SEGUE Status Report to the NSF

August 7, 2006

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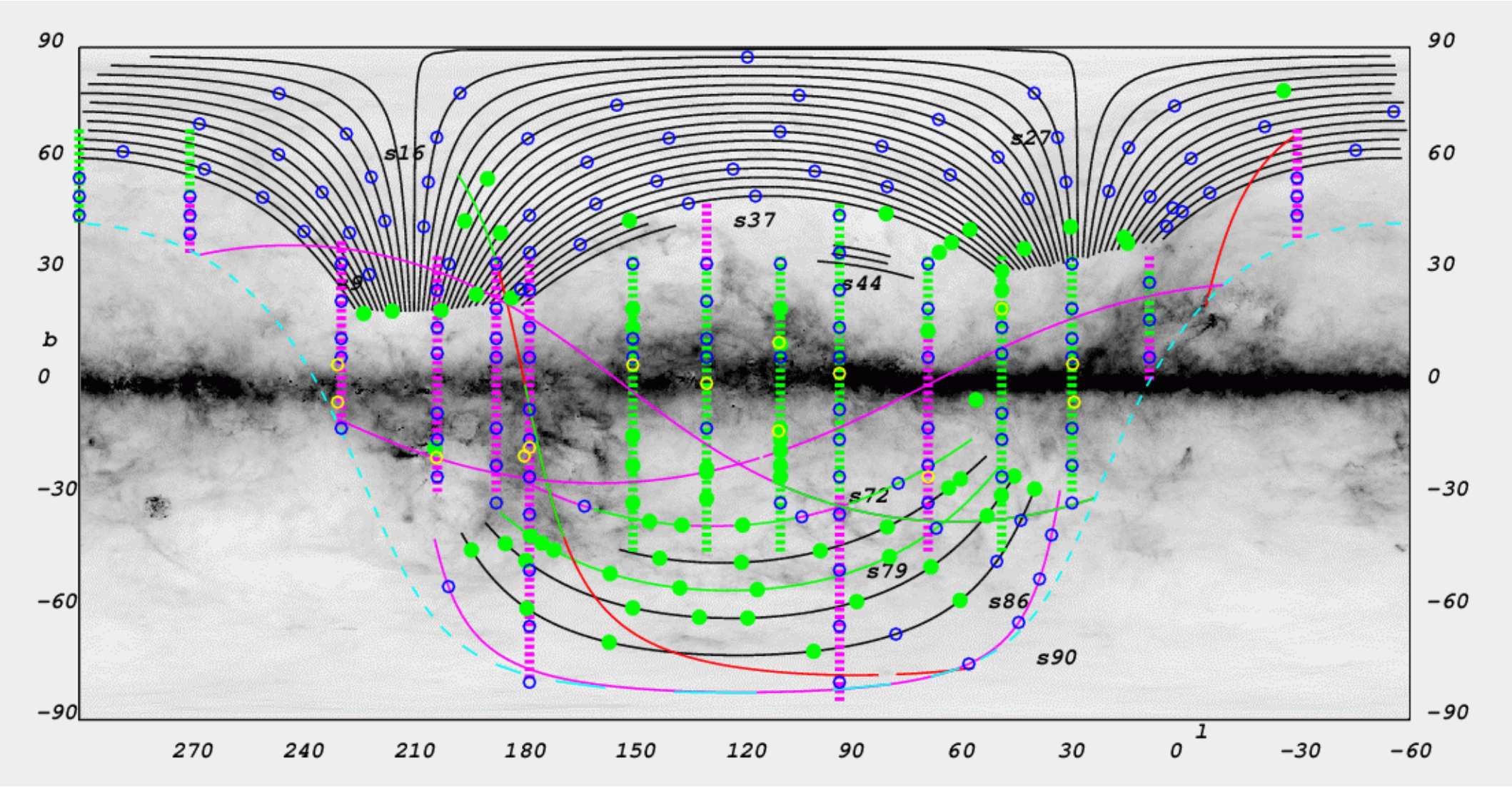
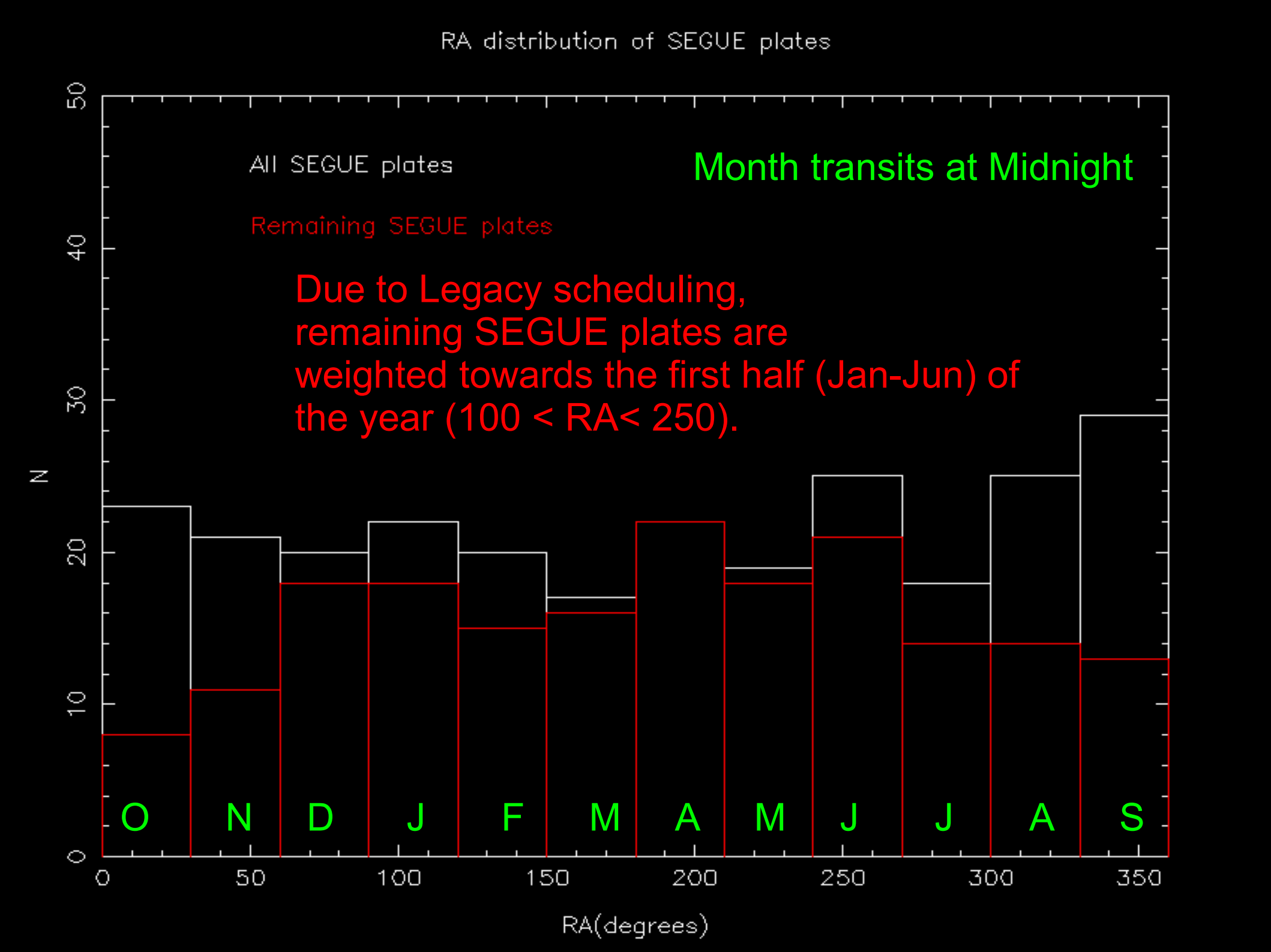
Fermilab
SEGUE co-leader

SEGUE Status as of July 15, 2006 (end of Year 1 of 3)



2271/3500 square degrees of imaging completed (64%), most remaining stripes in late South (winter observing),

146/400 plates completed (36%), more remaining tiles in North (spring observing).


RA distribution of SEGUE plates
All SEGUE plates
Remaining SEGUE plates
Month transits at Midnight
Due to Legacy scheduling,
remaining SEGUE plates are
weighted towards the first half (Jan-Jun) of
the year (100 < RA< 250).
N
0
10
20
30
40
50
0
50
100
150
200
250
300
350
RA(degrees)
O
N
D
J
F
M
A
M
J
J
A
S

SEGUE observing status at end of year 1:

2271/3500 square degrees of imaging completed (64%)

146/400 plates completed (36%), including over 7,000 BHB spectra, 24,000 G spectra, 15,000 F-turnoff stars, and over 1,000 K giants.

With over 33% of the imaging and spectroscopy complete, we are on track to meet the program baseline in the 3 scheduled years.

Status of development work for SEGUE:

- Spectro 2d pipeline upgrade
- Stellar parameter pipeline
- Photometric and spectroscopic calibration efforts
- Crowded,reddened field target selection and low-|b| photometry
- SEGUE database population and distribution

Spectro 2d pipeline upgrade (C. Loomis at Princeton heads effort):

Goals:

Improve sky subtraction in red (Ca triplet),
and spectrophotometric flux calibration in blue (better EqW. measures of Ca K, H-delta, et al.).

