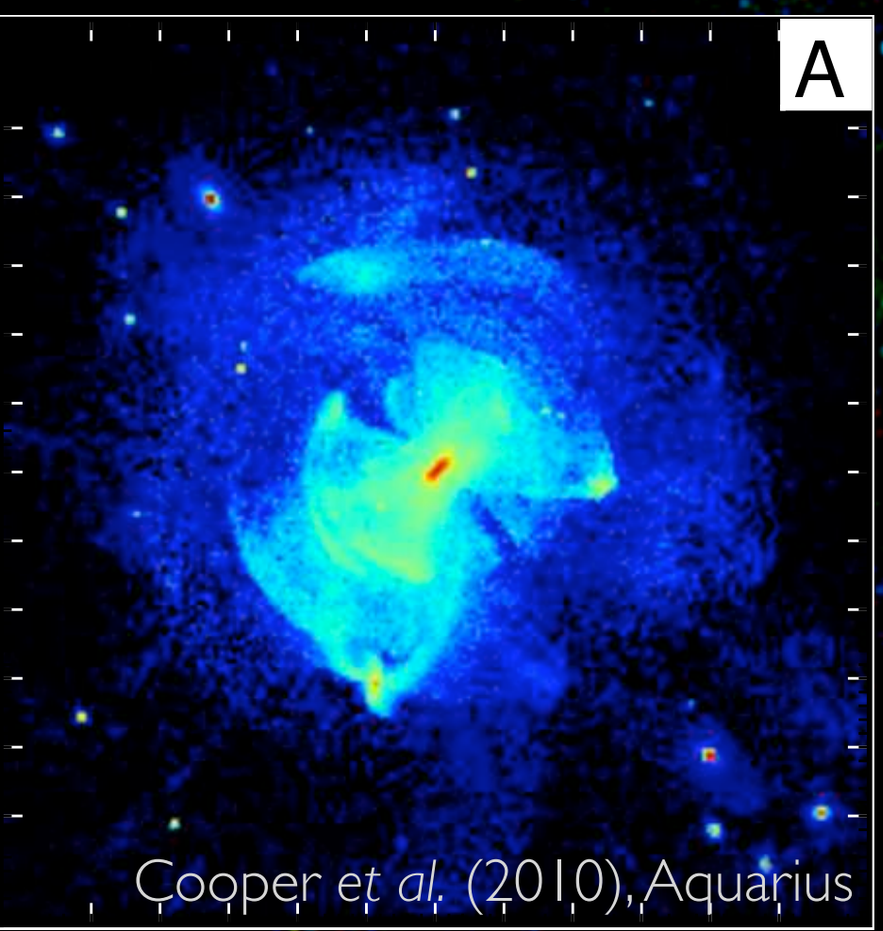
Martin *et al.* (2013; PAndAS)

How to access the stellar halo of Andromeda



Cooper *et al.* (2010), Aquarius

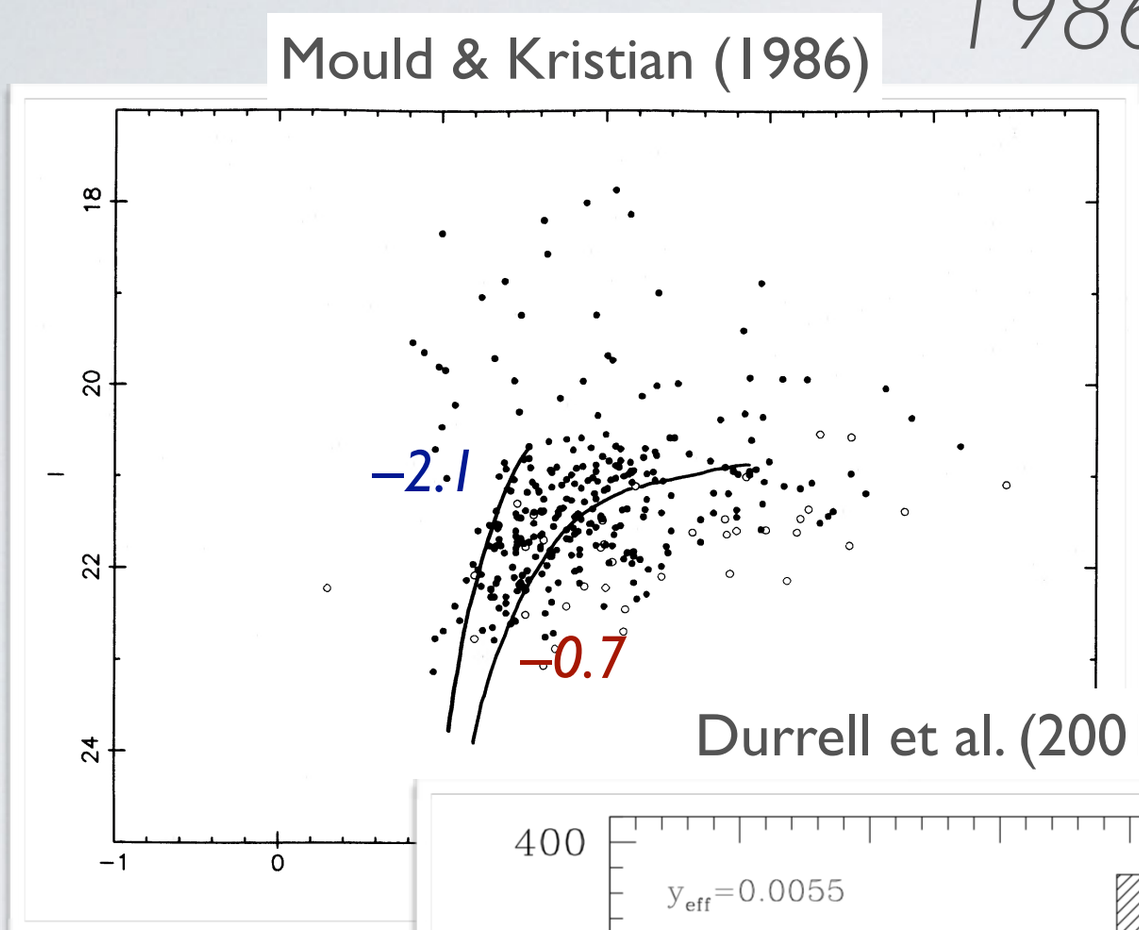
Nicolas Martin

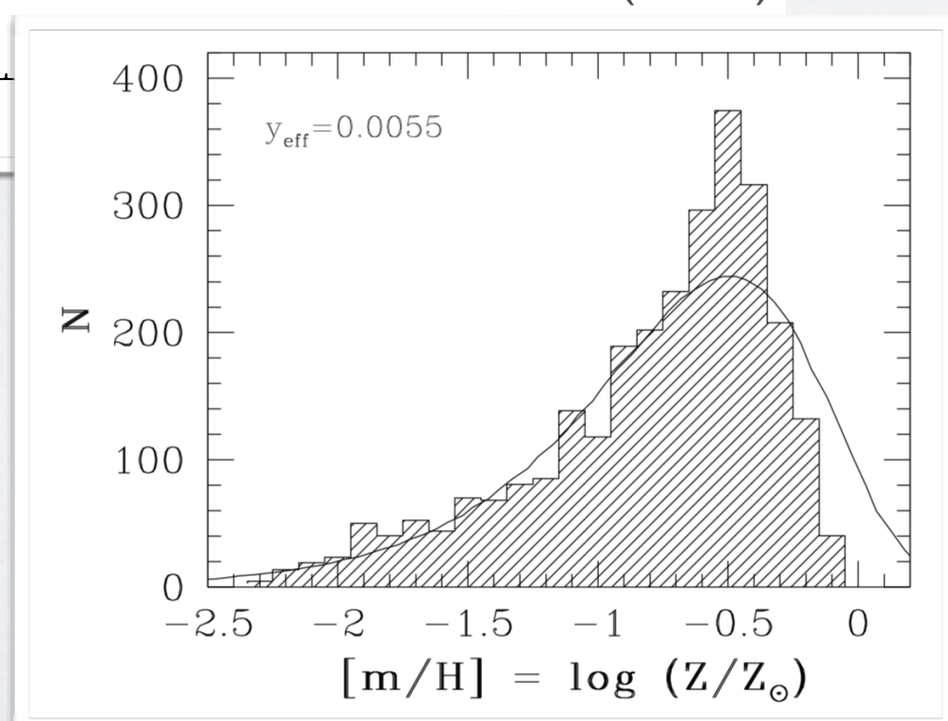
(Strasbourg Observatory & MPIA, Heidelberg)

