Observations of Suspected RR Lyrae Variable Stars

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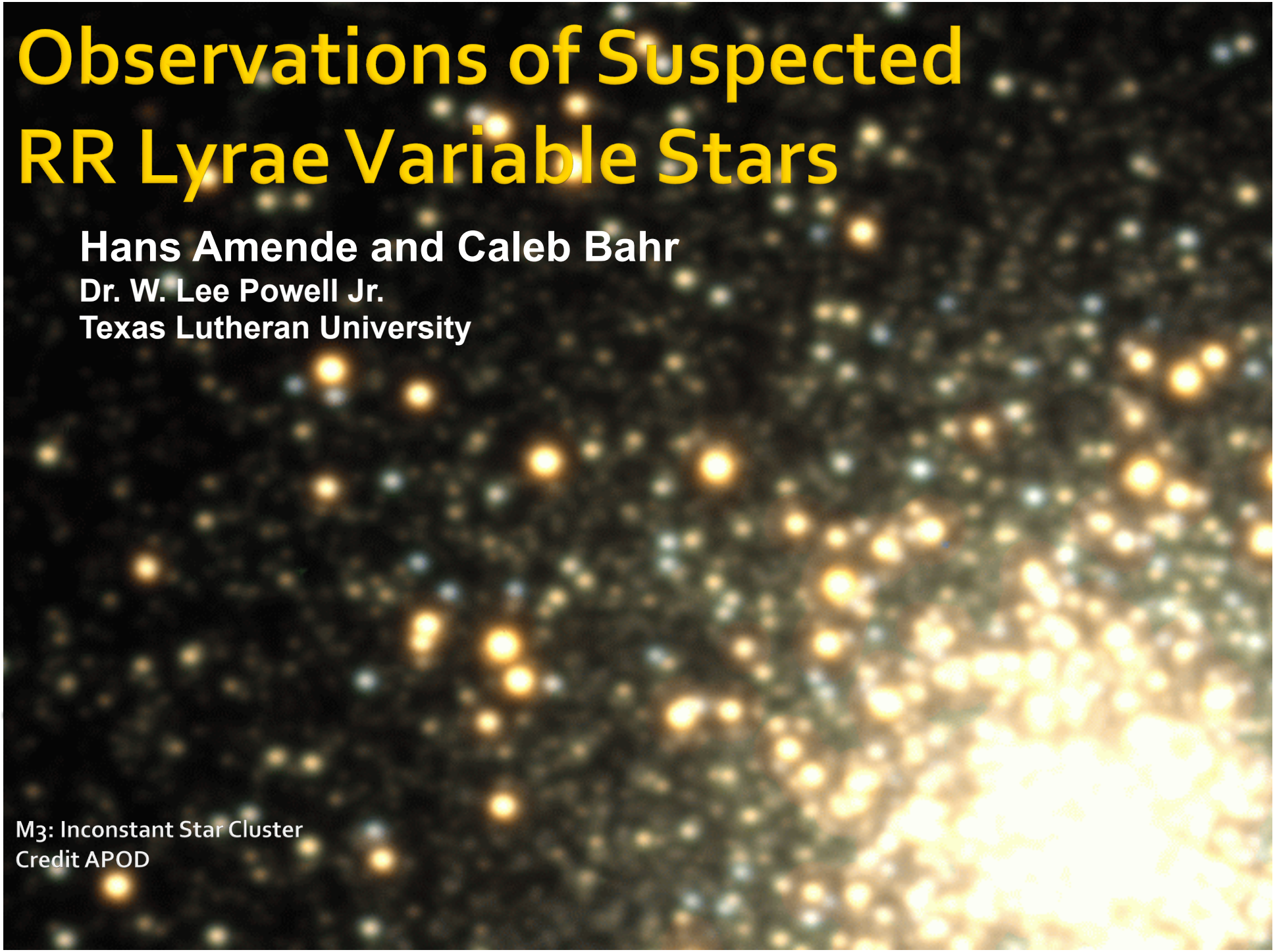


M3: Inconstant Star Cluster
Credit APOD

Why RR Lyrae Stars?