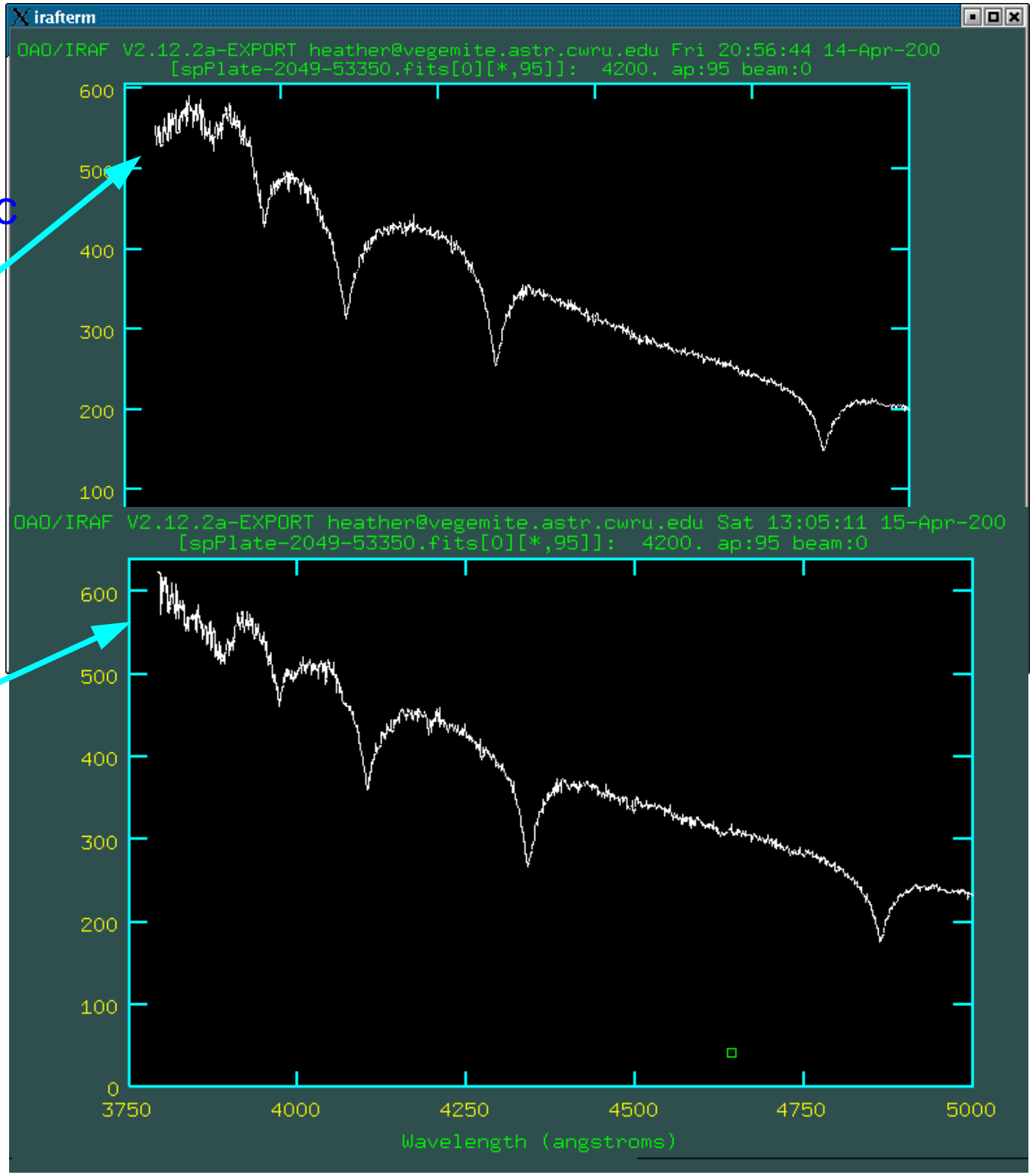
Improve zeropoints of radial velocity templates across all spectral types.

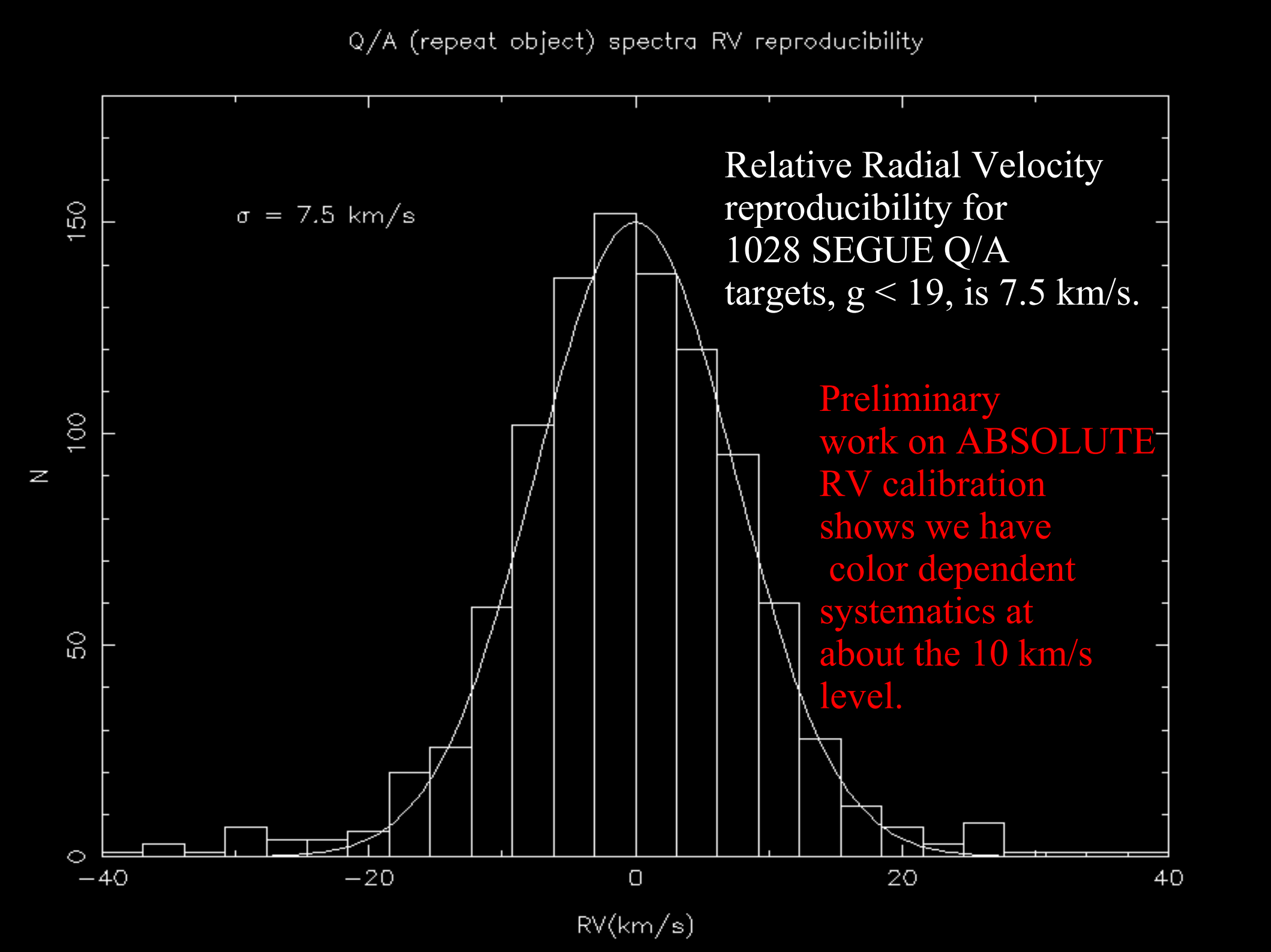
Status: Sky subtraction work completed, tested at Princeton.
Zeropoint work underway, futher refinement needed.

Next: Need Pipeline operational by this fall to facilitate reprocessing of all SEGUE spectra for DR6 release in July 2007 (this step has a long lead time of several months).

Old: Spectro v4 has spectrophotometric normalization problem at the very blue end (note rollover).

New: Corrected in spectro v5.




Q/A (repeat object) spectra RV reproducibility
σ = 7.5 km/s
Relative Radial Velocity reproducibility for 1028 SEGUE Q/A targets, g < 19, is 7.5 km/s.
Preliminary work on ABSOLUTE RV calibration shows we have color dependent systematics at about the 10 km/s level.
N
0
50
100
150
−40
−20
0
20
40
RV(km/s)

