

The Correlation Between the Photometric Variability and Spectra of Seven RV Tauri and Semi-Regular Stars

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ABSTRACT

RV Tauri and Semi-regular variables are difficult to study because some of their behavior is non-periodic. It is believed they are in transition from the AGB to white dwarfs, but this evolution is not very well understood. We have initiated a multi-year study of their behavior in order to better understand the relationships between their period and luminosity and other observational quantities as well as establishing any correlations between pulsation phase and stellar properties.

We present our preliminary results for seven stars, 3 RV Tauri and 4 Semi-regulars, obtained by studying the relationships and patterns, or lack thereof, between the variability of their light curves and corresponding changes in their spectra. The seven stars include R Sct, g Her, EU Del, Z UMa, V Vul, SX Her, and AC Her. The AAVSO International Database is the source of our photometric data. Our spectra come from a long term observing program organized by S. Howell using the Coude Feed Telescope at Kitt Peak National Observatory.

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DATA SET

Our photometric data was taken from AAVSO and our spectral data from the Coude Feed Telescope at KPNO. Details regarding the analysis of the data can be found at this conference in the adjacent poster number 342.12 by Walter *et. al.*

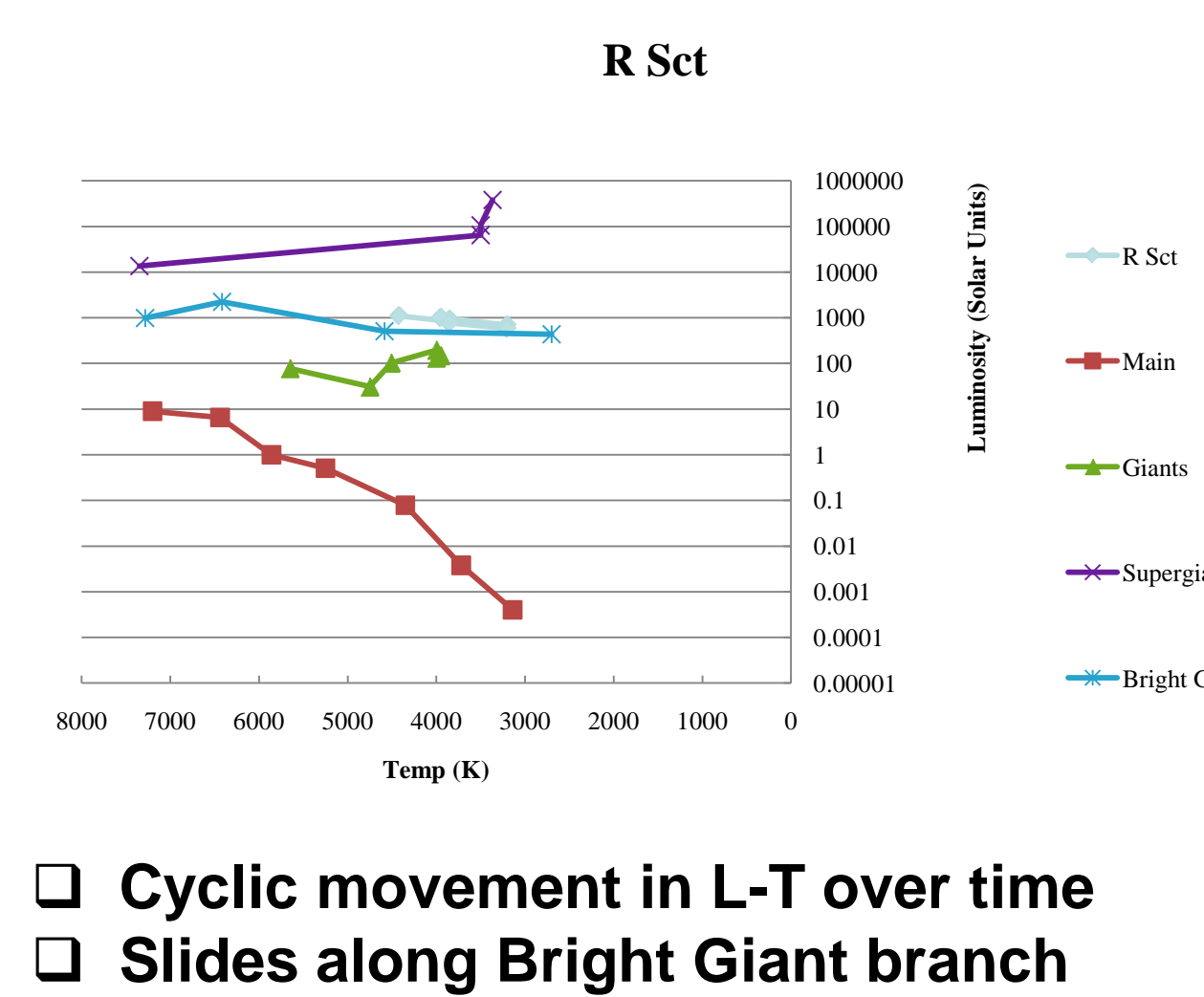
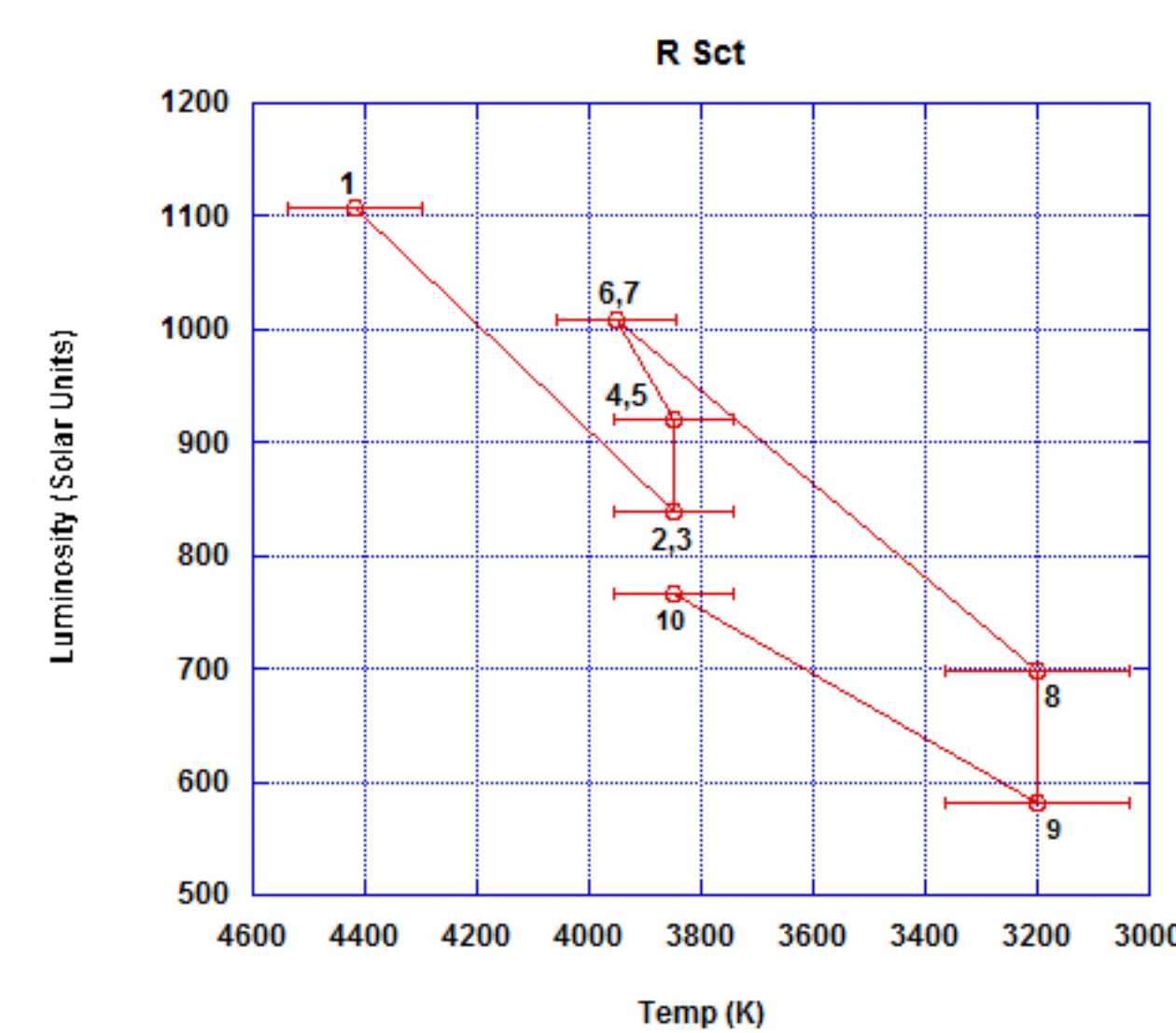
Star	Variable Type	Period (days)	# of Spectra	Dates of Spectral Coverage
