



HST Proper Motions along Stellar Streams

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[HST PROMO](#) Collaboration (Google for website)

HST PMs along Stellar Streams

1. Why **Stellar Streams**?

↳ Mass & shape of MW halo (Bowden, Vera-Ciro talks)

2. Why **Proper Motions (PMs)**?

↳ 2 components of motions → ~~model degeneracies~~

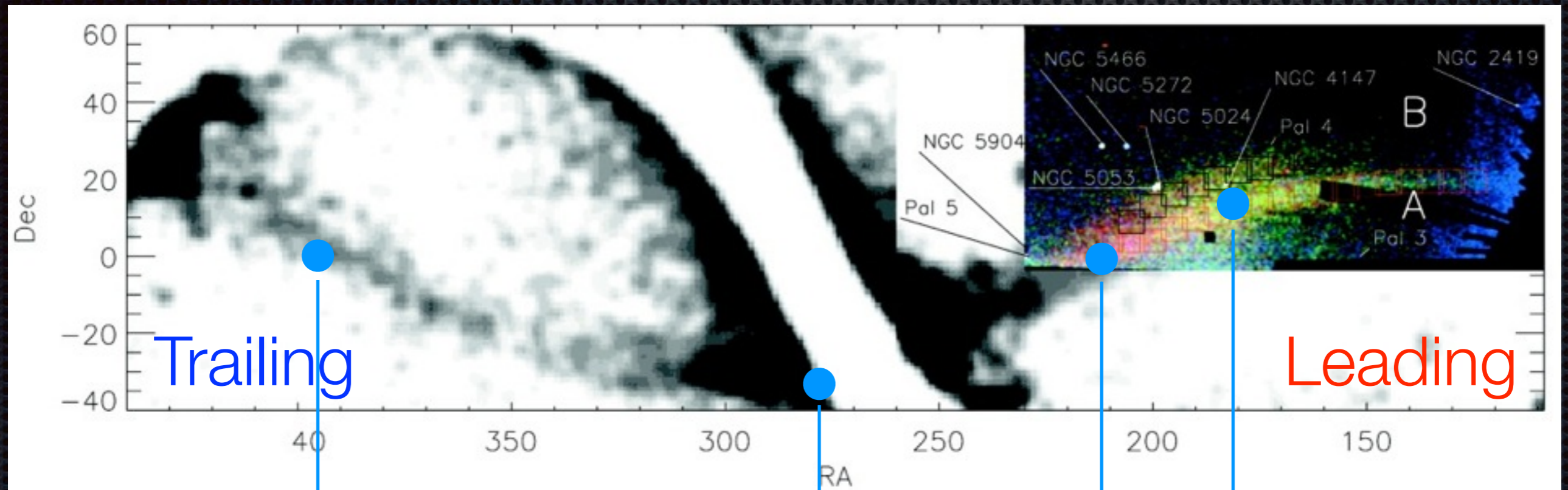
3. Why **Hubble Space Telescope (HST)**?

↳ Stable and well-calibrated

↳ Proven capabilities (e.g, M31, LMC, and Leo I)

- This talk: **Sagittarius & Orphan Streams**

Sgr Stream - Target Fields



2MASS (Majewski et al. 2003) + SDSS (Belokurov et al. 2006)

FIELD1

GDDS field

FIELD2

GC (NGC 6652)

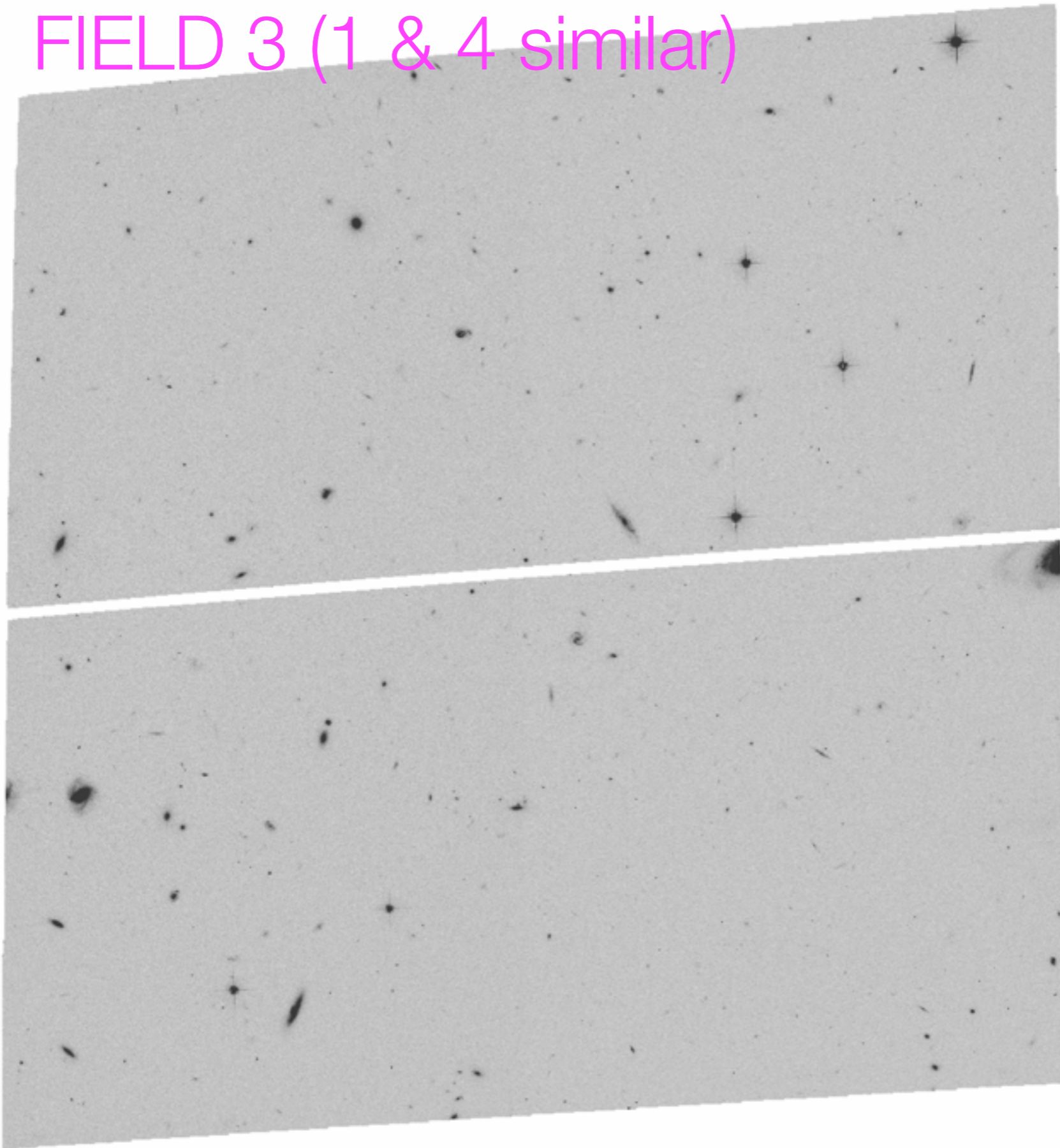
FIELD3

QSOs ($z \sim 4$)

FIELD4

- ✦ 2 epochs per field, $\Delta T = 6\sim 9$ years
- ✦ ACS/WFC F775W or F814W (+F606W for CMDs)

FIELD 3 (1 & 4 similar)