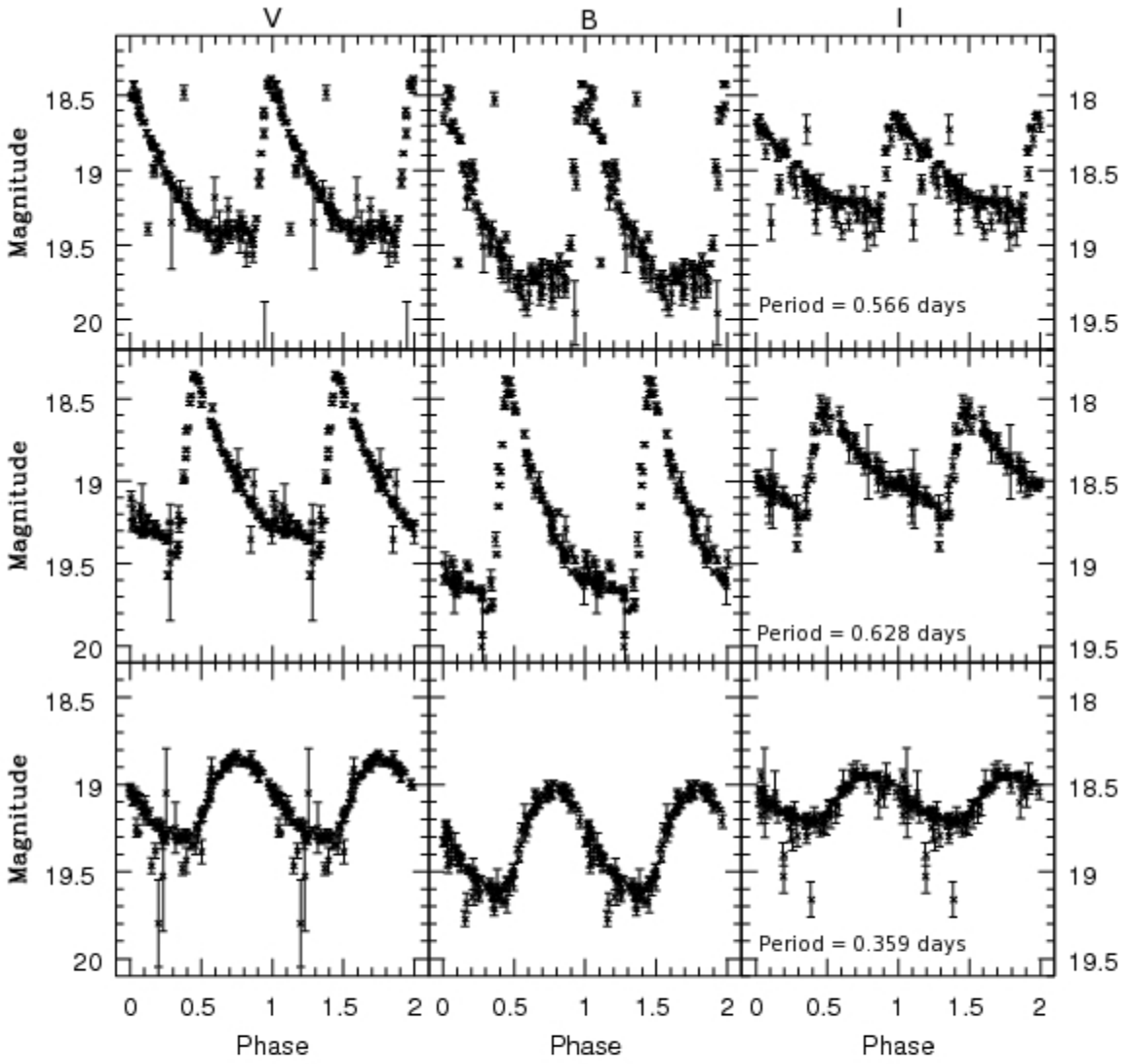
- They have easily identifiable light curves
- High luminosities make them visible across far distances
- Each has essentially the same intrinsic brightness
- They are particularly useful as standard candles