R Sct	RVA	146.5	10	7/20/02 – 6/26/07
g Her	SRb	89.20	7	7/4/03 – 6/29/07
EU Del	SRb	59.70	7	6/9/03 – 6/28/07
Z UMa	SRb	195.5	18	7/4/03 – 12/4/08
V Vul	RVA	75.70	9	6/9/03 – 6/26/07
SX Her	SRd	102.9	19	6/9/03 – 6/29/07
AC Her	RVA	75.01	15	6/9/03 – 12/6/08

UNDERSTANDING THE PLOTS

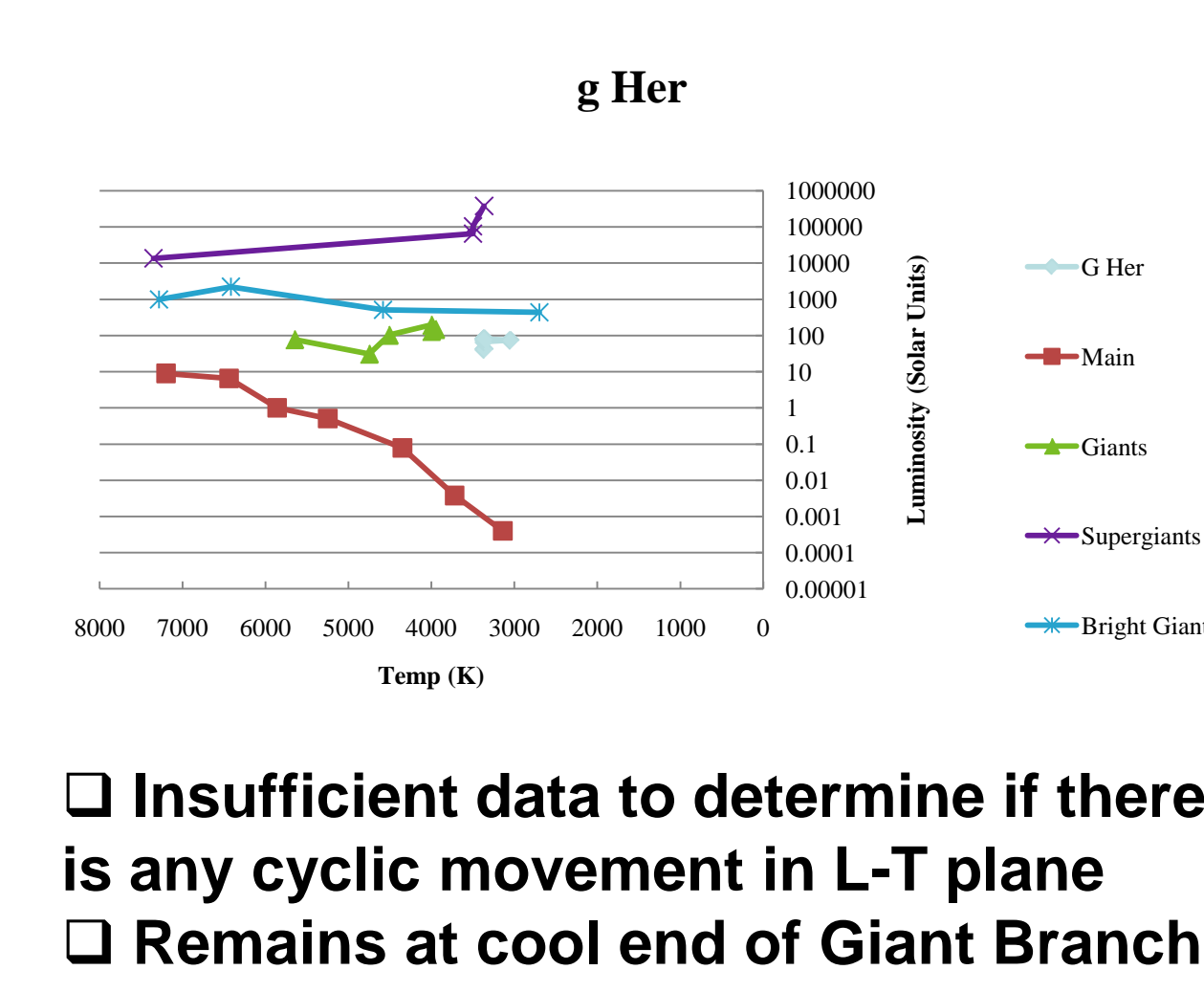
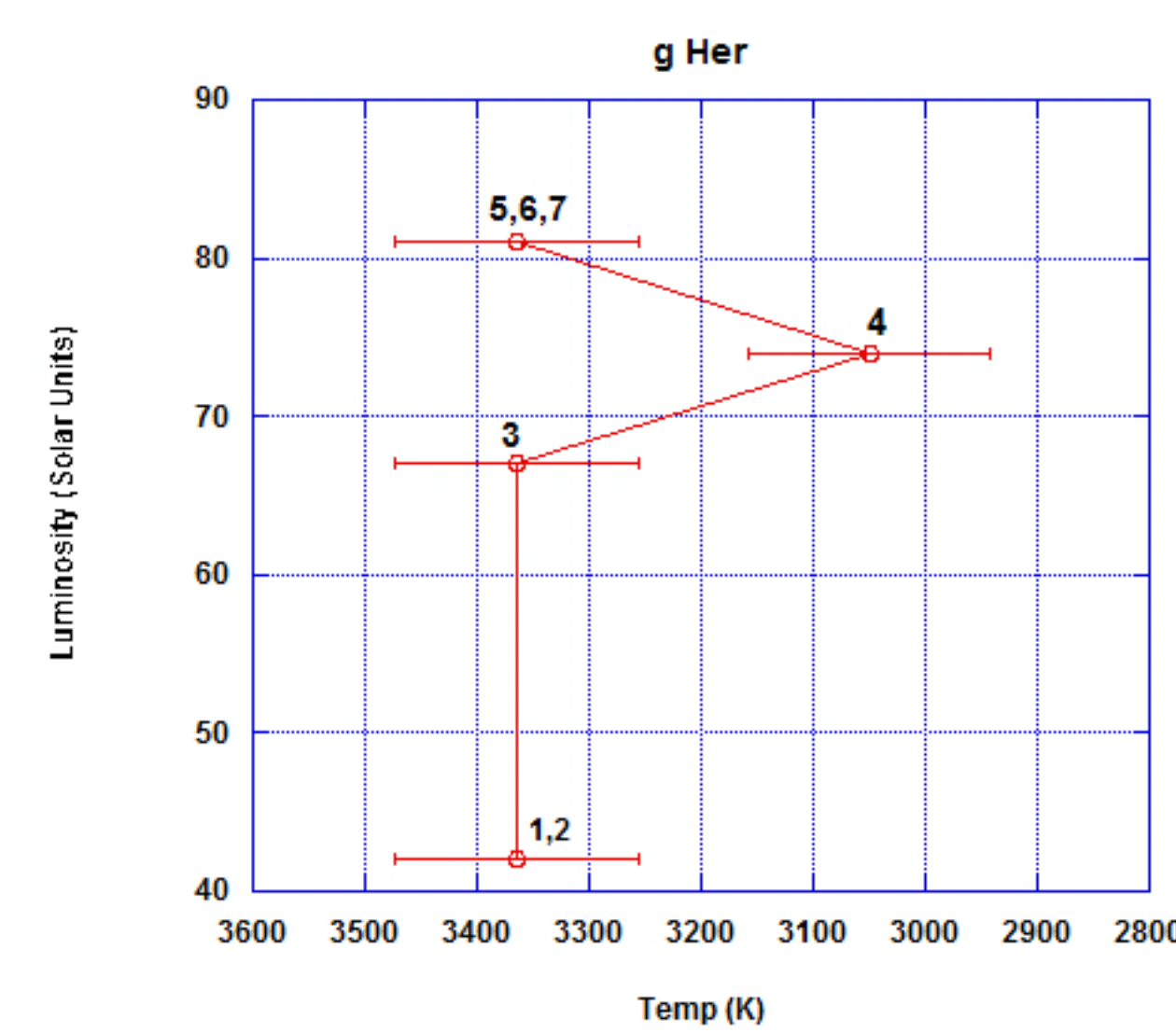
For each star we present two plots.

The larger plot shows the change of each star in L-T space as a function of time. The data points are numbered chronologically