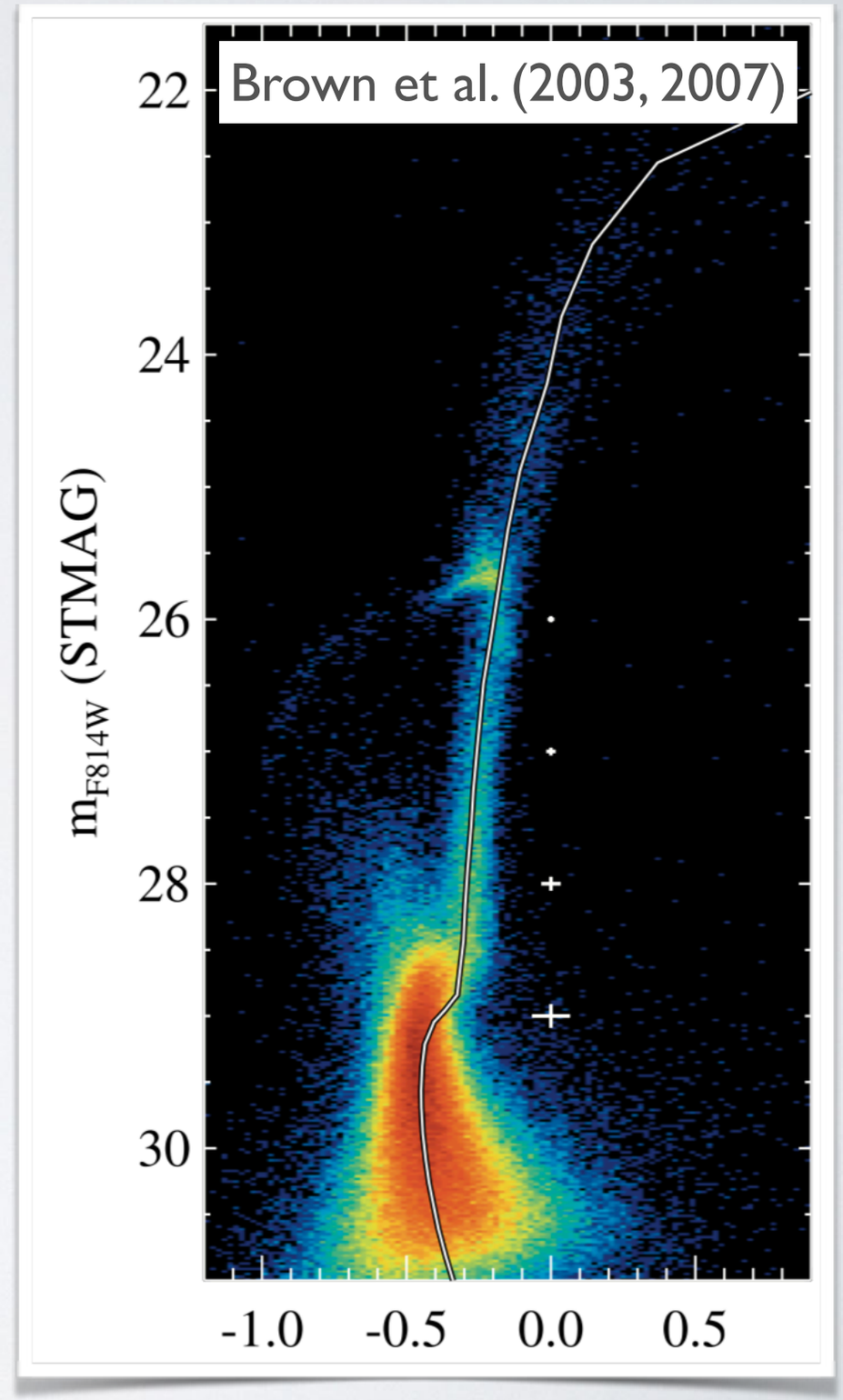
@nfmartin1980

A metal-rich M31 halo

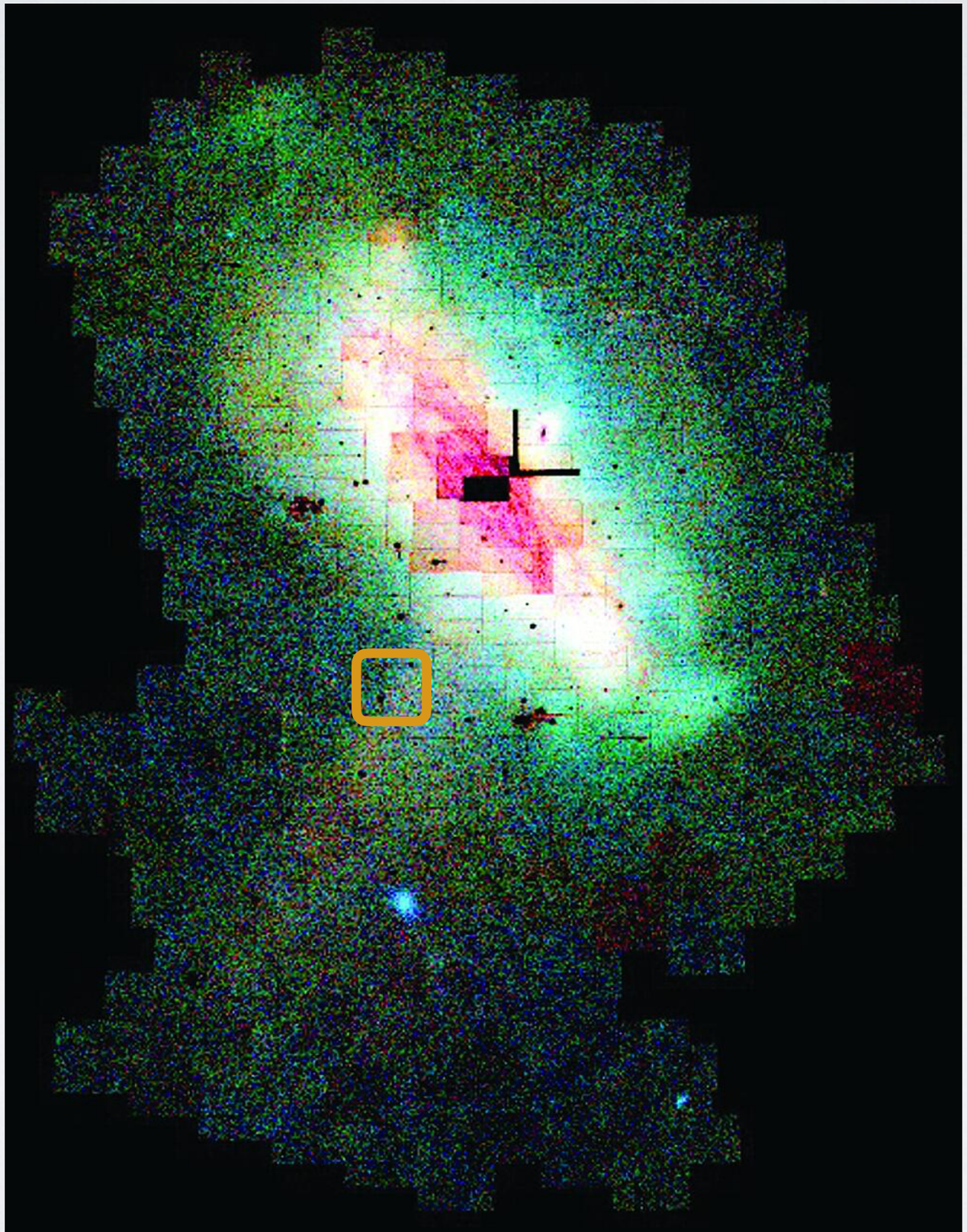
1986–200x







The 21st century revolution



Ibata *et al.* (2001)
Ferguson et al. (2002)
Irwin et al. (2005)

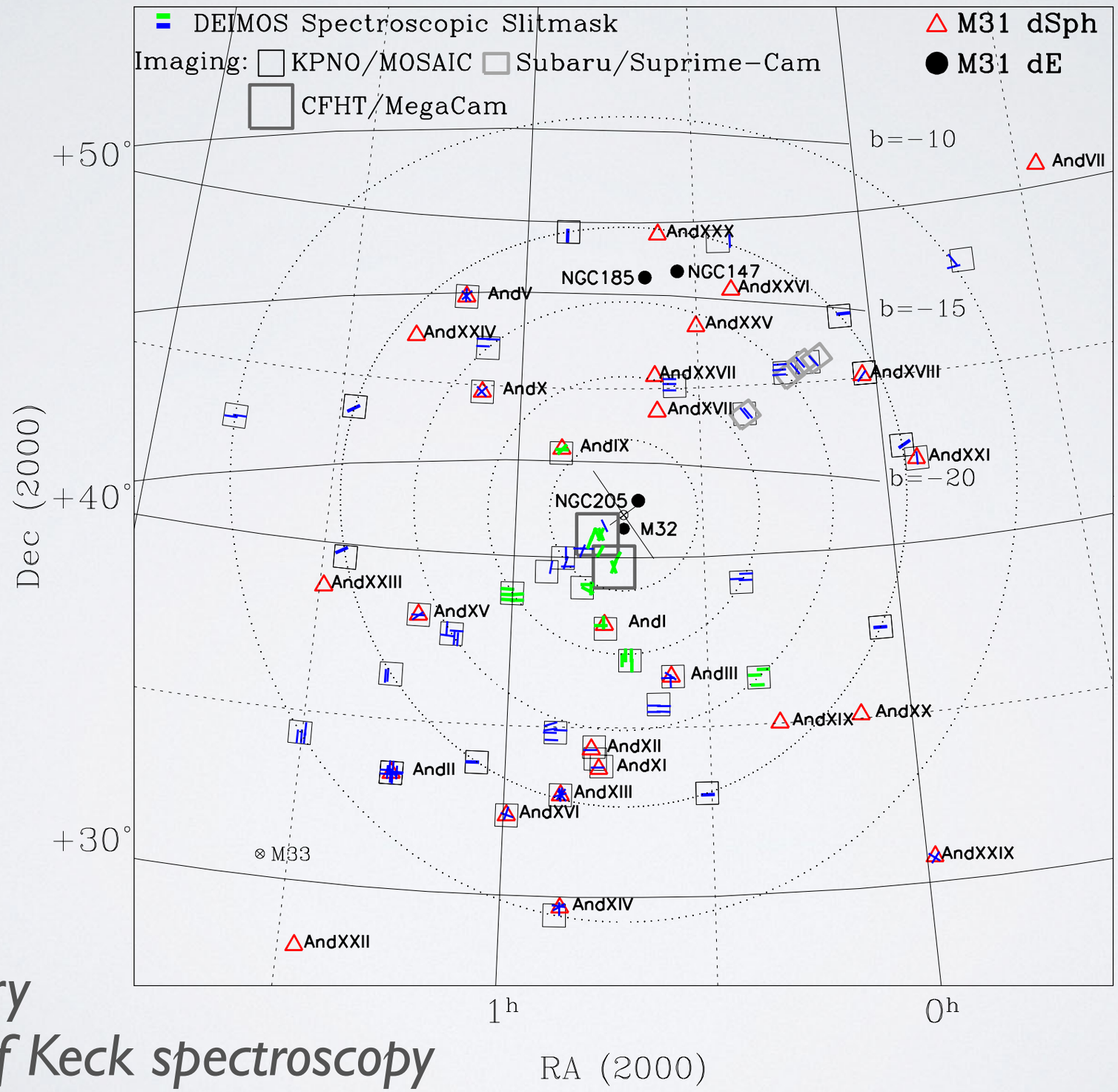
INT survey
CFHT survey
PANdAS
SPLASH

Why is it hard?

- Stellar halos are ***low surface brightness***
  → need to go faint for M31 (>3.5m telescope)
- Stellar halos are ***huge***
  → need to go wide for M31 (need wide-field cameras)
- Stellar halos are ***structured and complex***
  → requires in-depth characterization (need 8+m telescopes for spectroscopy)
- *The MW disk is in front of M31!!*

Going in-depth — SPLASH

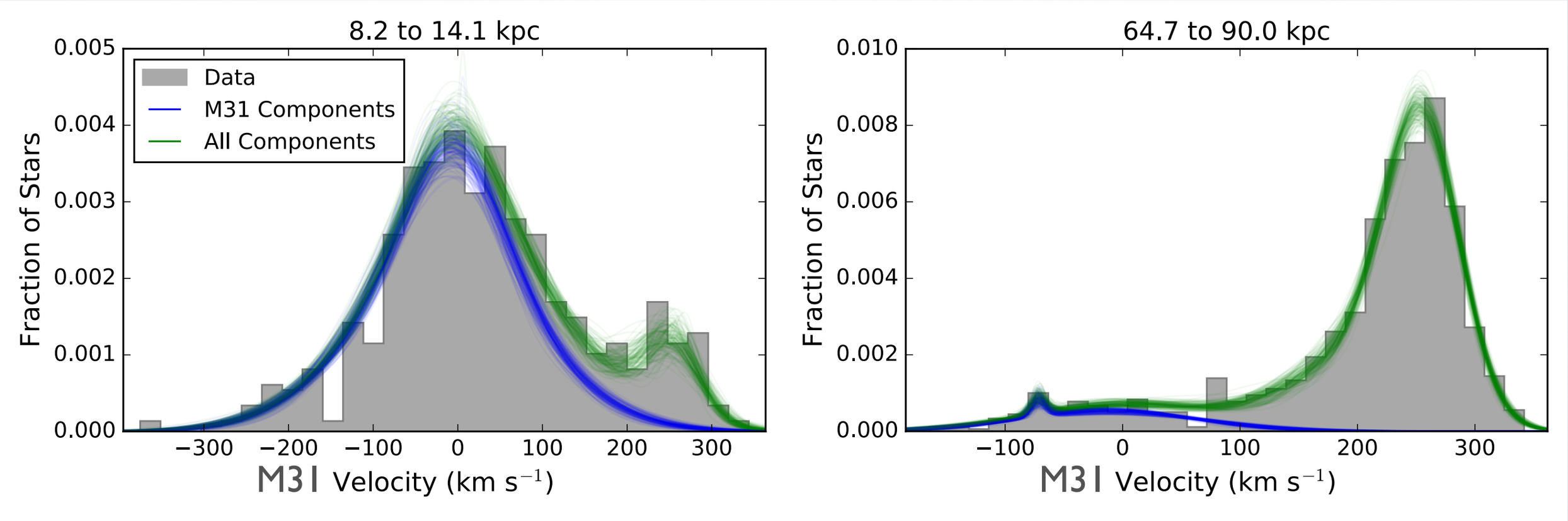
Gilbert *et al.* (2012, 2014, 2018)
see also Chapman et al. (2006), Koch et al. (2008)



2002–2011
KPNO photometry
~20–30 nights of Keck spectroscopy

Dealing with the MW foreground?

Gilbert *et al.* (2018)

