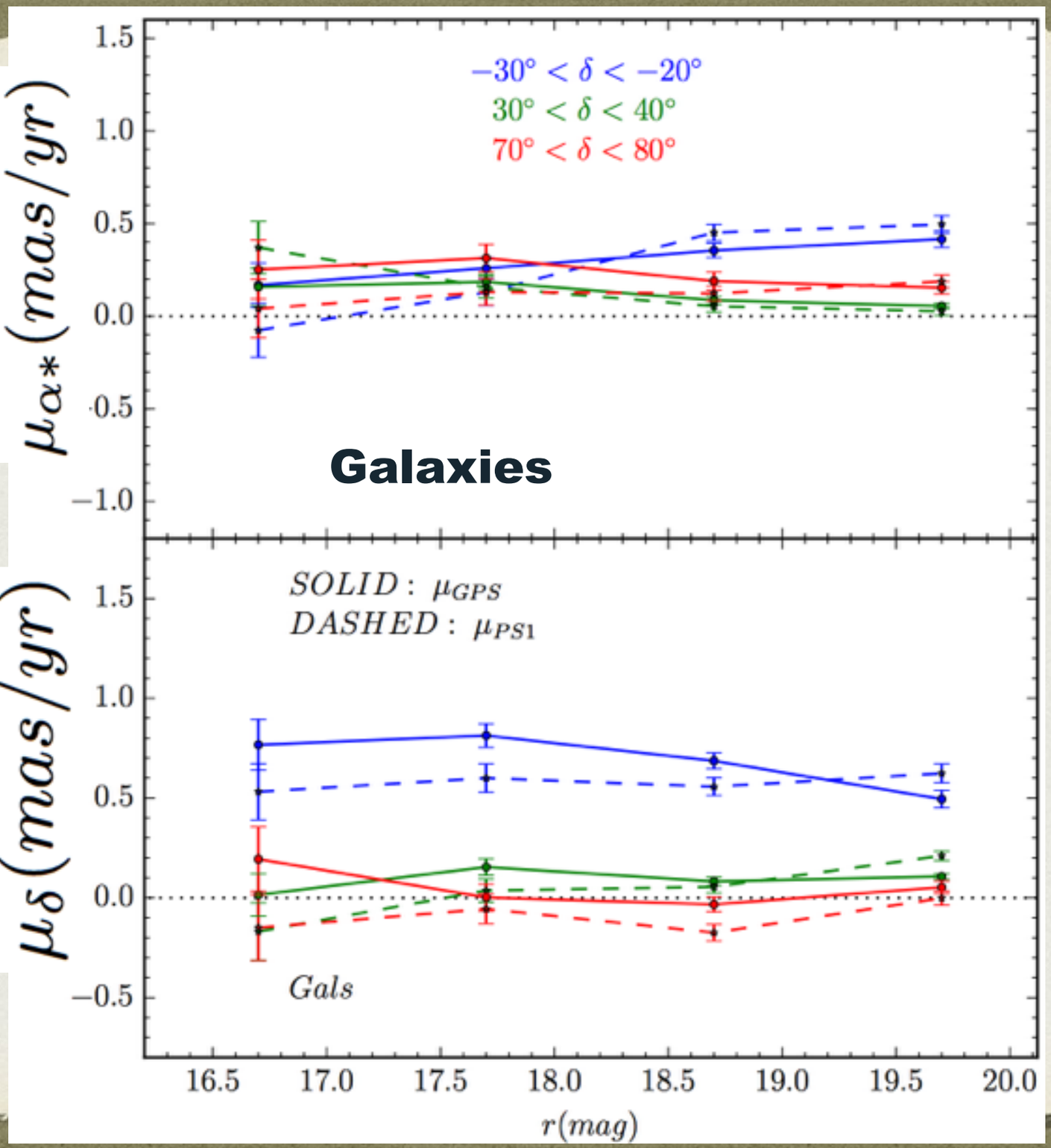


IMPACT OF DCR