from the first spectrum in our data set to the final one. Numbers plotted on top of each other indicate spectra that were acquired at approximately the same point in time. The red error bars show the range in T for an error of one spectral subtype. Note that the time steps between numbered points are not equal.

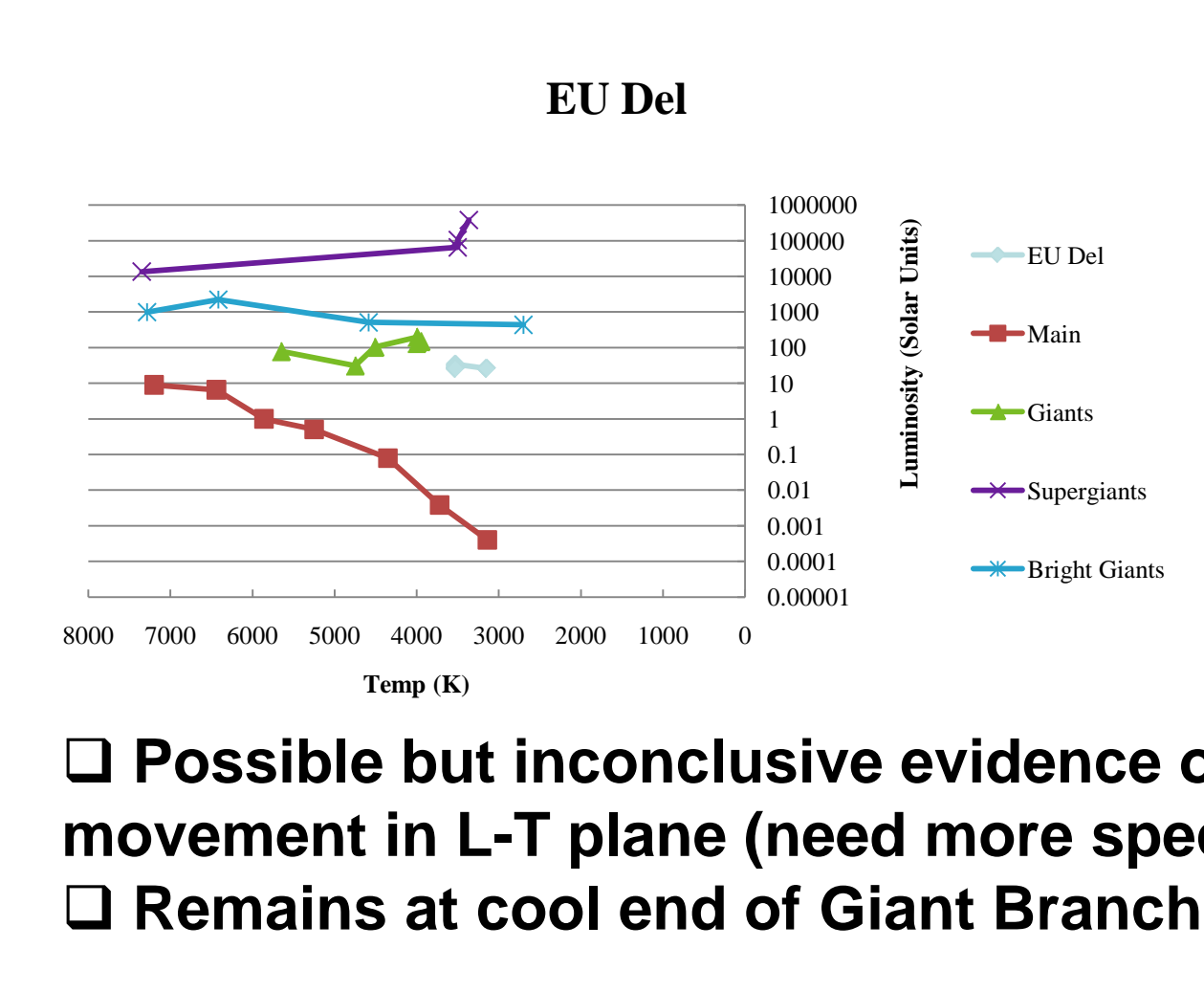
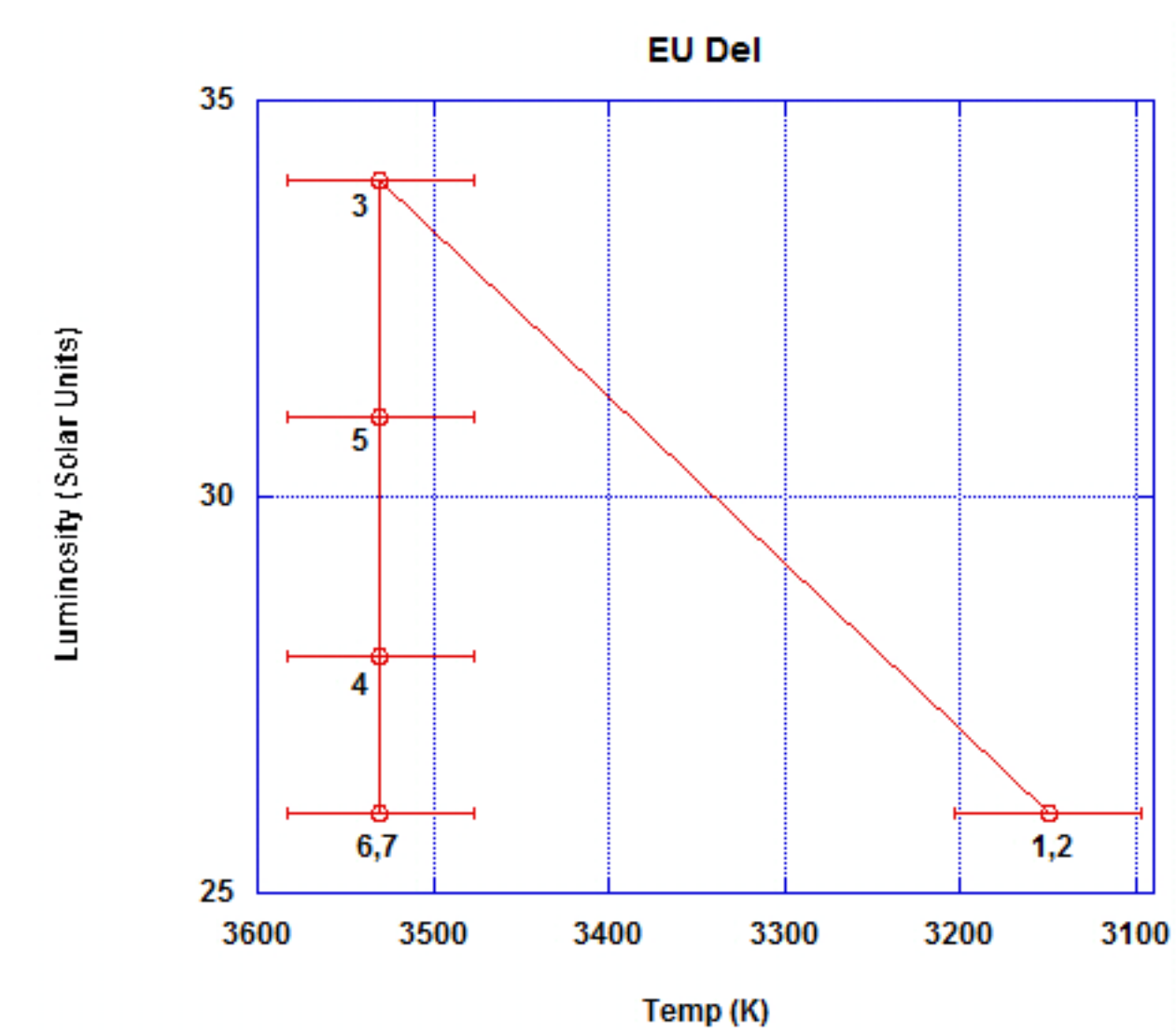
The smaller plot shows how the location on the HR diagram of each star over time compares to the location of the various stellar luminosity classes.