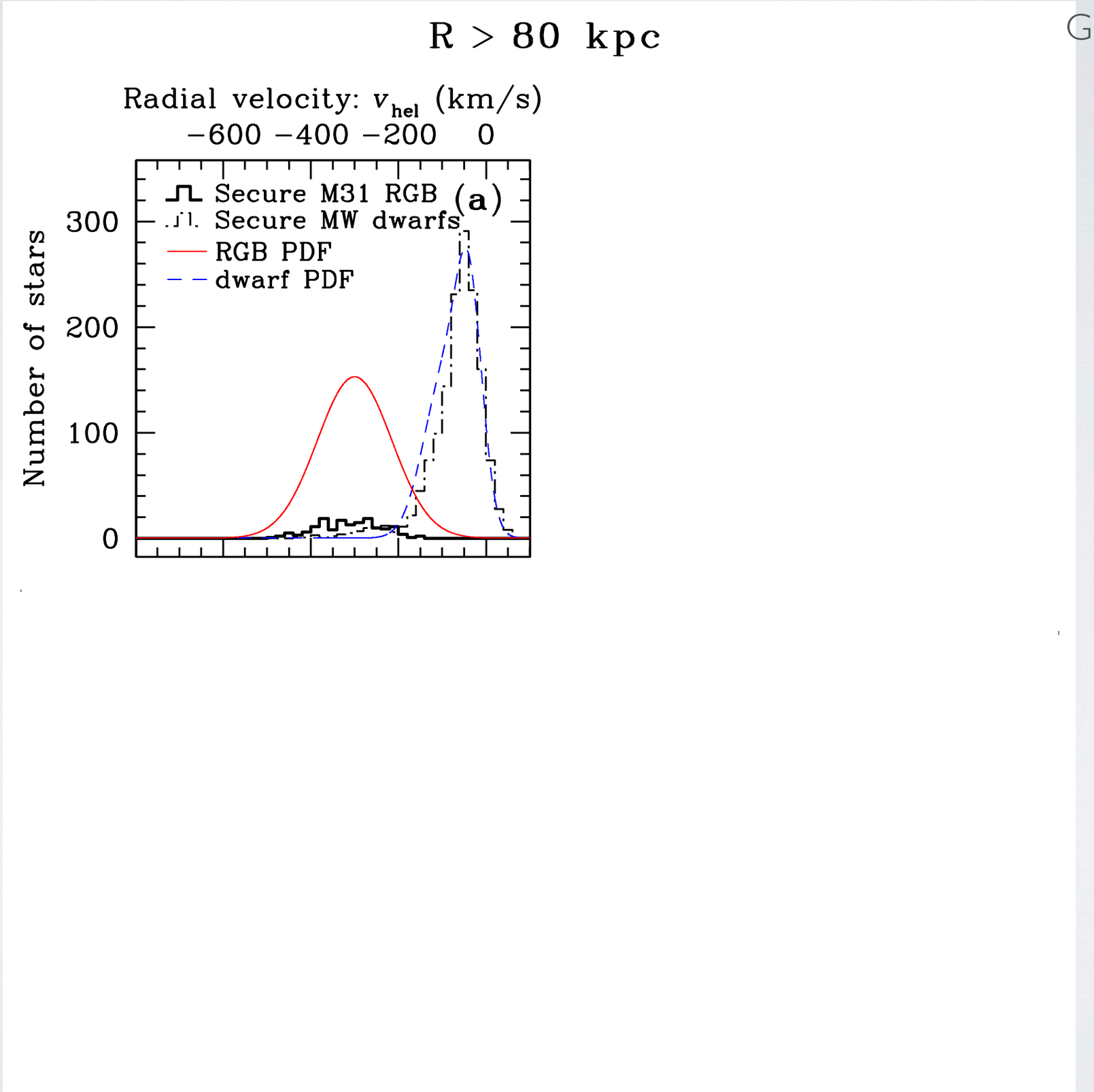


Andromeda + Milky Way

("smooth" + substructures)

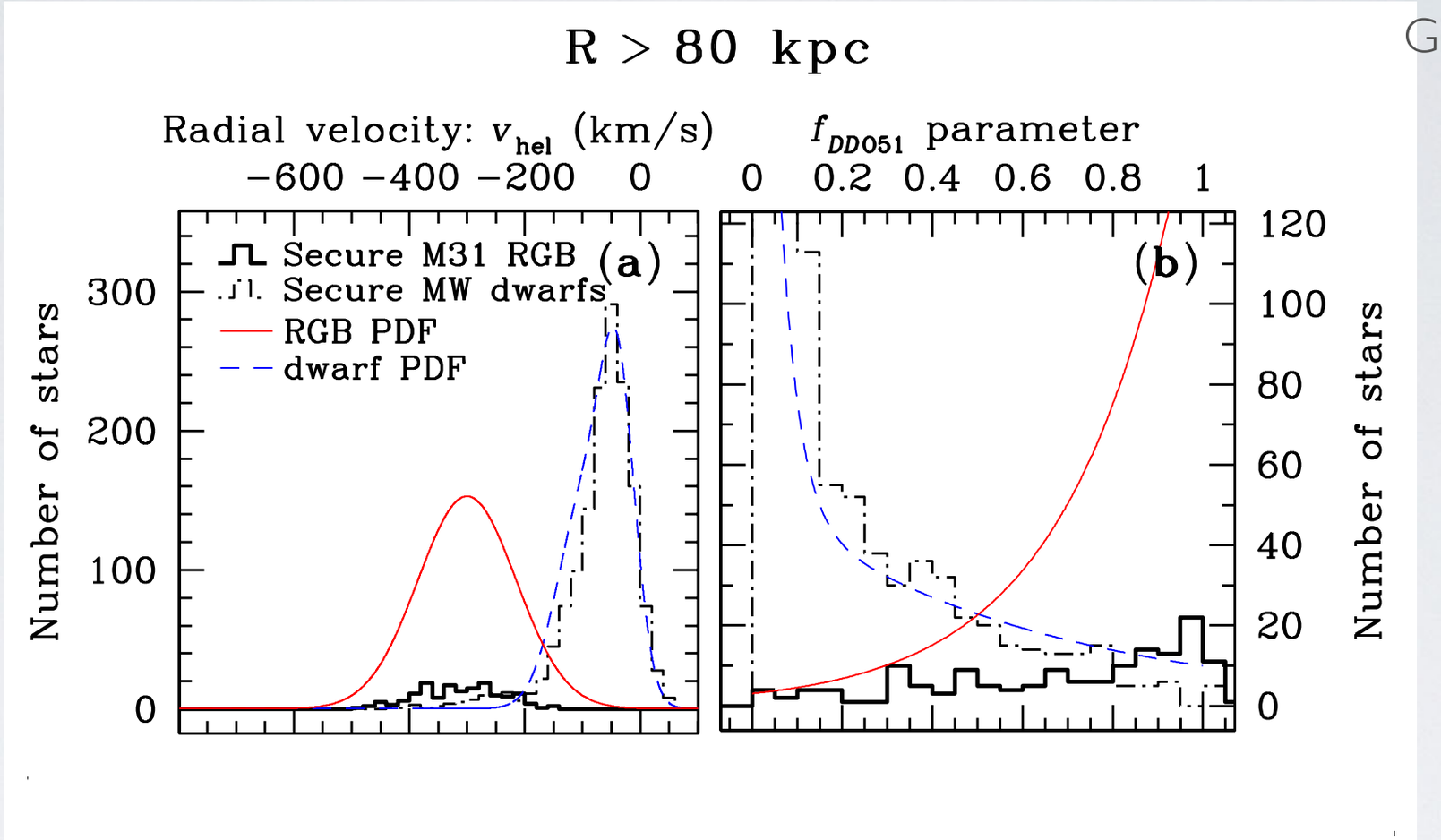
Combining all diagnostics

Gilbert *et al.* (2012)



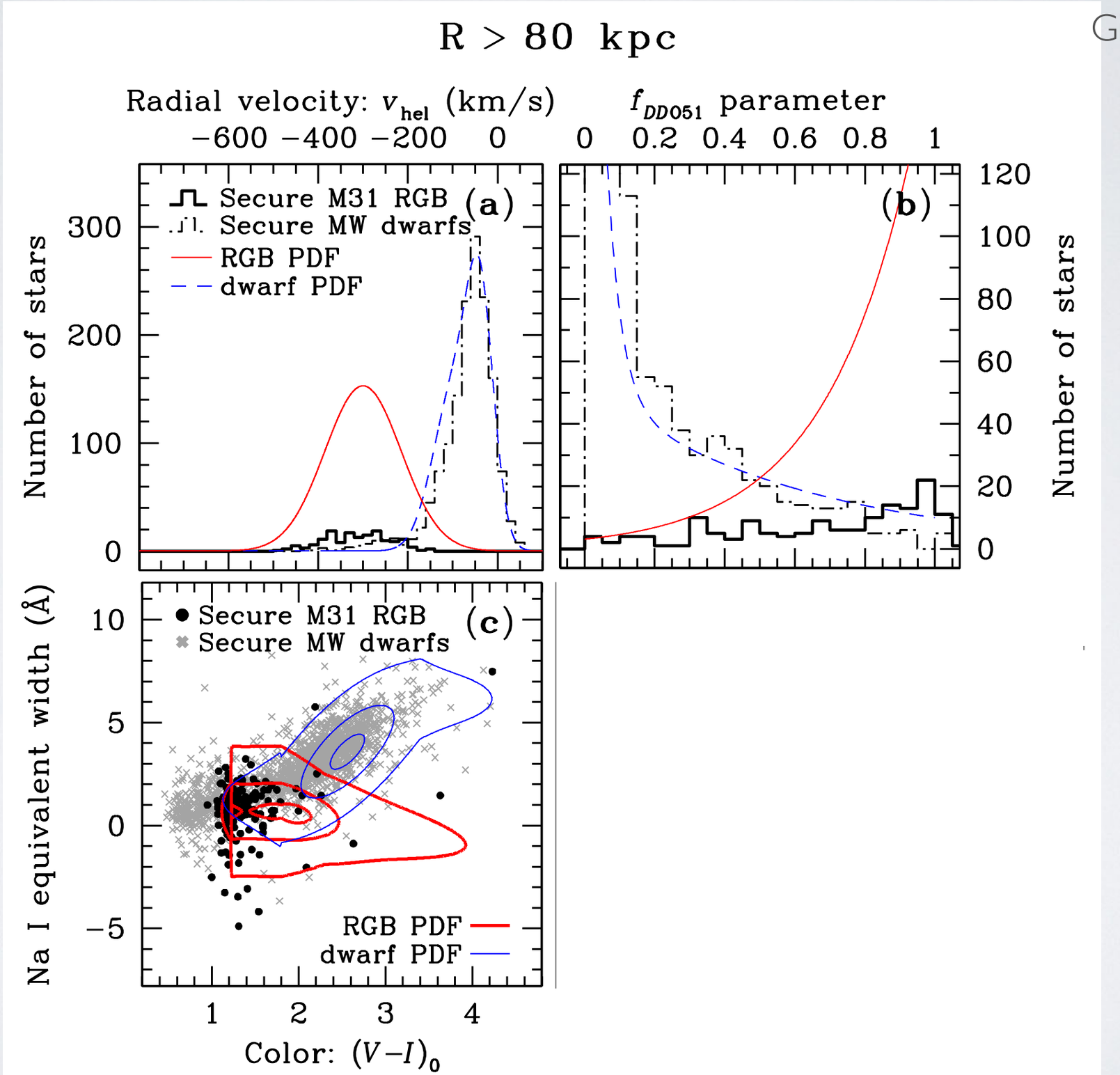
Combining all diagnostics

Gilbert *et al.* (2012)



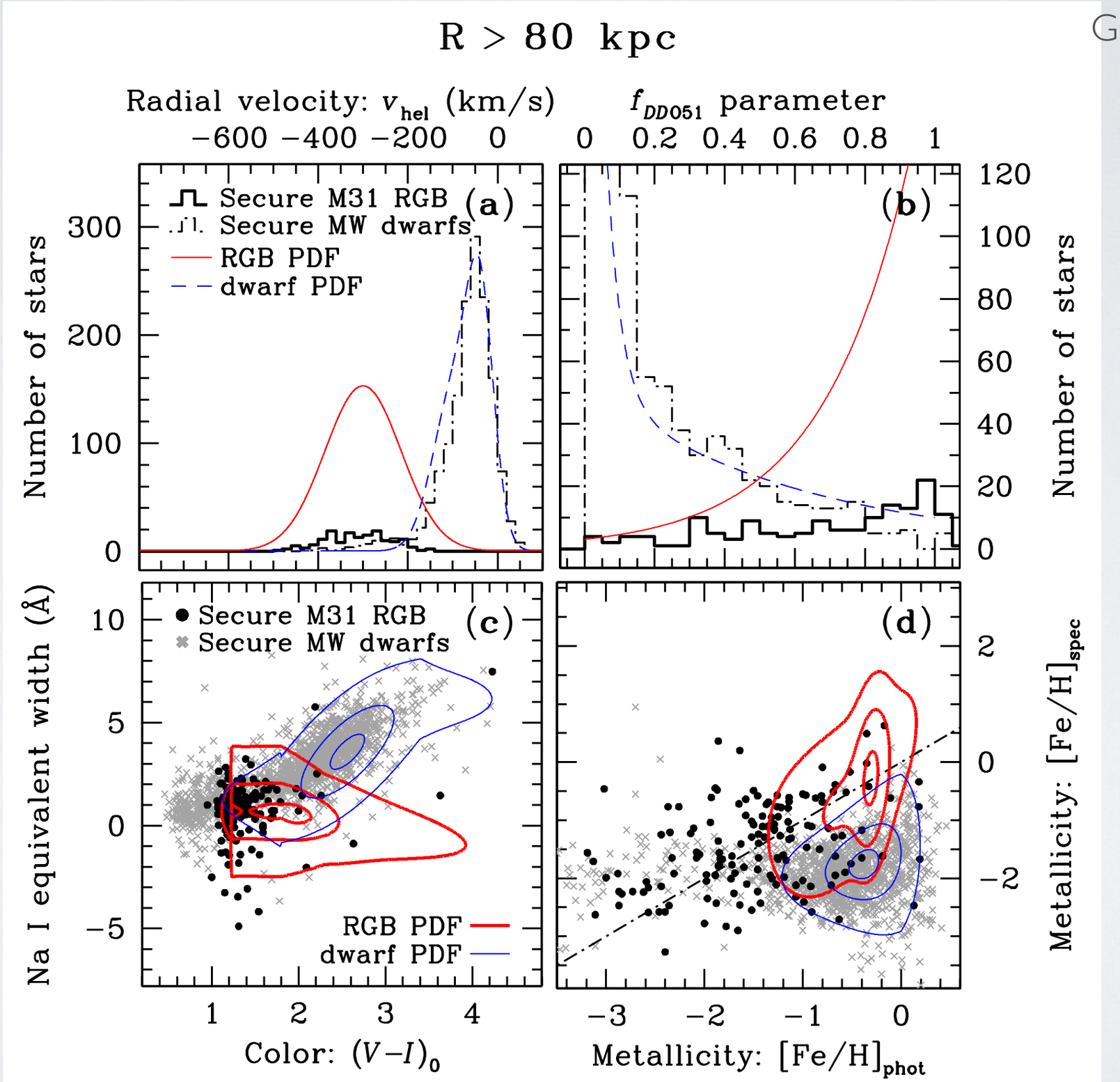
Combining all diagnostics

Gilbert *et al.* (2012)



