WFIRST shedding light on the Milky Way

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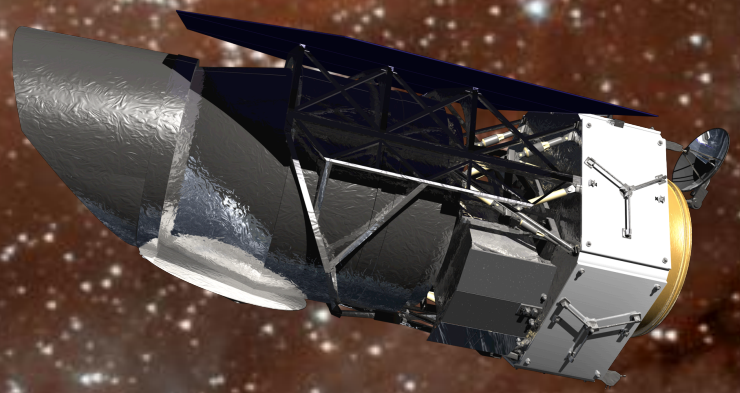
with help from Bob Benjamin and Jason Kalirai

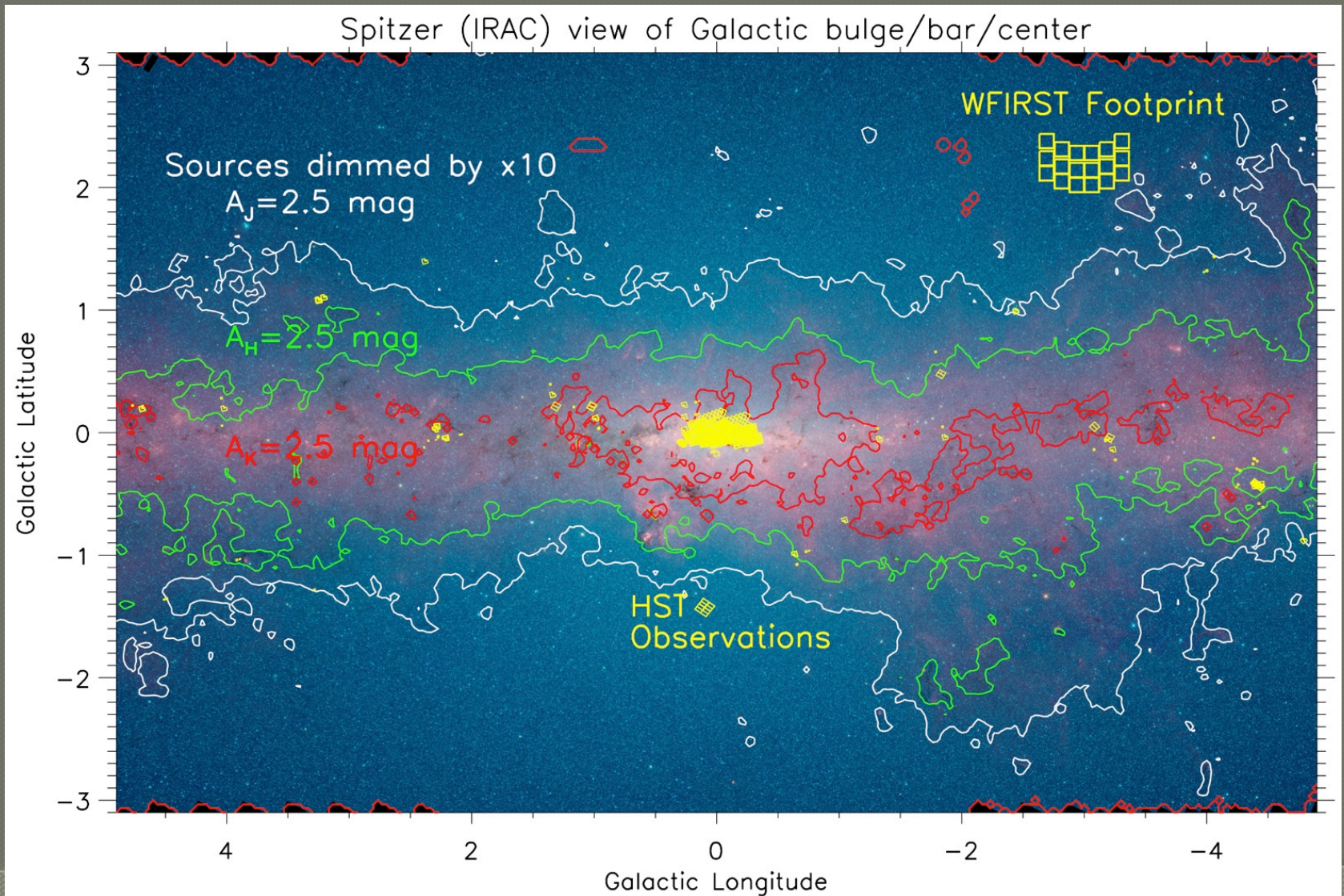


Answers enabled from understanding Galactic structure

- Knowledge of galactic gravitation potential
  - Distribution of dark matter
  - Detailed potential measurements will inform understanding of other galaxies
- Global conditions influencing star formation