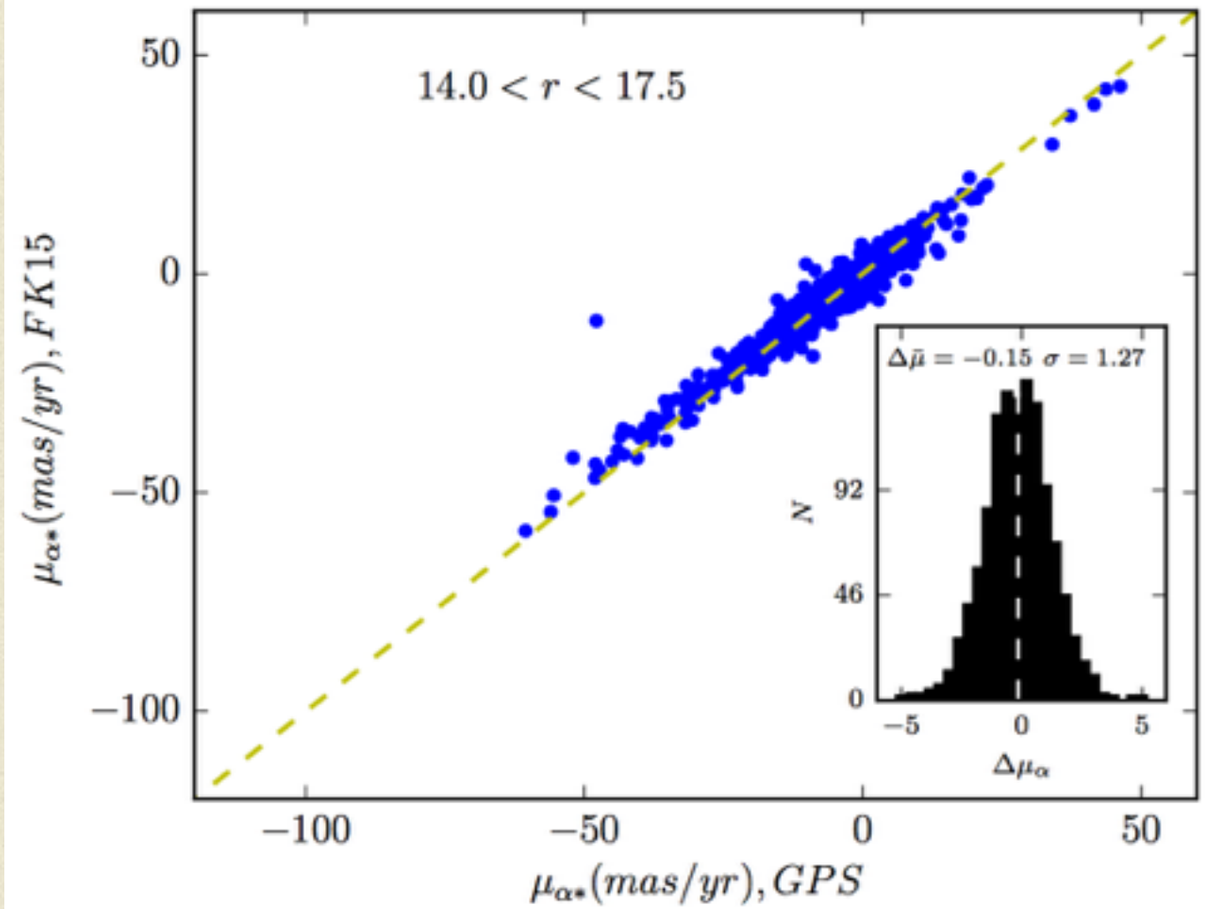


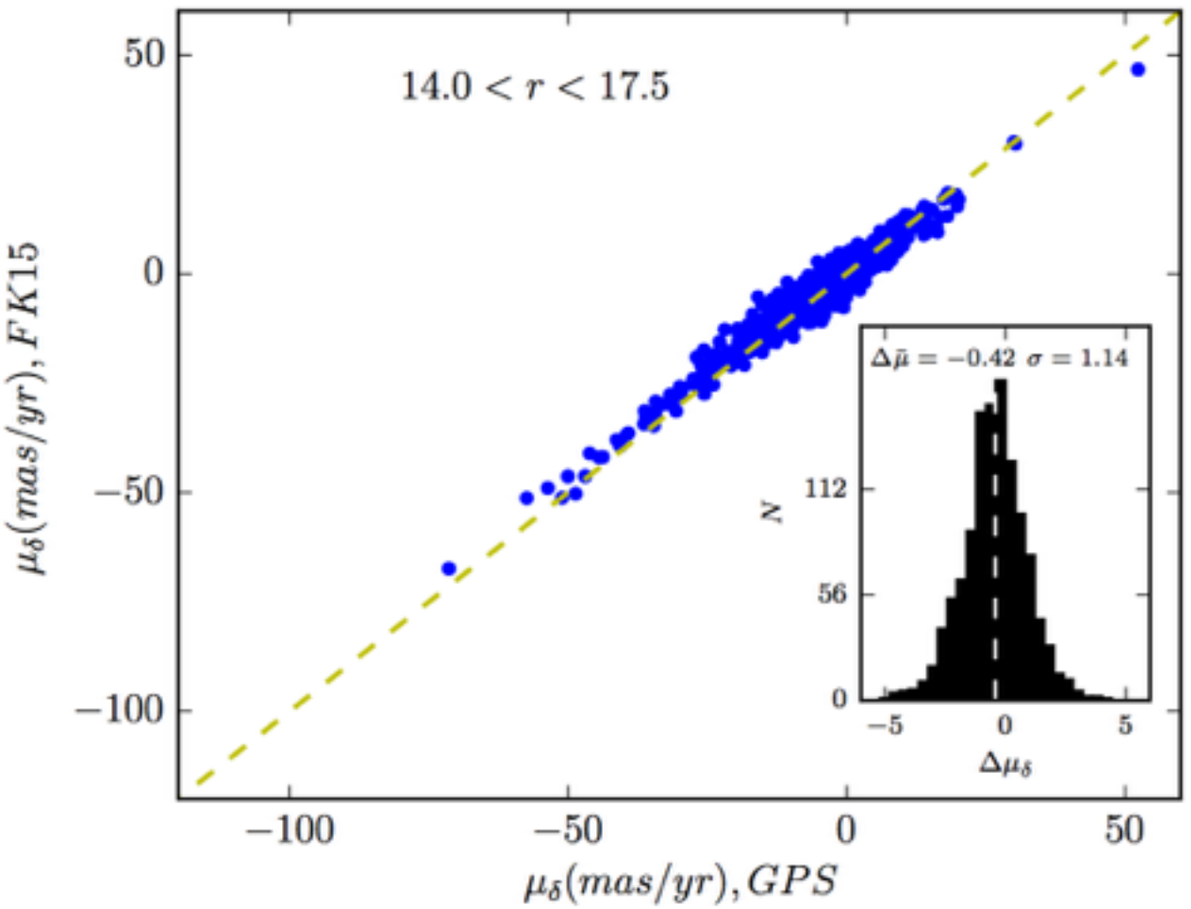