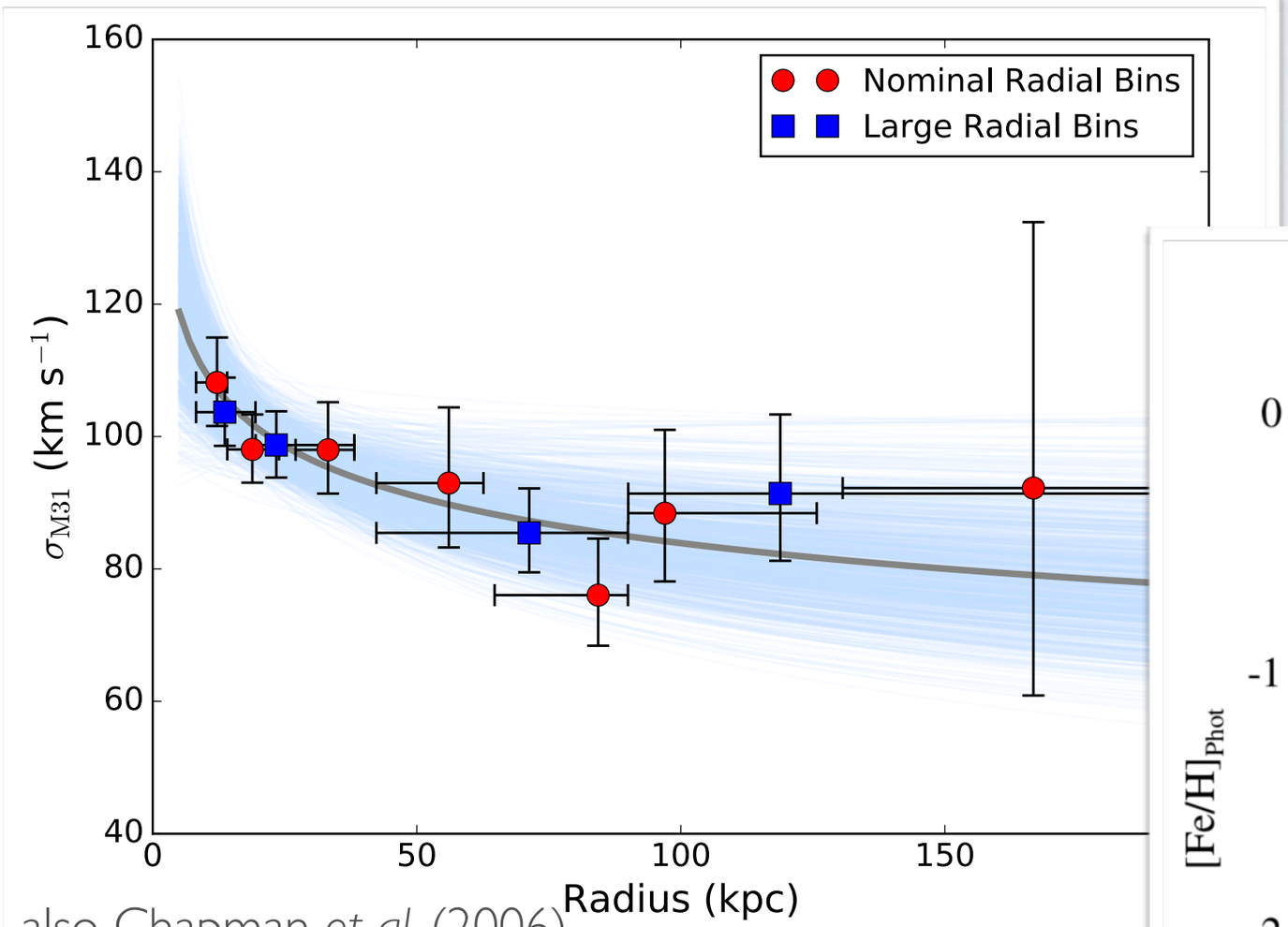
Combining all diagnostics

Gilbert *et al.* (2012)

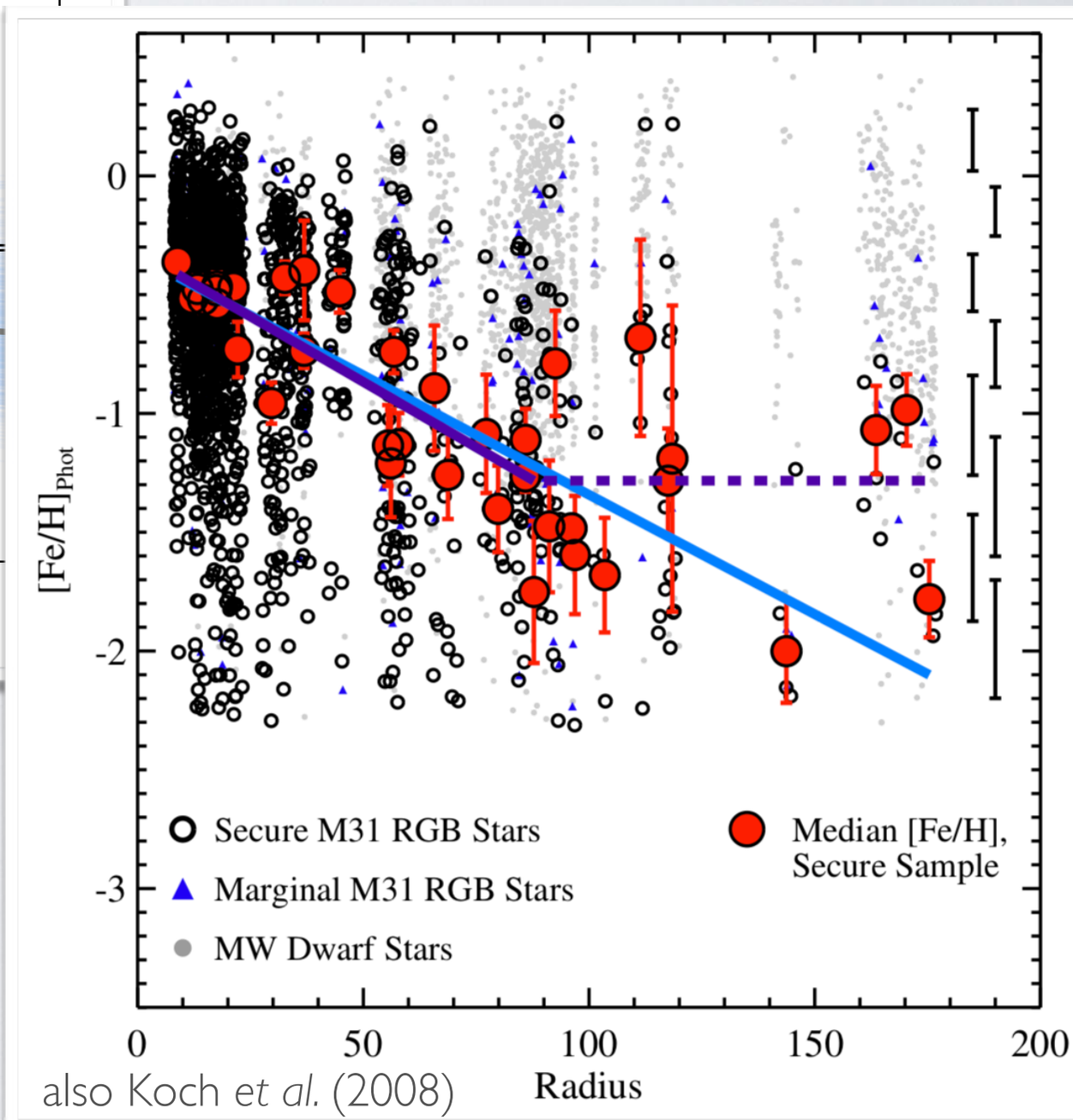


Access the M31 halo

Gilbert *et al.* (2014, 2018)



also Chapman *et al.* (2006)

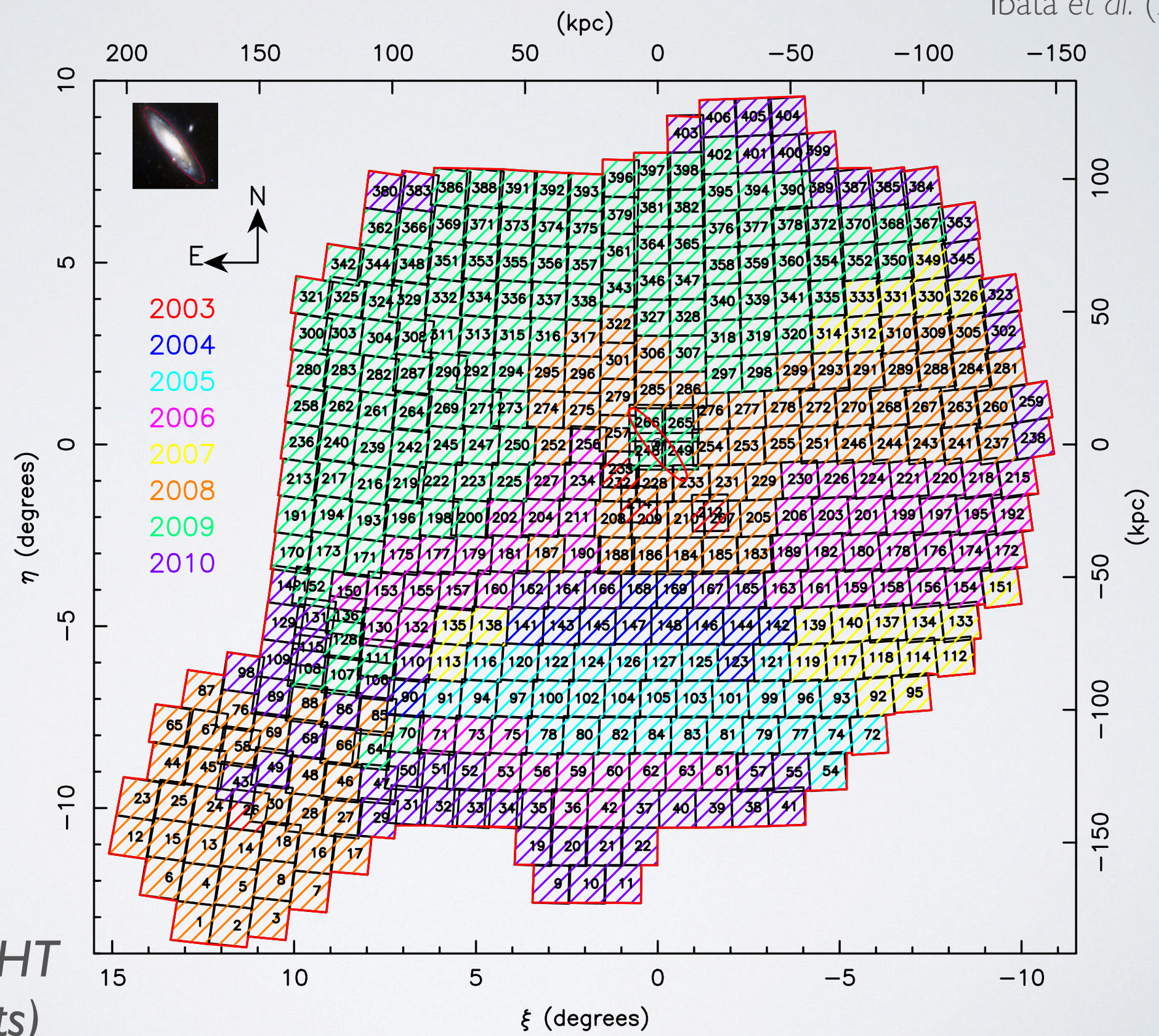


also Koch *et al.* (2008)