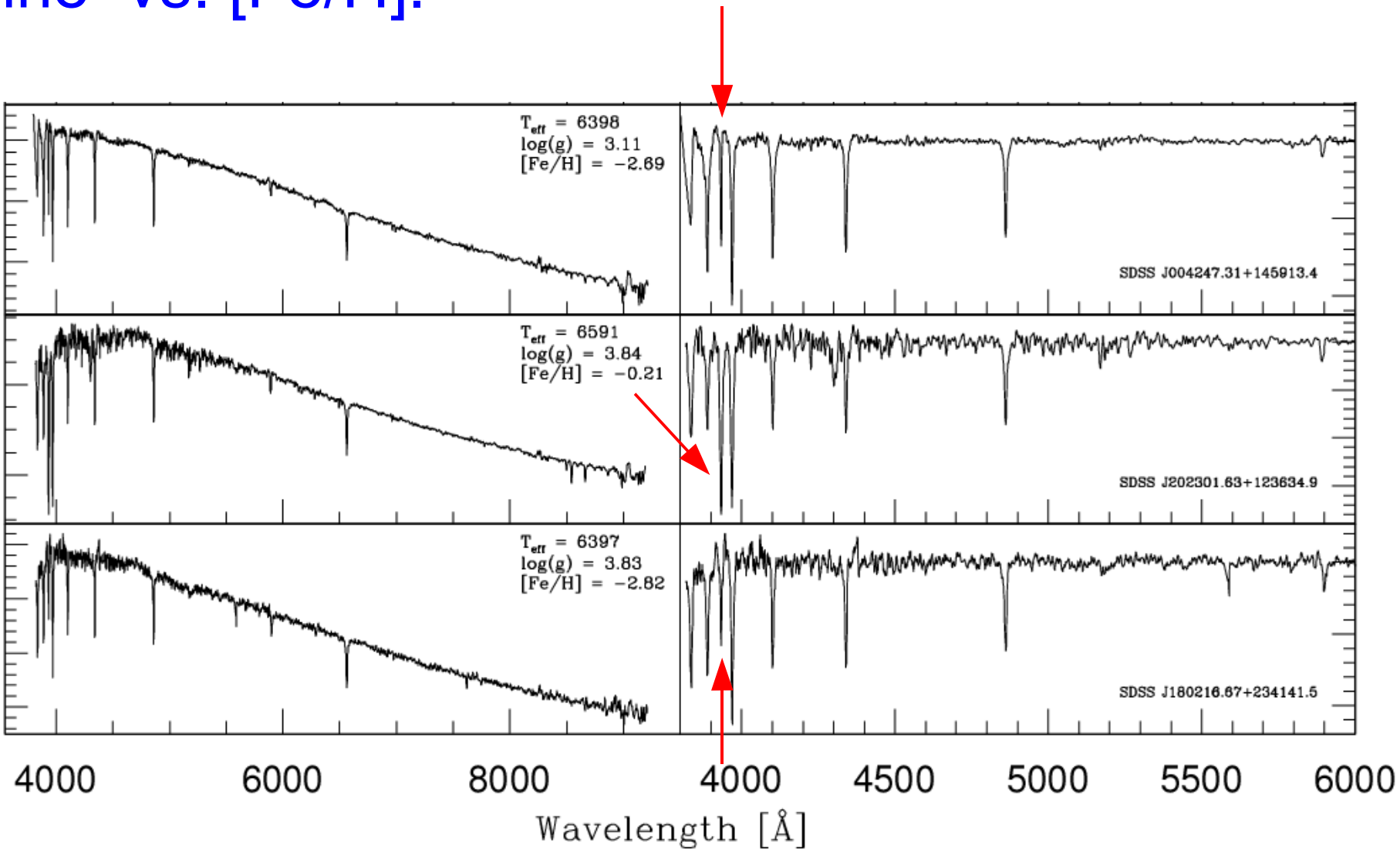
Stellar Parameter Pipeline (T. Beers of MSU heads effort, with Y. S. Lee, S. Thirupathi (MSU), C. Allende (UT), R. Wilhelm (TT):

Goal: Automate determination of [Fe/H], log g, Teff, for all SEGUE spectra. (Enhanced goal: [alpha/Fe] measures, individual elemental abundances, rare element abundances).

Status: First version (v1_0) of Pipeline is checked in to Code Repository (CVS) at FNAL. Testing underway.
Application: Pipeline being used to create Value Added Catalog of stellar parameters for SDSS-I stars.
Application: Used to identify [Fe/H] < -3 stars in Milky Way halo.
Application: determine carbon enhanced star frequency,
Application: search for evidence of abundance gradient in halo.

Next: In preparation for DR6, this version must be run independently (not by authors) at FNAL, be documented with outputs vetted and inserted into database.

Three F-type turnoff stars from SEGUE data, analyzed with the stellar parameter pipeline (SPP). Note the correlation of depth of Ca K (3933) line vs. [Fe/H].



Photometric calibration and spectroscopic <<-->> photometric tie in effort: (D. Tucker, FNAL, J. Johnson, OSU, H. Morrison, CWRU lead)

Goals:

Determine ugriz <---> u'g'r'i'z' <---> UBVRI filter transforms to 2% accuracy, esp. for Giant Branches of known globulars, (J. A. Smith, APSU, TN, and J. Clem, LSU external participants).

Determine feasibility of using u-g, g-r, r-i photometric colors as 'photometric metalicity' and 'photometric luminosity' classifiers. If possible, allows stellar population work to extend from SEGUE sample of 240,000 spectra to much larger (N > 10^7) SDSS stellar imaging catalog.

Status: Photometry (USNO, PT) and Hi-res spectroscopy (HET, Keck) for many faint stars (g > 15) obtained at numerous other telescopes, data being analyzed.

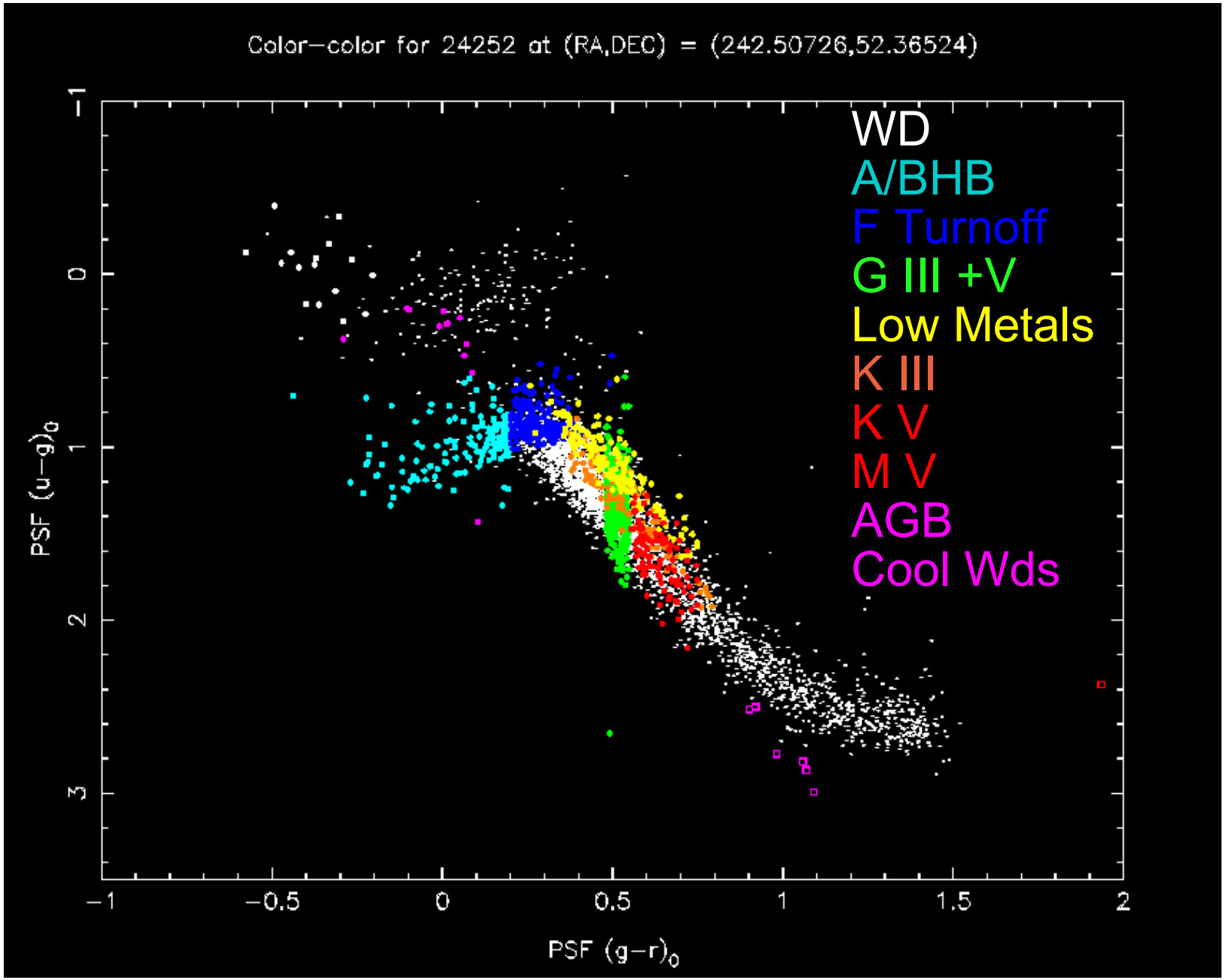
Next: Assemble data, match to existing SEGUE data, derive transforms. Will evolve beyond DR6.

Crowded, reddened target selection and processing of low-latitude (|b| < 20 degrees), crowded field regions

(Robert Lupton (Princeton), Jennifer Johnson (OSU), V. Smolcic (MPH), P. Harding (CWRU) are co-investigators).

Status of Target selection: Low-latitude algorithm signed off on by collab at Santa Fe meeting (Mar 2006). Basically: because of reddening uncertainties, low-lat algorithm reduces number of targeting categories from 12 to 3 (blue objects, K-M giants, and high-proper motion objects).
About 6 plates obtained on-sky with this algorithm, currently being analyzed.

