Mapping the Milky Way halo with NSLS

Beyond SDSS & Pan-STARRS1

+ MSE (ex-ngCFHT)

Pan-STARRS1
(Slater et al. subm.)

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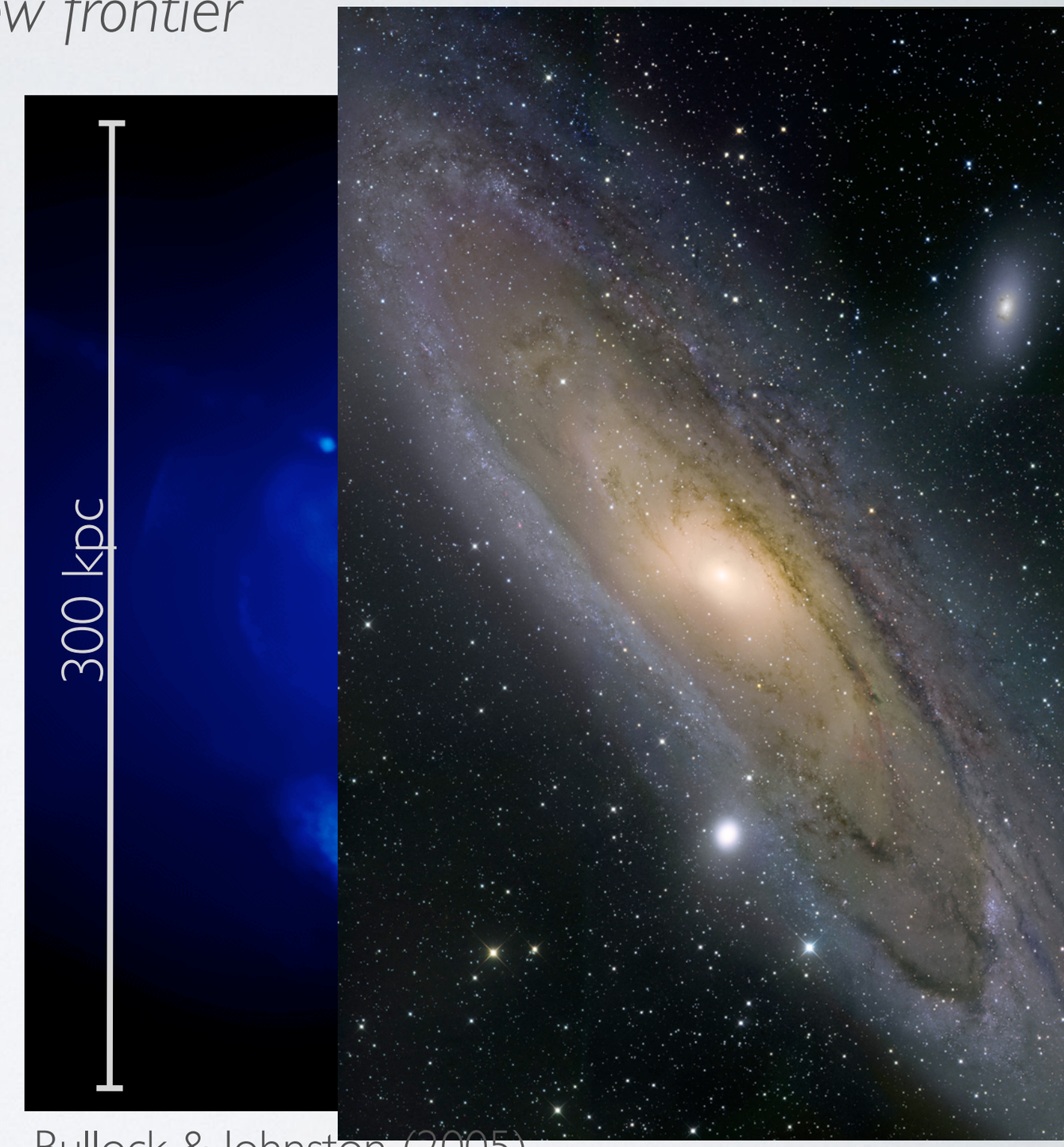
Cosmology on galaxy scales

the new frontier

- Large scale cosmology is now largely understood
  - Λ Cold Dark Matter universe
- How do baryons condense at the center of dark matter halos?
- Clear discrepancy between dark matter and stellar distributions
  - "missing satellite crisis"
  - hierarchical build-up?



Bullock & Johnston (2005)

M31 (PAndAS)