Typical RR Lyrae Light Curves

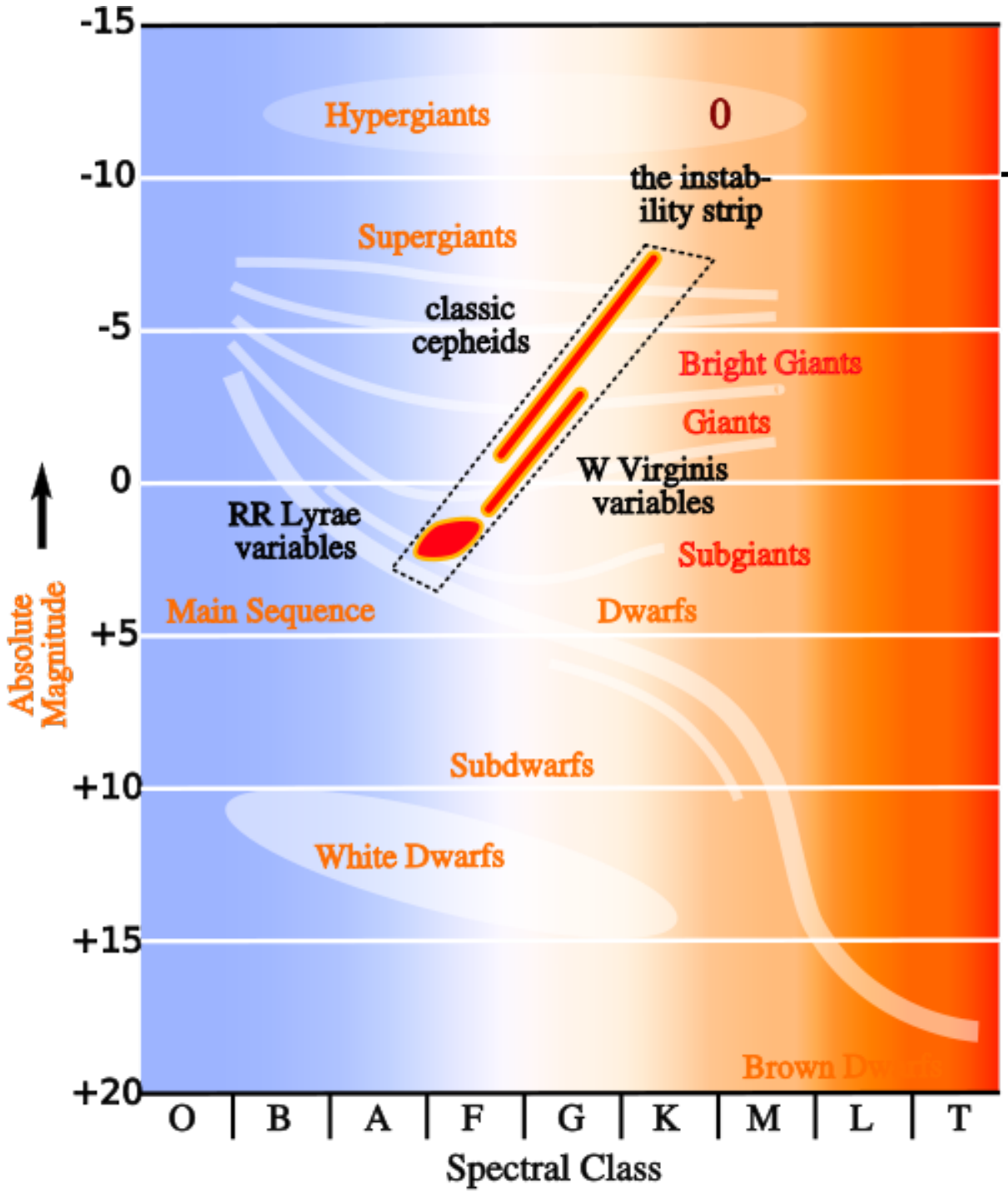
A

B

C



Credit:
Kuehn et al



The instability strip.