- density profile
- velocity dispersion profile
- metallicity profile
- (kinematically) "smooth" vs. structured

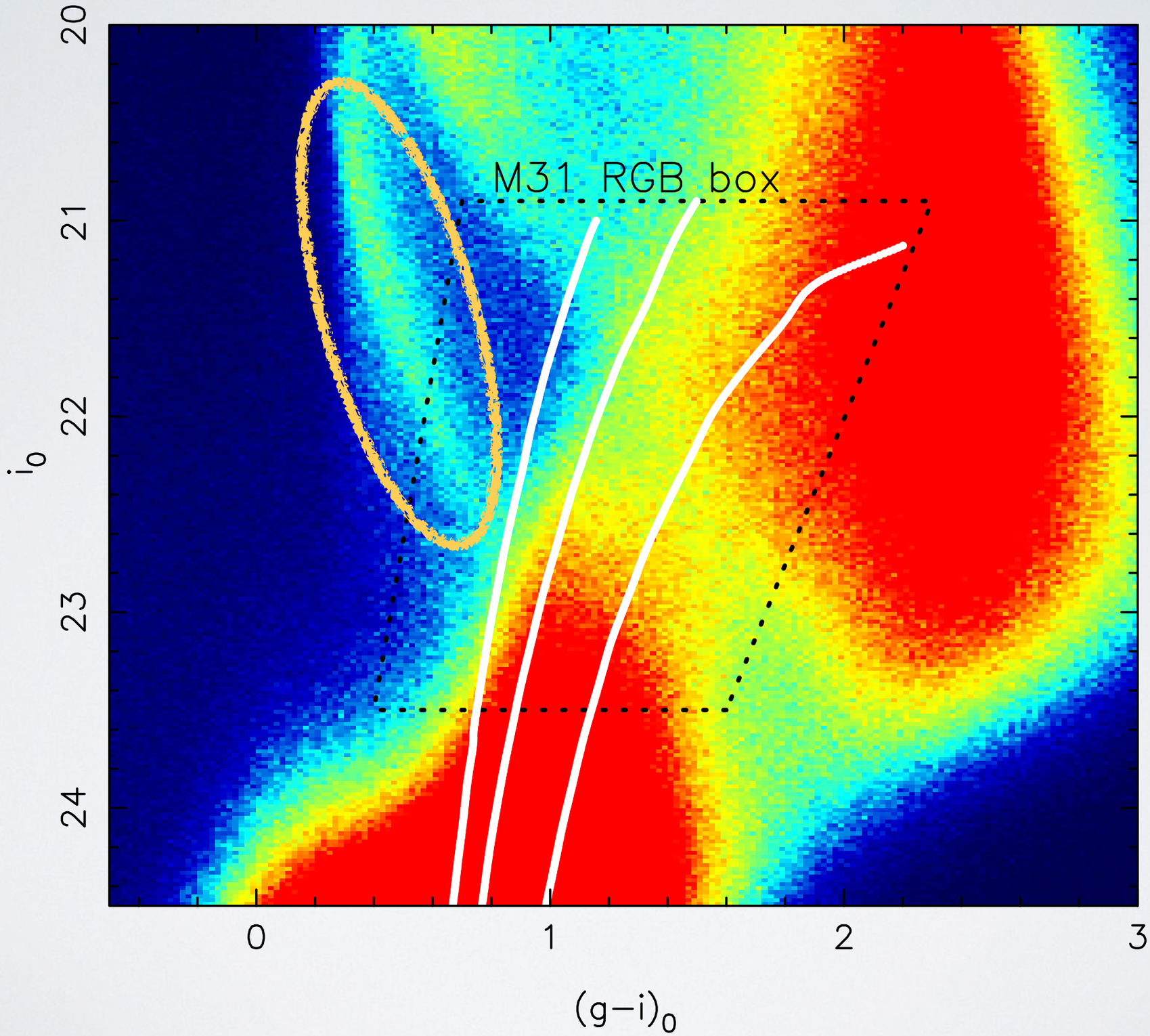
Going wide — PAndAS

Ibata *et al.* (2014)



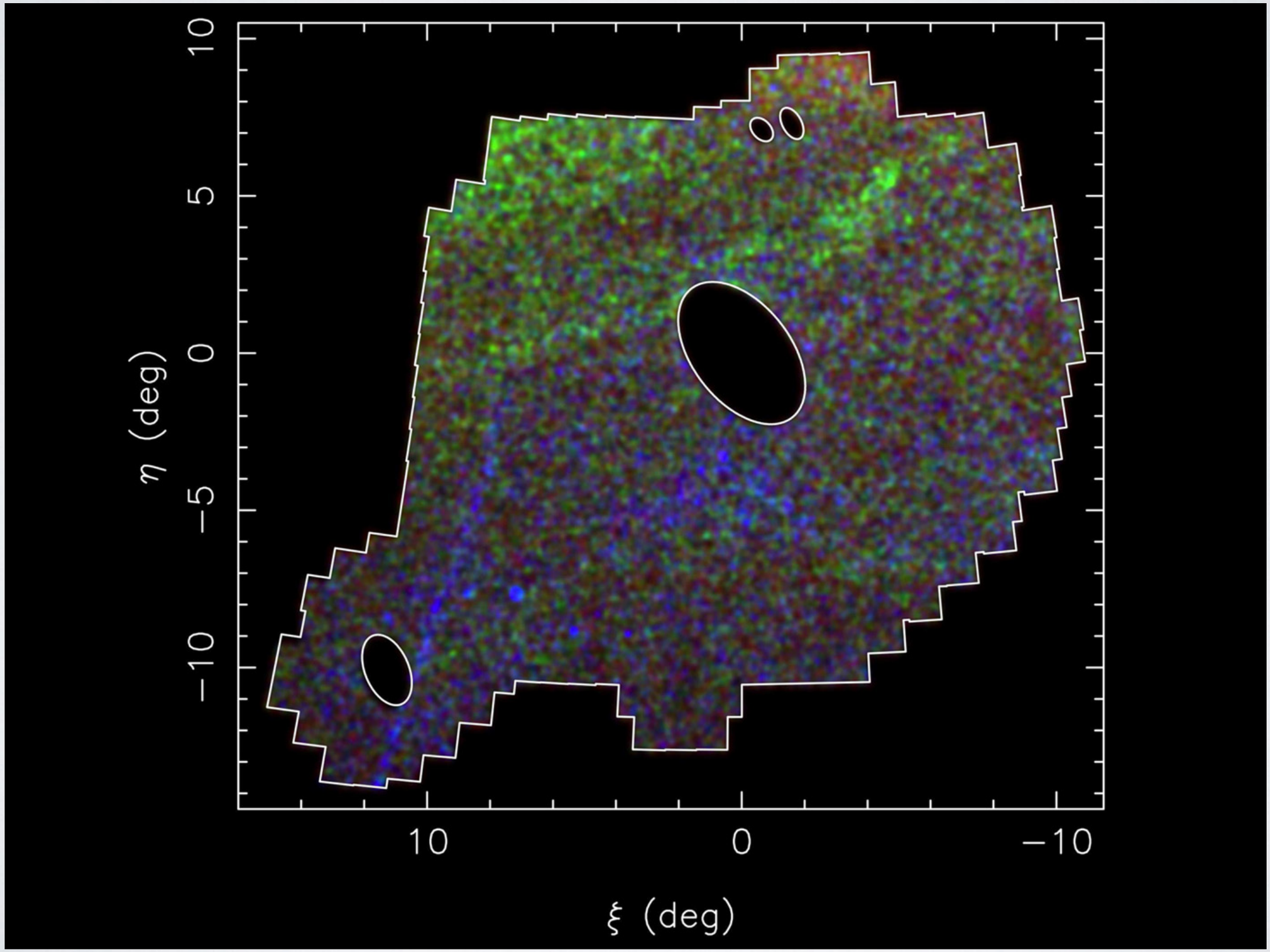
400 deg²
~60 nights with CFHT
(+ many Keck nights)

The PAndAS CMD

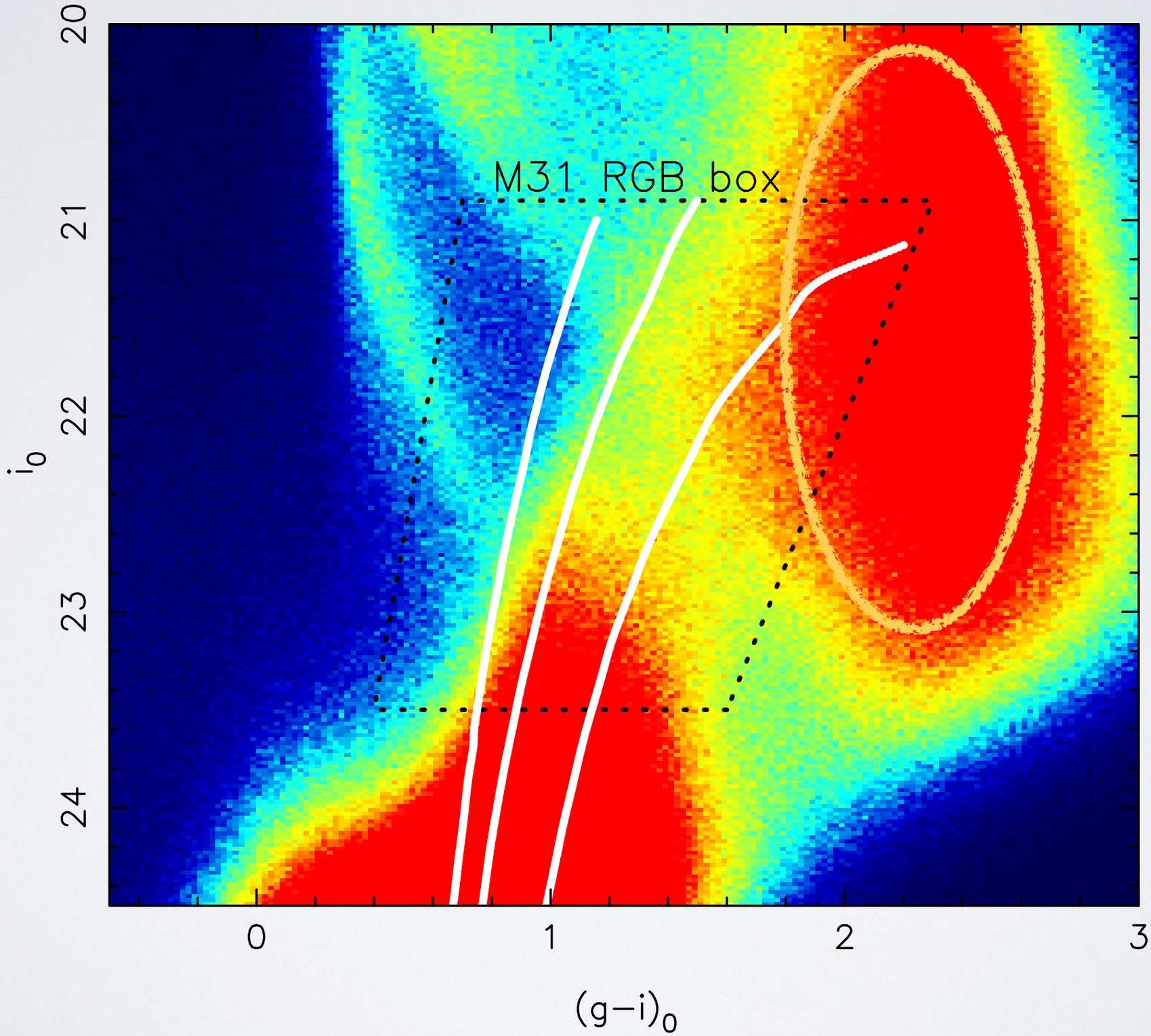


The foreground MW halo

Martin *et al.* (2014)