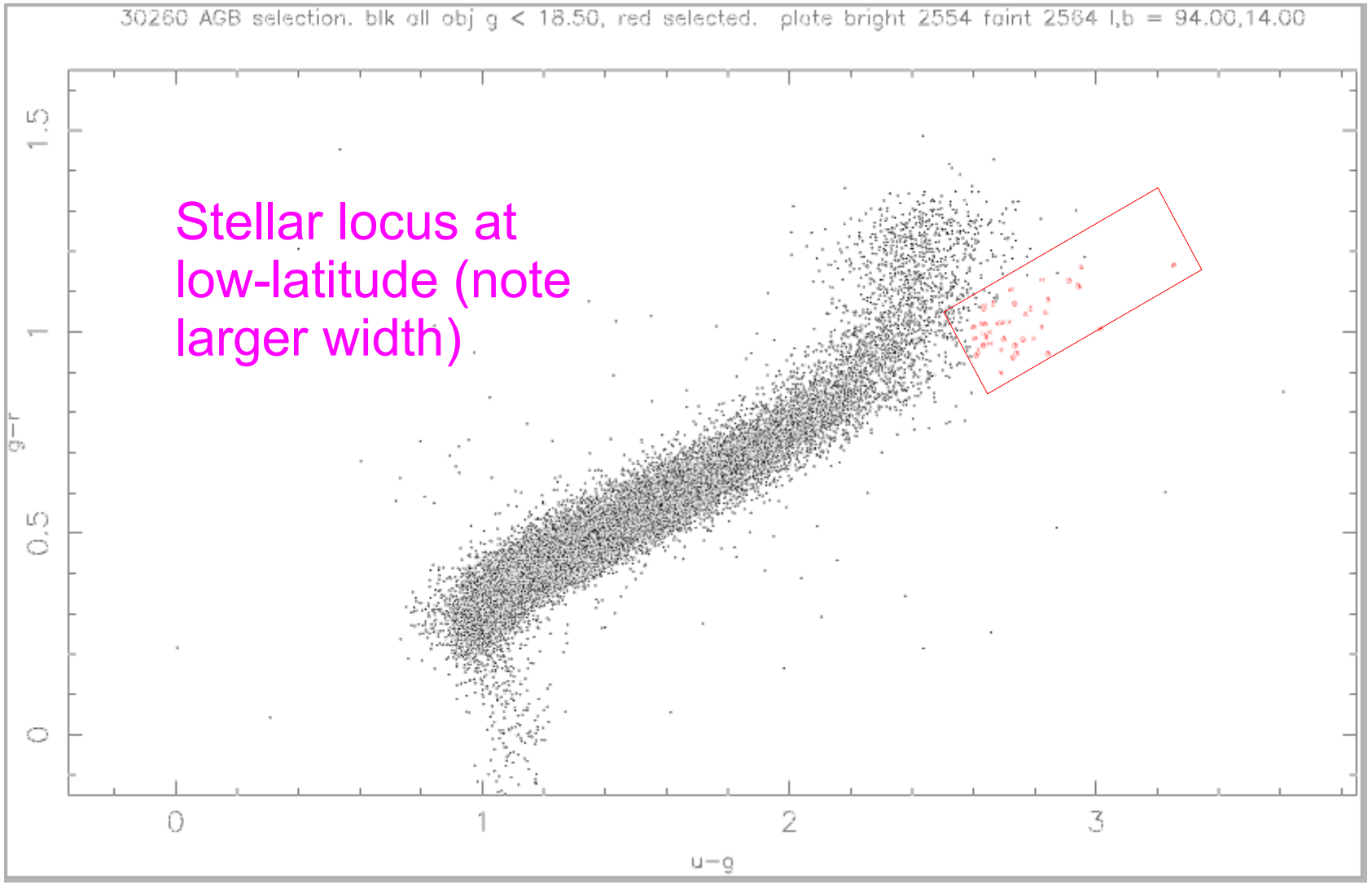
Status of Crowded field photometry: Parallel efforts to process crowded fields with DAOPHOT, doPhot, PanStarrs codes, and match zeropoints onto photo (default SDSS code) in uncrowded realms. Will not be complete for DR6, but on-going effort through 2008. Hooks being inserted into database.



This Target Selection algorithm at $|b| > 20$ is done, and won't change for remainder of survey.

SEGUE high-lat currently has 12 categories, (not shown are Proper motion selected sdMs and Brown Dwarfs).

One of three low-latitude selection areas: The AGB/M-giant box.



Database population and data distribution

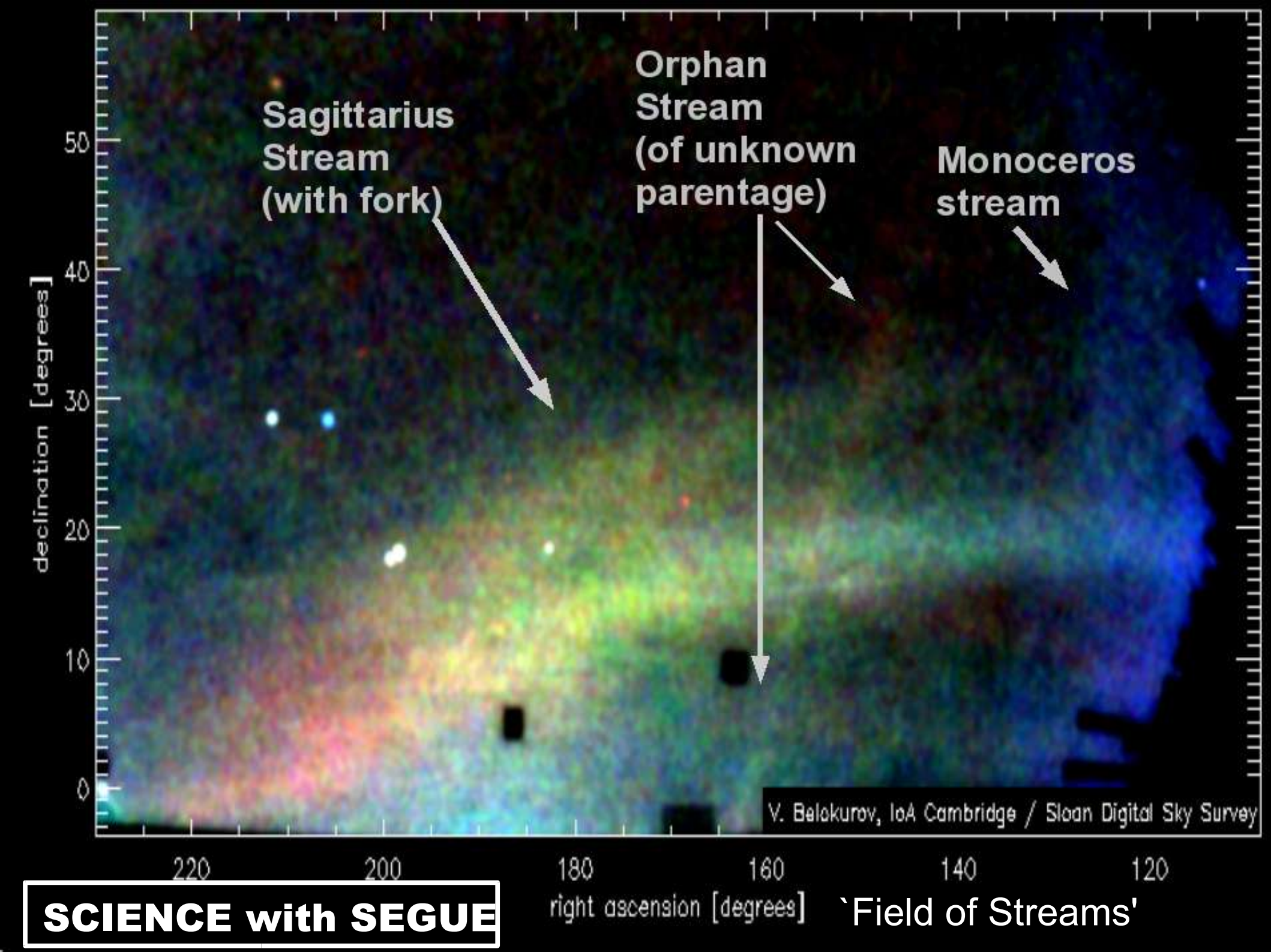
(Heads: Yanny, FNAL, Ani Thakar, JHU)

Status: Data model changes defined and signed off on in meetings; Change requests filed; code changes in progress.

Early SEGUE plates (obtained under SDSS-I), have been included in DR5 data release, as is, i.e. without any extra stellar parameters such as [Fe/H], log g, etc.