Aq E

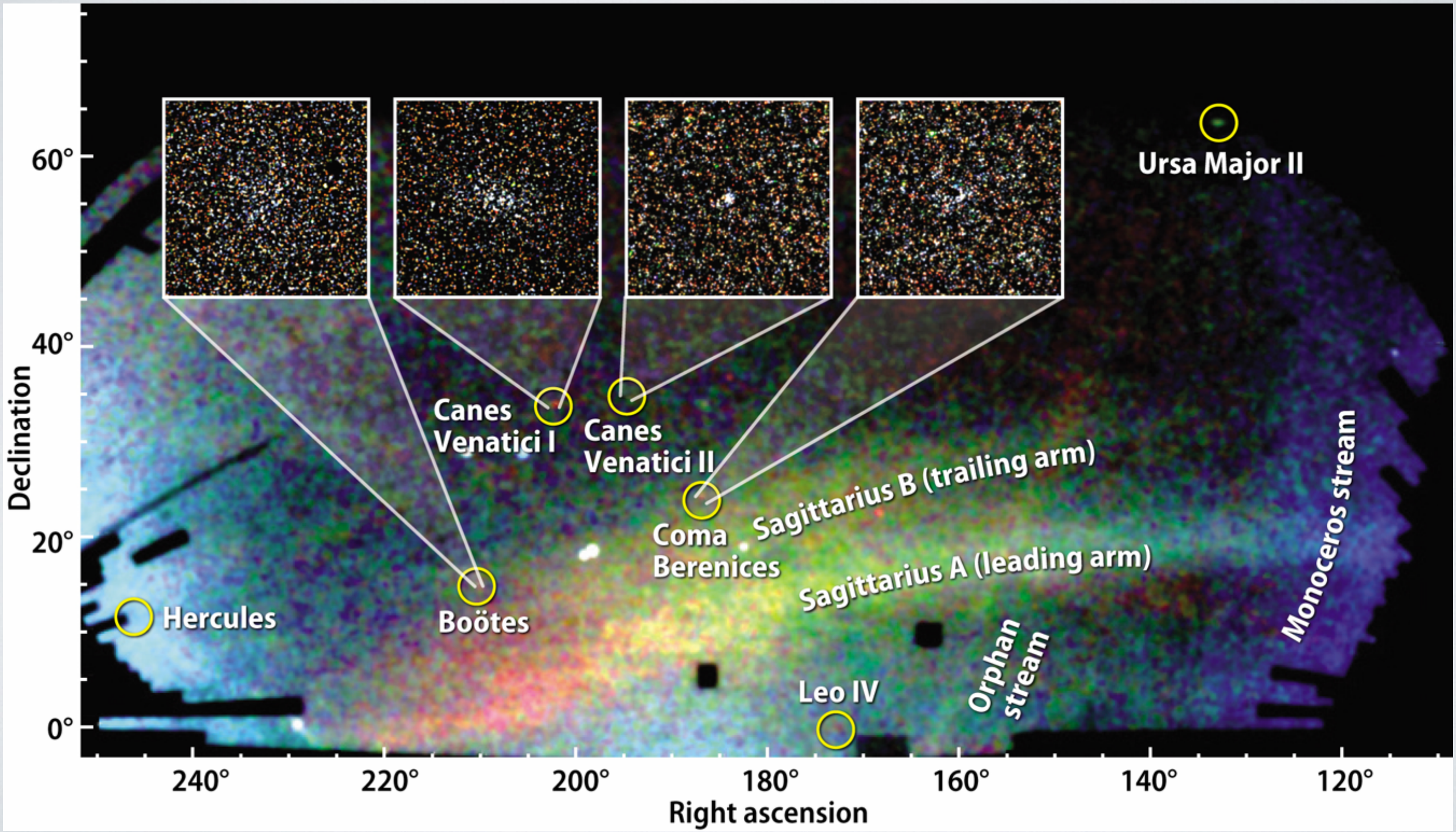
Aq B

Aq C

Thomas, Martin, Ibata, et al. (in prep)