IMPACT OF DCR

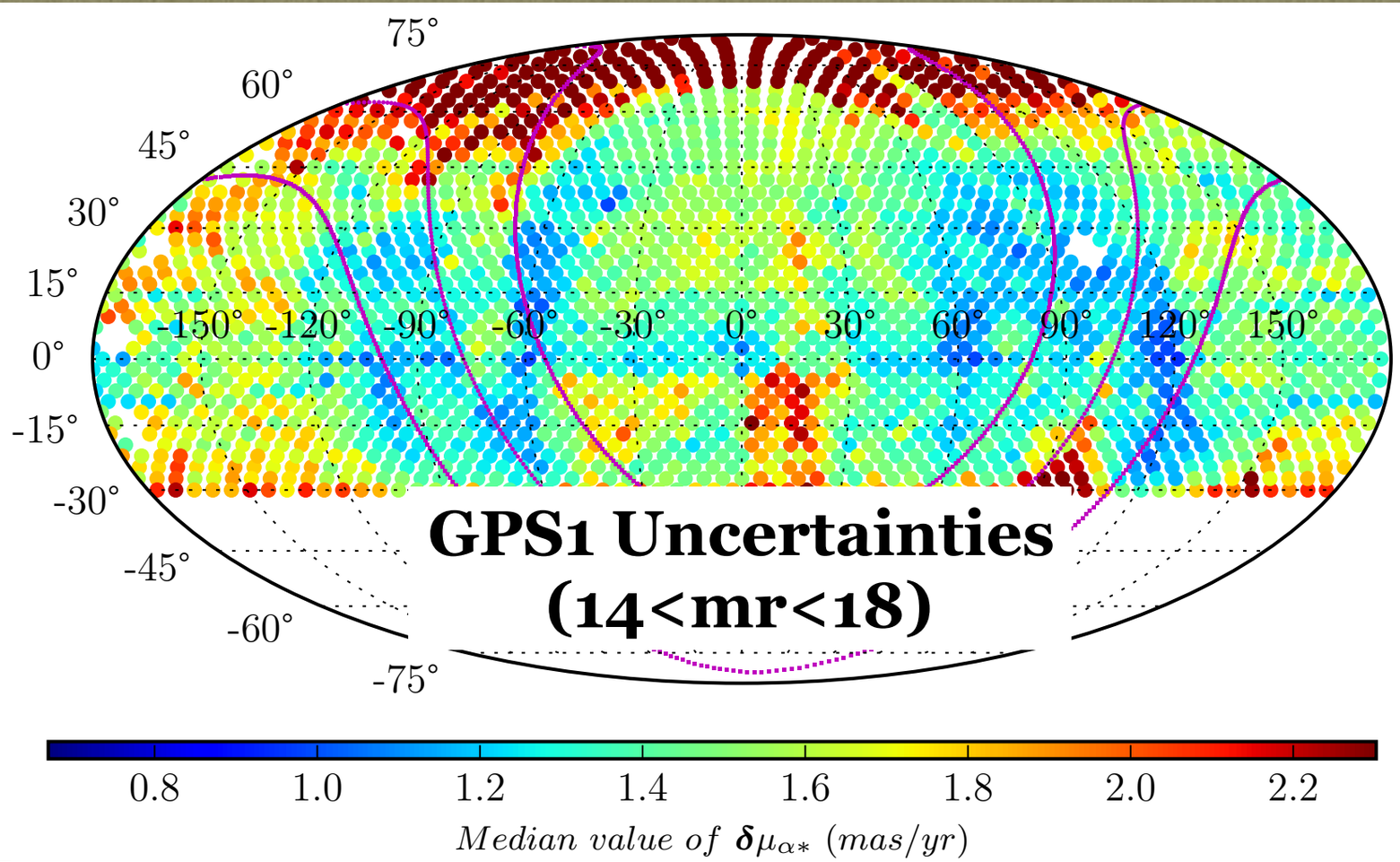