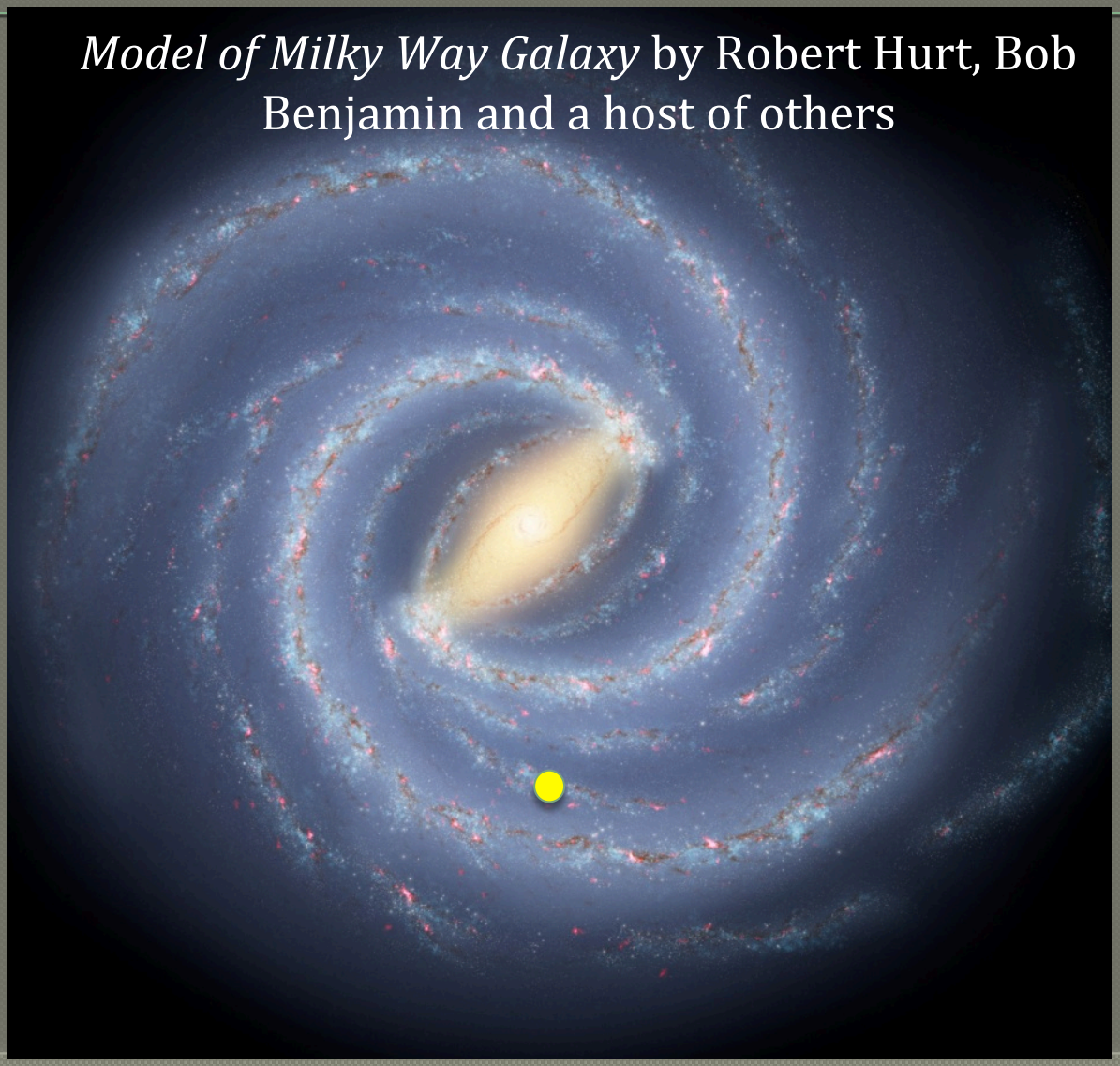
GAIA View of Milky Way

Near-IR essential for Galactic plane studies

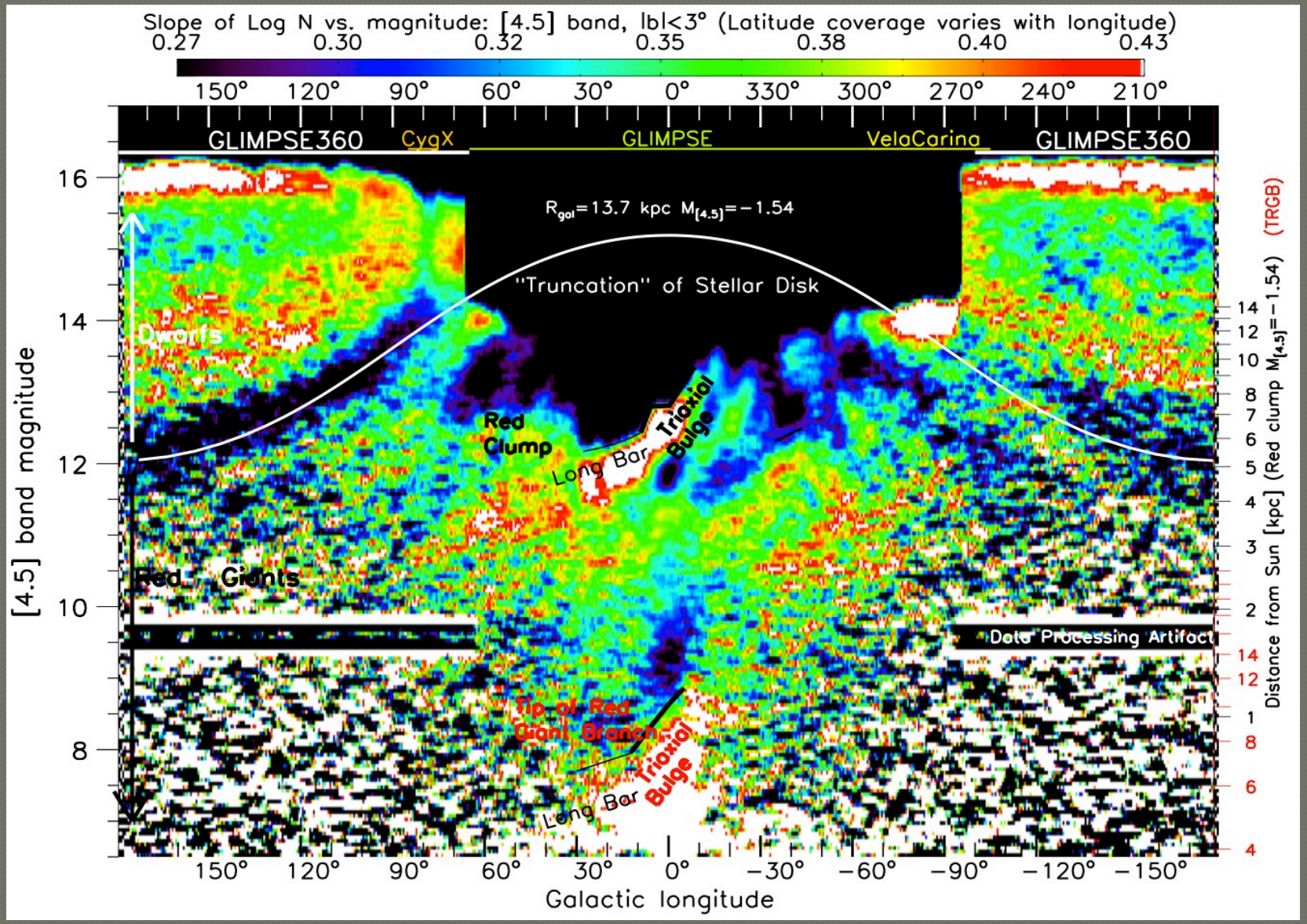


Current understanding of Galactic structure

Model of Milky Way Galaxy by Robert Hurt, Bob Benjamin and a host of others

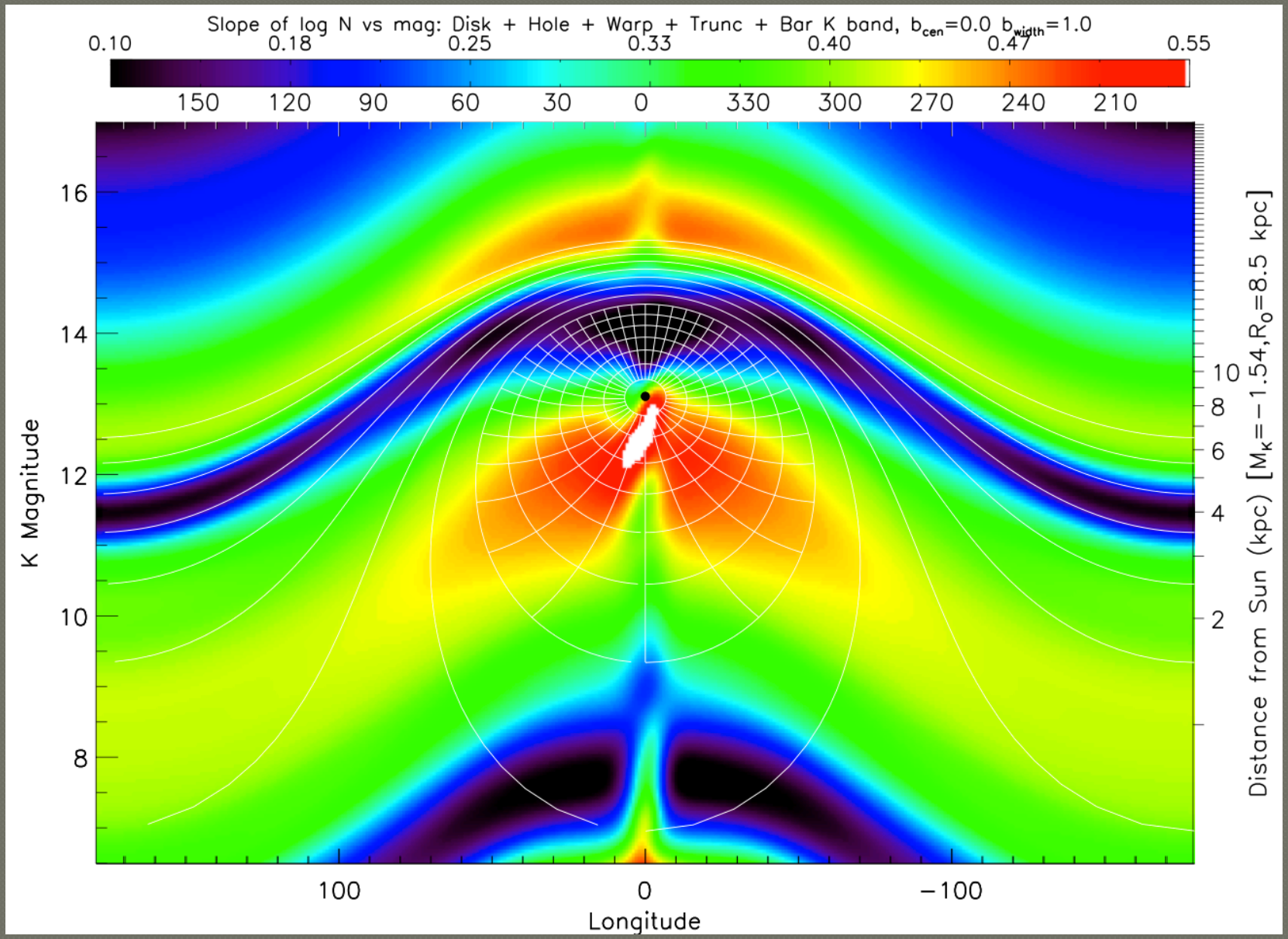


Galactic Structure from Red Clump Giants