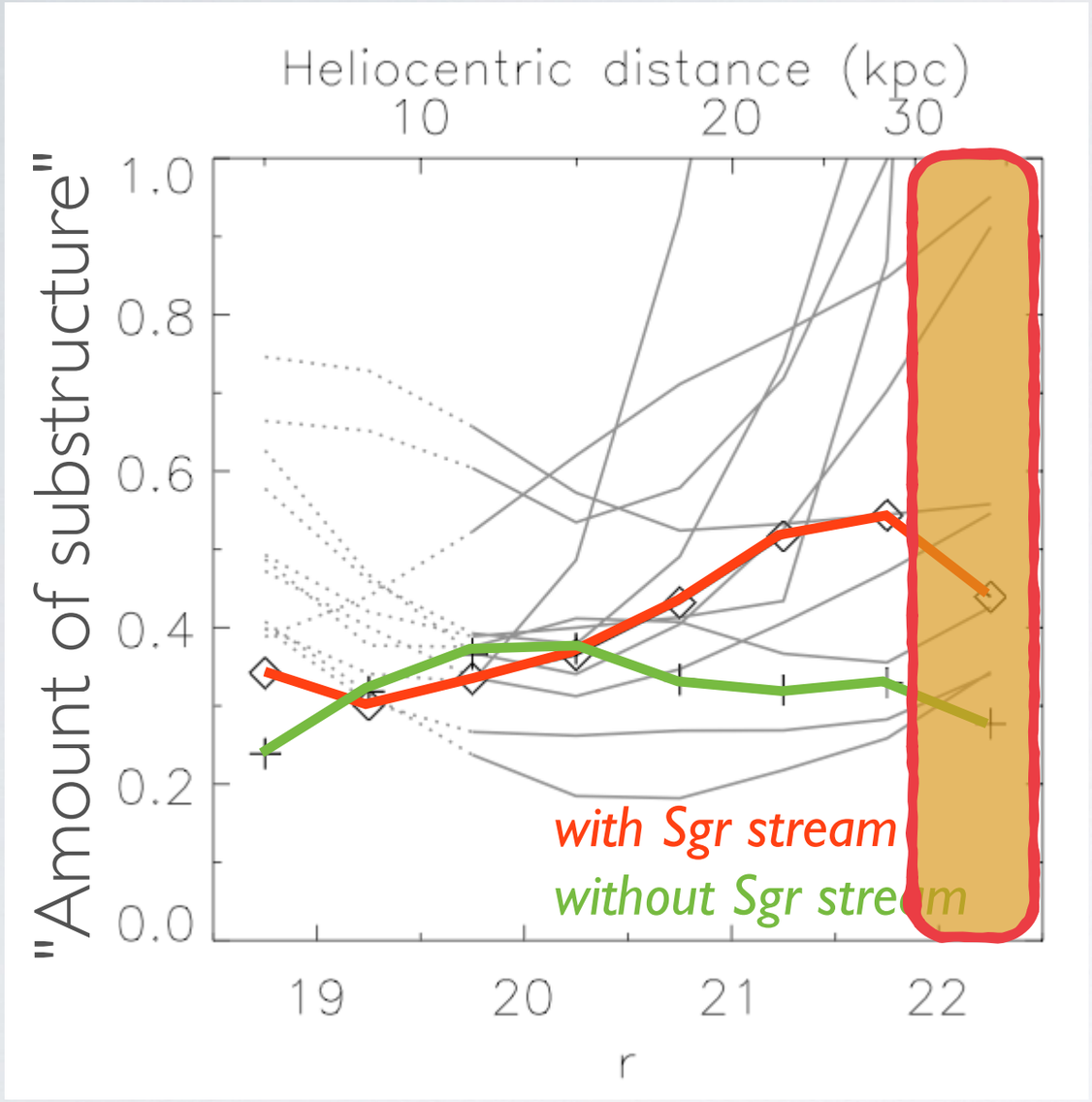
The SDSS breakthrough

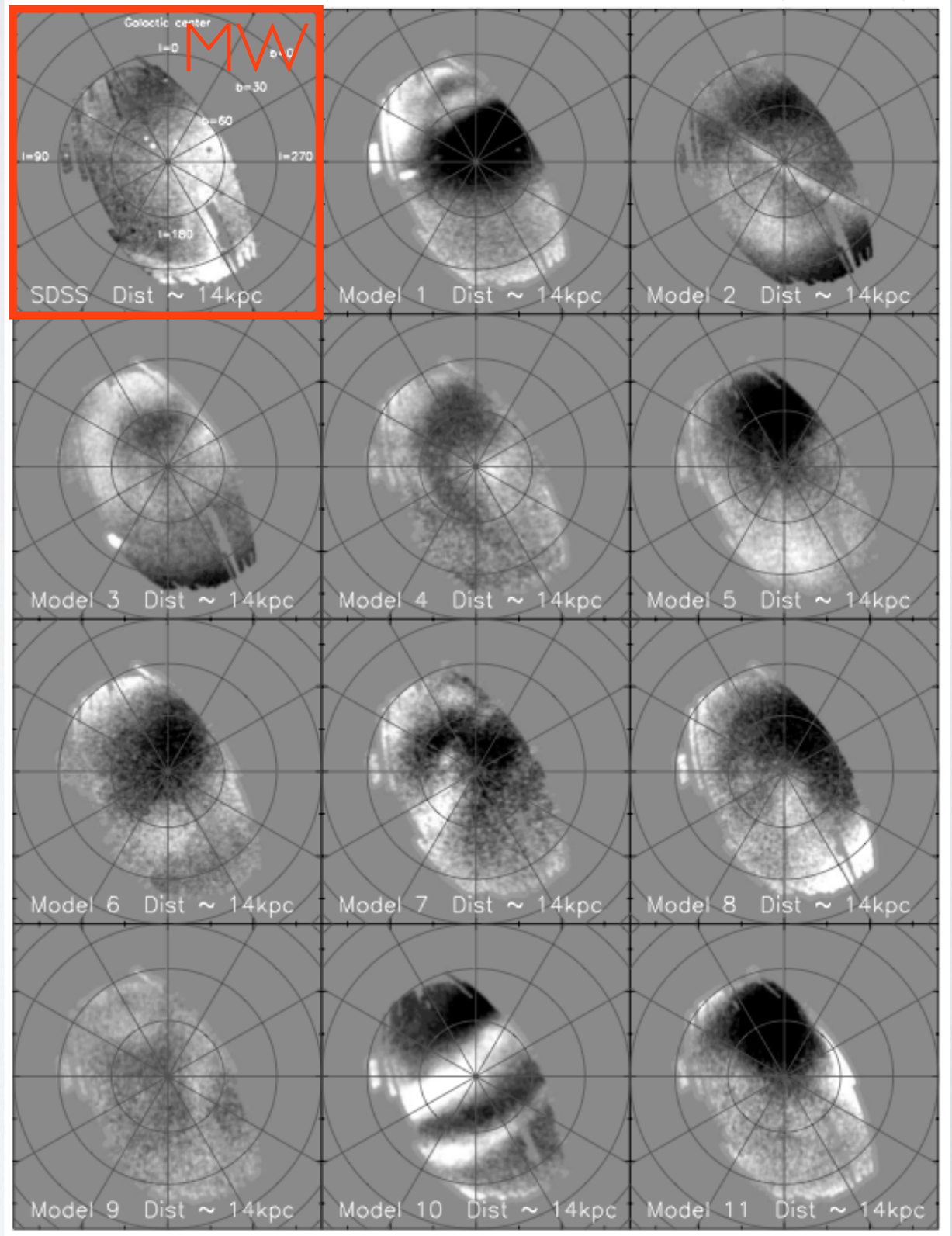
Belokurov, Zucker et al. (2006+)…



Are structures consistent with ΛCDM?

Bell et al. (2006+)