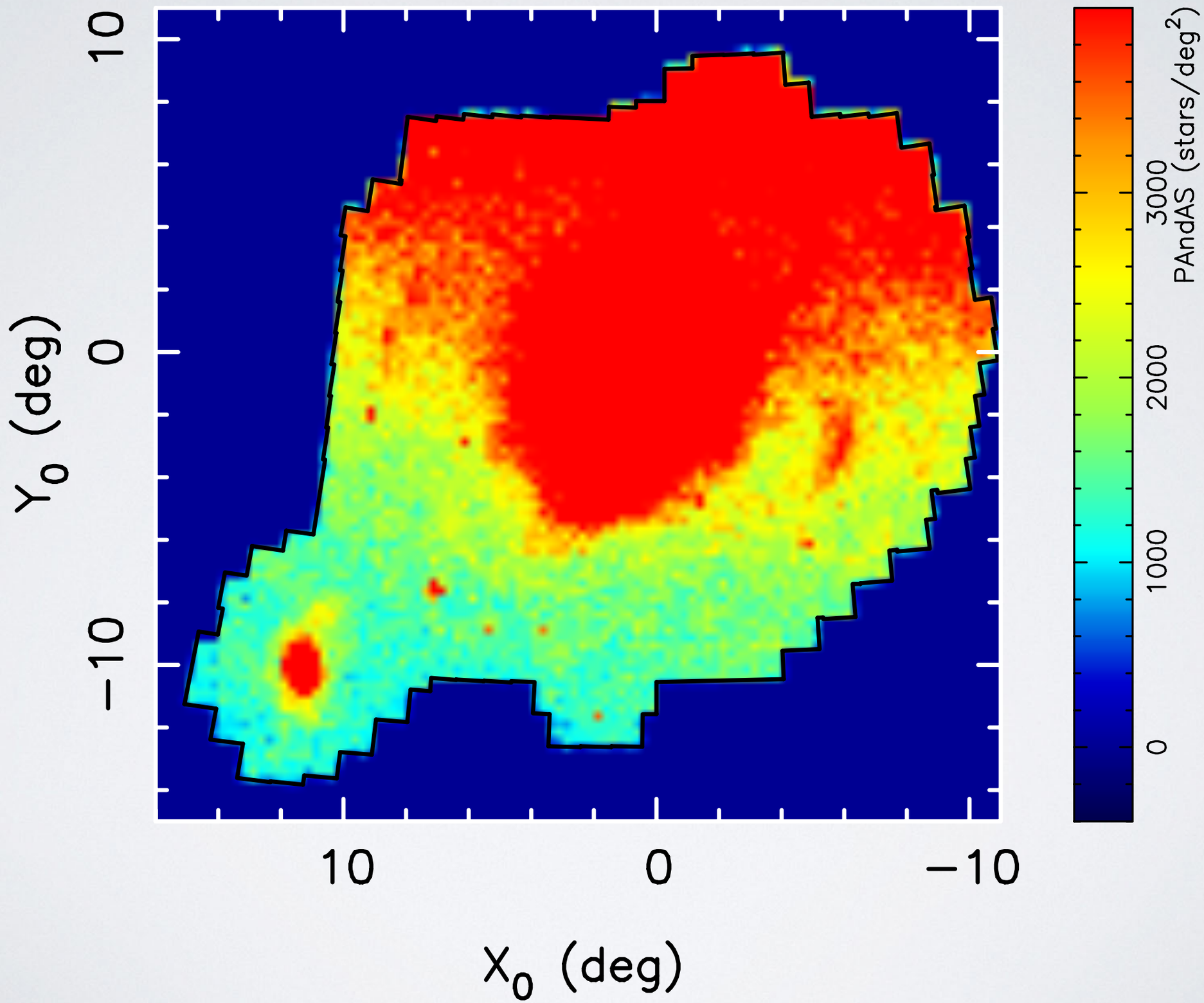


The PAndAS CMD

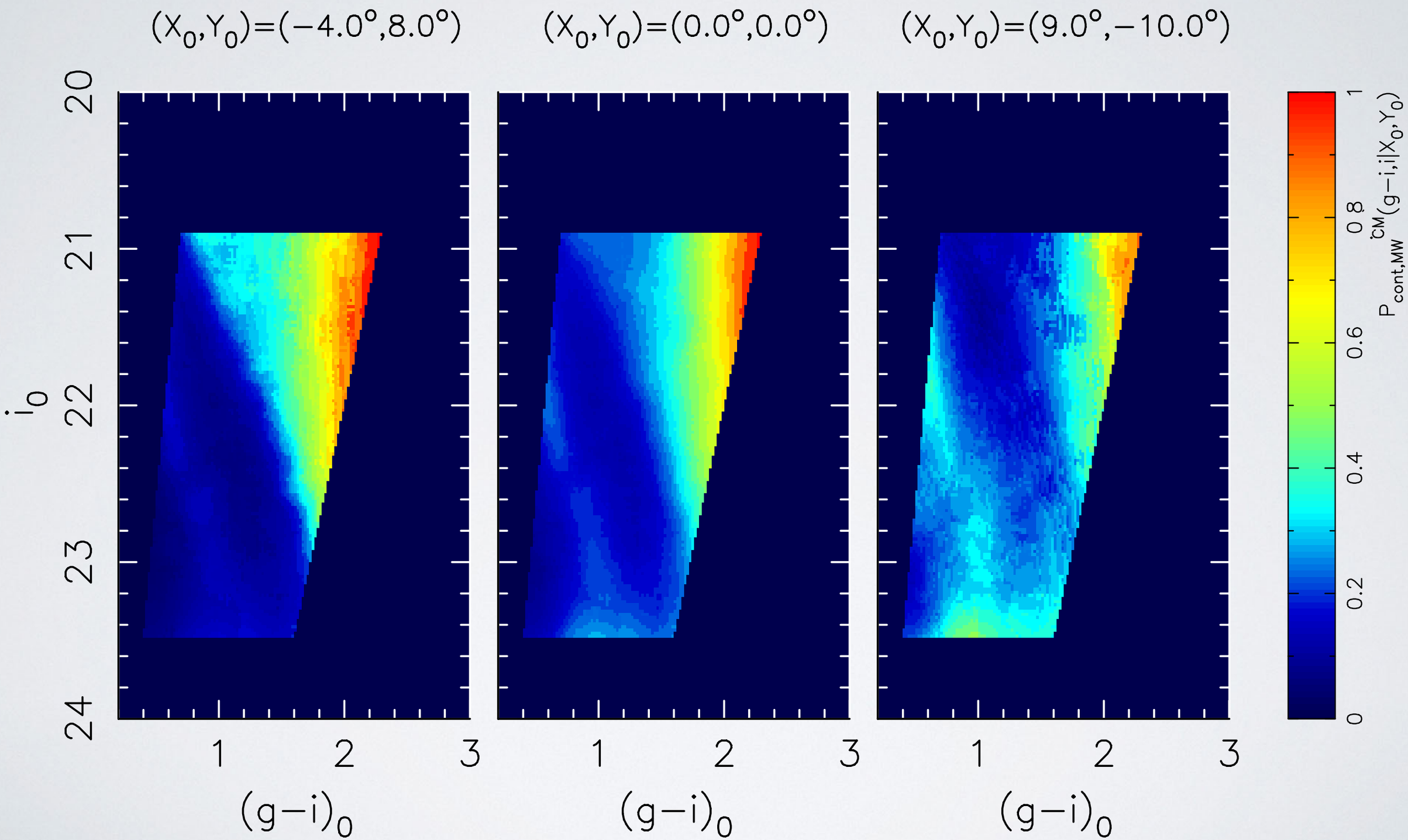


The Milky Way contamination

Martin *et al.* (2013)