9.2

18

28

37

46

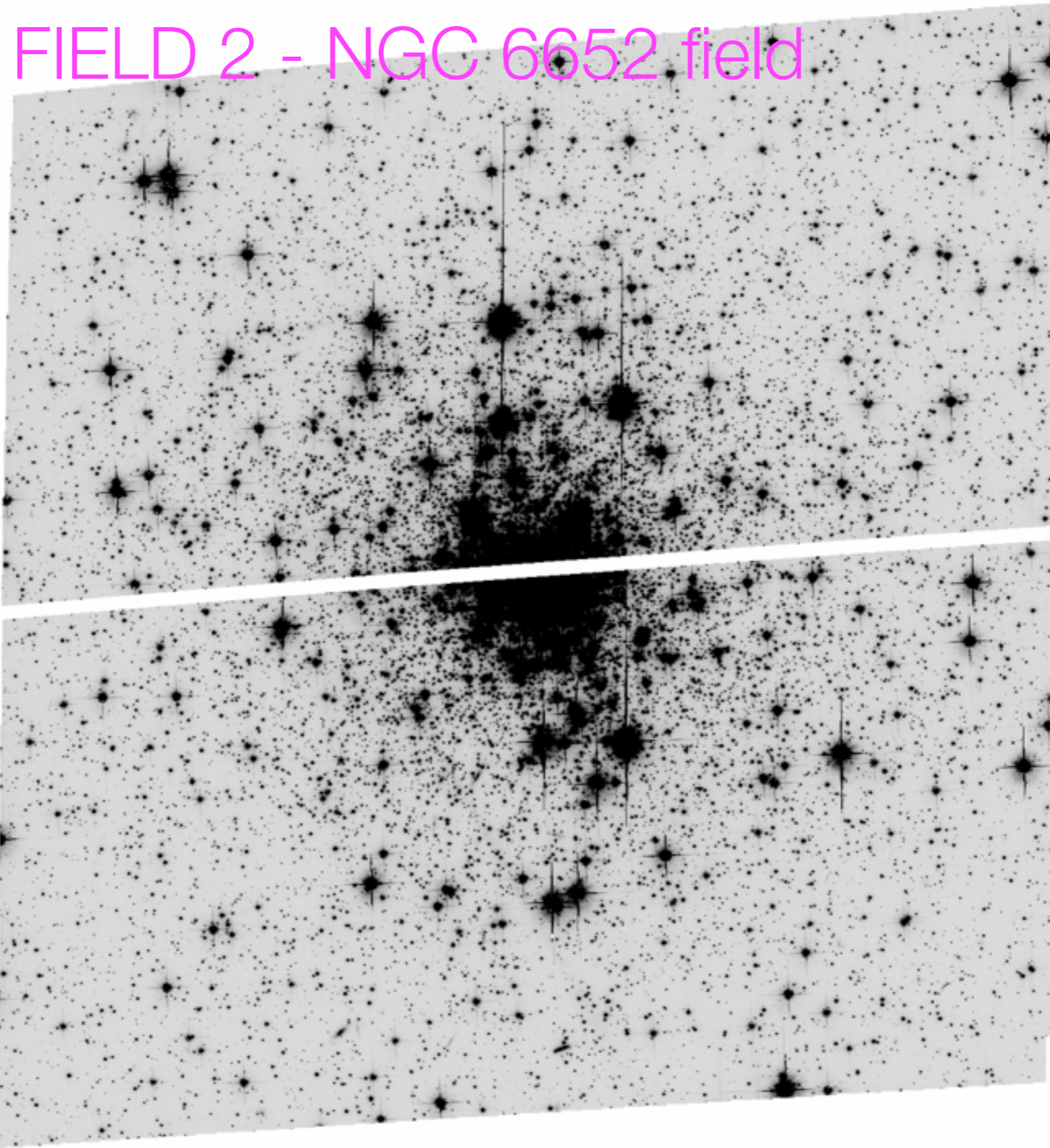
55

65

74

83

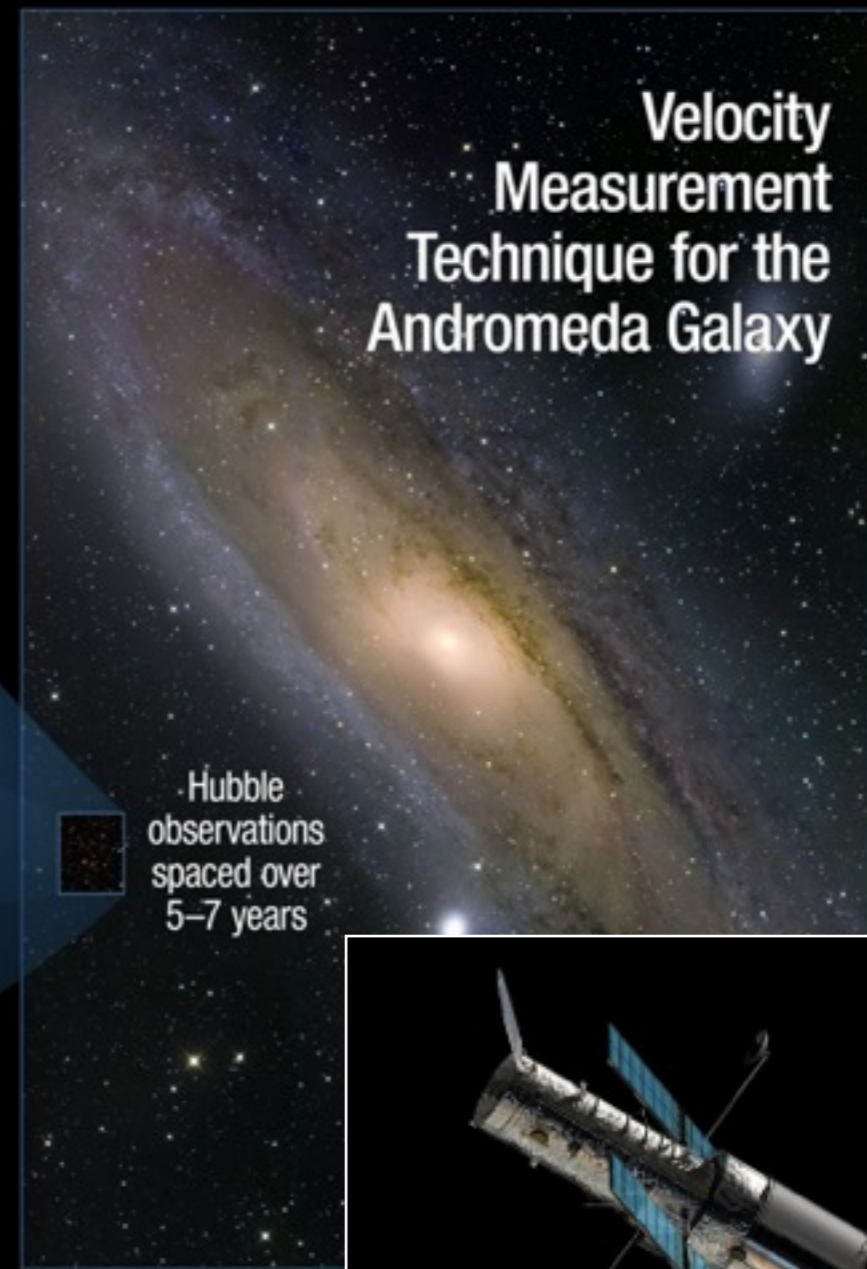
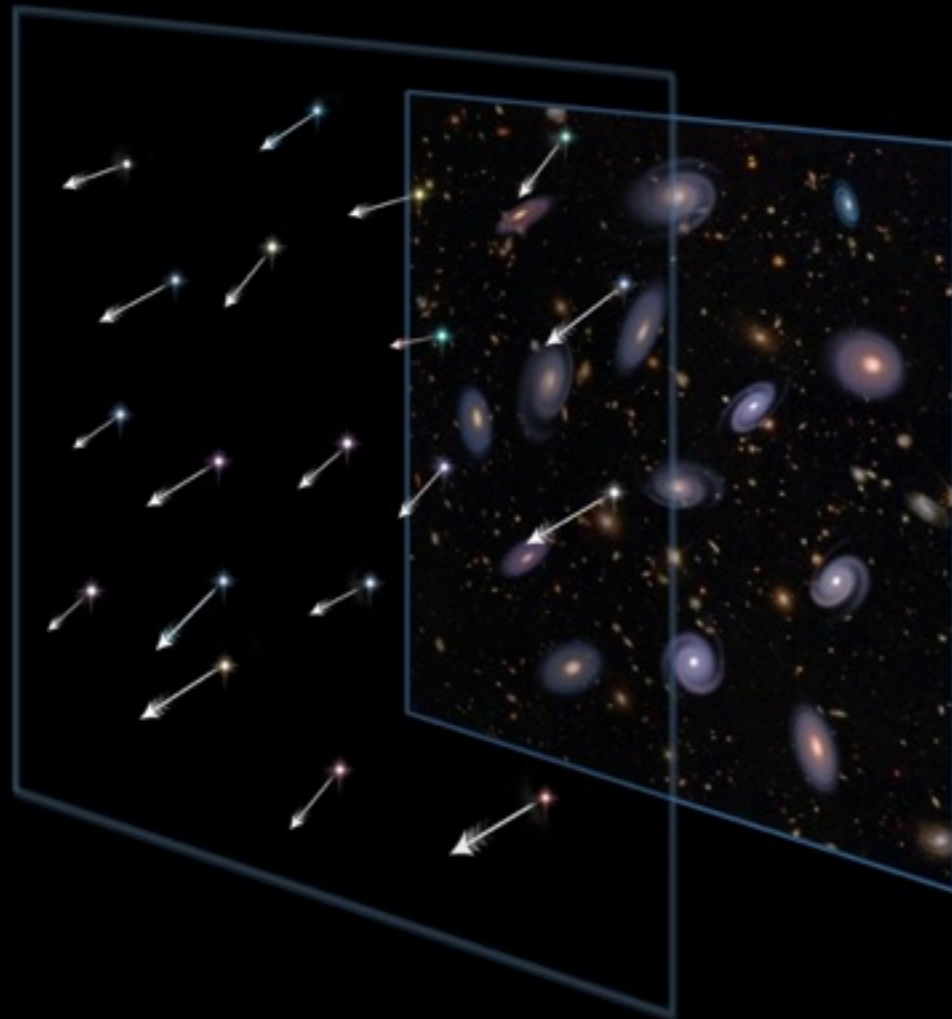
FIELD 2 - NGC 6652 field