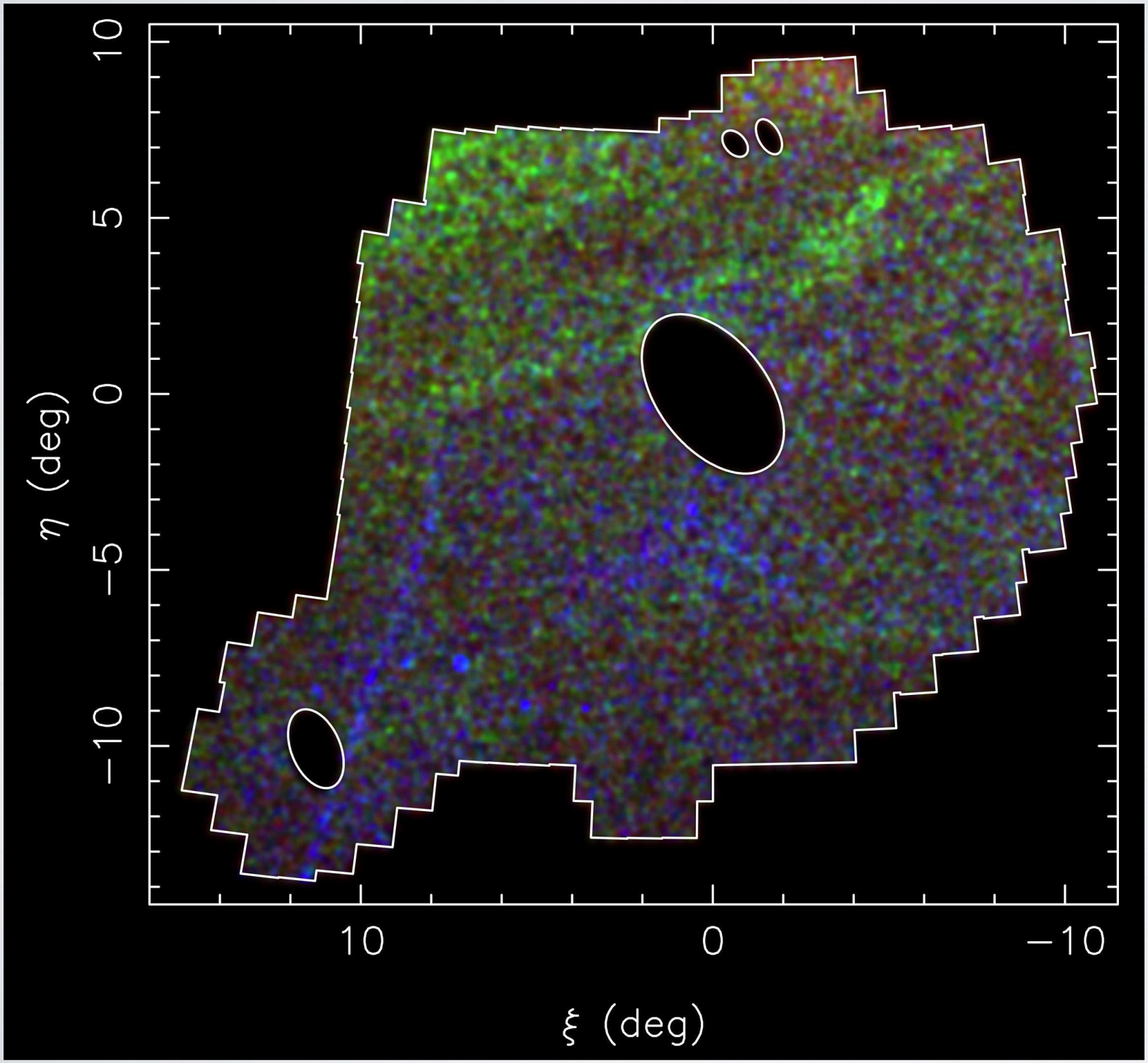




What stellar halo at D>50 kpc?

Deconstructing the halo with NSLS

Martin et al. (2014)



PAndAS (MW)

Field of Streams

17 kpc

22 kpc

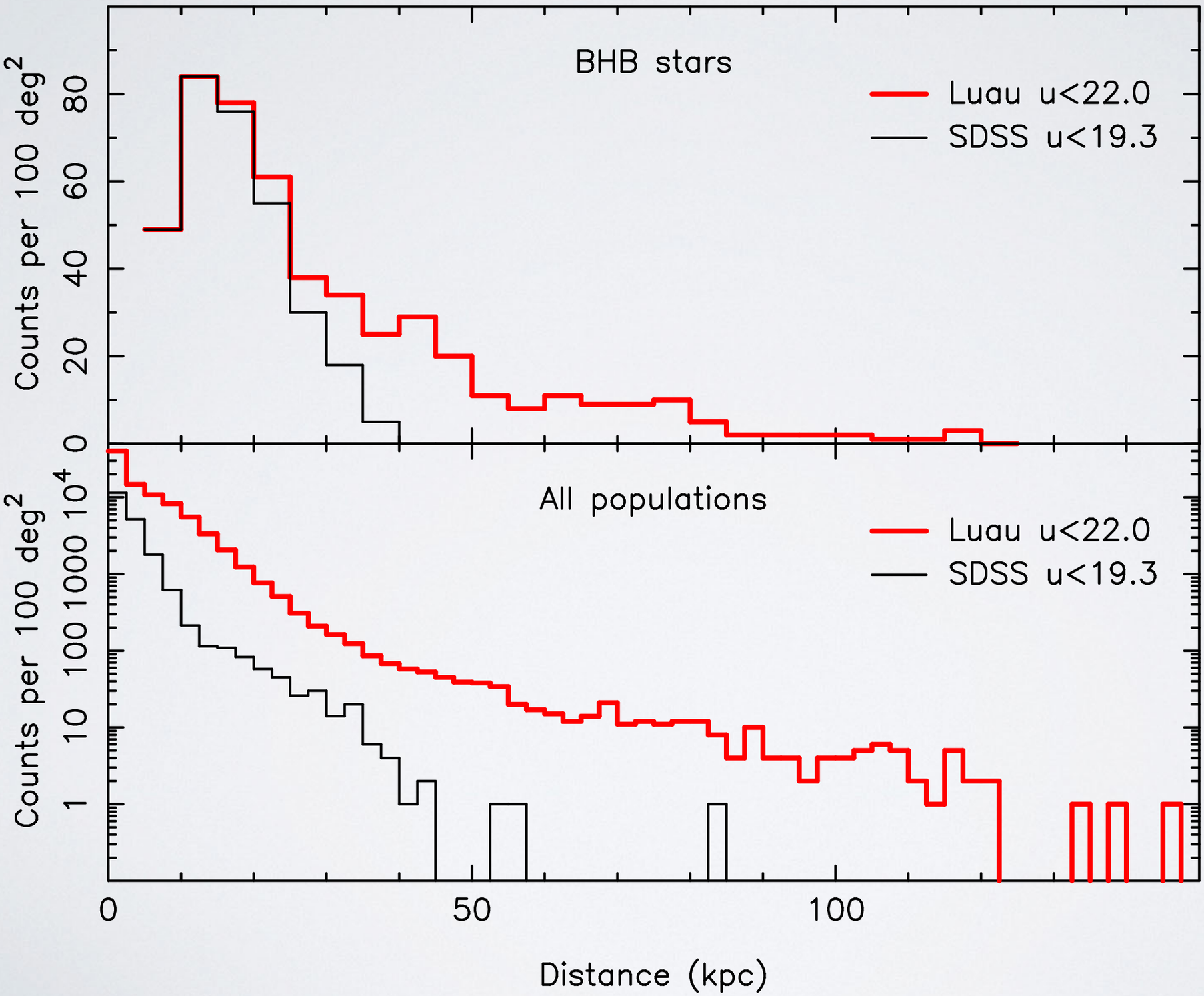
32 kpc

Beyond SDSS depths

Fainter!