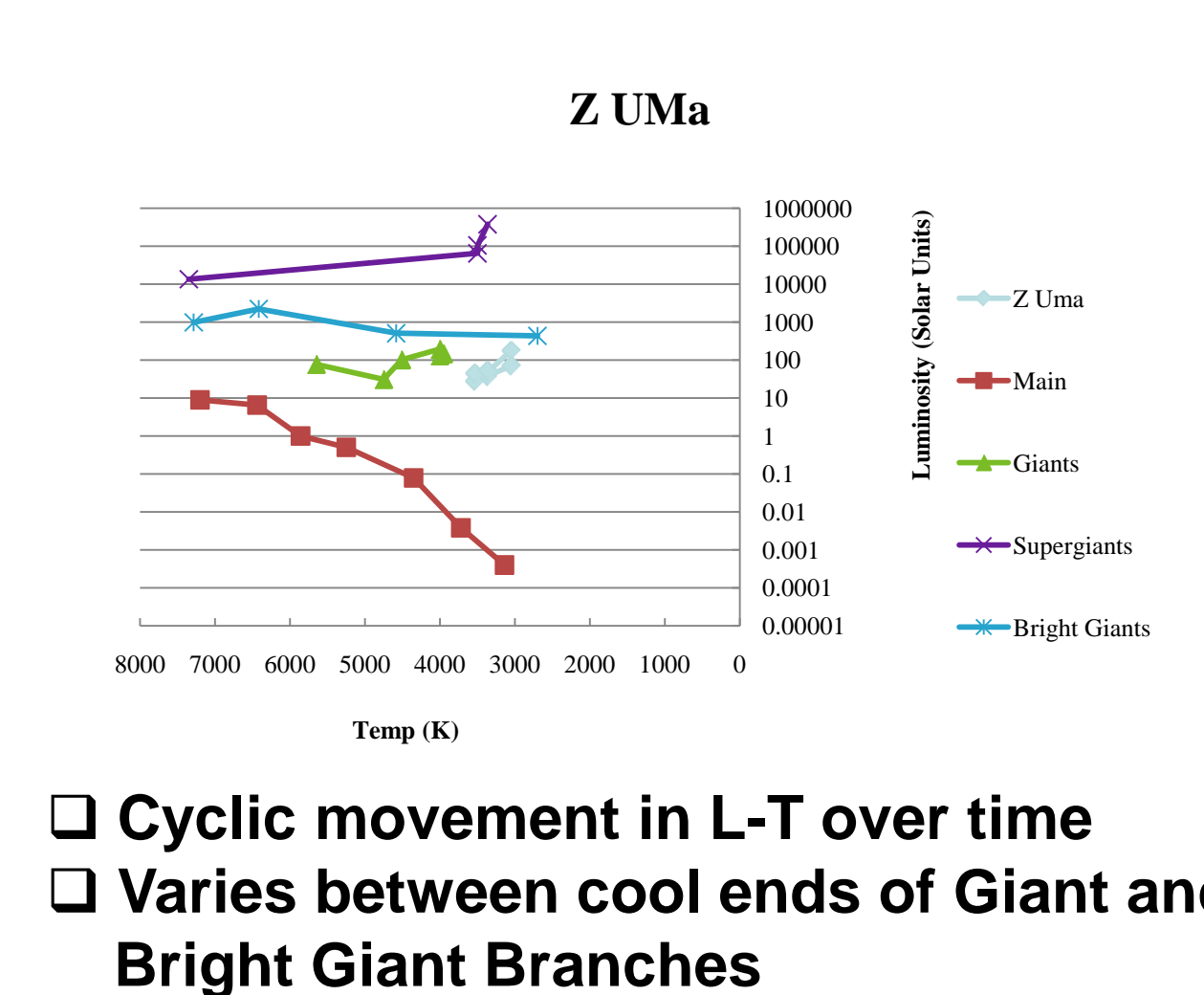
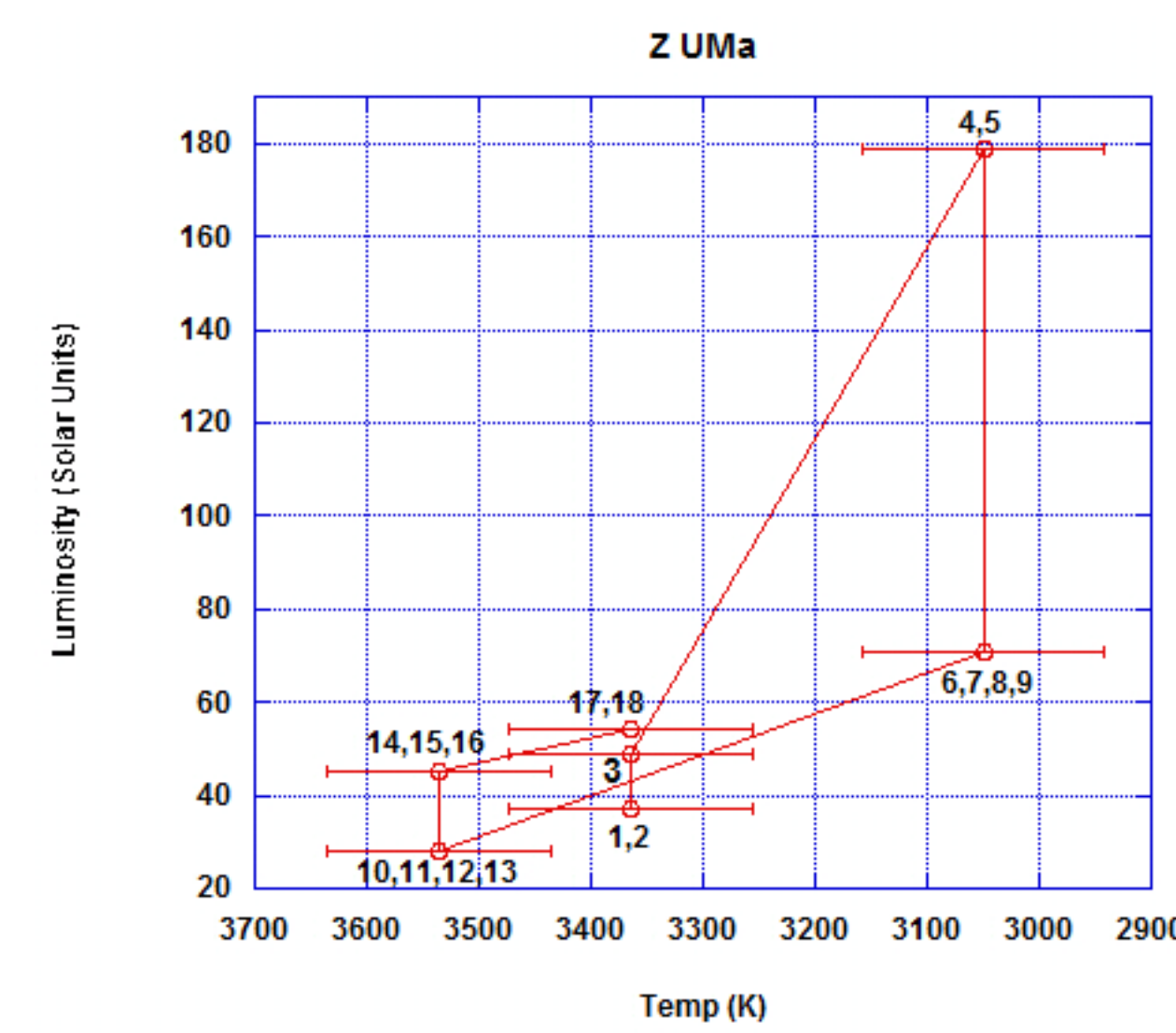
- Cyclic movement in L-T over time