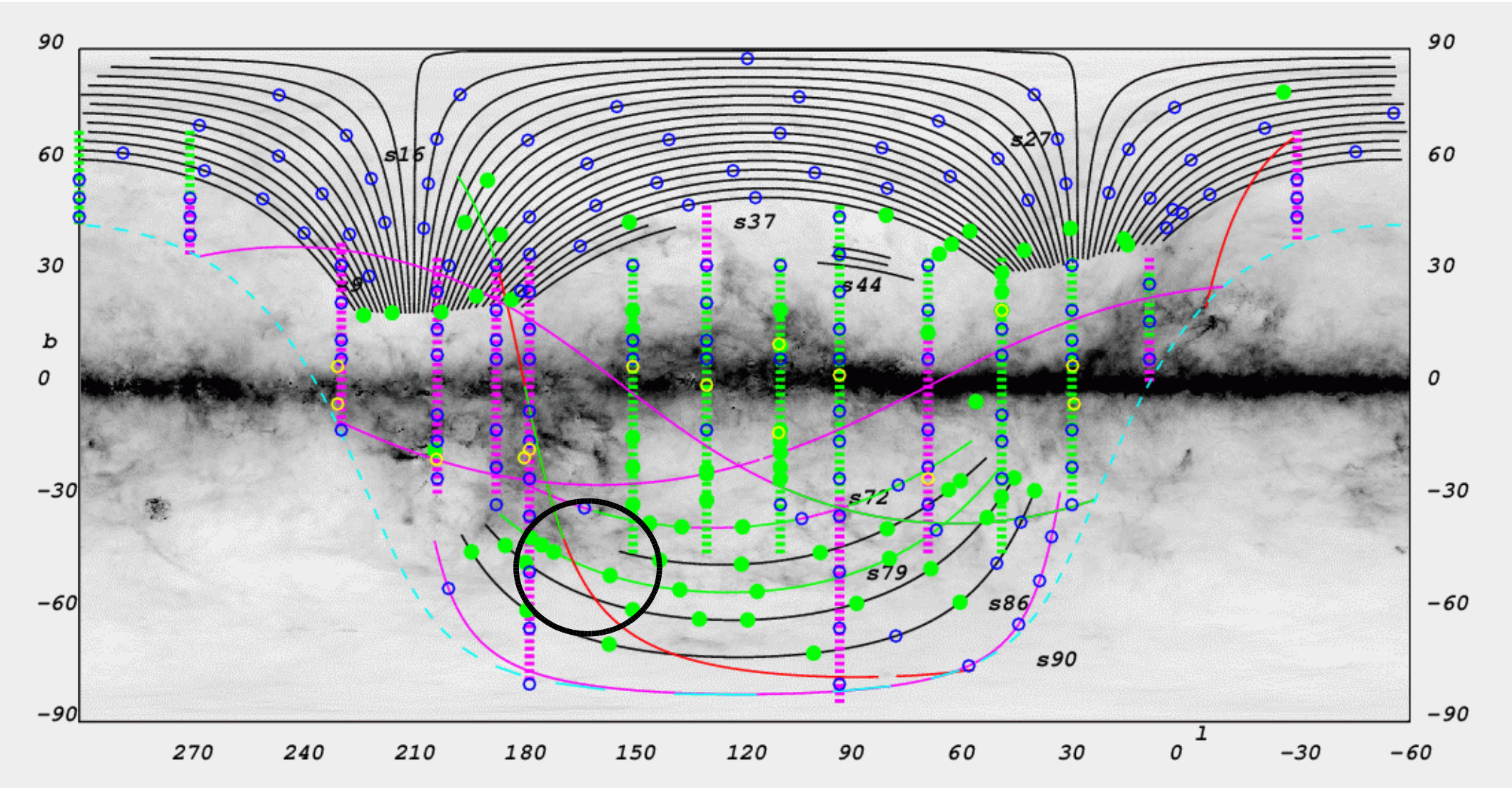
Next: Need progress on Data model changes by early fall 2006 to meet DR6 deadline, as this is a long lead time item.

Next: Some early SEGUE science....



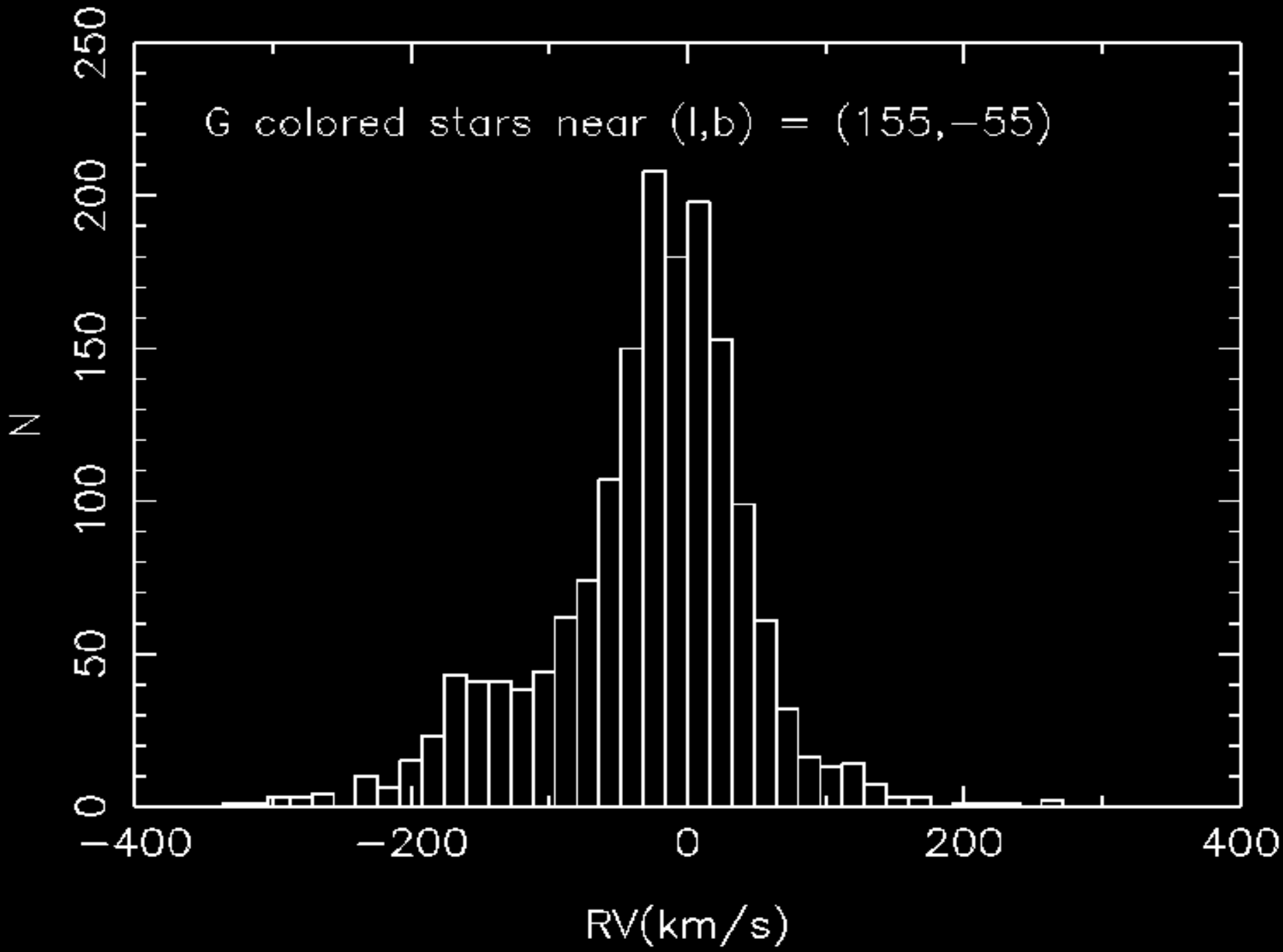
SCIENCE with SEGUE

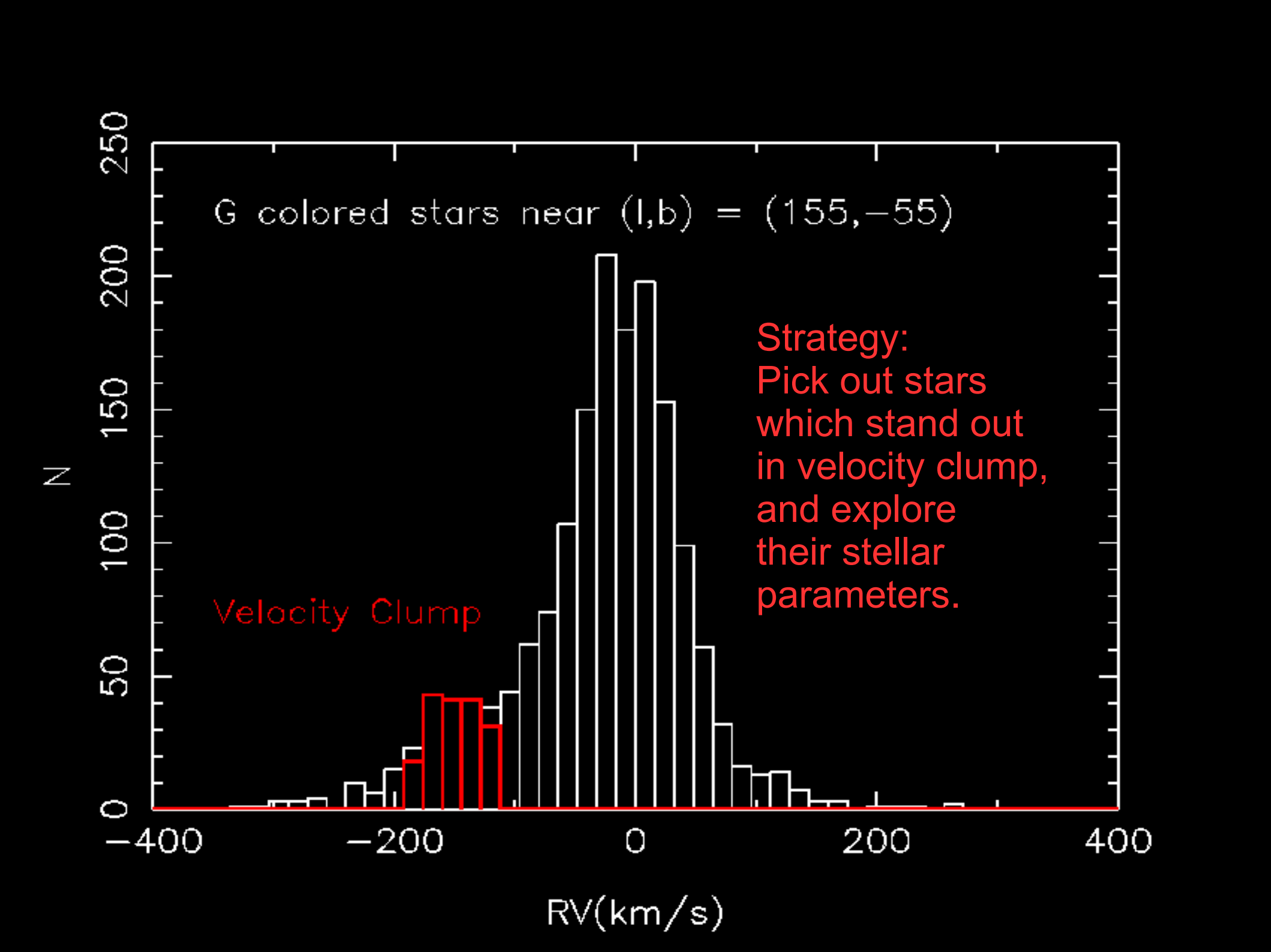
`Field of Streams'