Deconstructing the halo with NSLS

Luau Large Programme (Ibata +McConnachie)

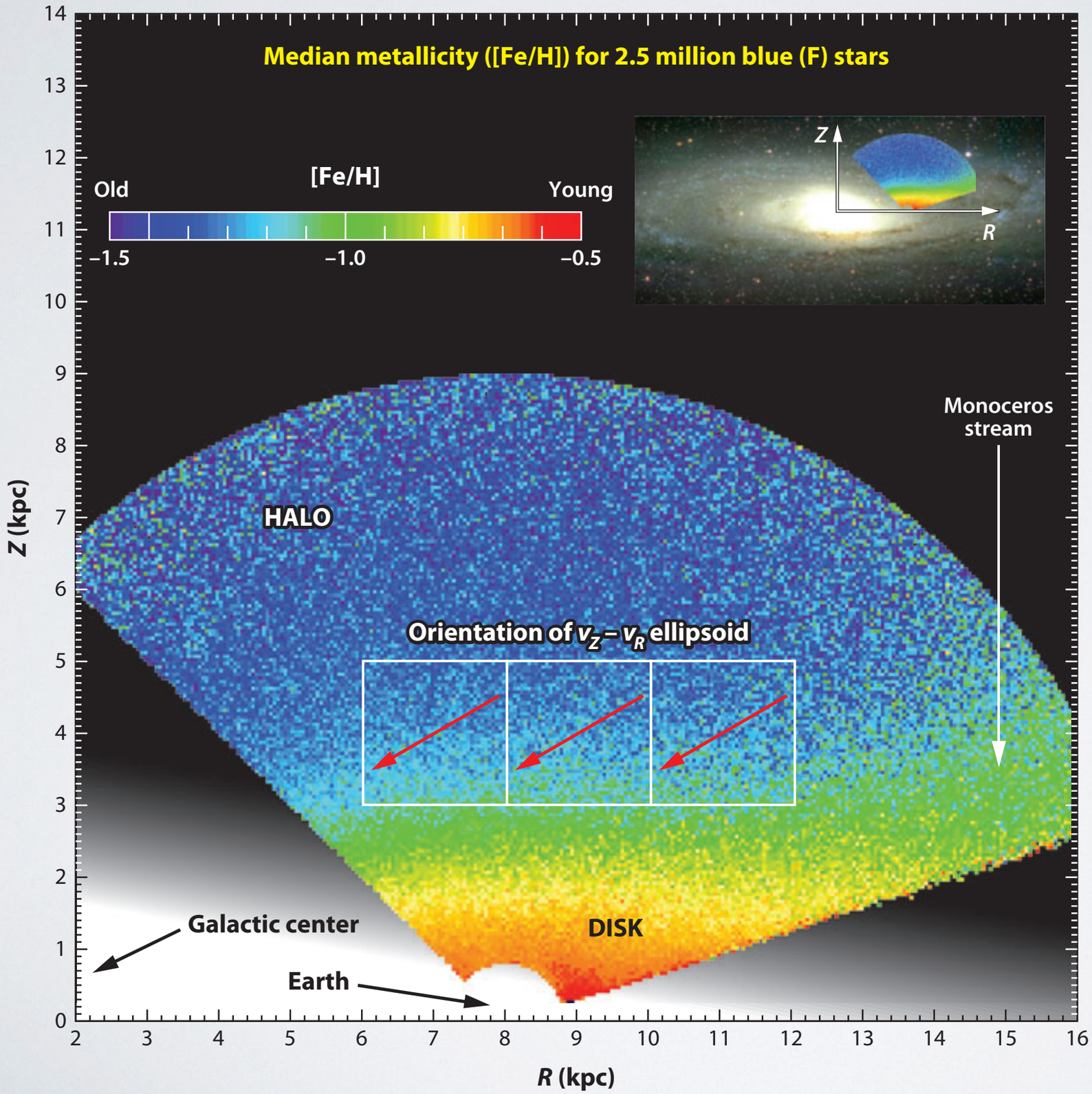


Fainter!

Further!

Deconstructing the halo with NSLS

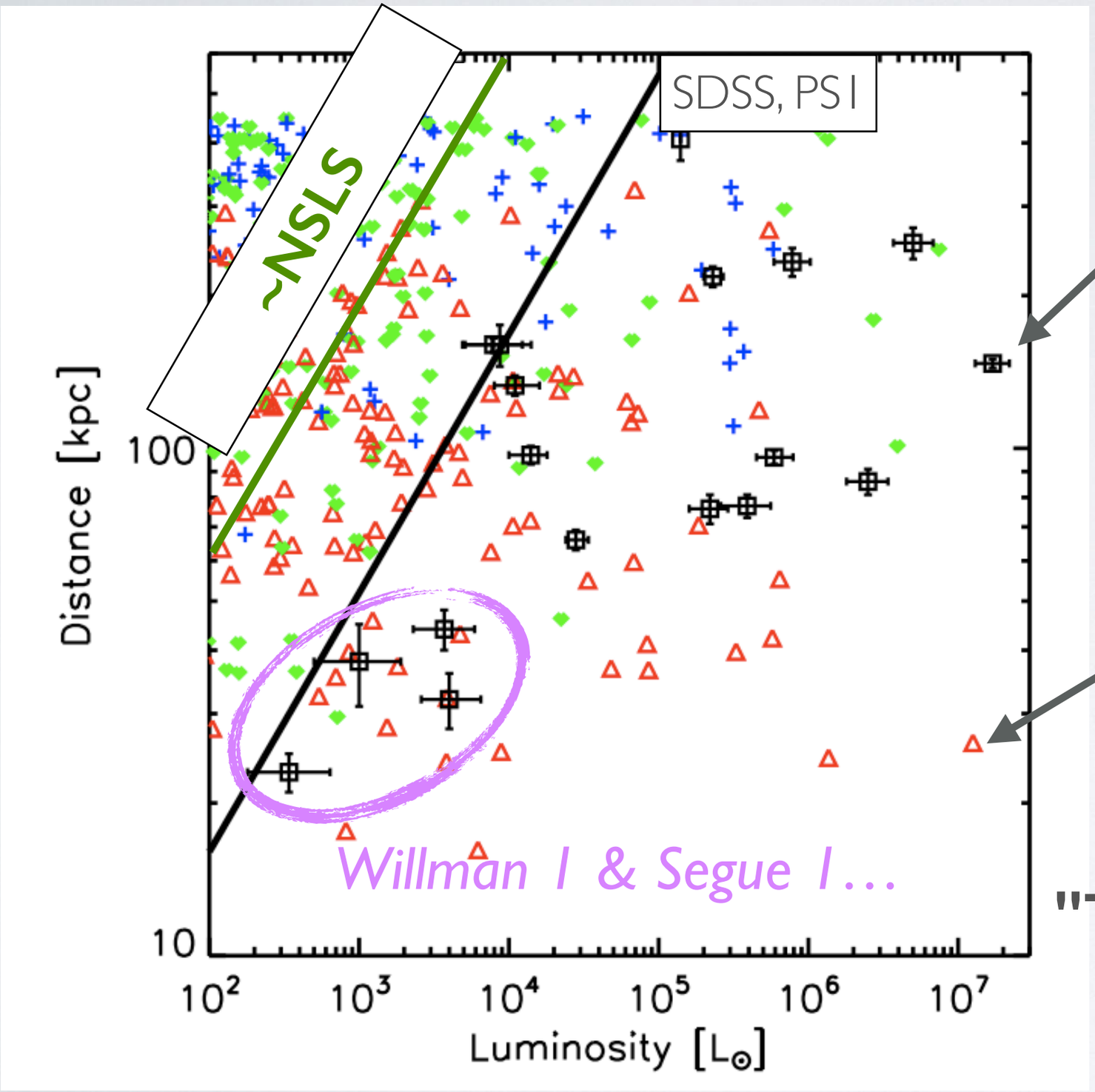
Ivezić et al. (2012)