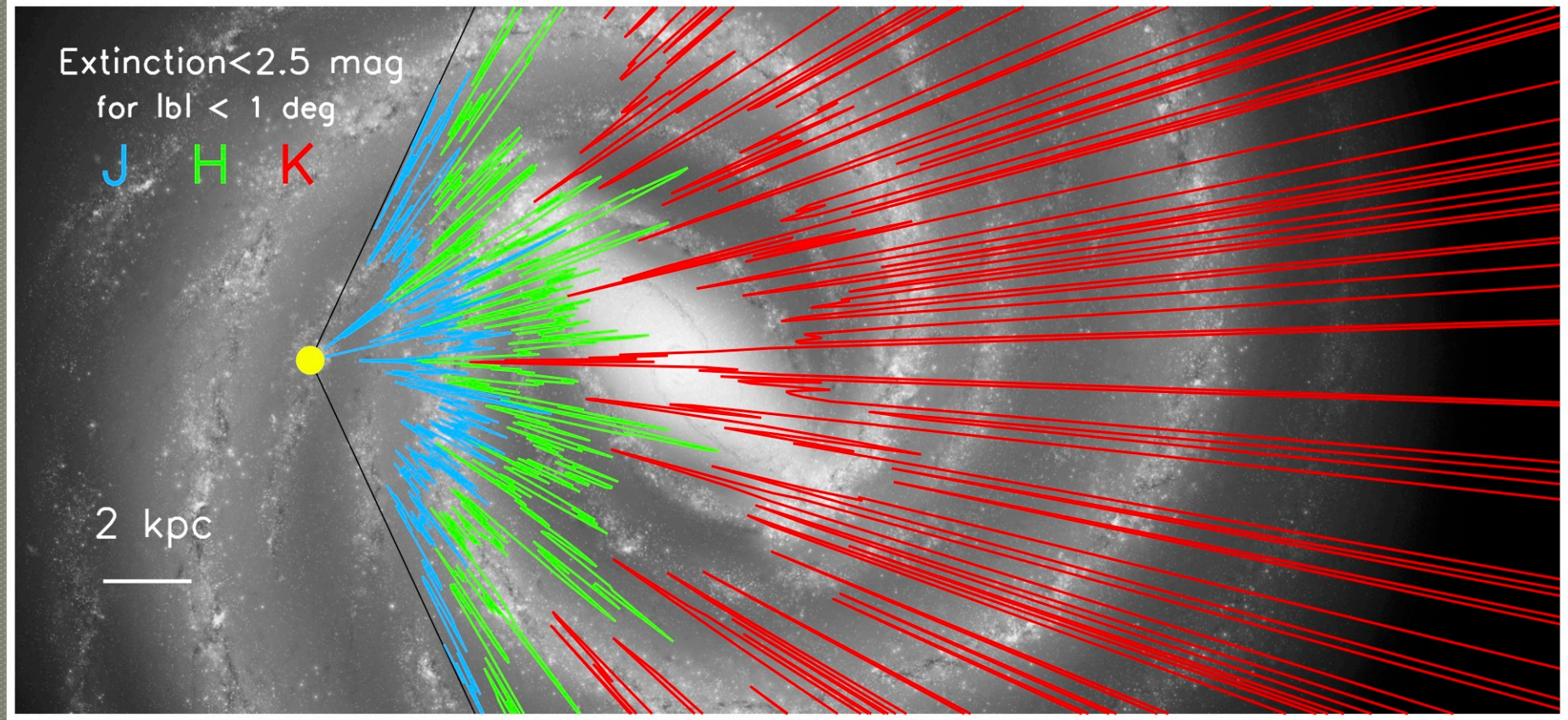
Data and analysis (Benjamin 2012)

Galactic Structure Model



Density model (Freudenreich 1998) + LF (Girardi et al 2005)

WFIRST can see through the Galactic Plane

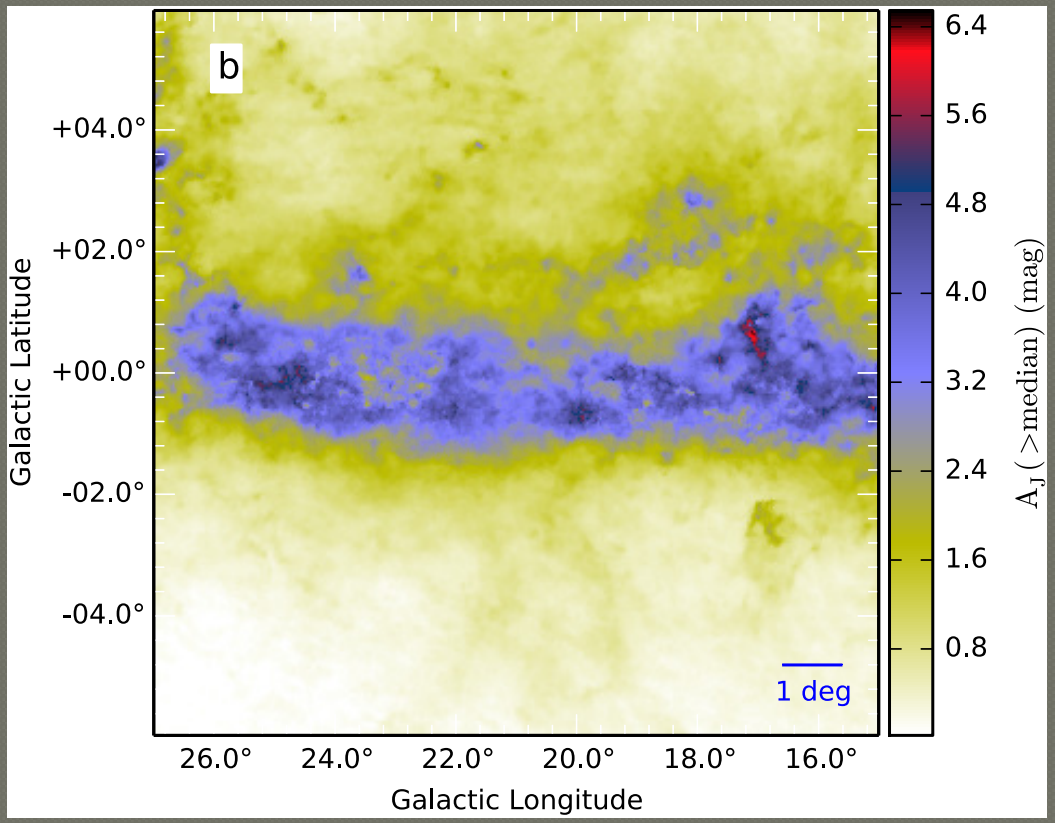


Low Latitude Survey with WFIRST

- Some large swath of Galactic plane
  - Most of the action is within $|b| < 1°$, $|l| < 60°$
  - Nearby Star Forming Regions
  - Will see the entire Galaxy at fantastic resolution
    - **0.11 arcsec = 1100 AU at 10 kpc**
  - Confusion limited observations of Galactic plane in days
- Measure Structure of Galaxy
- Examine Star Forming regions on large scales and in detail at same time
- Extinction mapping of Galaxy
- Evolved Stellar Populations
- Supernova Remnants, Dust Shells, Outflows, ….