Paper on our discovery method!

Soon to be resubmitted including six TLU undergrads…

Identification of RR Lyrae Variables in SDSS from Single-Epoch Photometric and Spectroscopic Observations

Ronald Wilhelm[1,7], W. Lee Powell, Jr.[1,7], Timothy C. Beers[2], Branimir Sesar[3], Carlos Alende Prieto[4], Kenneth W. Carrell[1,7],Young Sun Lee[2], Brian Yanny[5], Constance M. Rockosi[6], Nathan De Lee[2],Gwen Hansford Armstrong[1,7], Stephen J. Torrence[1,7]

Received _____; accepted _____

Submitted version November 23, 2007

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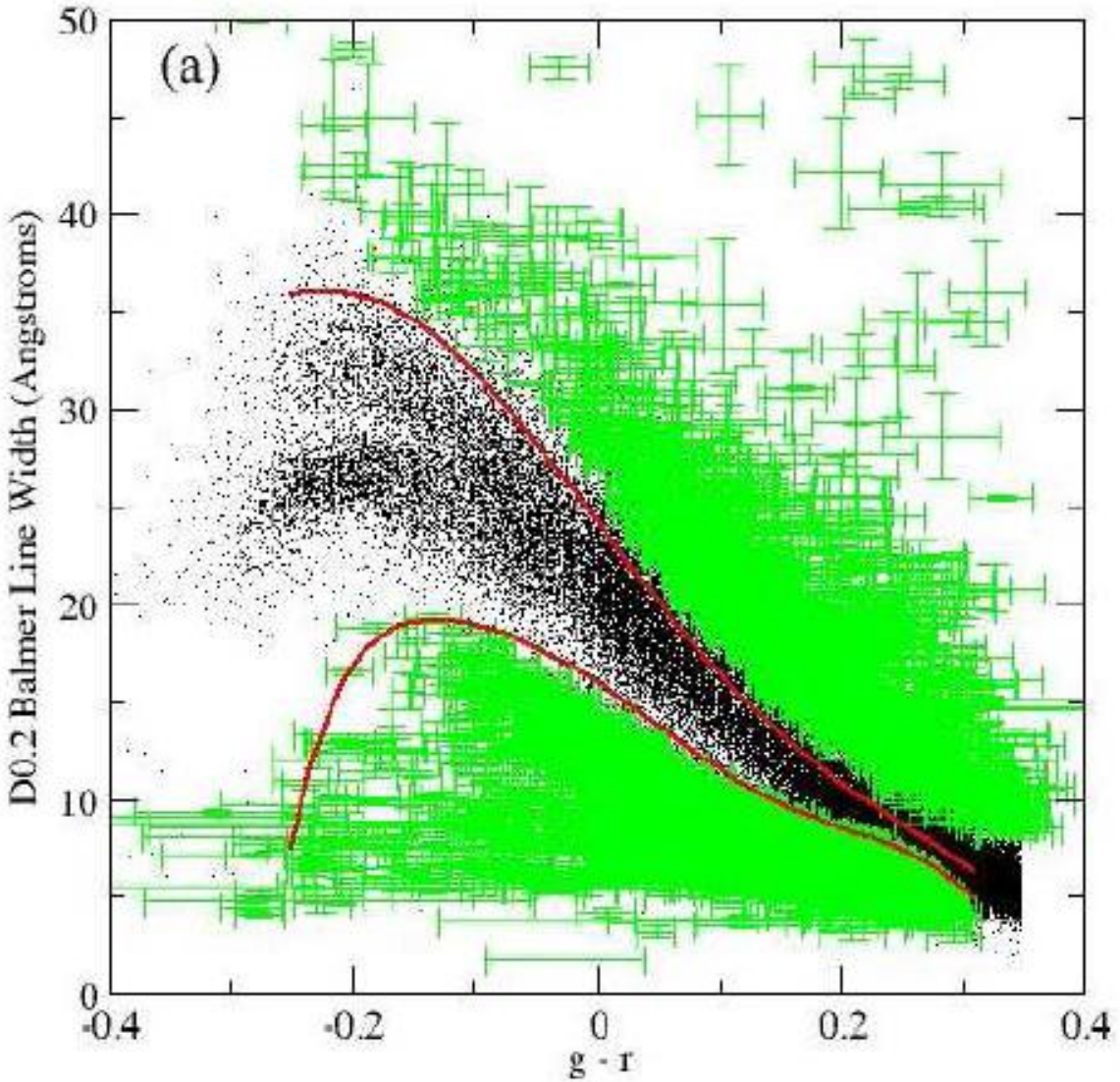
The method…