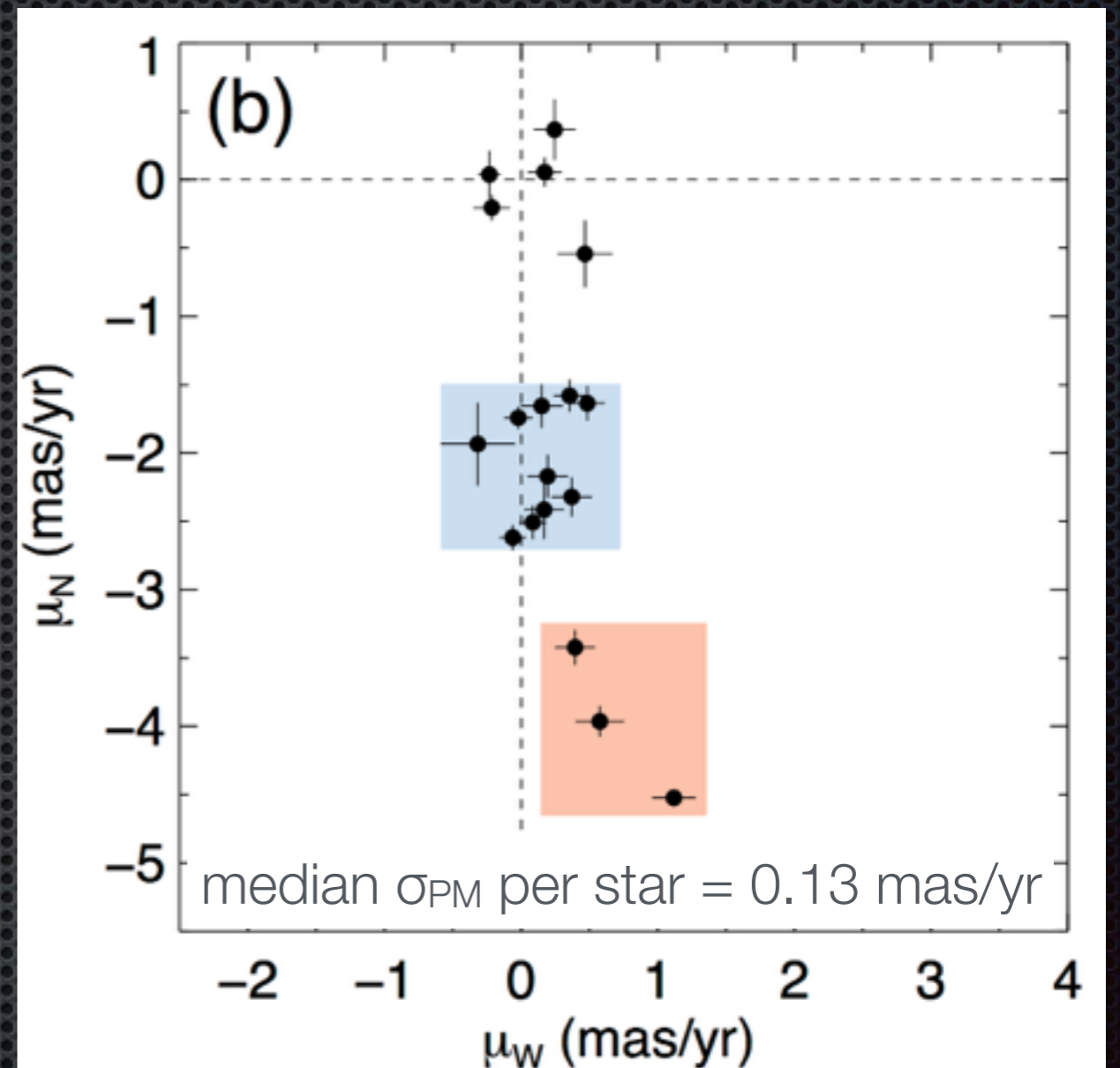
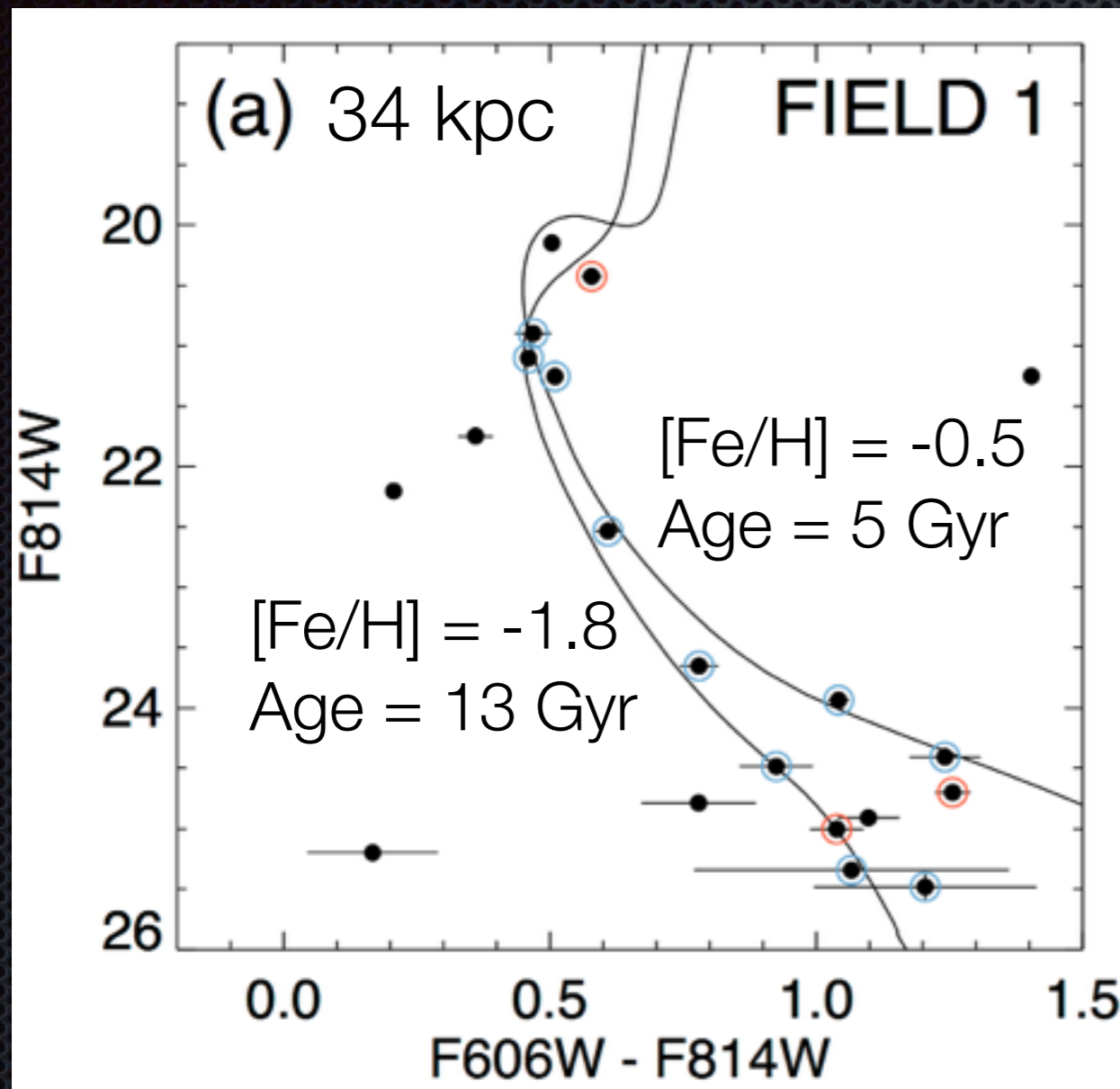
50 100 150 200 250 300 350 400 450

Proper Motion Measurements