Extinction Mapping

- Color excess method, many variants using NIR J, H, K
- Resolution (~3 arcmin) and depth (A_V~ 20) limited by depth of data (2MASS)
- WFIRST has potential to resolve molecular cloud cores (0.1 pc) throughout Galaxy



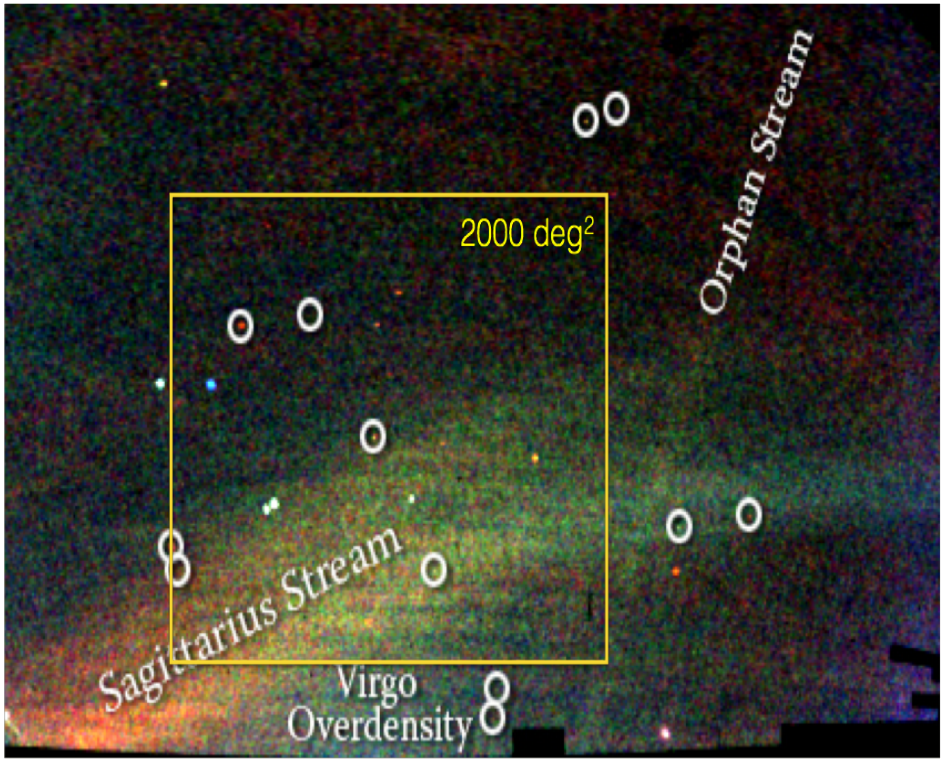
Juvela et al. (2015)

Wide Field Maps of the Milky Way Halo

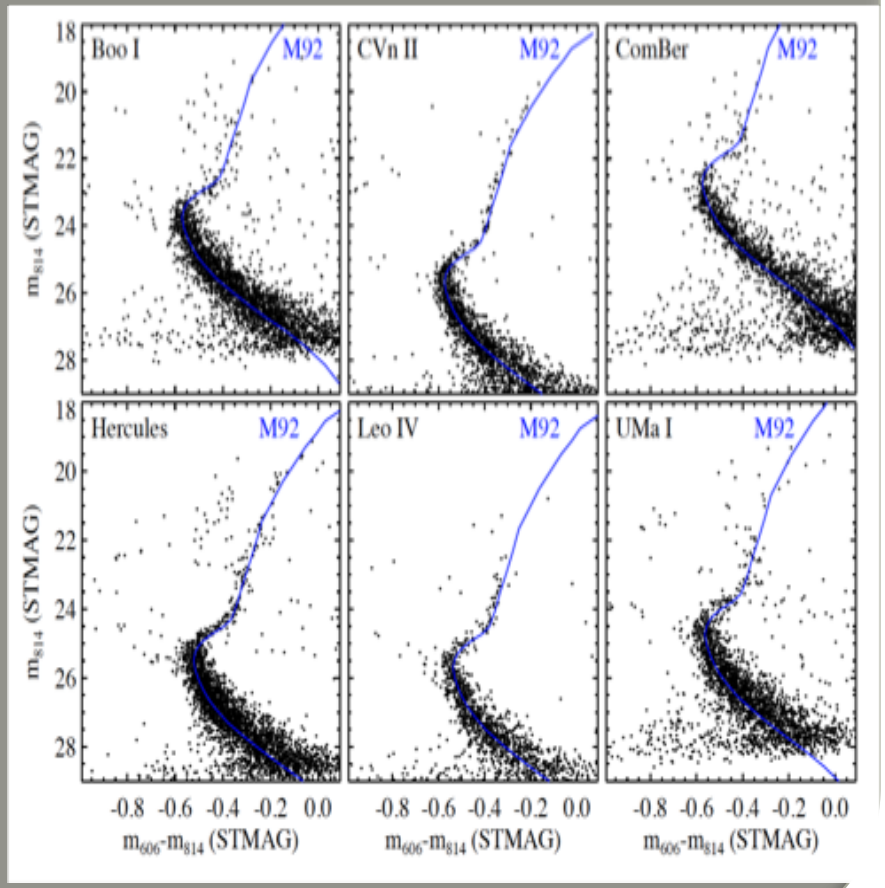
Substructure and Dwarf Galaxies

- Dramatically increase the contrast of Milky Way streams and UFDs enabling detection through the halo
  - SDSS Field of Streams detects the faintest substructure to merely 1% of the MW Volume
  - WFIRST HLS will enable structure detection throughout the full volume of the 2000 sq deg

- WFIRST is also the ideal tool to characterize the star formation histories of this pristine material



SDSS Field of Streams - Belokurov et al. (2006)