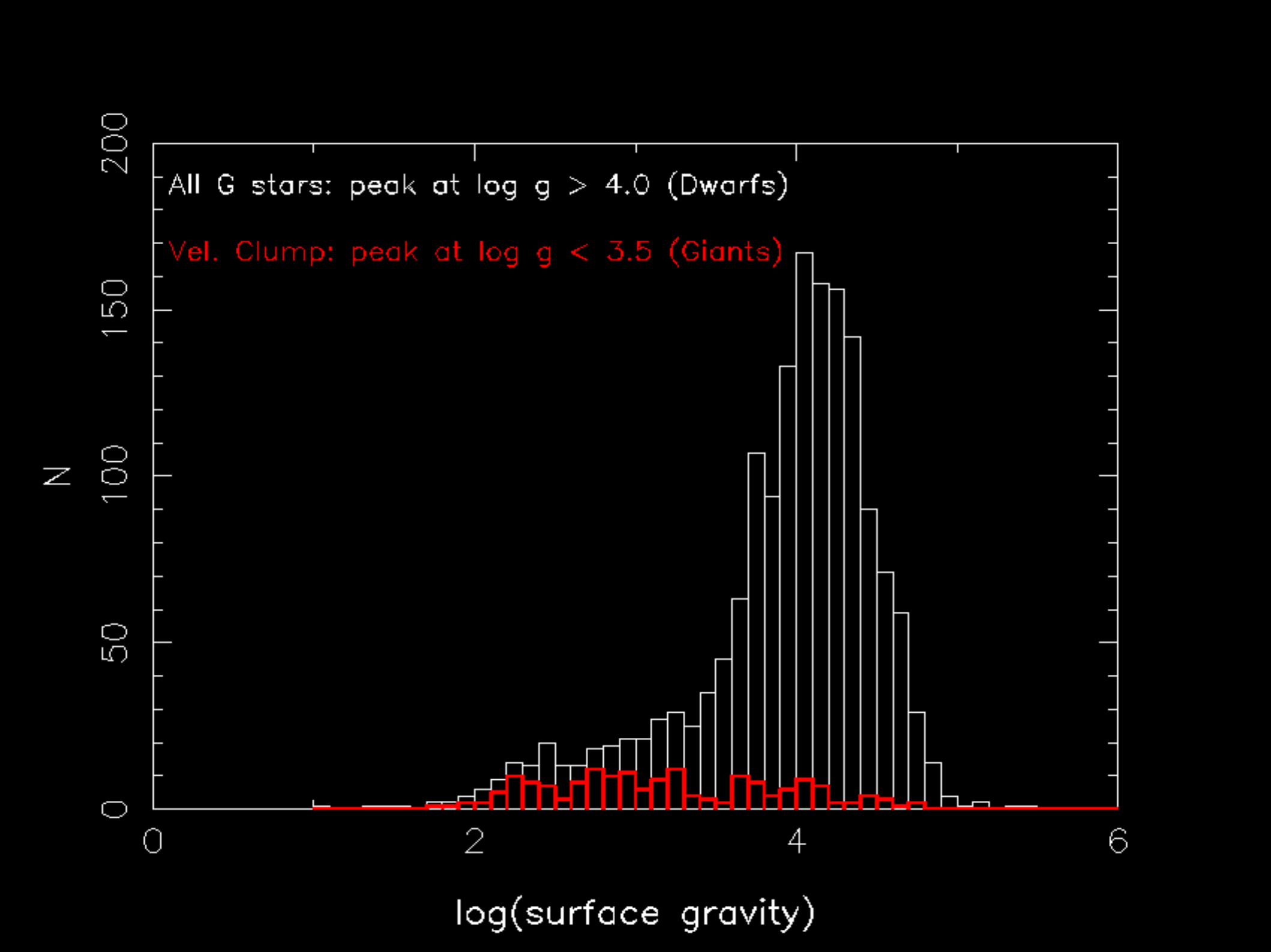


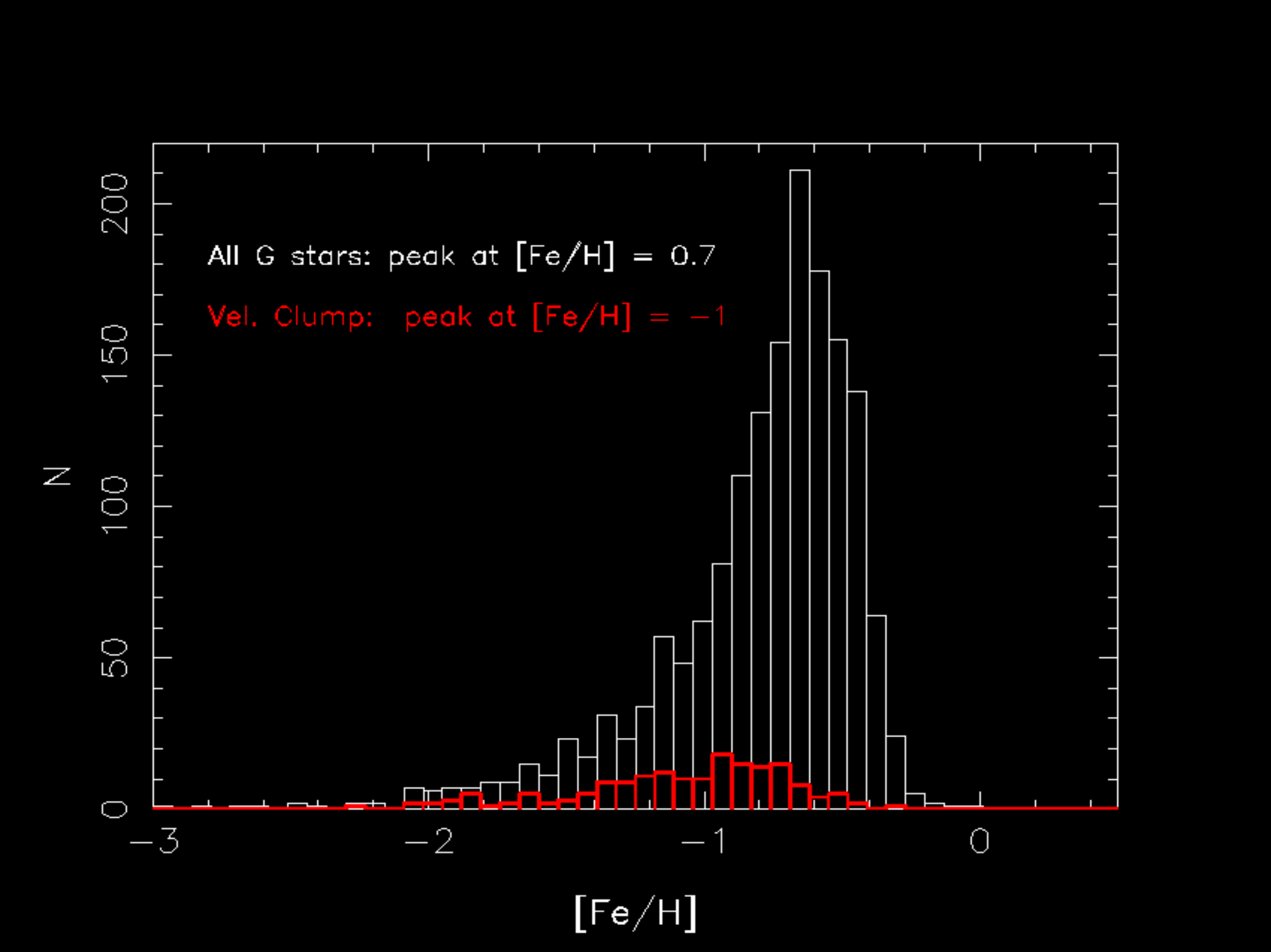
Select all G-colored stars (0.45 < g-r < 0.55) from SEGUE plates in this area of sky, within 10 degrees of Sag. Dwarf tidal stream crossing. Explore the stellar populations in vicinity of a stream....