← Foreground M31 stars with arrows showing M31 motion
○ Background galaxies in the distant universe

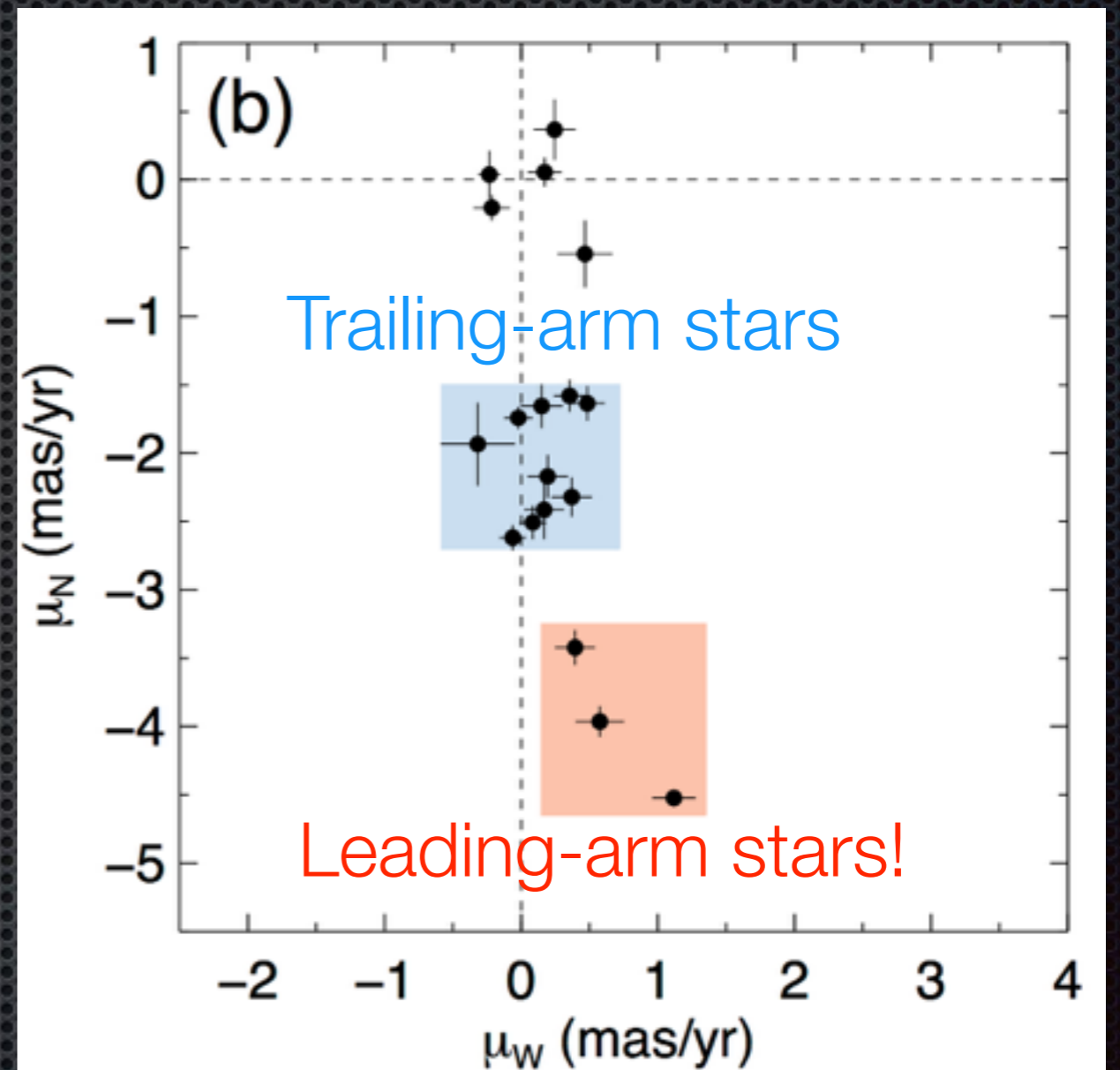
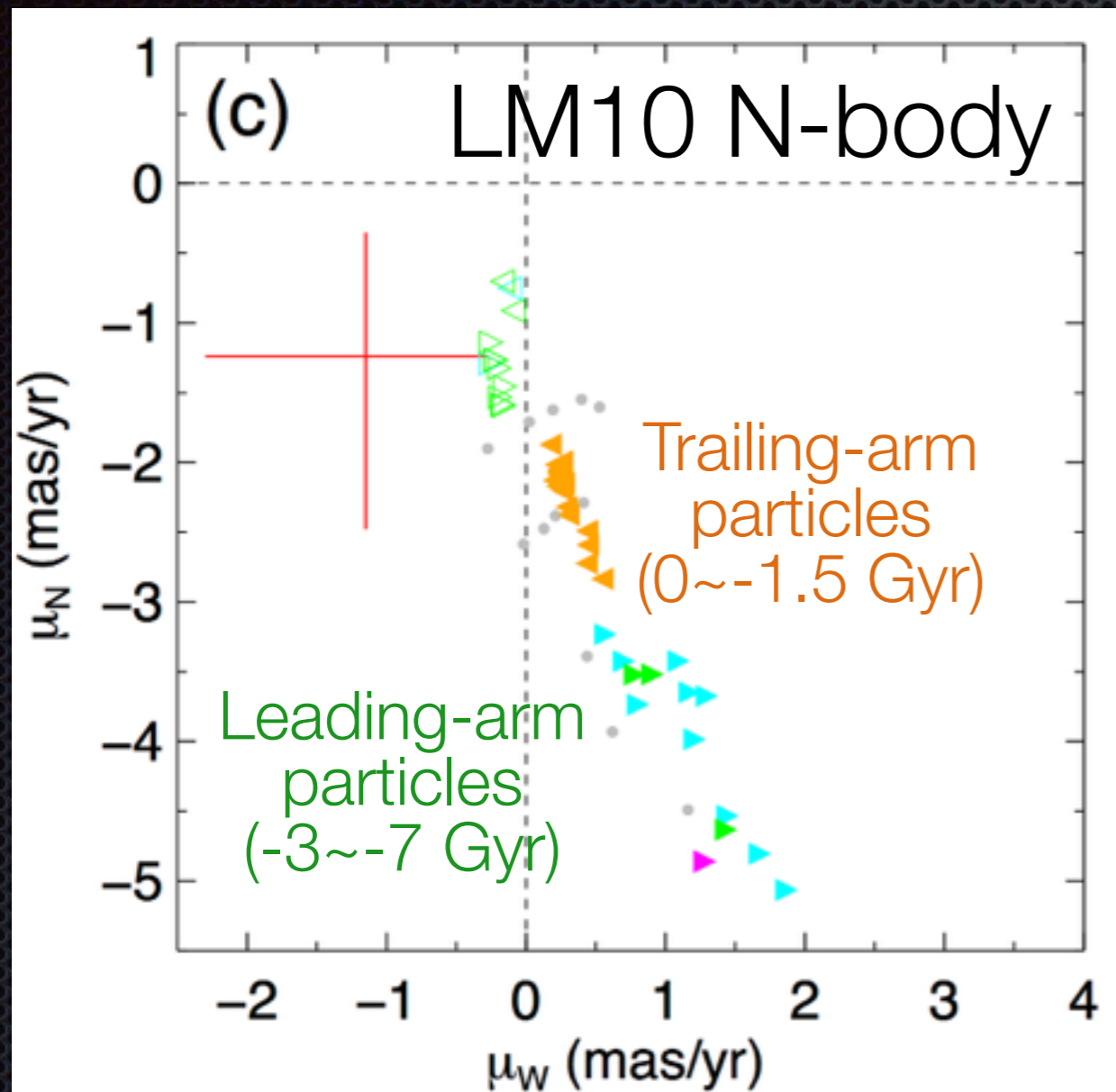