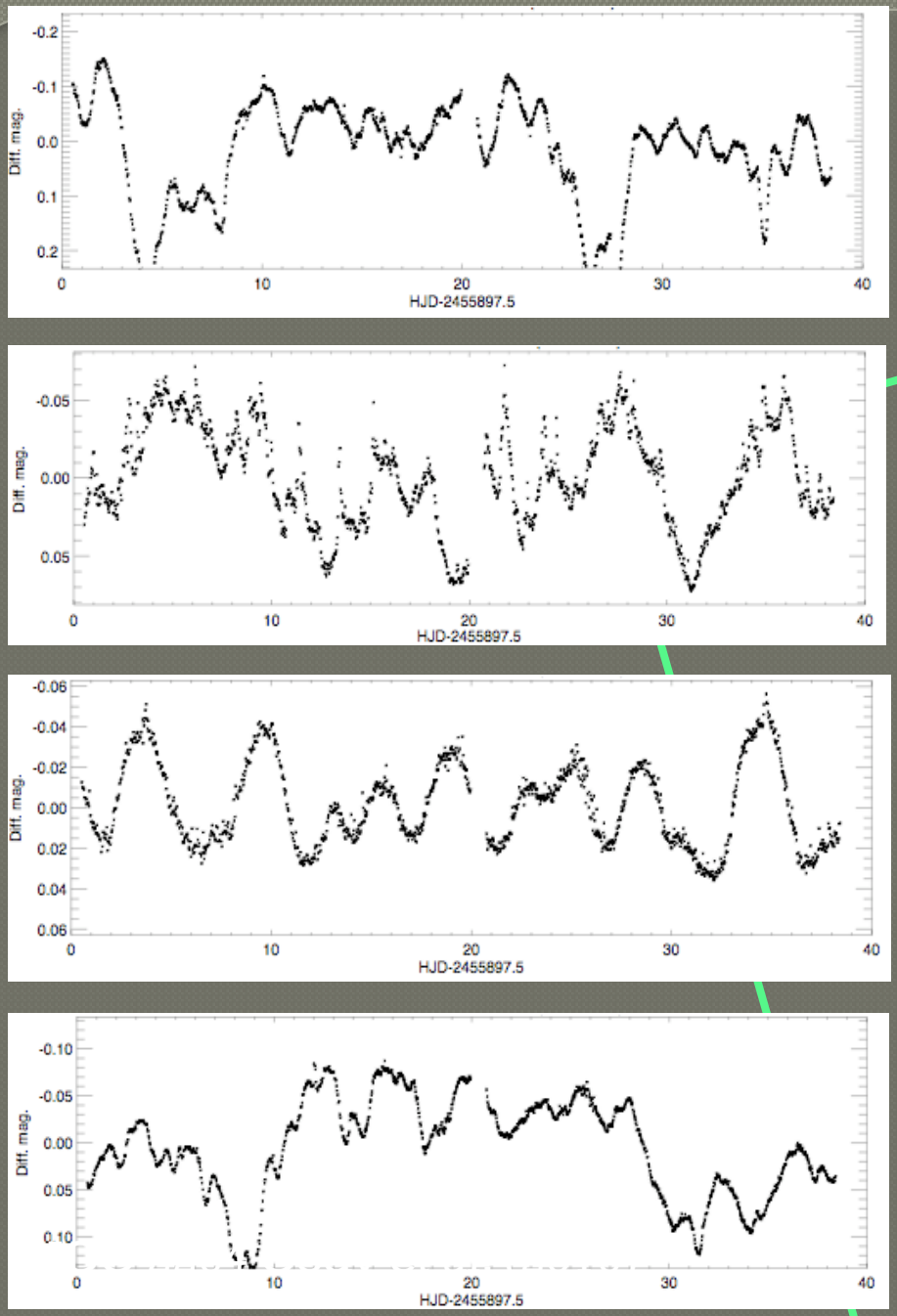


Brown et al. (2014)

Content donated by J. Kalirai

Protostellar Variability

- CoRoT, Spitzer, K2 monitoring of star forming regions have provided a wealth of high quality light curves in the visible and mid-IR
- WFIRST monitoring of star forming regions will provide considerably more information on accretion, disk structure and protostellar activity
- Trick will be being able to classify and model observed light curves