- Dr. Ron Wilhelm worked on the blue star spectroscopy pipeline for SDSS.
- His routines kept a list of stars that were rejected by the pipeline.
- Among the rejects are out-of-phase RR Lyrae stars

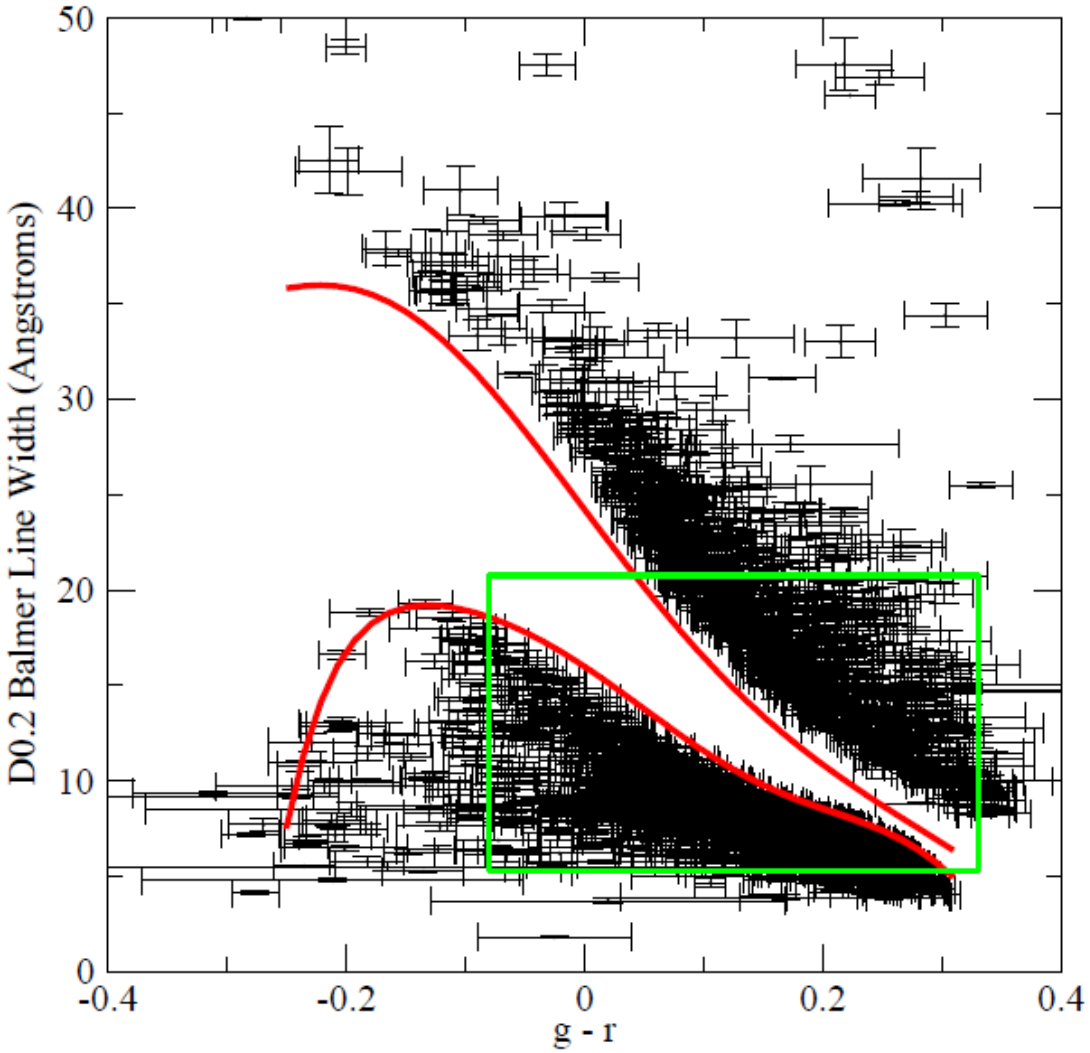
The method…

- Make use of the spectroscopic sample as a second epoch of observation.
- When spectroscopy and photometry are taken out of phase the hydrogen Balmer lines and the g-r color (both temperature sensitive) will show pronounced disagreement.