Sgr Stream - FIELD 1



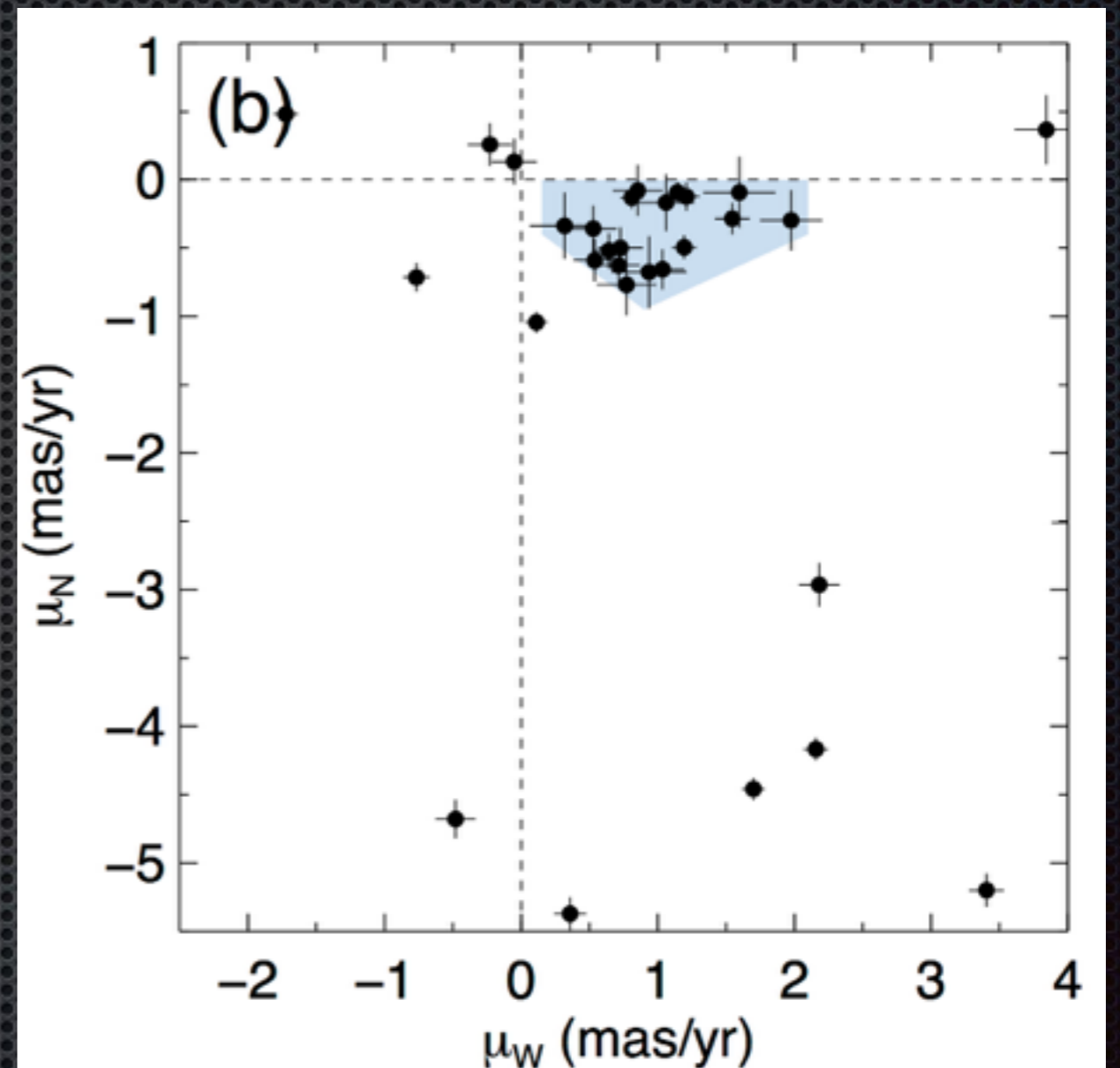
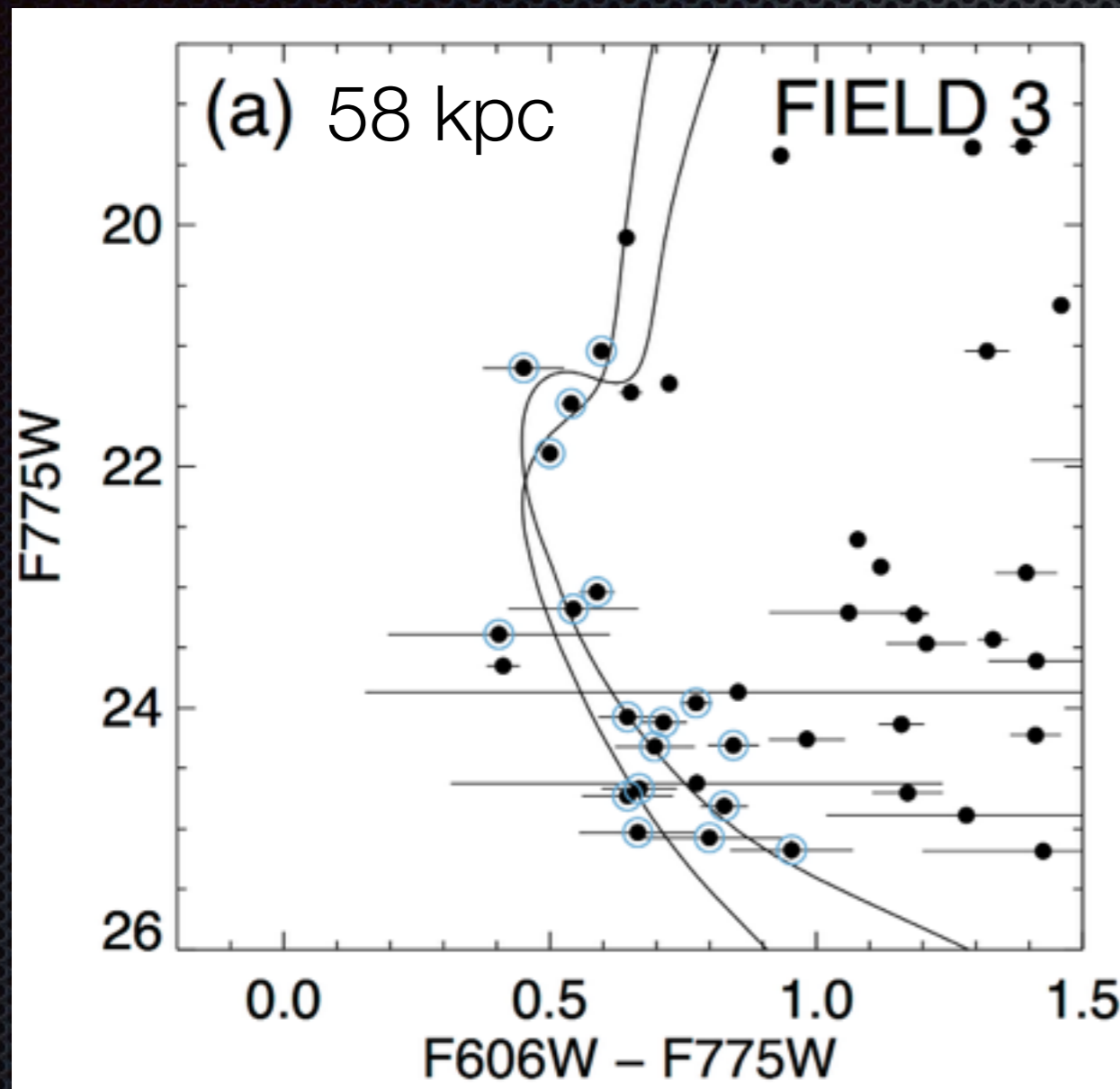
Trailing-arm Field