out to 30 kpc (matching GAIA volume)!

The MW satellite system

Bullock et al. (2010)



MW dwarf galaxies

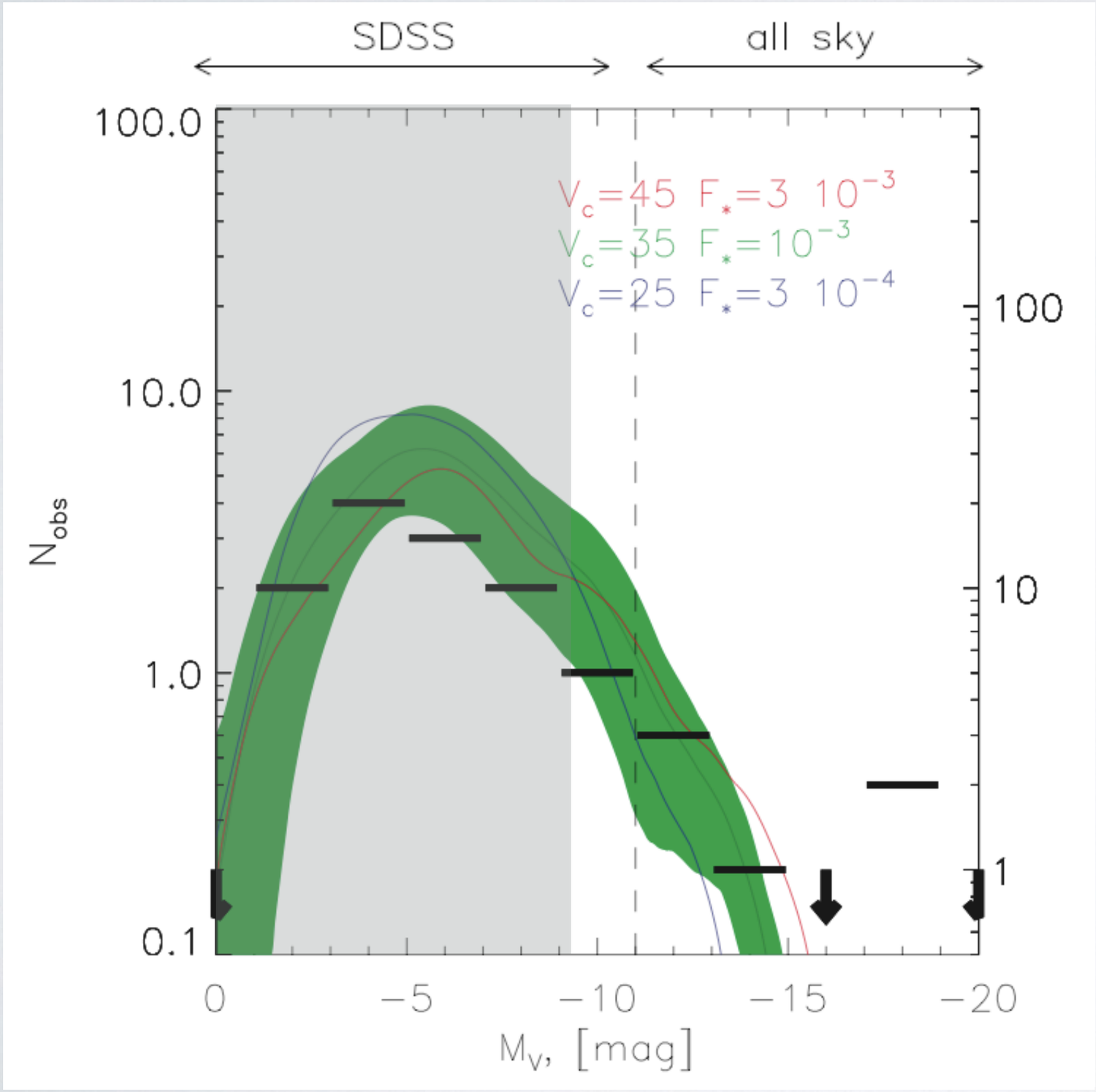
ΛCDM-based simulations

"The most DM-dominated dwarf galaxies"

Remnants? Pristine?

The faint end of galaxy formation

Koposov et al. (2009)



Large uncertainty at faintest end, the most sensitive!