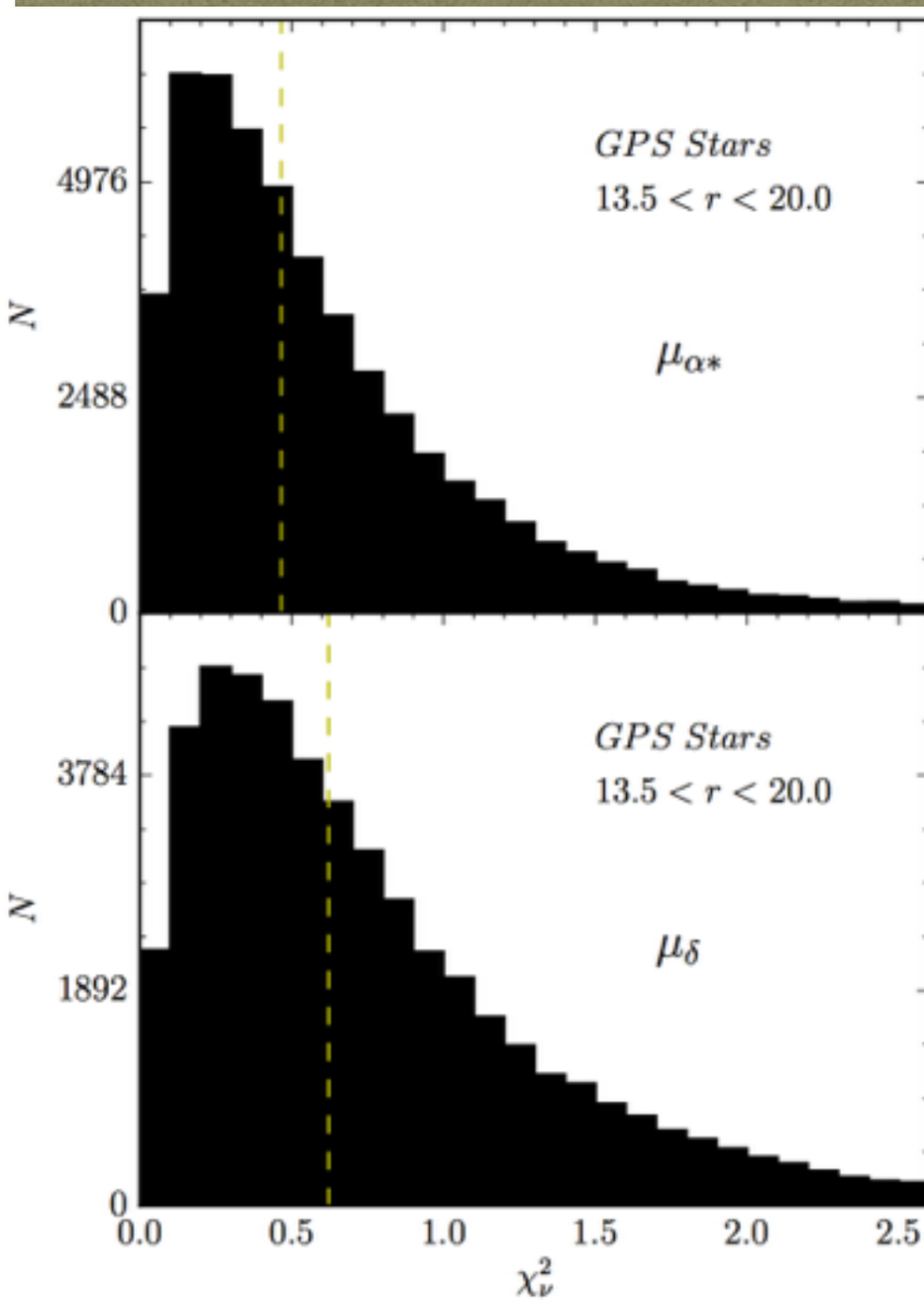
COMPARISON(NEARBY PAL5)