Sgr Stream - FIELD 1



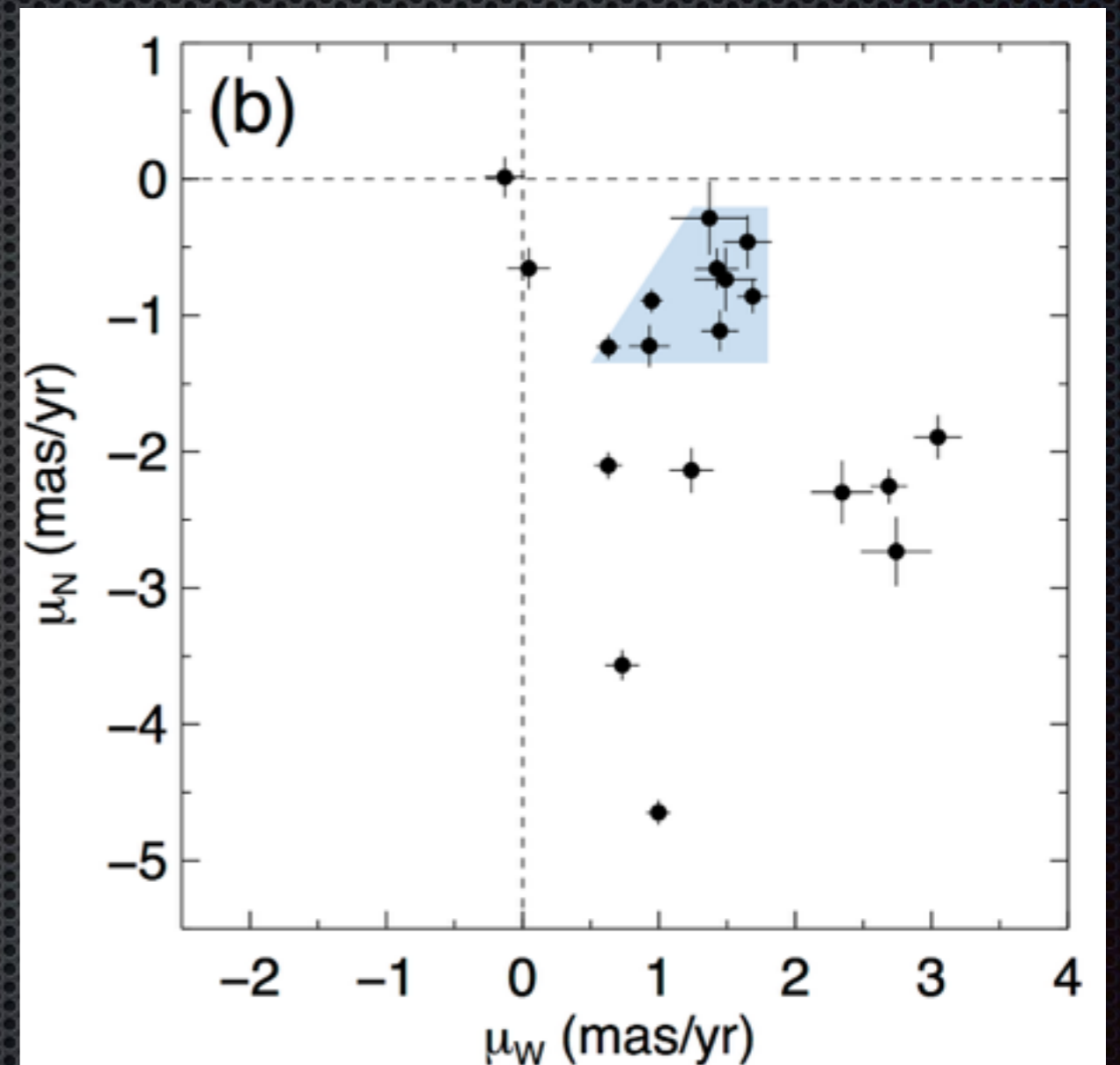
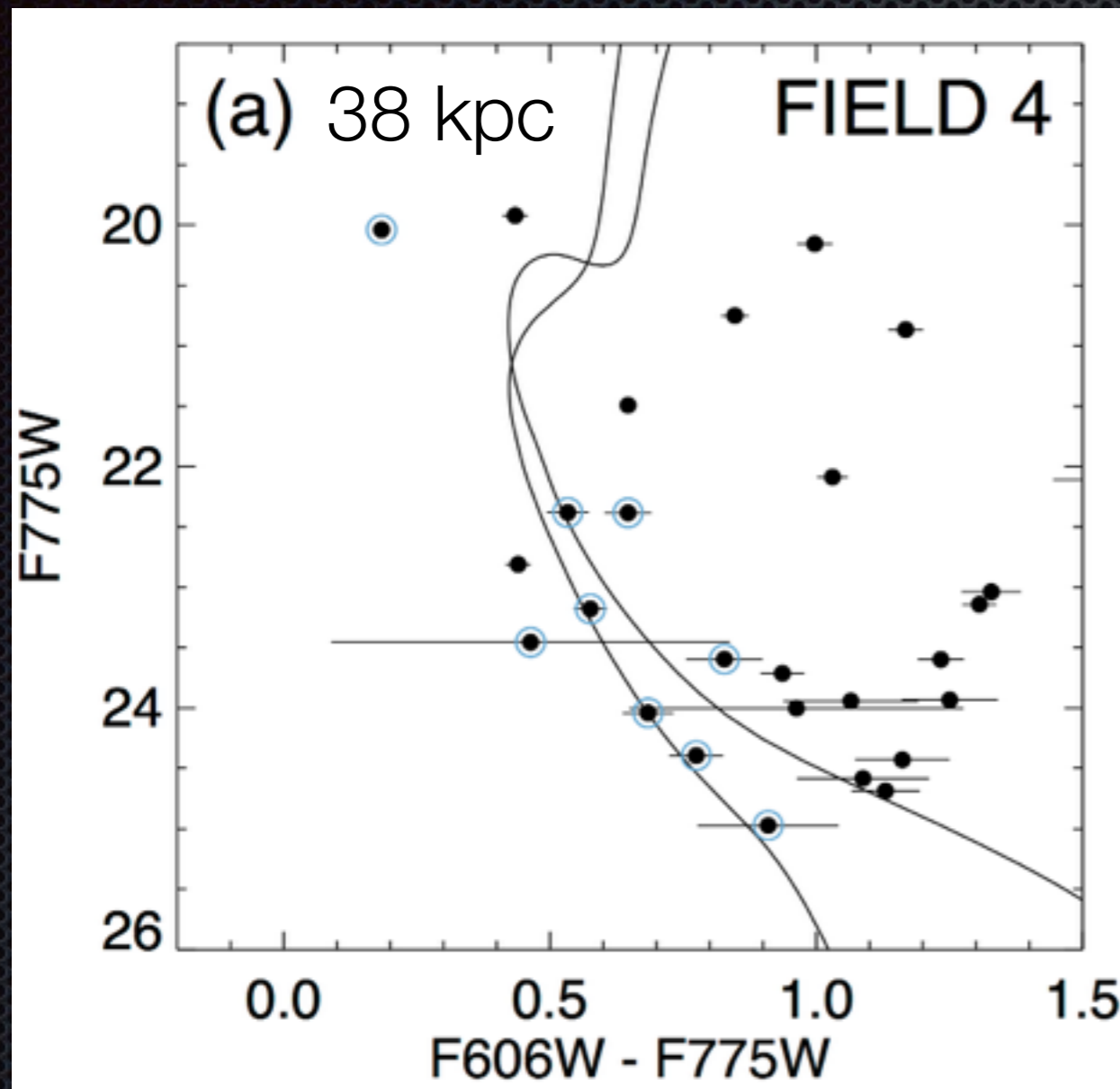
Trailing-arm Field

Sgr Stream - FIELD 3



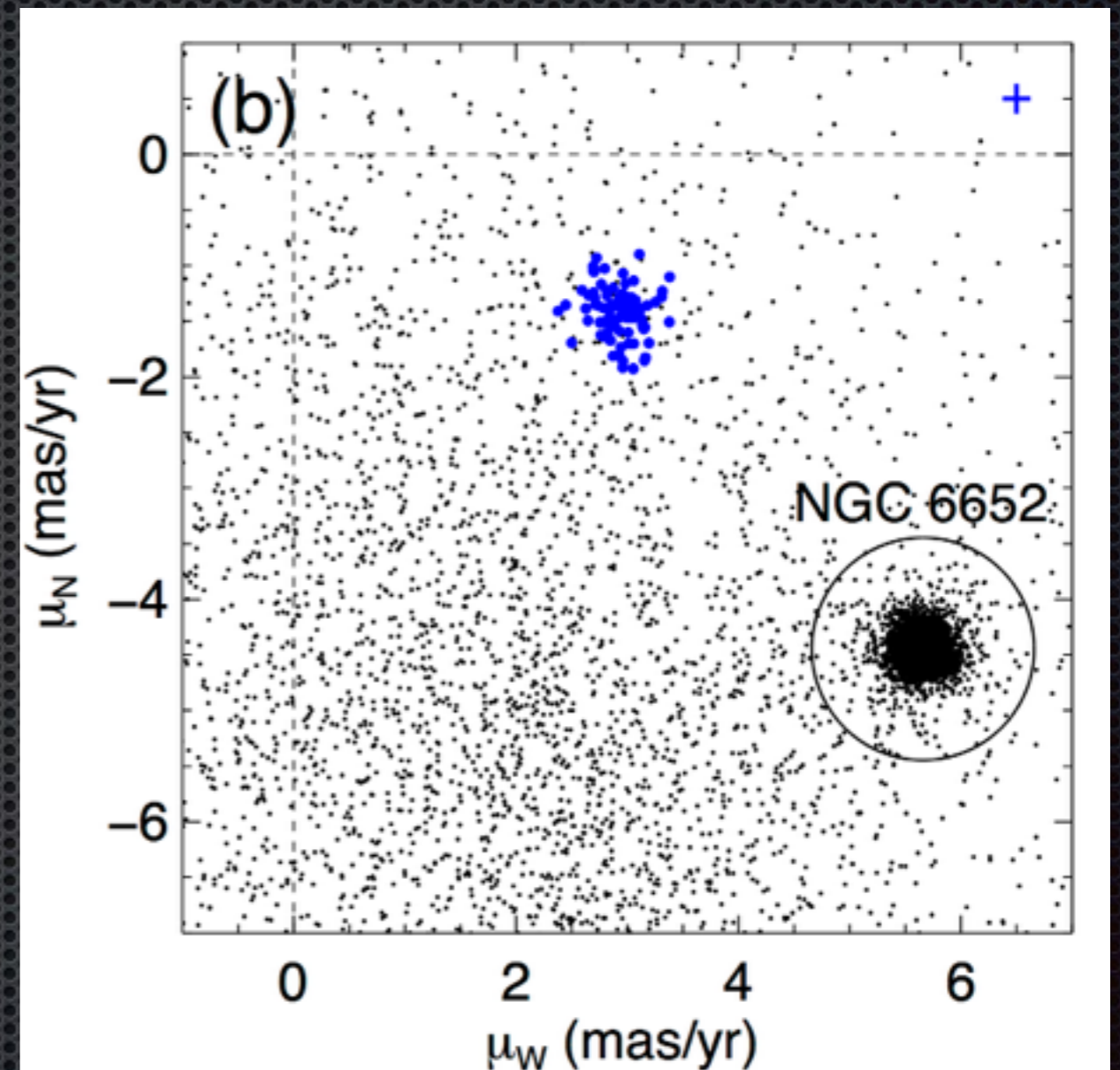
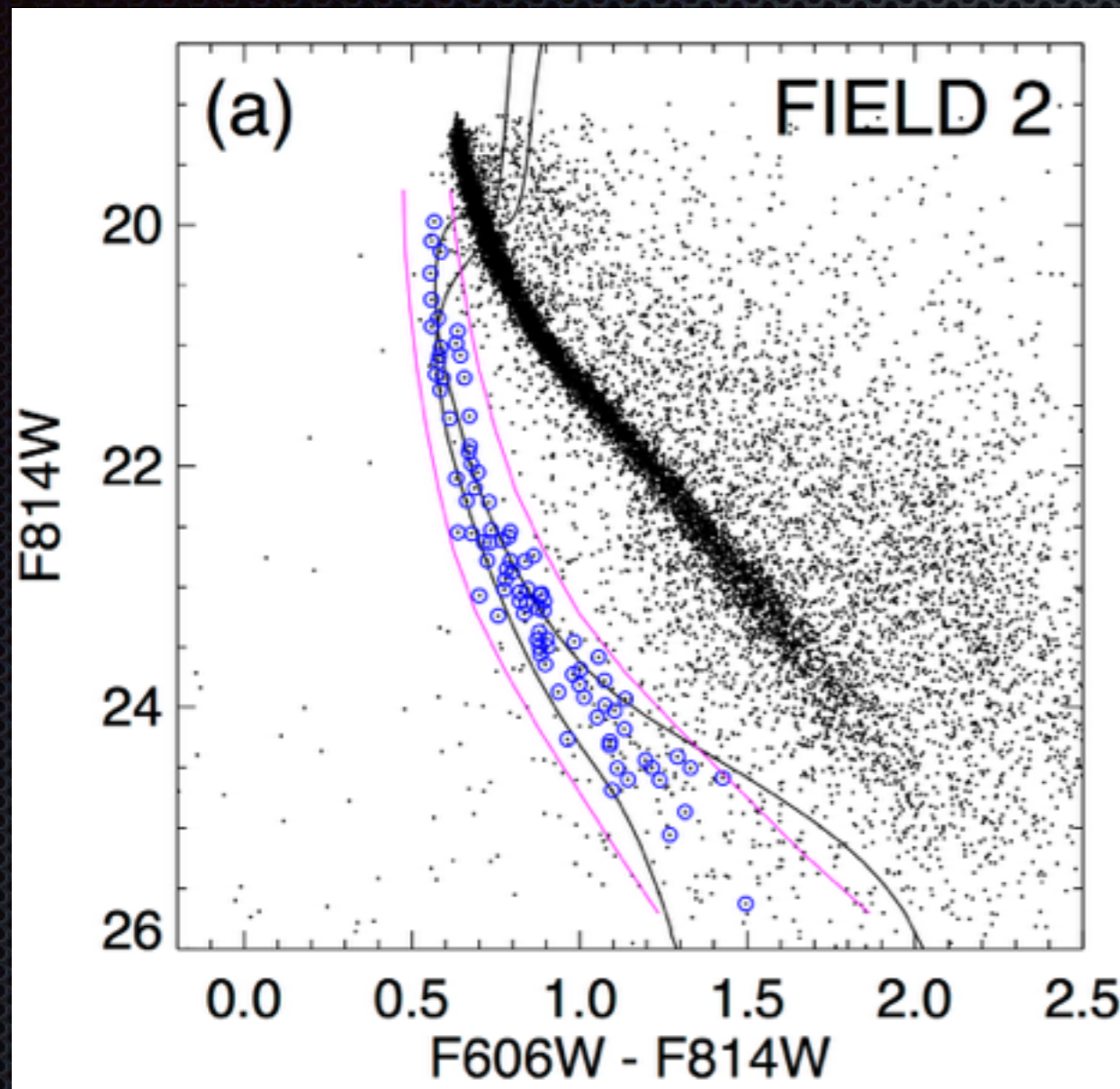
Leading-arm Field