Need to find many more

Summary

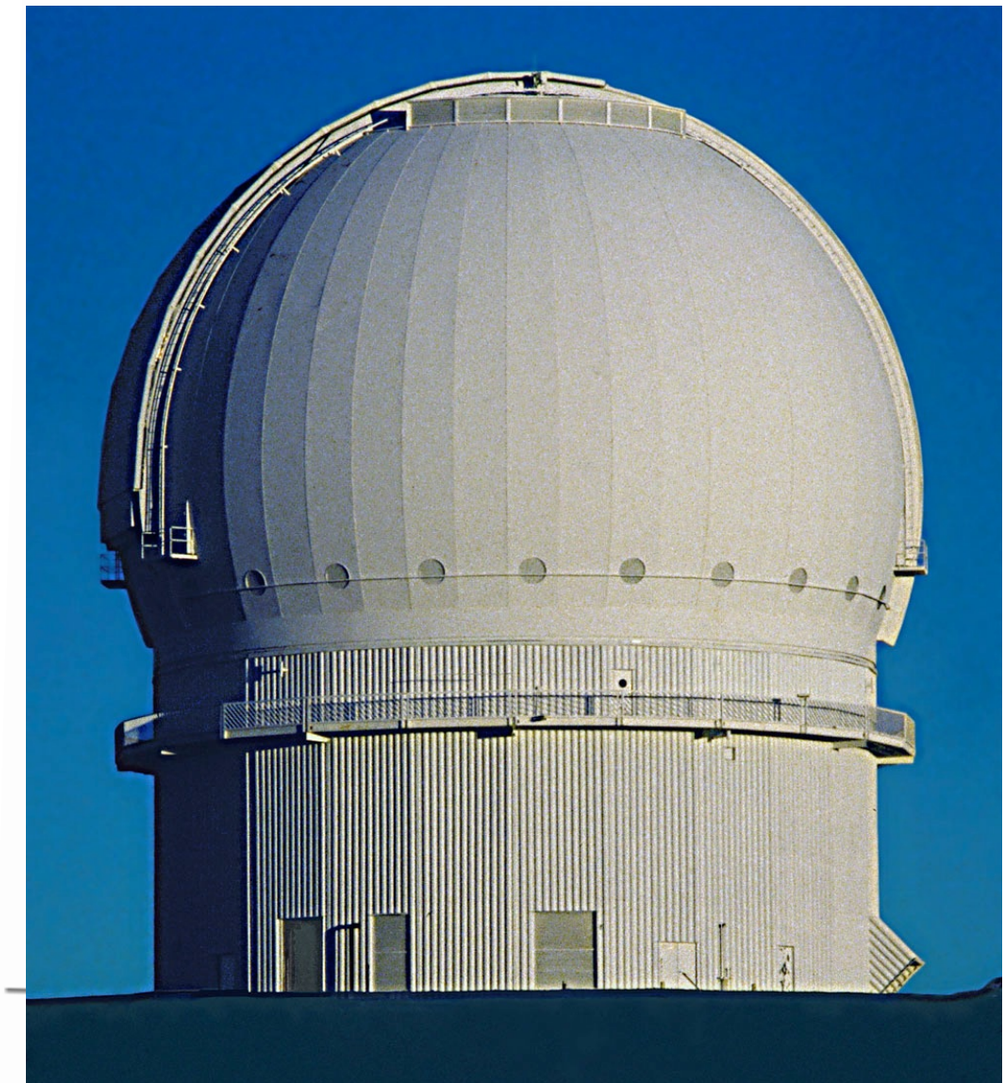
- With NSLS…
  - …go beyond mapping the local environment
    - 30 kpc → ~60 kpc for MSTO stars (60 kpc → ~120 kpc for BHB stars)
  - …investigate the nature of faintest MW satellites
  - …superb star/galaxy separation to gri ~ 24.5

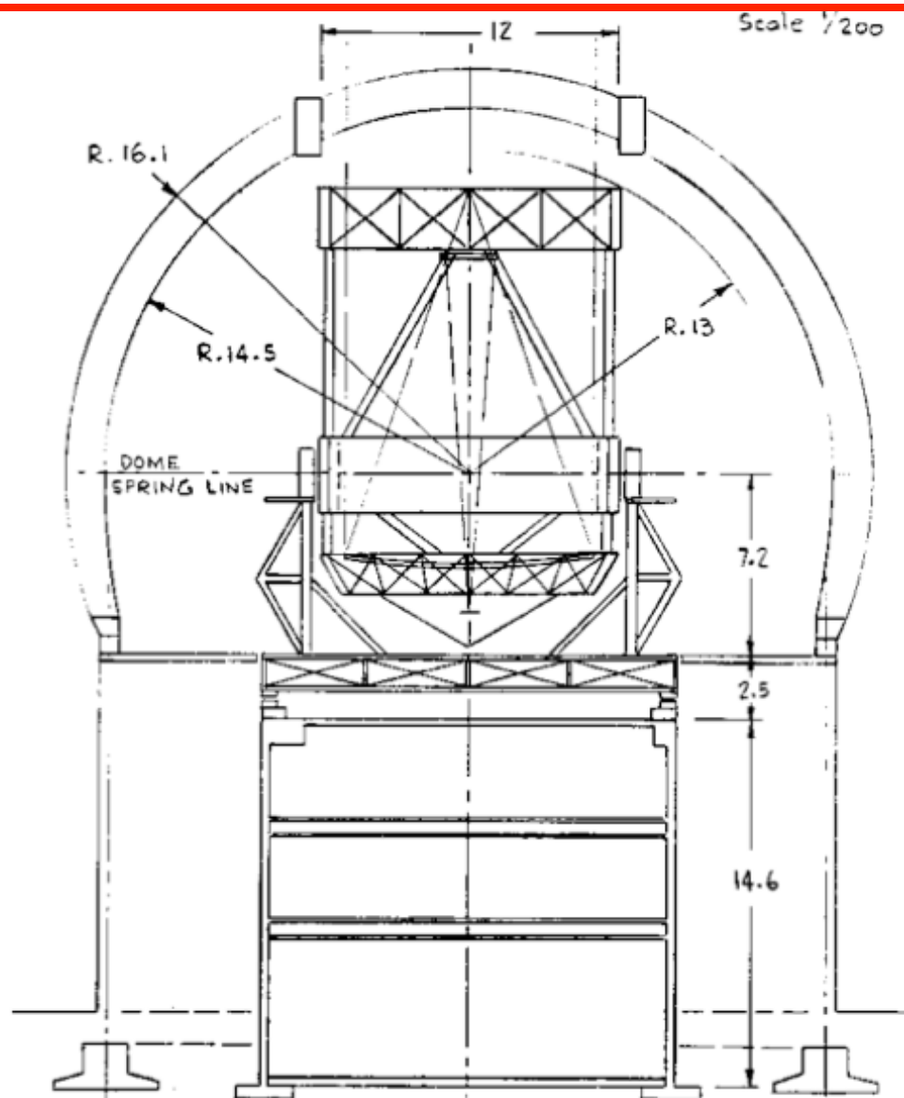
The **M**auna Kea **S**pectroscopic **E**xplorer

The “Next Generation CFHT” original concept

Create a new and expanded partnership to:

1. replace the present 3.6m primary mirror with a 10m-class (segmented) mirror, mounted on the existing pier.
2. install a **dedicated** wide-field (1.5 deg^2) multi-object spectrograph that can simultaneously collect spectra for >3000 sources.