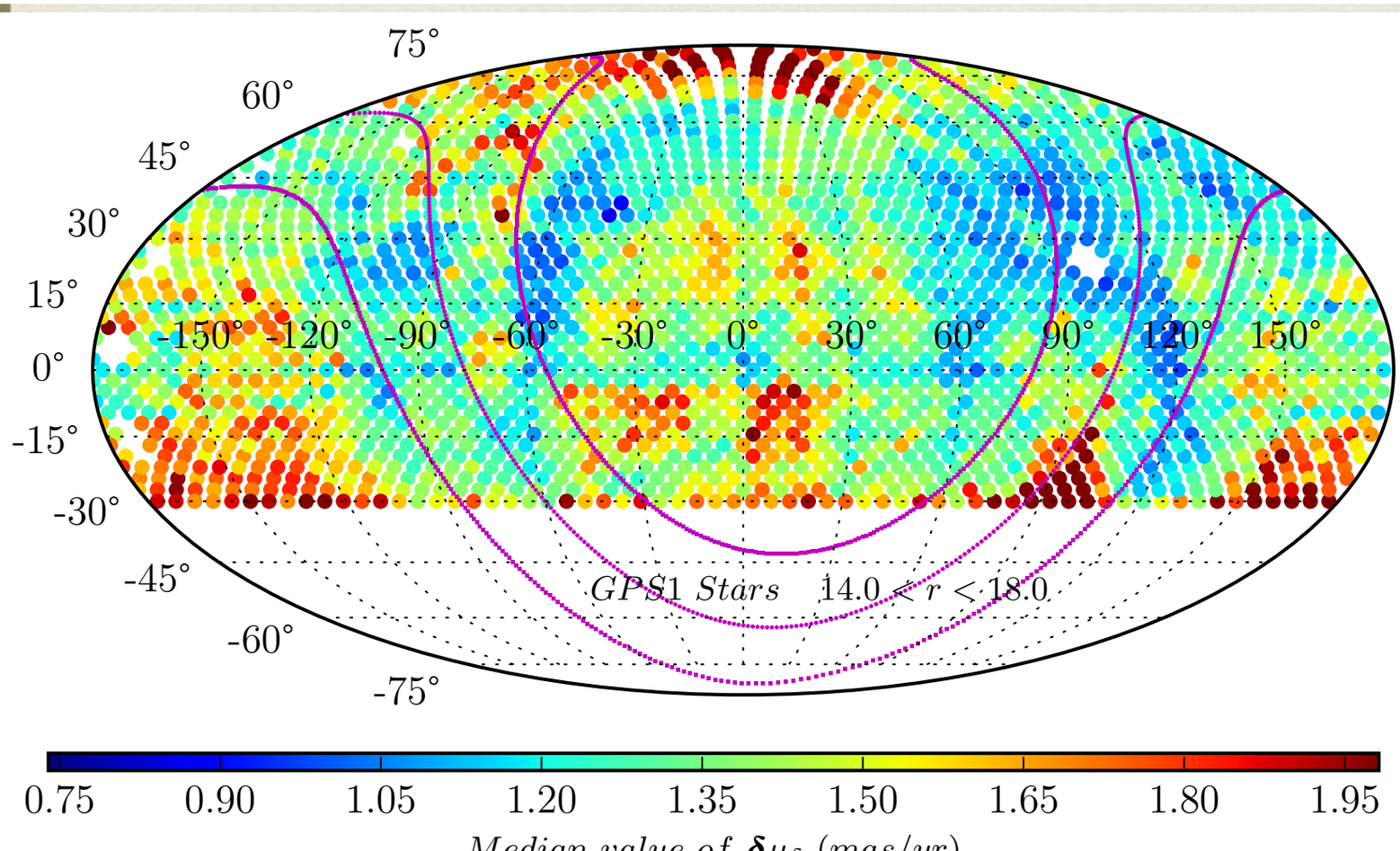




Fritz & Kallivayalil (2015)







Reduced chi2

IMPACT OF DCR