Sgr Stream - FIELD 4

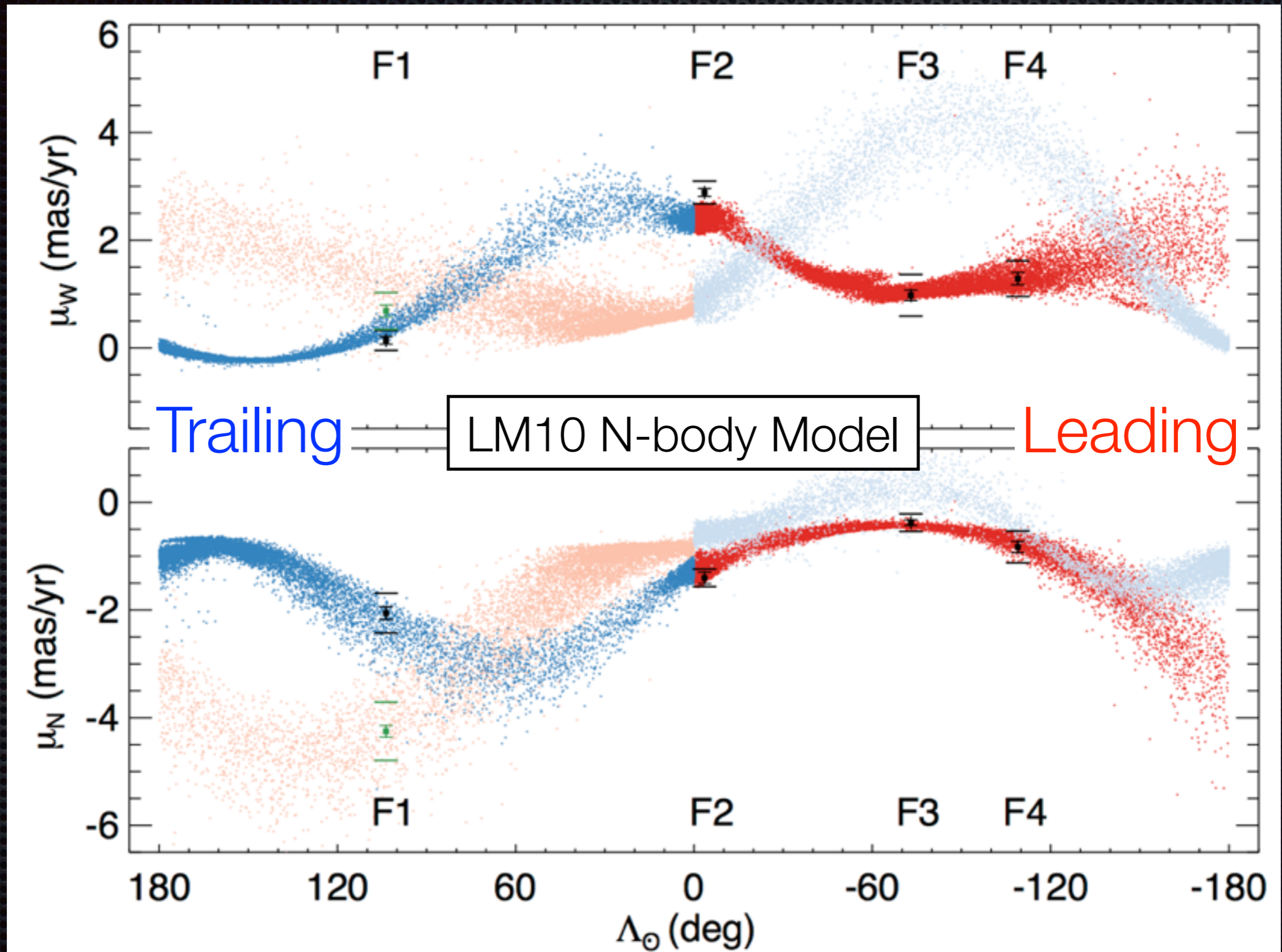


Leading-arm Field

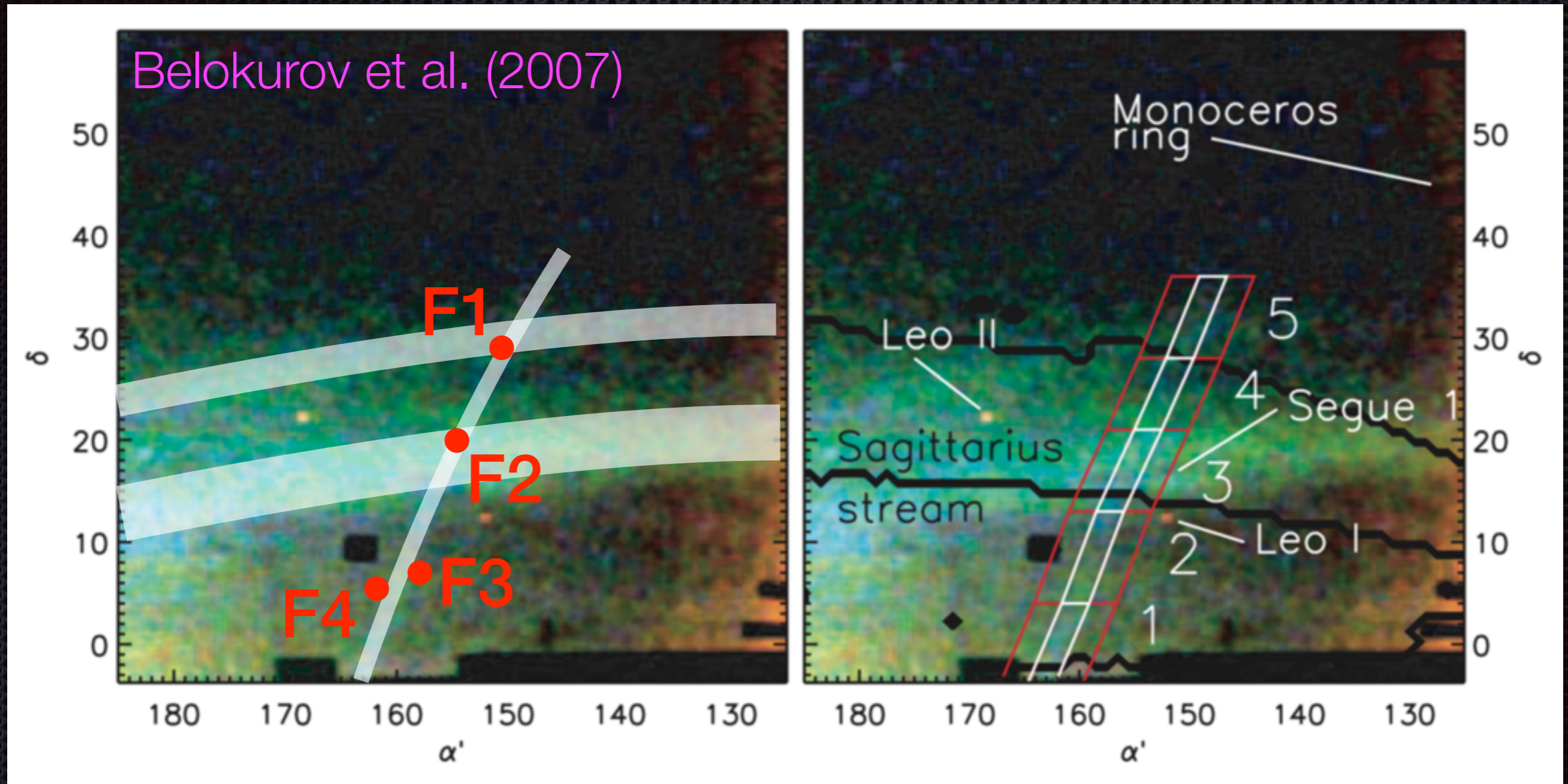
Sgr Stream - FIELD 2



Data-Model Comparison

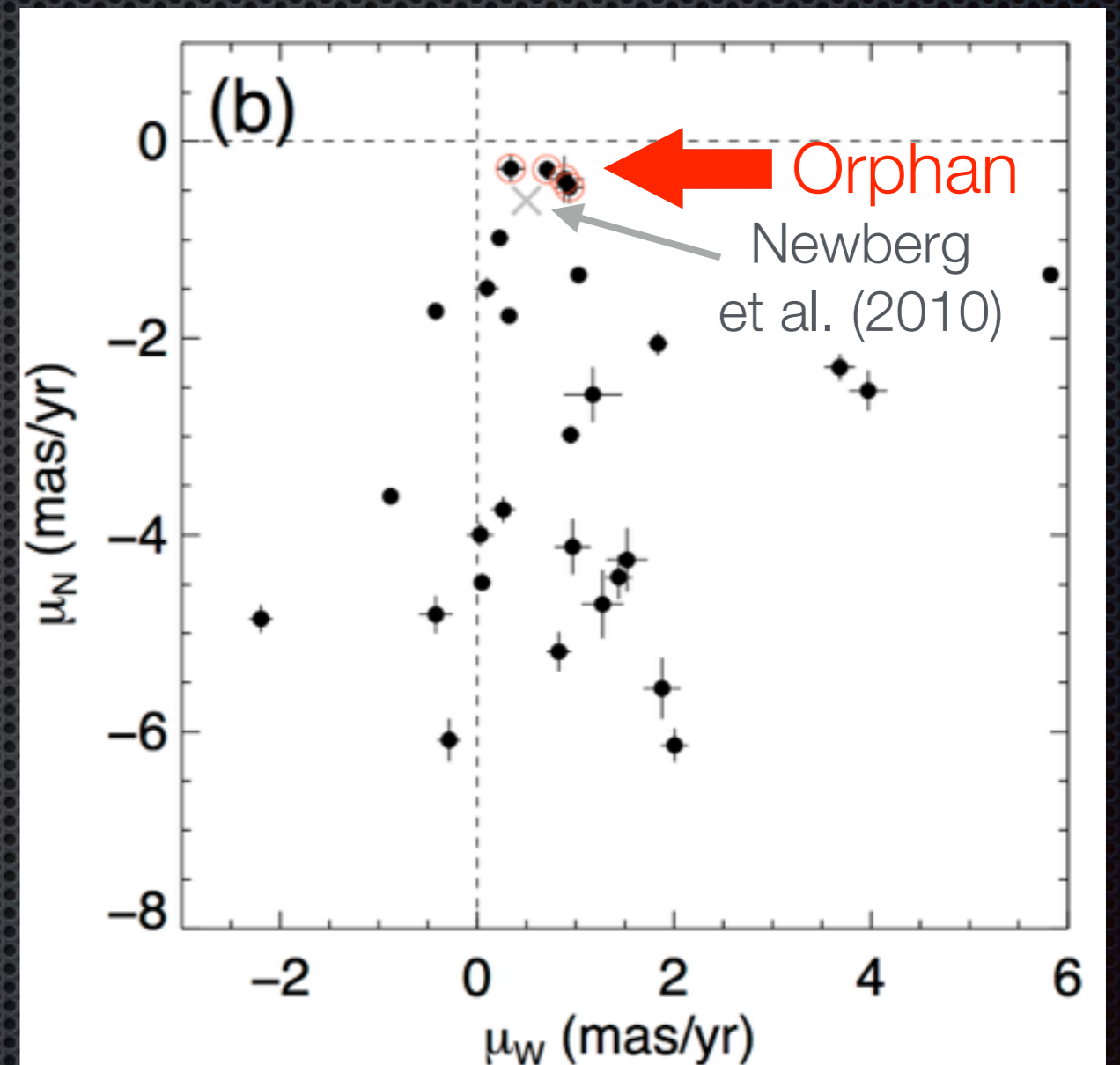
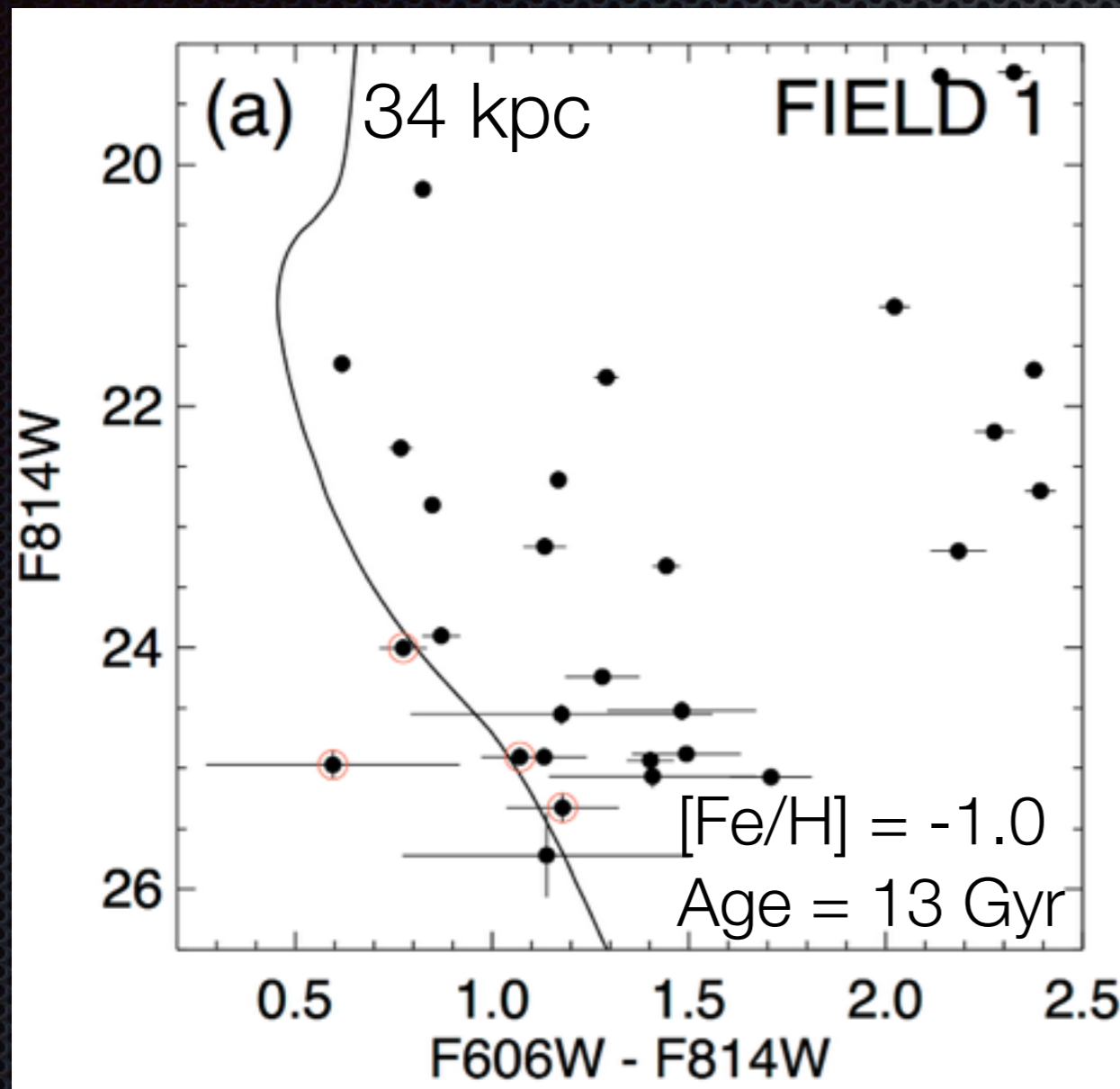