Balmer Line widths as a function of g-r color



Theoretical limits for instability strip parameters

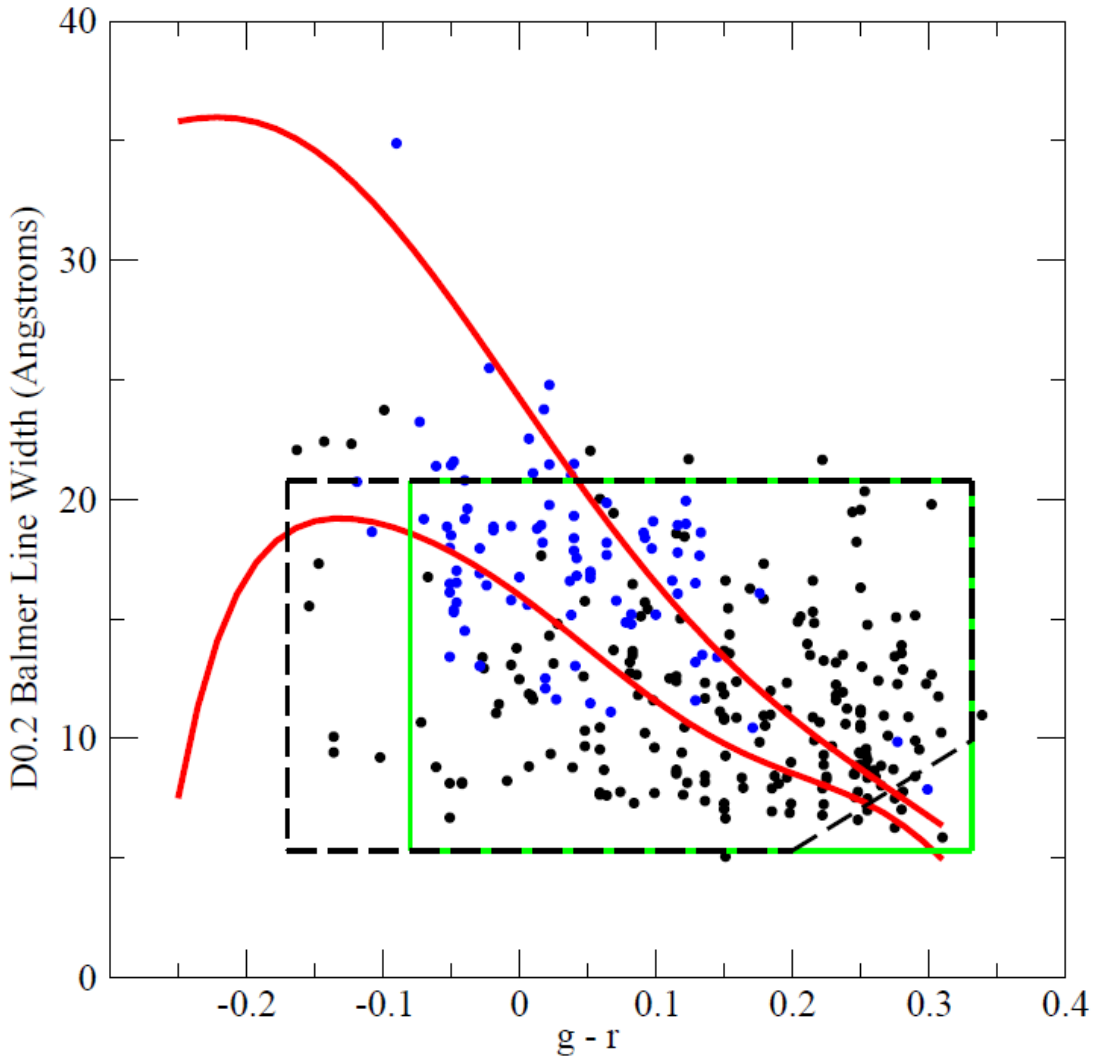


Stripe 82

- Stripe 82 of SDSS was observed repeated times.
- A large set of RR Lyrae variables have been confirmed in the stripe (Sesar et al.).
- These stars were used to further fine tune the selection box.

Known Variables (SDSS)

- RRab
- RRc



Stripe 82 results for method…

- Our method is around 85% accurate at predicting RR Lyrae (though definitely not complete).
- The resulting candidate list numbers over a thousand, ranging from 15^{th} to 20^{th} magnitude. All of these stars need follow up observations!!!
- We have the ability to probe Galactic sub-structure using this dataset.

Testing the method outside of Stripe 82

- Suspected variables have been observed using the 0.8m telescope at McDonald Observatory, first by Dr. Powell at Texas Tech and over the past three years at TLU (Andrew Jastram ('09), Dylan Ginn ('09), Carly Hansen ('10), Talitha Muehlbrad ('11), Caleb Bahr ('12), and Hans Amende ('13))

Testing the method outside of Stripe 82

- Observed at least two variables per night in both B and V filter to determine variability (150 sec in V, 180 sec in B)

- Observing runs in Dec '08, Feb '09, June '09, Oct '09, June '10, May '11, and July '11.

Testing the method outside of Stripe 82

- In the past three years at TLU 21 suspected RR Lyrae have been observed, with 19 being confirmed as variable
  - Five appear to be RRc
  - Twelve appear to be RRab
  - Two look to be some other type of variable, perhaps Delta Scuti