0.1 mag
Diff. mag.
HJD-2455897.5
0.1
Diff. mag.
HJD-2455897.5
0.1
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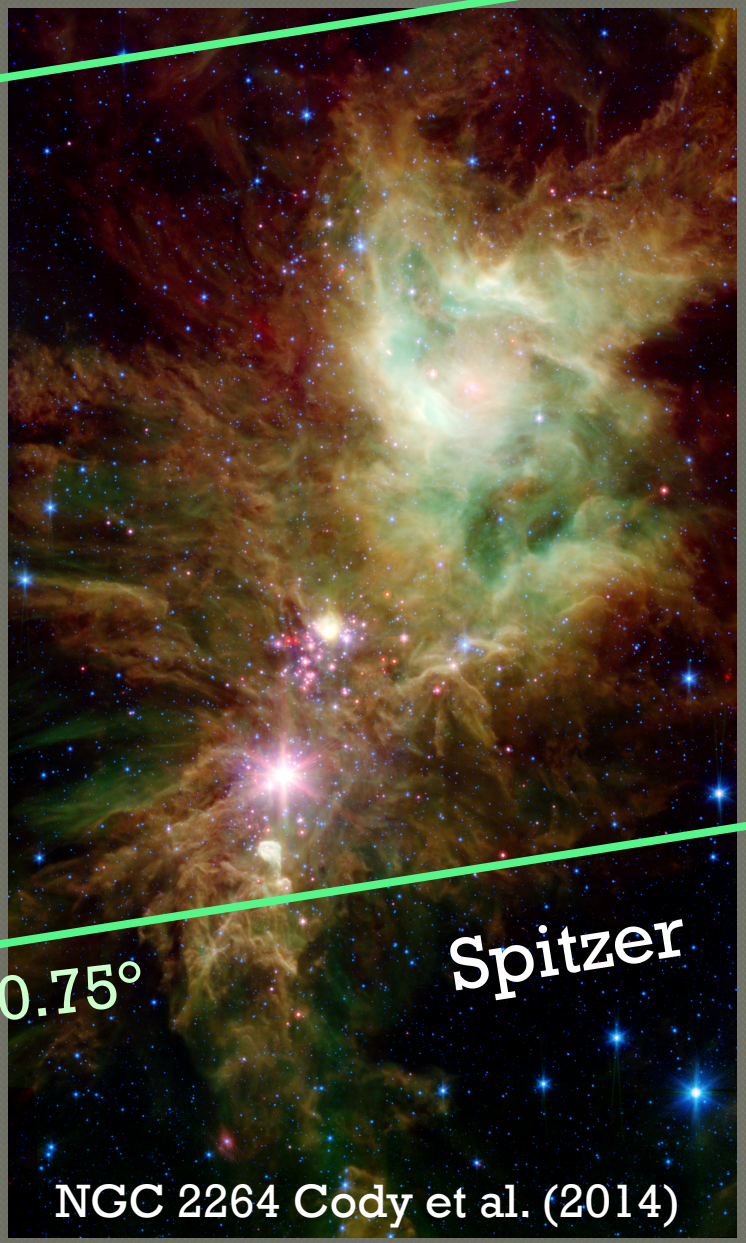
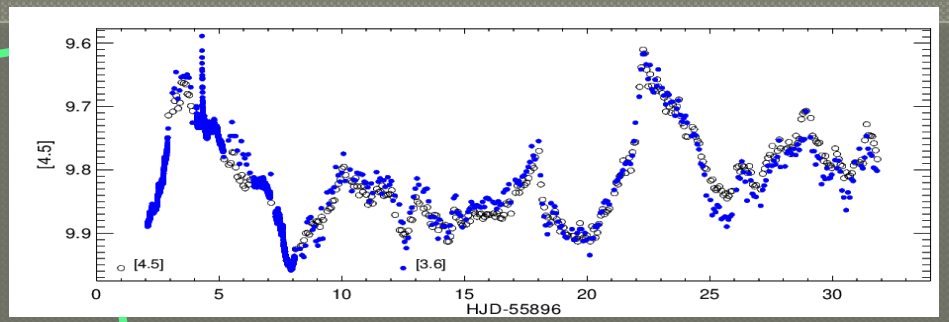
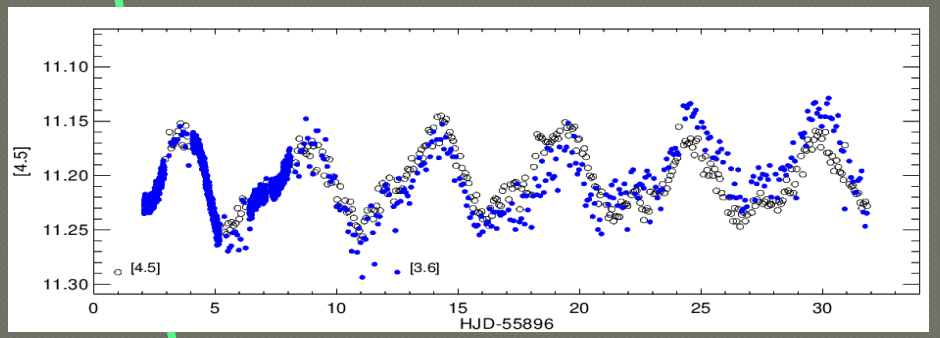
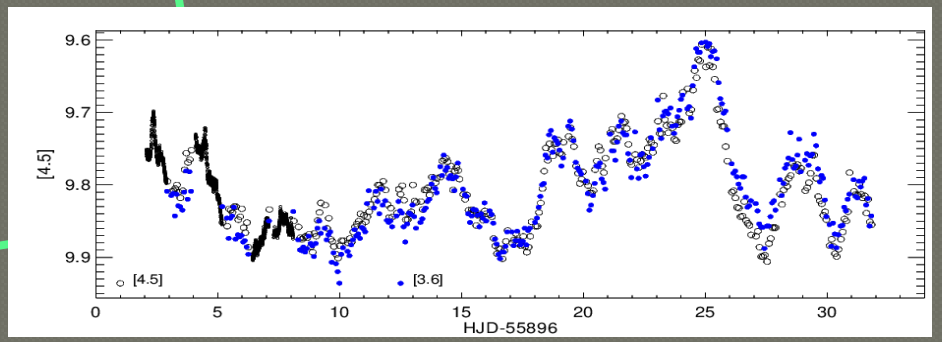
HJD-2455897.5
0.1
Diff. mag.
HJD-2455897.5
40d