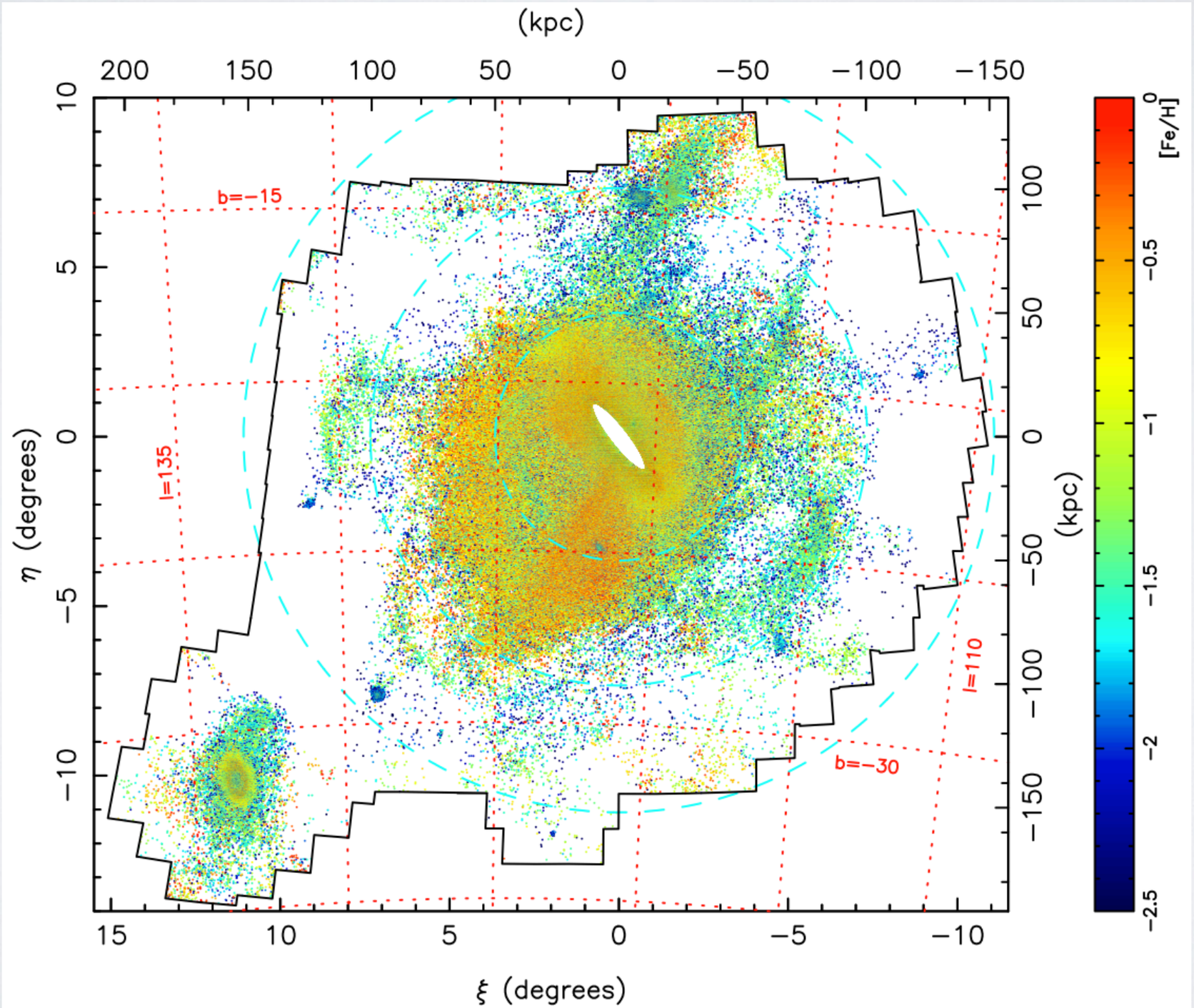
A variable MW contamination



The M31 stellar halo

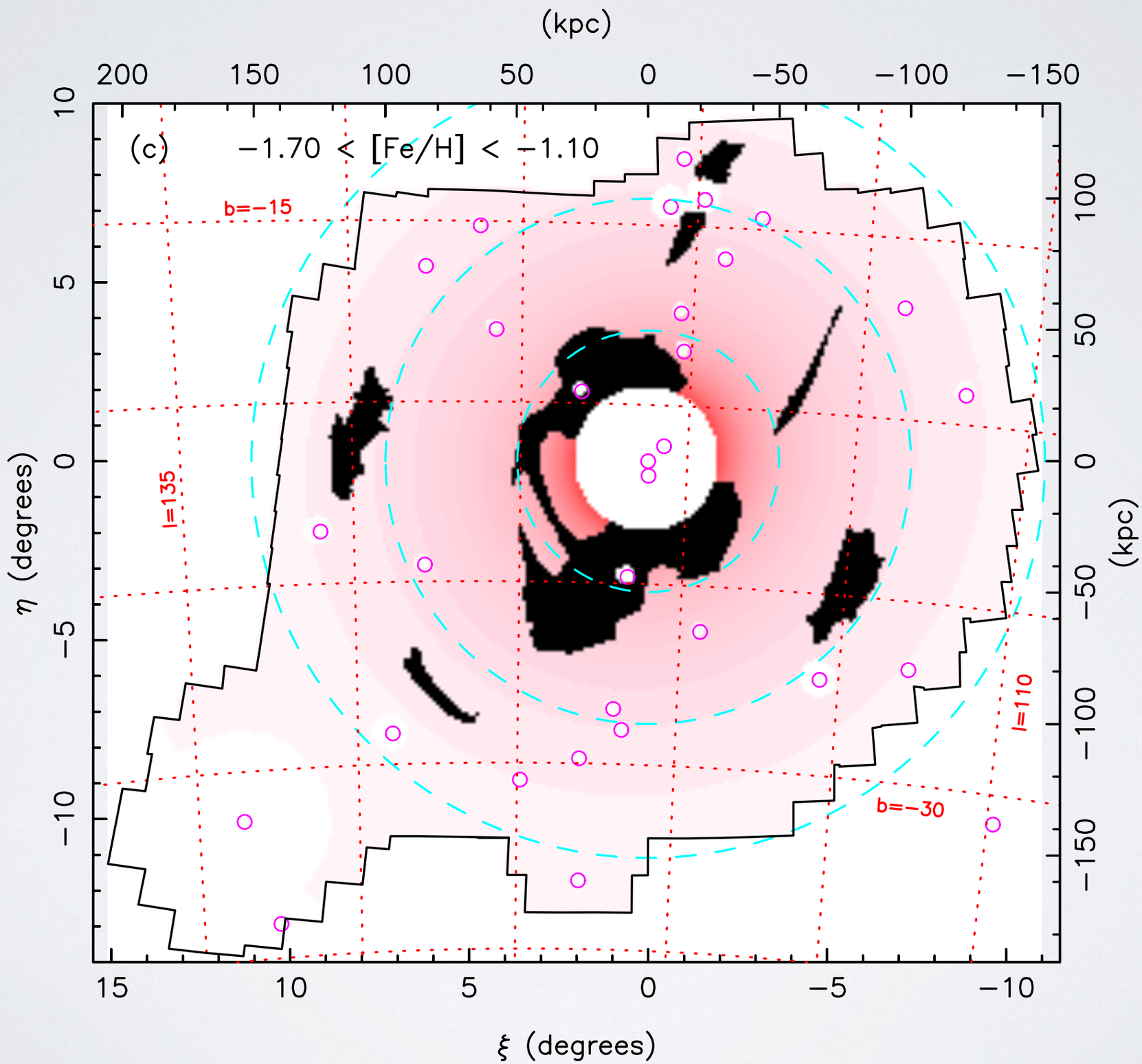
Ibata et al. (2014)

"Statistical" removal of Milky Way foreground model

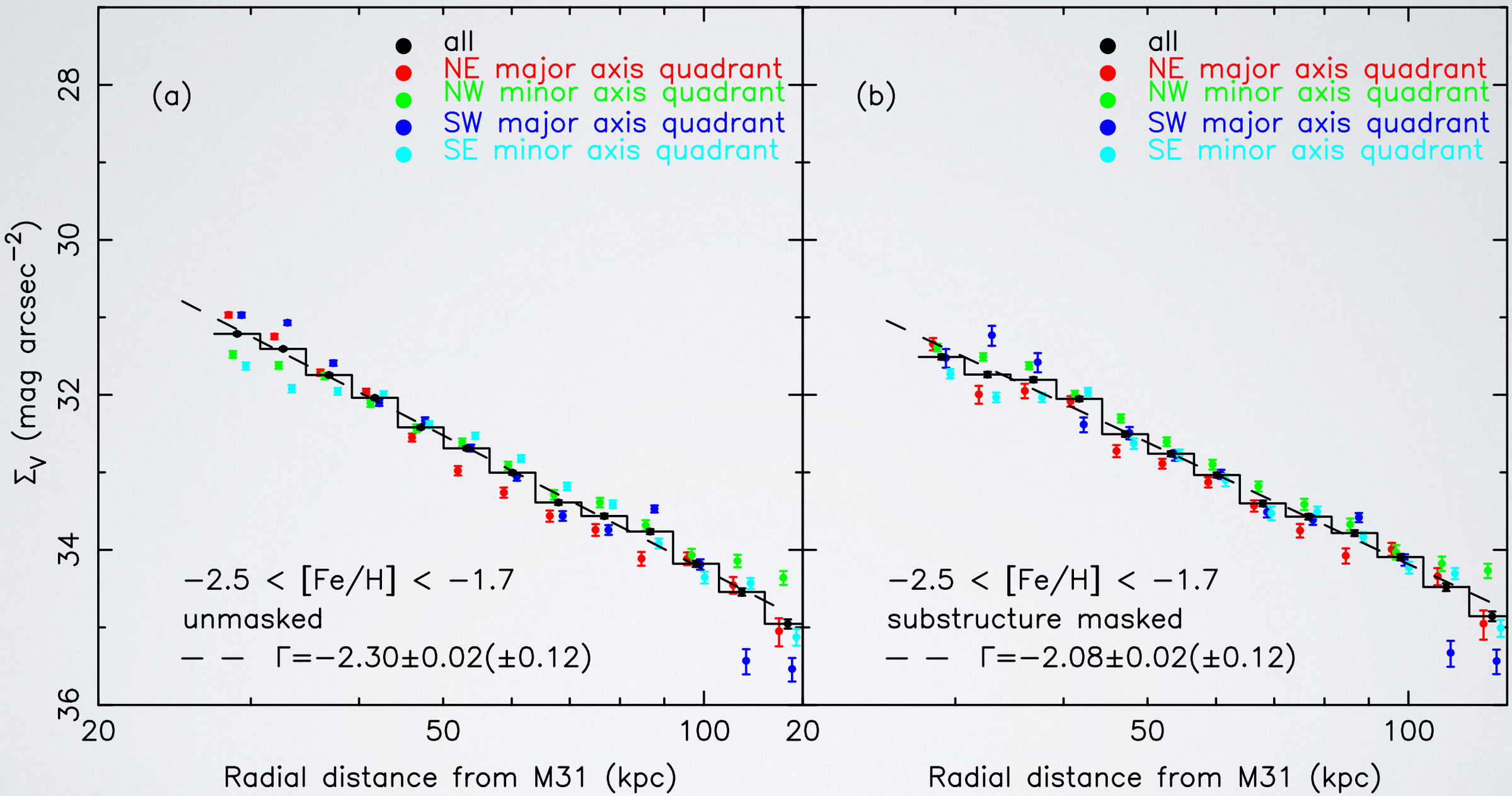


"smooth" vs. structured

Ibata et al. (2014)



"smooth" vs. structured

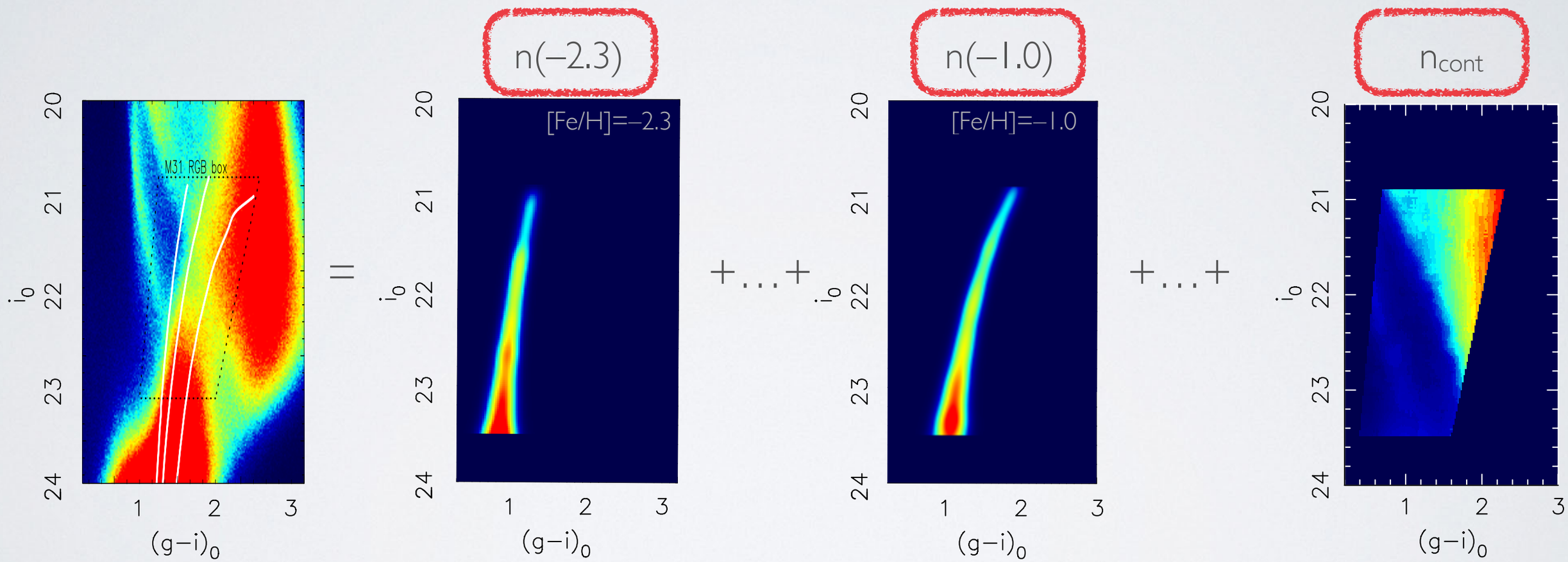


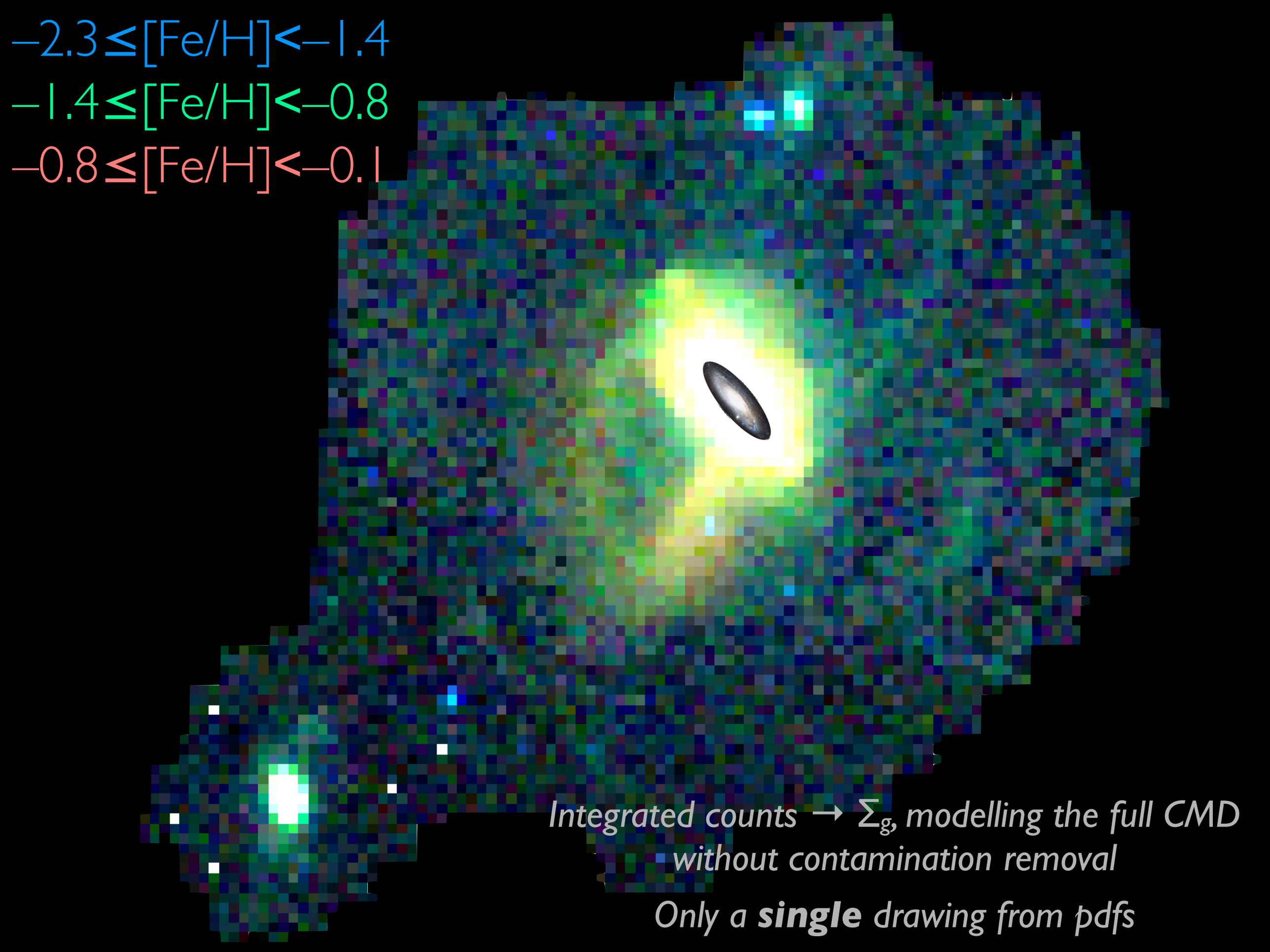
But is "smooth" really smooth? Only so down to the survey depth

Decomposing PAndAS

Martin et al. (in prep.)