Orphan Stream - Target Fields

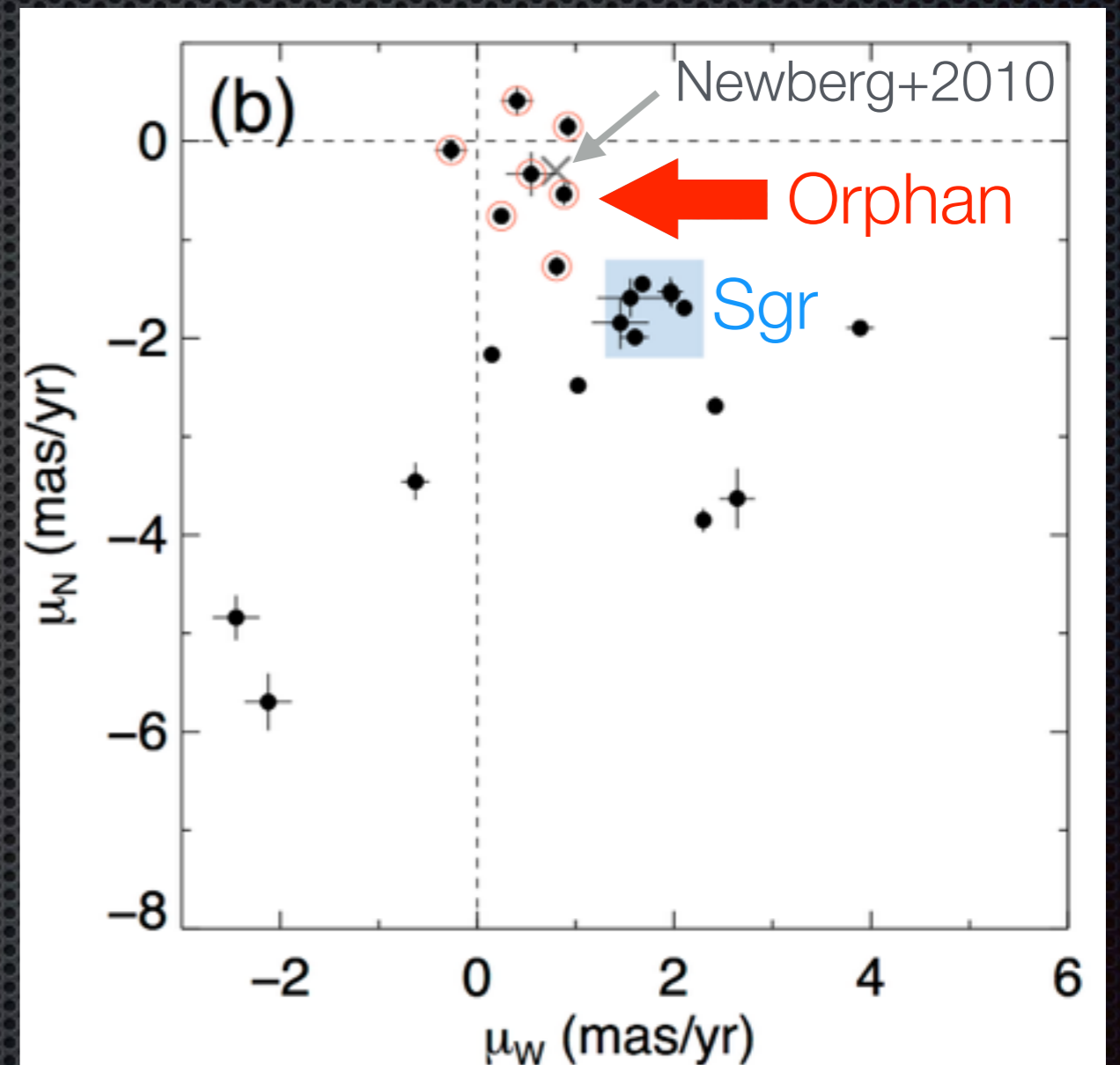
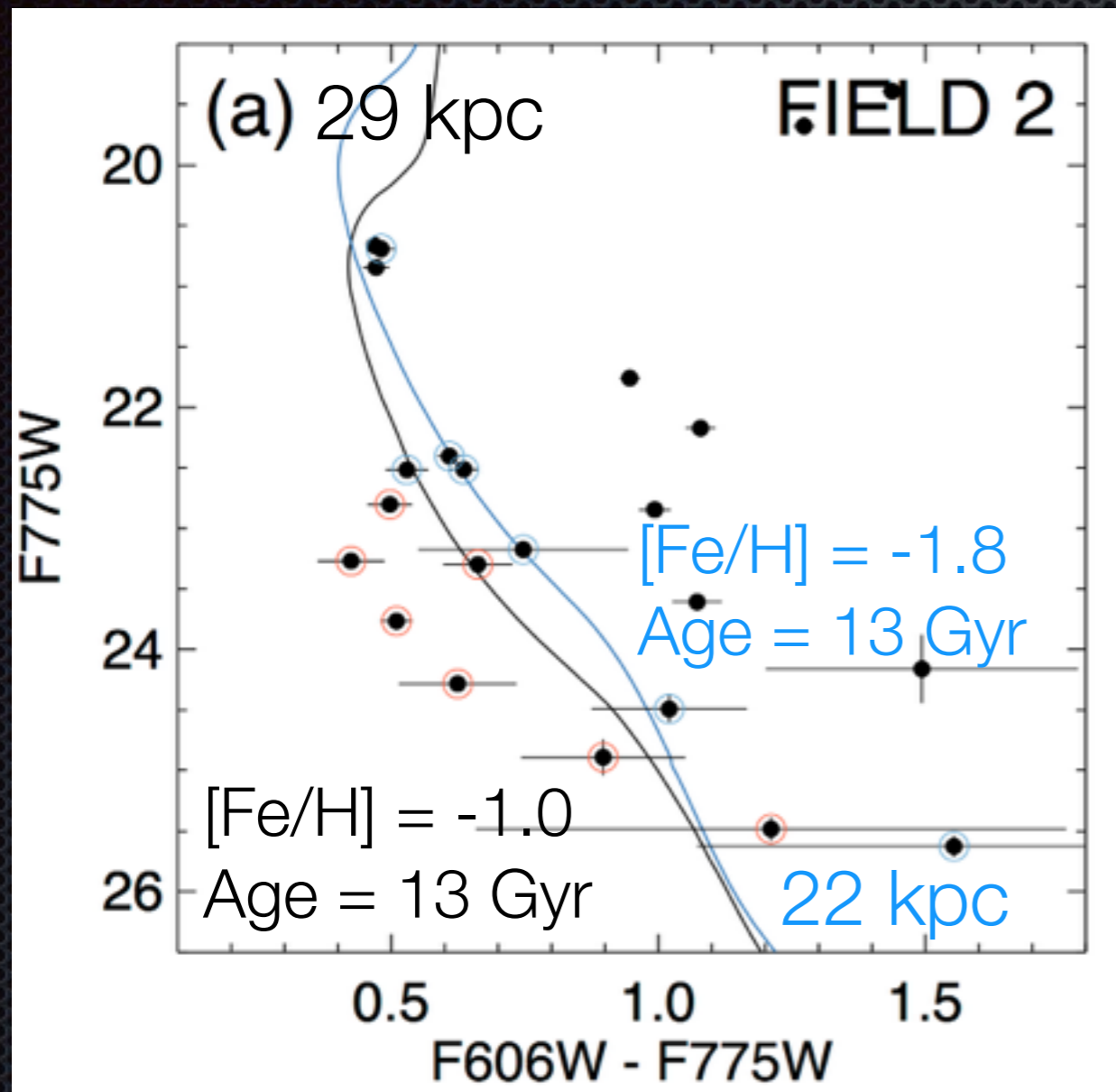


- ✦ 2 epochs per field, $\Delta T = 10\sim 12$ years
- ✦ ACS/WFC F814W/F775W (+F606W for CMDs)

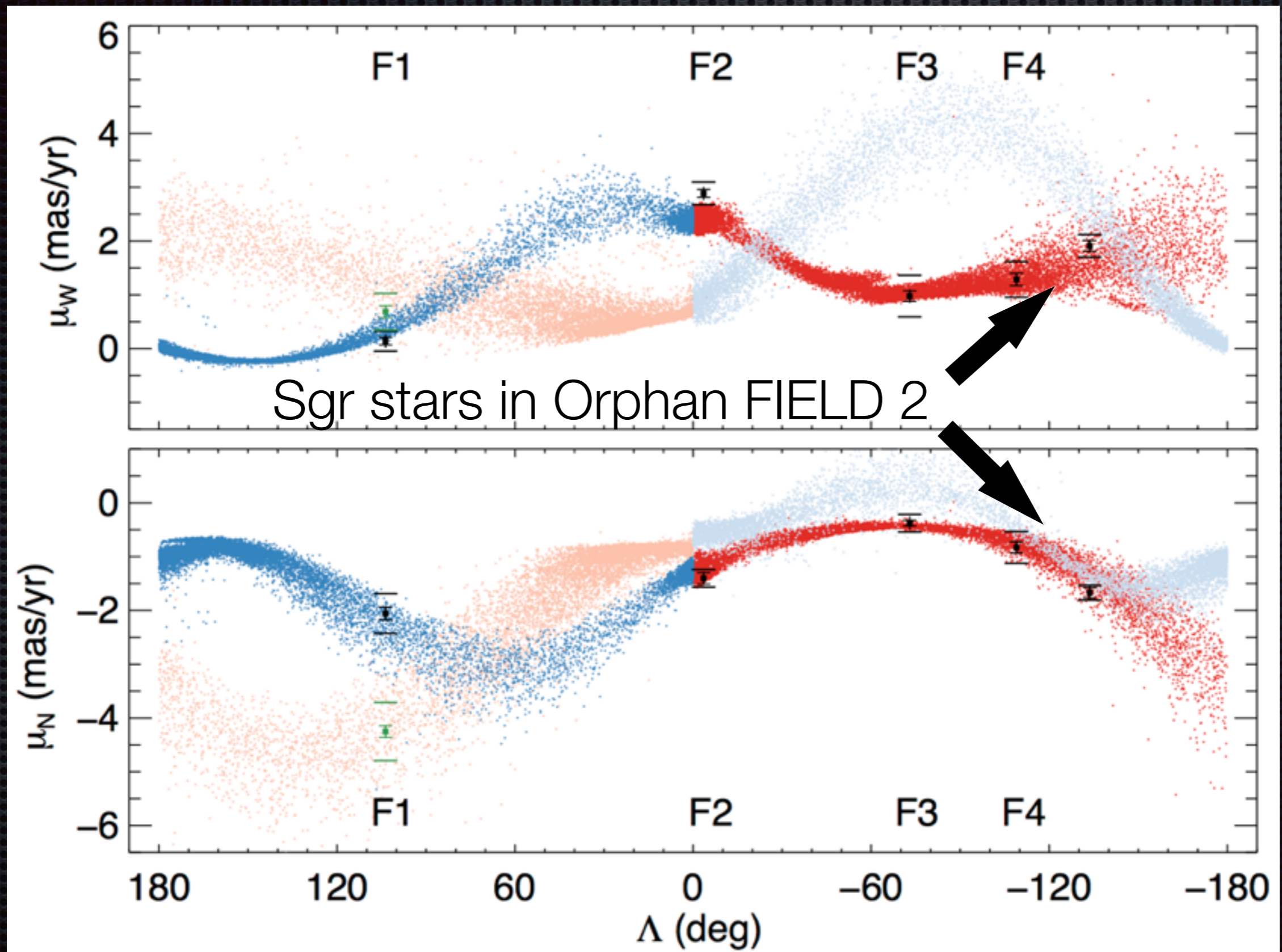
Orphan Stream - FIELD 1



Orphan Stream - FIELD 2



Sgr Stream + Orphan F2



Conclusions

- ✦ Identified Sgr & Orphan stars and PM measured.
 - ↳ HST works very well on MW halo streams.
- ✦ PM results broadly consistent with existing models.
 - ↳ Detailed data-model comparison in process.
- ✦ HST allows star-by-star PM analysis.
- ✦ Multiple PM clumps found in some fields.

Proper Motions of Distant Halo Stars: New Clues to Milky Way Structure, Evolution and Mass

- Approved [Legacy Archival Project](#) (Cy21)
- [>150 HST fields](#) with multi-epoch data ($\Delta T > 1$ yr)
- PMs for [>700 MW halo stars](#)
 - ↳ ~ 100 $D > 50$ kpc / ~ 20 $D > 100$ kpc
- Main goals: halo mass profile, stellar density, [halo substructures](#) (new streams + satellites?)
- PMs for all stars will be public
 - ↳ Numerous possibilities!