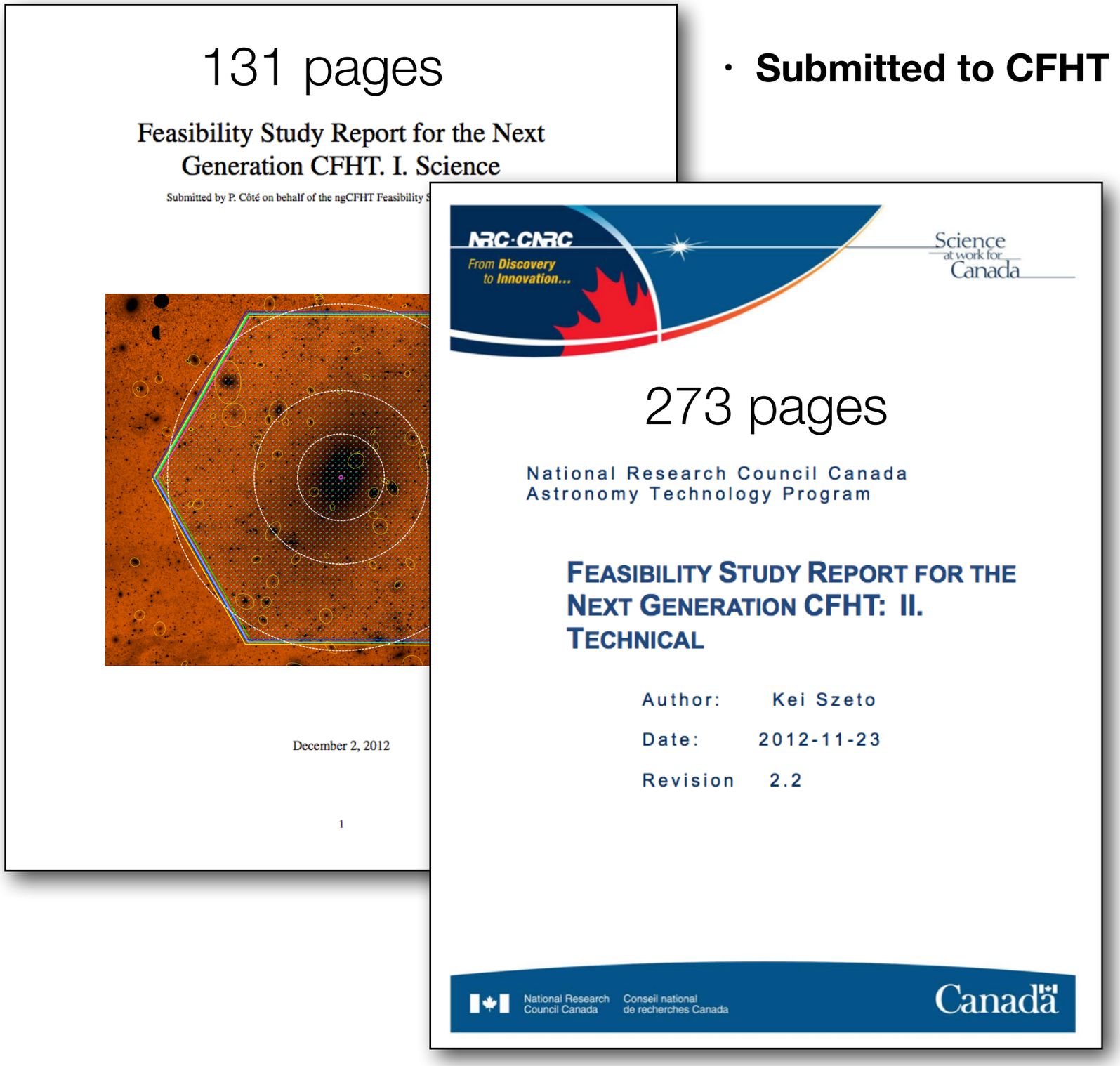




MSE/ngCFHT Development:

Completed (unsolicited) Feasibility Studies at http://ngcfht.org

See also: http://mse.cfht.hawaii.edu



- **Submitted to CFHT SAC and Board in Fall 2012**

Primary Outcomes

- Redevelopment could utilize the existing pier and building with only minor modifications.
- The conversion would not increase the visual footprint of CFHT on Mauna Kea.
- **No technical "show stoppers" with the telescope, enclosure, spectrograph, fibre-feed system, or operations model.**

Defining concept of MSE

MSE will:

- obtain efficiently very large numbers (>10^6) of low- (R ~ 2 000), moderate- (R ~ 6 500), and high-resolution (R ~ 20 000) spectra
- for faint (20 < g < 24) science targets
- over large areas of the sky (10^3 – 10^4 sq.deg)
- spanning blue/optical to near-IR wavelengths (0.37 – 1.3μm).
- At the highest resolutions, it should have a velocity accuracy of <<1 km/s
- At low resolution, complete wavelength coverage should be possible in a single observation

- **Unique science cases of MSE stemming from:**
  - **10 m aperture**
  - **Operation at a range of spectral resolutions**
  - **Dedicated Operations, producing stable, well-calibrated and characterised data**
  - **Long lifetime**

- *Natural path from 4m-class facilities (MS-DESI, 4MOST, HERMES...) and 8m class instruments (Subaru/PFS) to MSE*

Space-based Completement

Wide-field Follow-up

MSE

- *NSLS-fed targets*
- *Euclid photo-z calibrator*
  (need 30k spectra down to AB 24.5)

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  - …investigate the nature of faintest MW satellites
    - …superb star/galaxy separation to gri ~ 24.5
- Extraordinary complementarity with MSE
  - well matched target provider in North + Euclid calibration
- No strong observing strategy requirement
  - but 3 sub-exp preferred (variability) + largely staggered fields
  - *Luau* could provide a large chunk of *u*-band observations