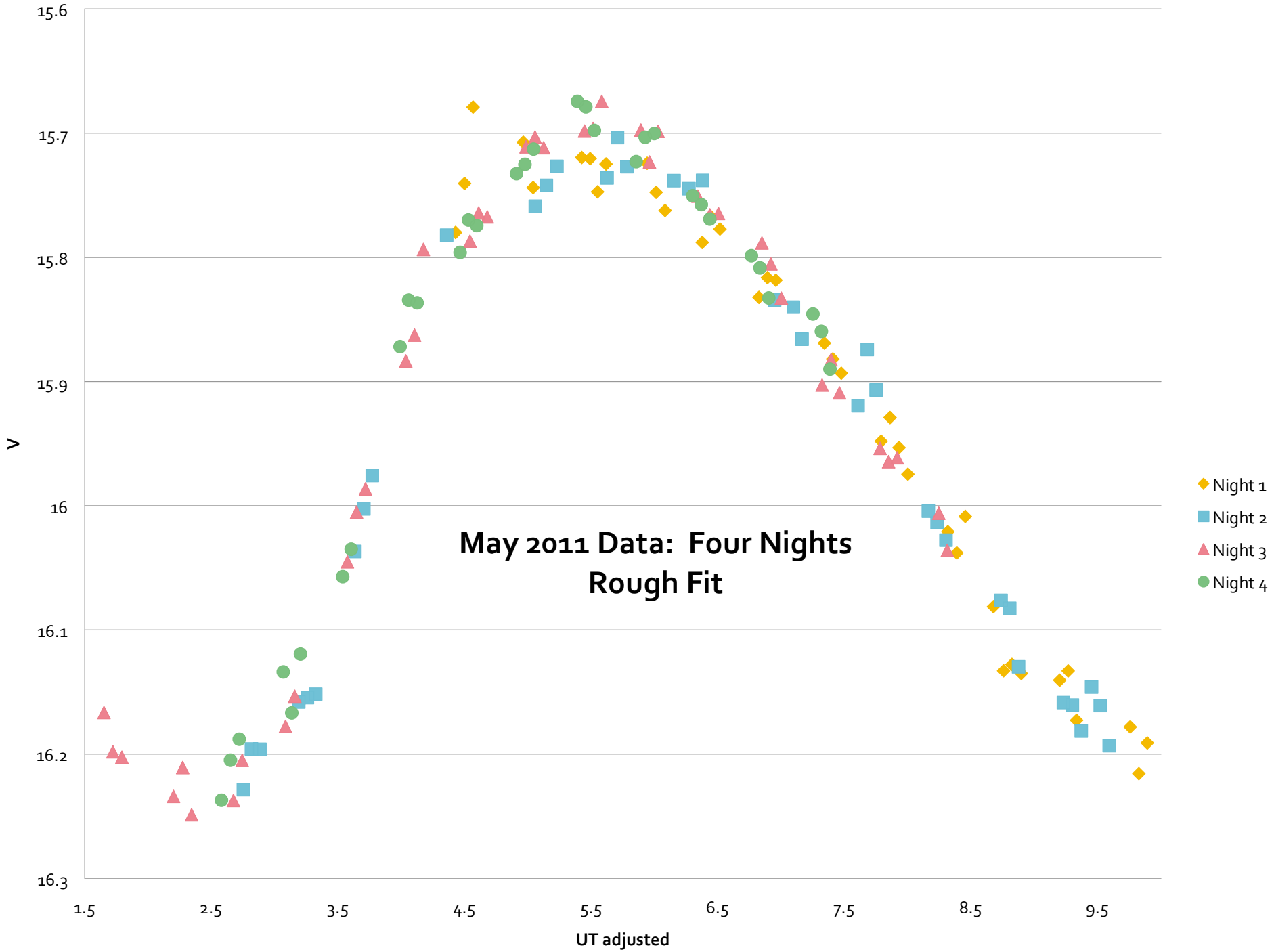
Summer 2011

- Hans and Caleb worked to make follow-up observations of one of the confirmed RR Lyrae that appeared to be type RRc.

- Four nights in May, four in July (lost 1.5 nights to a failure of the focus motor): around 235 total data points spanning the entire lightcurve in both B and V.

Summer 2011

- Period: 7.2 hours.
- Amplitude: 0.51 mag in V
- Rough magnitude: V = 16


May 2011 Data: Four Nights
Rough Fit
V
UT adjusted
15.6
15.7
15.8
15.9
16
16.1
16.2
16.3
1.5
2.5
3.5
4.5
5.5
6.5
7.5
8.5
9.5
Night 1
Night 2
Night 3
Night 4

On-going Work

- We are still working on analyzing the rest of the data.
- Fourier analysis of the light curve.
- Calibration of the comparison stars to standard stars.

Acknowledgements

- McDonald Observatory for the observing time
- AAS/NASA for support through a Small Research Grant
- TLU for additional financial support
- Dr. Ron Wilhelm (U of Kentucky)
- Dr. W. Lee Powell Jr.