For a given 15'x15' spatial pixel region:

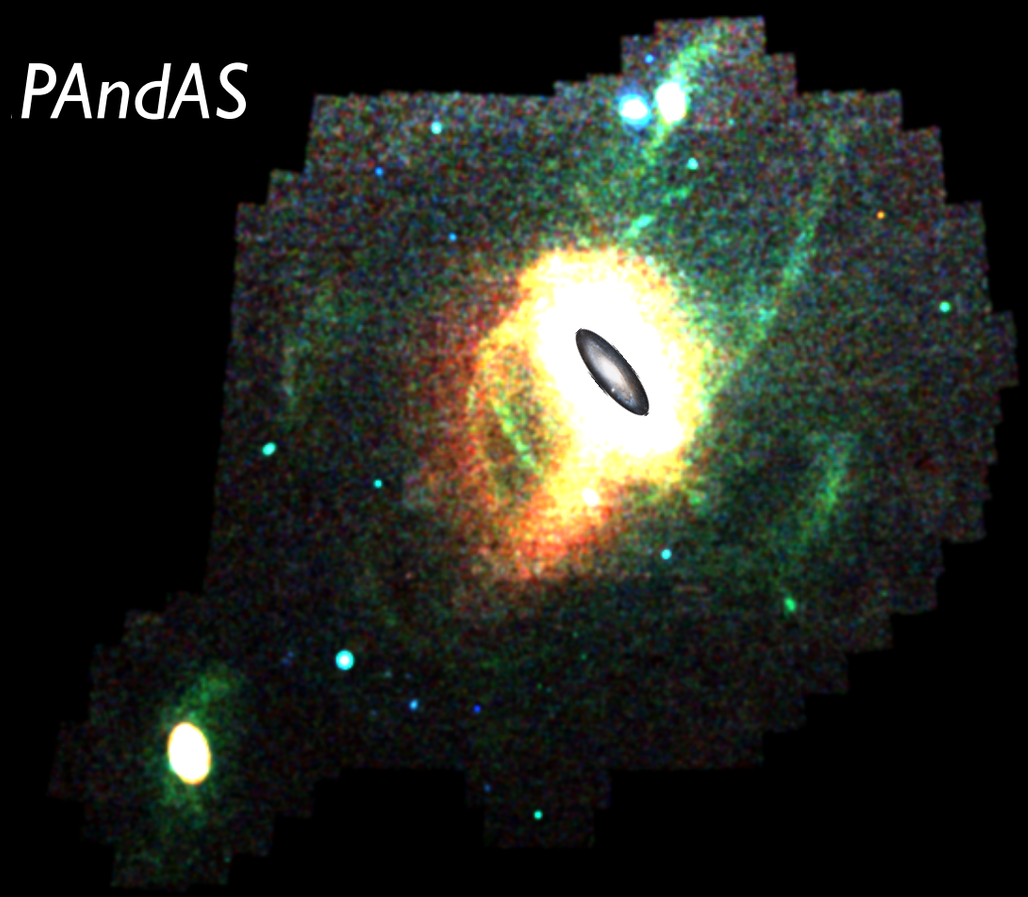


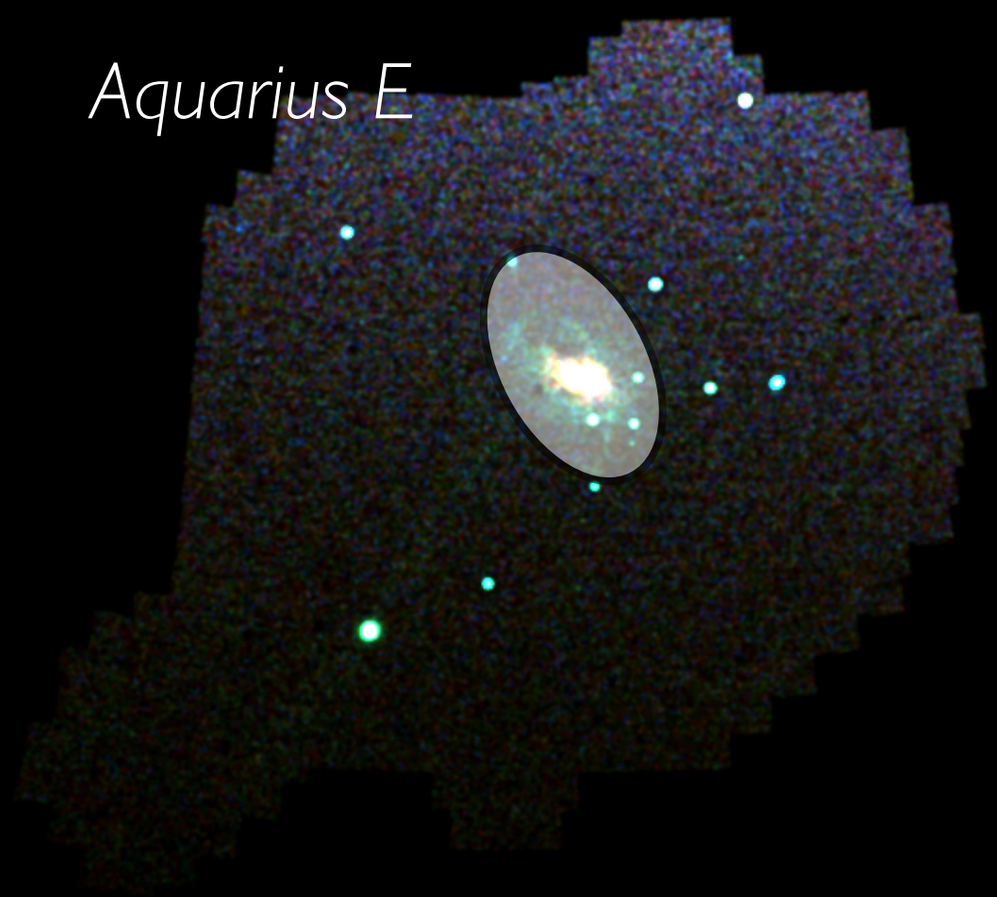

–2.3≤[Fe/H]<–1.4
–1.4≤[Fe/H]<–0.8
–0.8≤[Fe/H]<–0.1
Integrated counts → Σ_g, modelling the full CMD
without contamination removal
Only a **single** drawing from pdfs

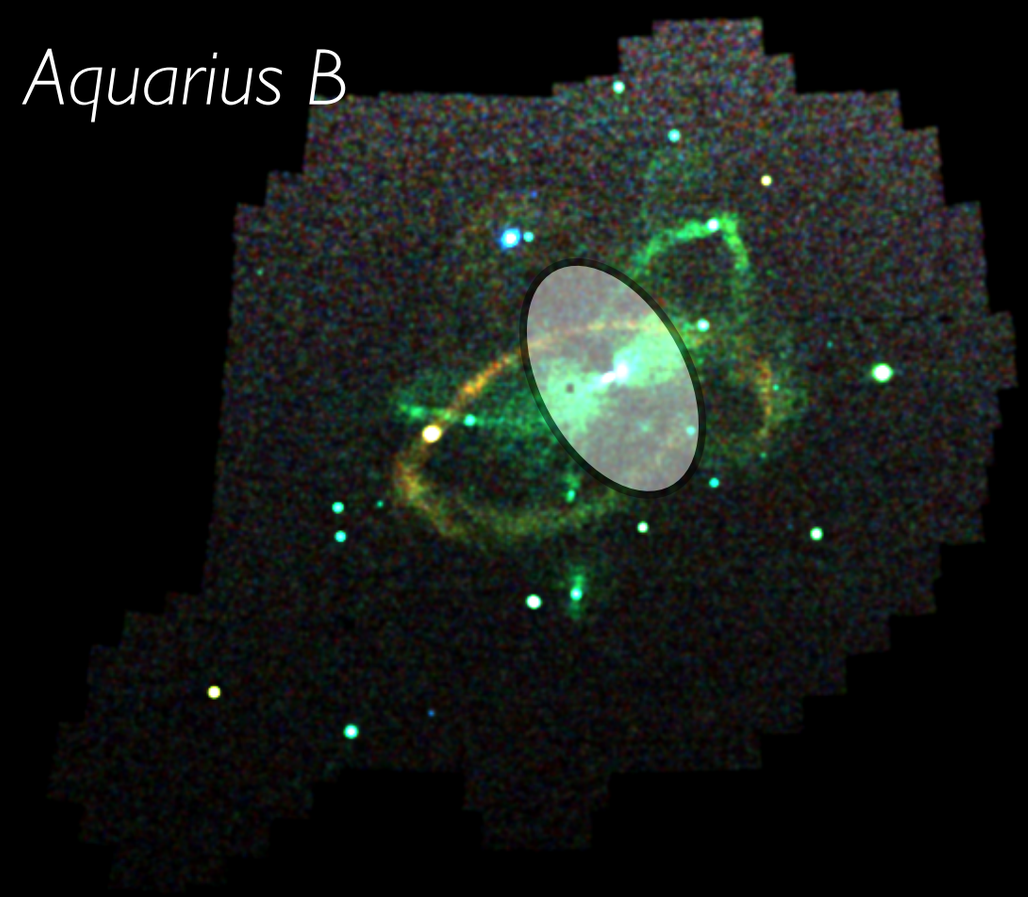
The future?

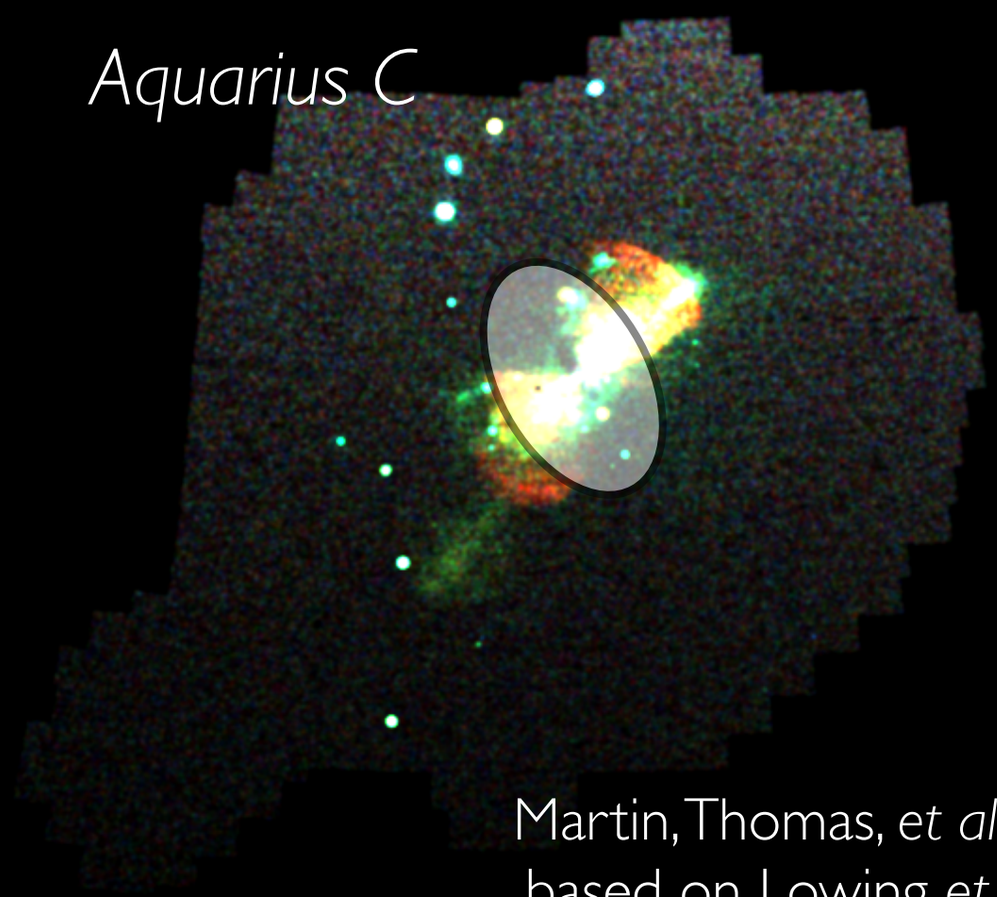
- *Surveys:*
  - HyperSuprimeCam on Subaru?
  - Subaru Prime Focus Spectrograph for a systematic study?

- Going towards a *"proper" observation/simulation comparison*
  - Bringing the simulations to observational space
  - "Dumbing them down" with the observations' limitations, noise, and systematics









Martin, Thomas, *et al.* (in prep)
based on Lowing *et al.* (2014)