Heliocentric Radial Velocity distribution

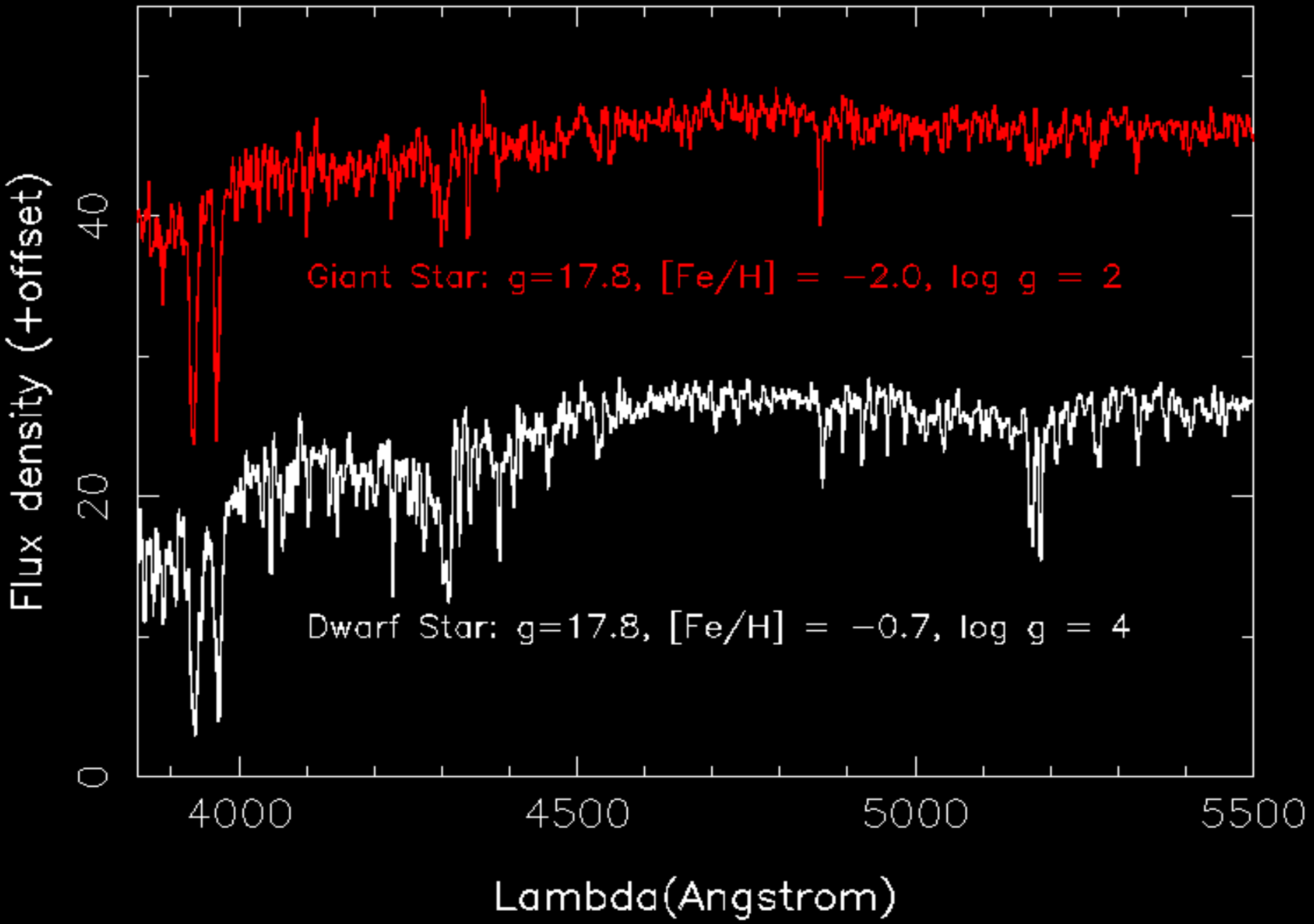



G colored stars near (l,b) = (155,−55)
Velocity Clump
Strategy:
Pick out stars
which stand out
in velocity clump,
and explore
their stellar
parameters.
N
0
50
100
150
200
250
−400
−200
0
200
400
RV(km/s)


All G stars: peak at log g > 4.0 (Dwarfs)
Vel. Clump: peak at log g < 3.5 (Giants)
N
0
50
100
150
200
0
2
4
6
log(surface gravity)


All G stars: peak at [Fe/H] = 0.7
Vel. Clump: peak at [Fe/H] = −1
N
0
50
100
150
200
−3
−2
−1
0
[Fe/H]

Two stars with nearly identical photometry may be separated spectroscopically: One is a distant giant, the other a local dwarf.



The Bootes Satellite: One of about 10 new dwarf Milky Way companions (2006 Belokurov et al. astro-ph/0604355)

Very faint sparse Milky Way dwarf galaxy or disrupted cluster companion, d=45 kpc from sun.

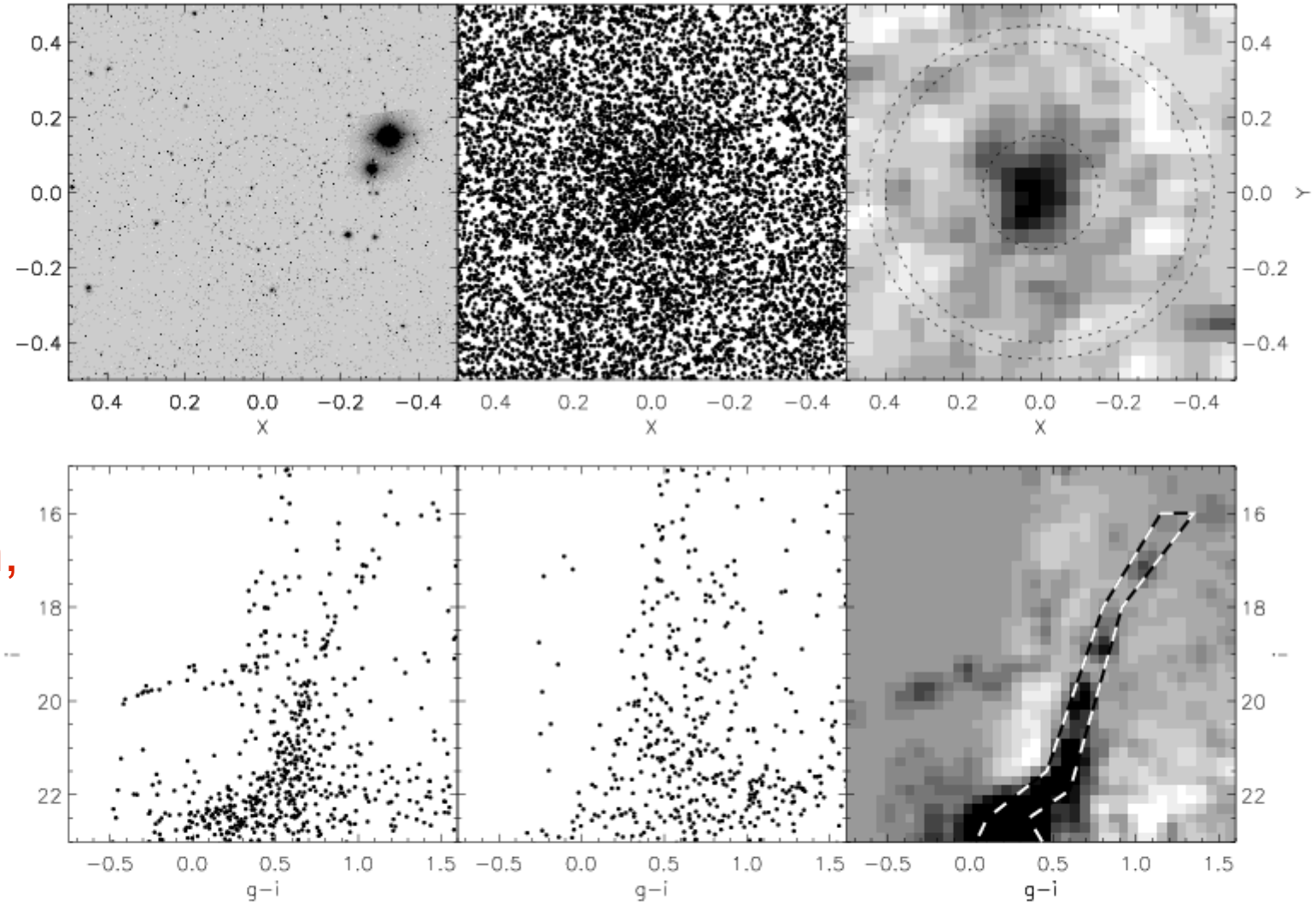
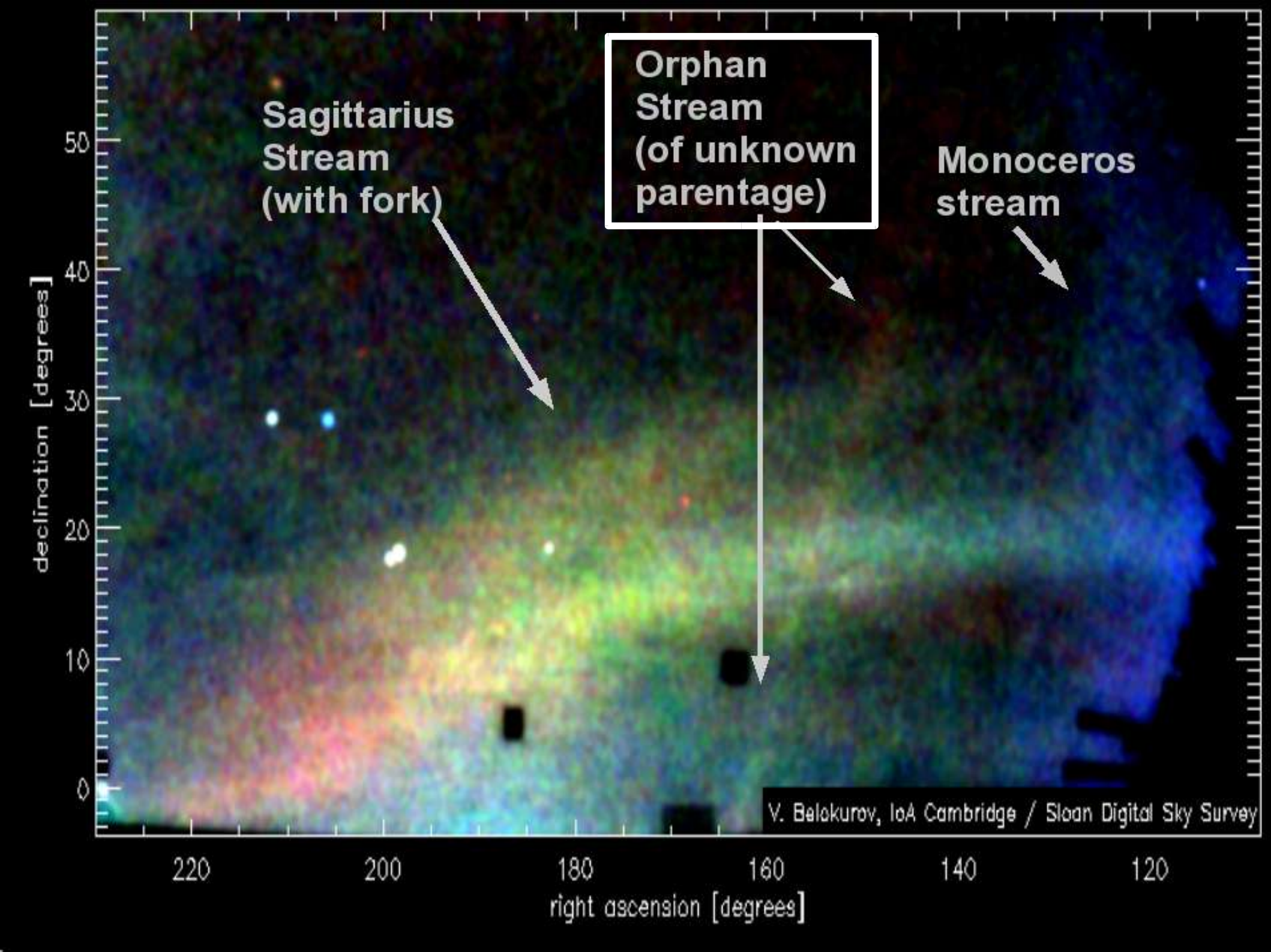
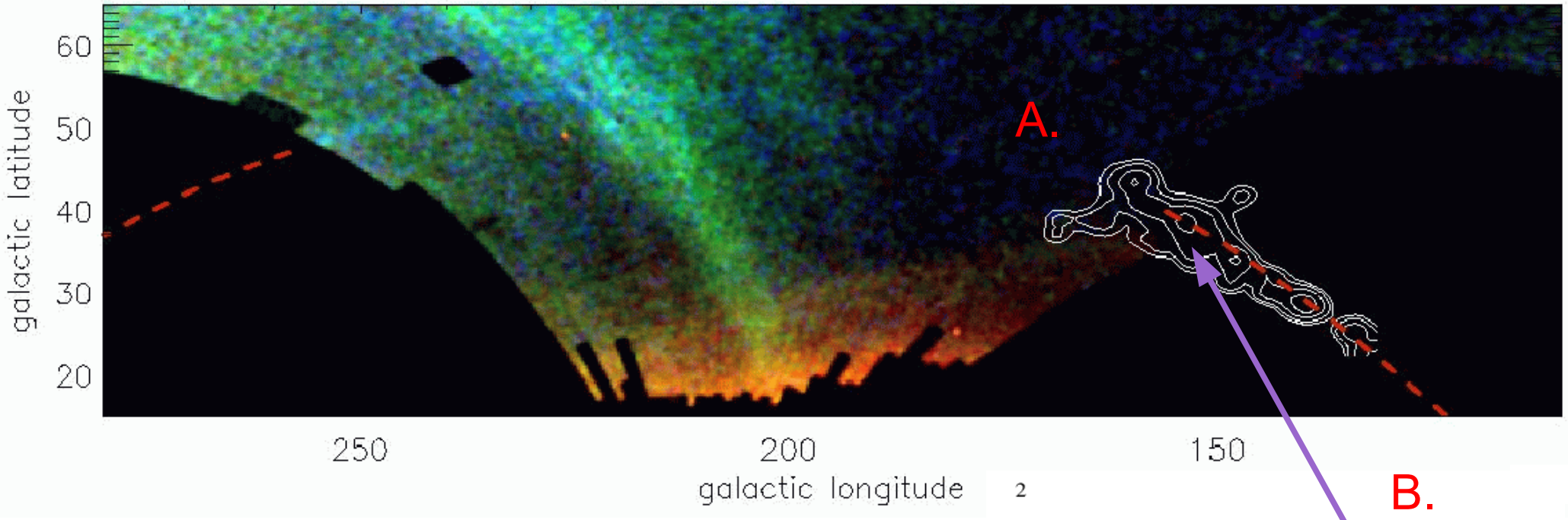