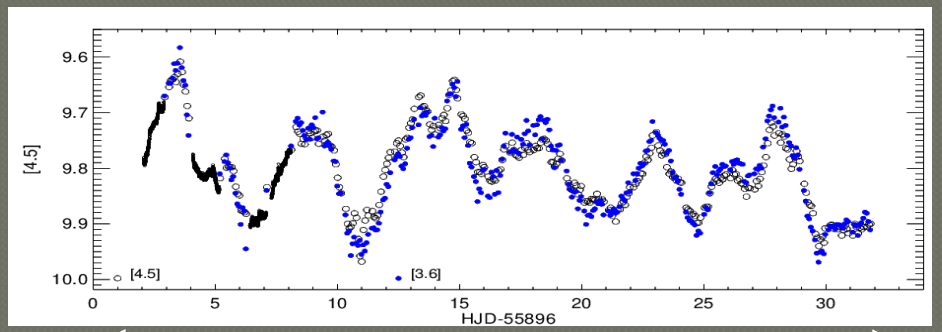

NGC 2264 Cody et al. (2014)
0.75°
CoRoT











0.1

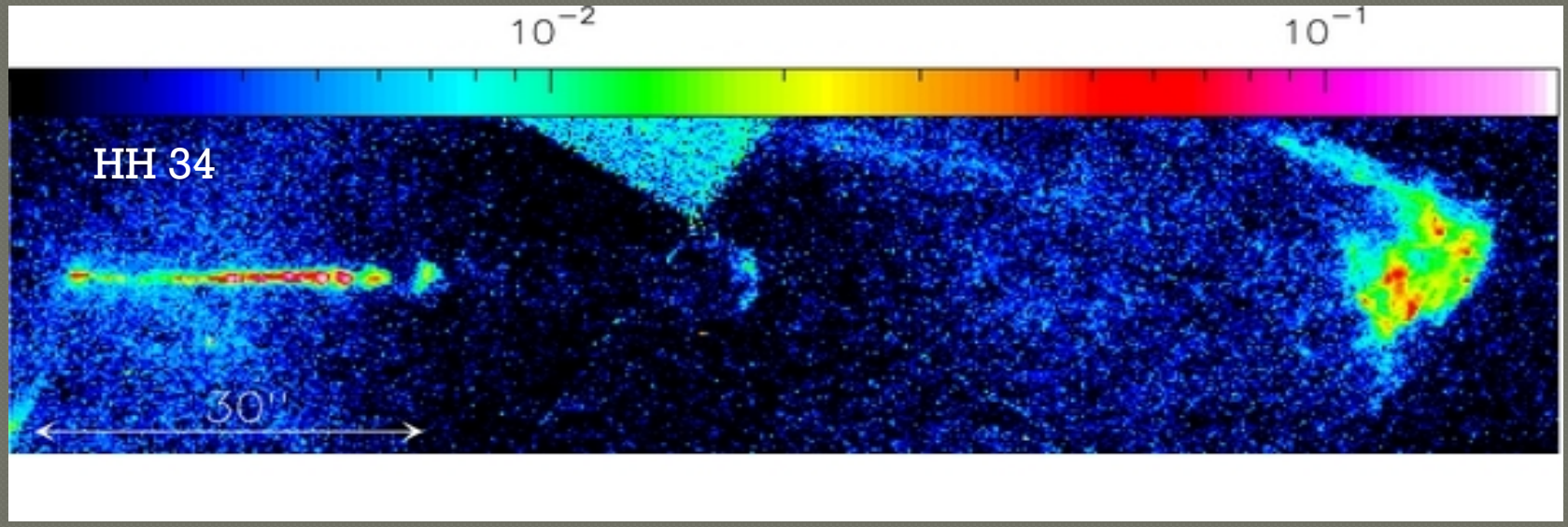
0.1

0.1

0.1

30d

Motion of HH Objects

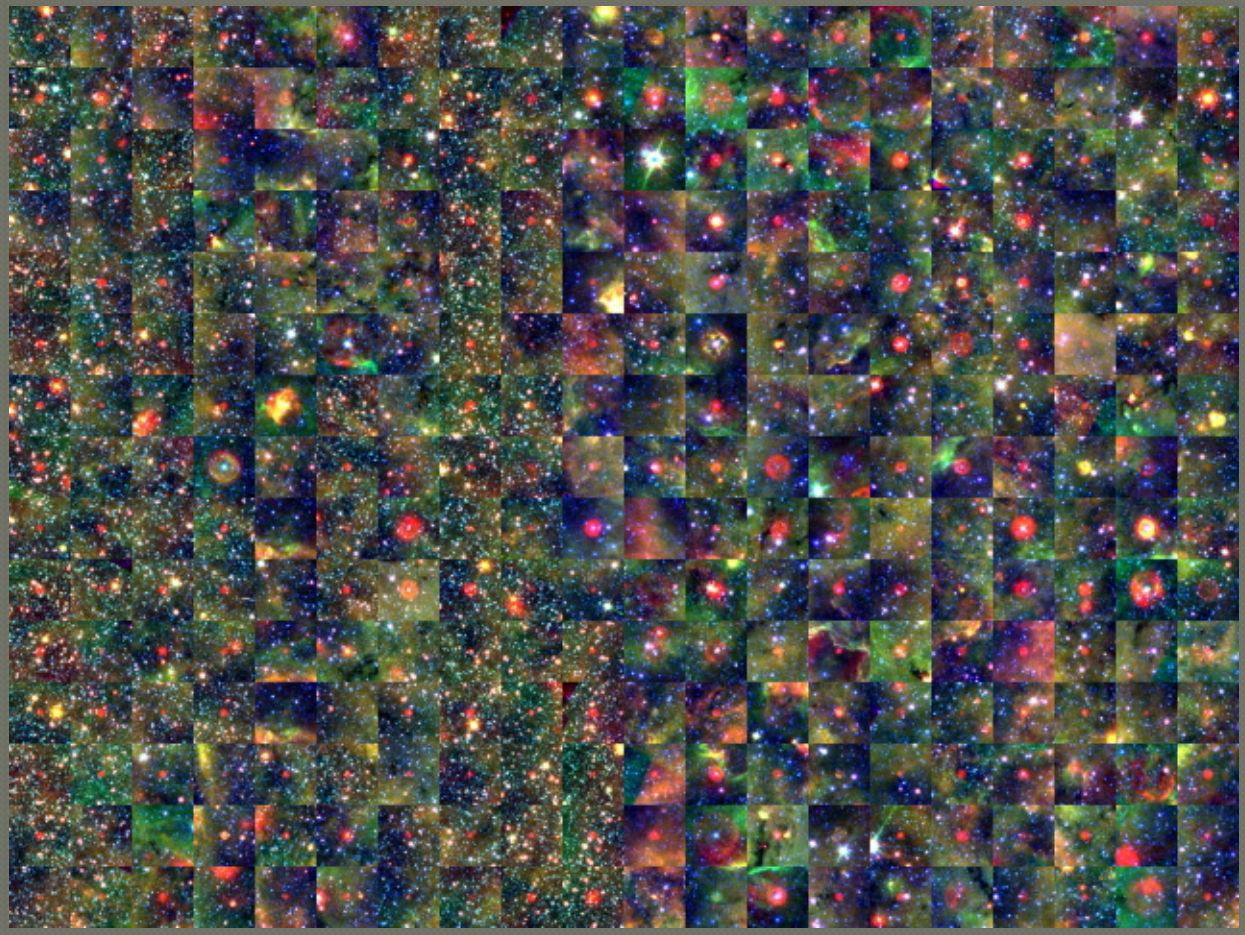


- Time history of outflows for entire star forming regions
- Identification and proper motion measurement of distant HH objects using improved astrometry of WFIRST
- Would require early epoch

Raga et al. (2012)

Serenditpity of large surveys

- MIPSGAL bubbles are one example
- Infrared dark clouds are an older example
- WFIRST will certainly increase our detailed understanding of the stellar content and evolution of the Milky Way



Montage courtesy of N. Flagey

Summary

- Lots of value in low latitude survey and extensions to high latitude surveys
  - Large areas can be mapped efficiently
- Serendipity and statistics are key
- Galactic science would benefit from both blue and red filters

Advertisement – Spitzer Beyond DDT proposals

- 2000+ hours available in three DDT calls perfect for WFIRST precursor observations
- 28 February 2017
- 12 September 2017
- 10 April 2018

Comparison with ground based surveys