FIG. 1.— The Boötes Satellite: *Upper left:* Combined SDSS g, r, i images of a $1° \times 1°$ field centered on the overdensity. X and Y are the relative offsets in right ascension and declination, measured in arcdegrees. The dotted circle indicates a radius of 0.15°. *Upper middle:* The spatial distribution of all objects classified as stars in the same area. *Upper right:* Binned spatial density of all stellar objects. The inner dotted circle marks a radius of 0.15°, and the two outer circles have a radius of 0.4° and 0.45° respectively. Bins are $0.033° \times 0.033°$, smoothed with a Gaussian with a FWHM of 0.1°. *Lower left:* CMD of all stellar objects within the inner 0.15° radius circle. There is a clear red giant and horizontal branch, even without removal of field contamination. *Lower middle:* Control CMD, showing all stellar objects in the annulus between 0.4° and 0.45° of the center. *Lower right:* A color-magnitude density plot (Hess diagram), showing the inner CMD minus the control CMD, normalized to the number of stars in each CMD. A mask is shown around the satellite's sequence.


Sagittarius
Stream
(with fork)
Orphan
Stream
(of unknown
parentage)
Monoceros
stream
declination [degrees]
50
40
30
20
10
0
220
200
180
160
140
120
right ascension [degrees]
V. Belokurov, IoA Cambridge / Sloan Digital Sky Survey

Belokurov et al. AN ORPHAN IN THE FIELD OF STREAMS astro-ph/0605705



New Connections made with SDSS-II:

A: Orphan Stream on same orbit as HI High Velocity clouds!

B: UMa-II dwarf (d=30 kpc) has same line of sight as High Velocity cloud complex A!

Zucker et al. astro-ph/0606633:

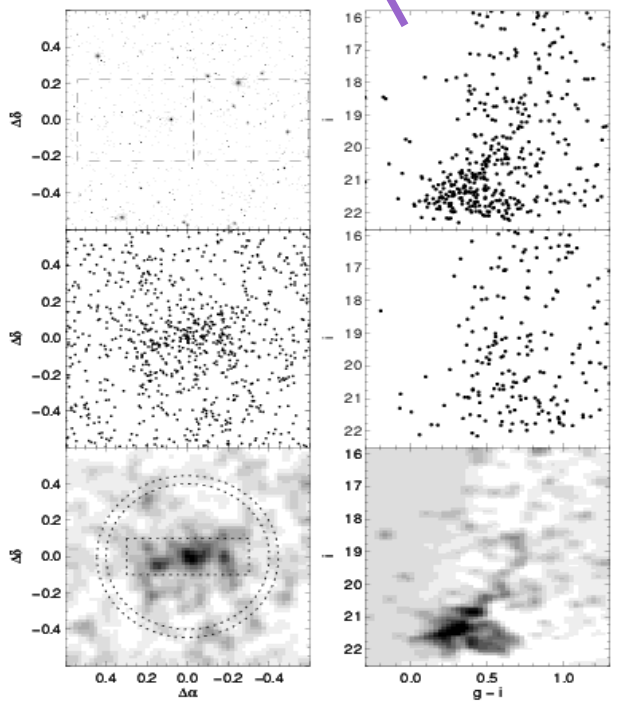


FIG. 1.— The UMa II Dwarf as seen by SDSS: *Upper left:* Combined SDSS

SEGUE participants and management:

Brian Yanny [Co-leader], D. Tucker+ *student (FNAL)
Connie Rockosi (UC Santa Cruz, Lick) [Co-leader]
Heidi Newberg and *student (RPI)
*J. A. Smith (Austin Peay State,TN)
Hugh Harris, Jeff Munn (USNO)
Heather Morrison, Paul Harding, and *student (CWRU)
*James Clem (LSU)
Jennifer Johnson (OSU)
Tim Beers, S. Thirupathi, Y. S. Lee (MSU)
*Carlos Allende Prieto (UTexas, Austin)
*Ron Wilhelm (Texas Tech)
Peregrine McGehee (LANL)
Kyle Cudworth, Evalyn Gates (U. Chicago)
G. Knapp, J. Gunn (Princeton)
Craig Loomis, Robert Lupton (Princeton)
Dan Zucker, G. Gilmore, V. Belokurov (Cambridge)
Eric Bell, H. W. Rix, V. Smolcic (Max Planck Heidelberg)
S. Lepine, M. Shara (Am. Museum Nat. History,NY)
M. Steinmetz, M. Schrieber (AIP, Potsdam)
Andreas Just, A. Belikov(ARI, Heidelberg)
Z. Ivezic, J. Bochanski (U Washington)
R. Wyse, A. Thakar (JHU)
E. Grebel, K. Jordi (Basel)
Steph Snedden, Kurt Anderson (APO, NMSU)

* = External Participant

Staying in contact:

Weekly phone conferences

SEGUE Meetings:

Santa Fe, NM:
Mar 25-27, 2006

Upcoming:
Seoul, South Korea:
Sep 22-24, 2006
(with SDSS-II collaboration)

Mini-meetings:

Yanny, Rockosi --> MSU (SPP)
Beers, Thirupathi, Lee --> CWRU (calib)

Summary:

While SEGUE is on track to complete its data taking during its scheduled 3 year lifetime, there is little margin for slippage in the plate rate.

The SEGUE software development is proceeding on 5 fronts; first versions of several projects should be completed this fall in order to successfully meet the DR6 deadline by mid-2007.

An early look at SEGUE science, leveraged off of the SDSS-I imaging data, shows great promise.