- Slides along Bright Giant branch



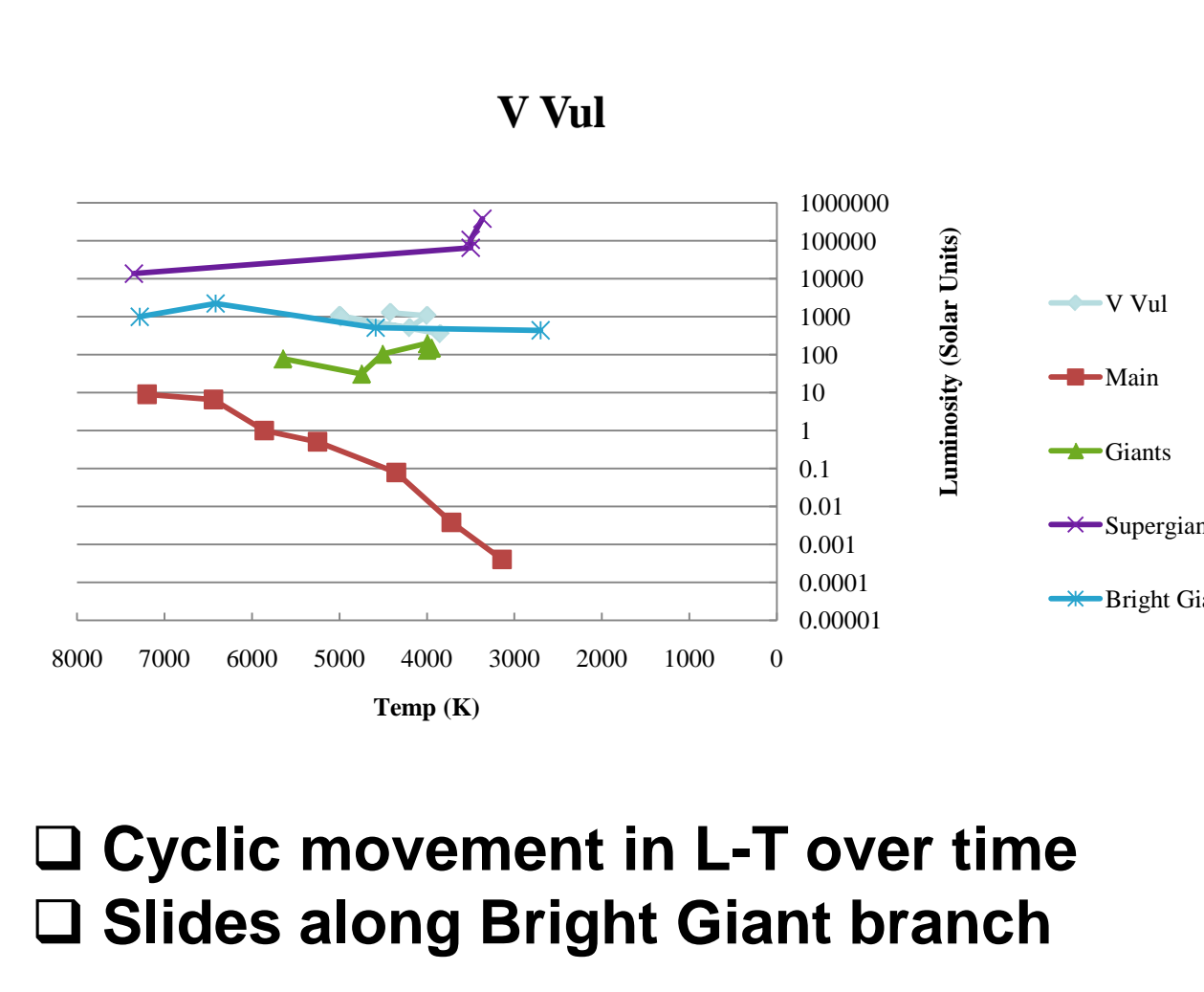
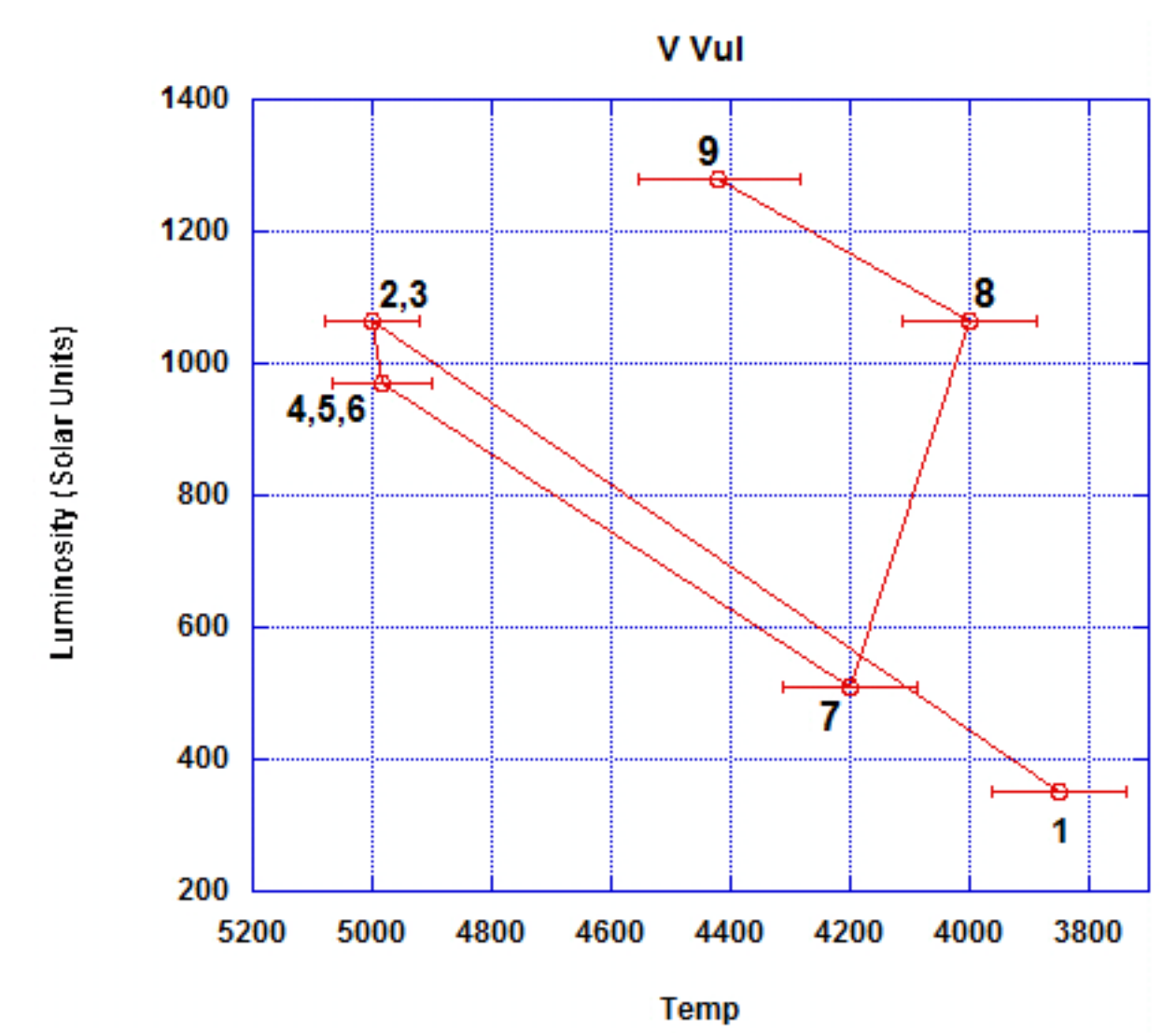
- Insufficient data to determine if there is any cyclic movement in L-T plane
- Remains at cool end of Giant Branch



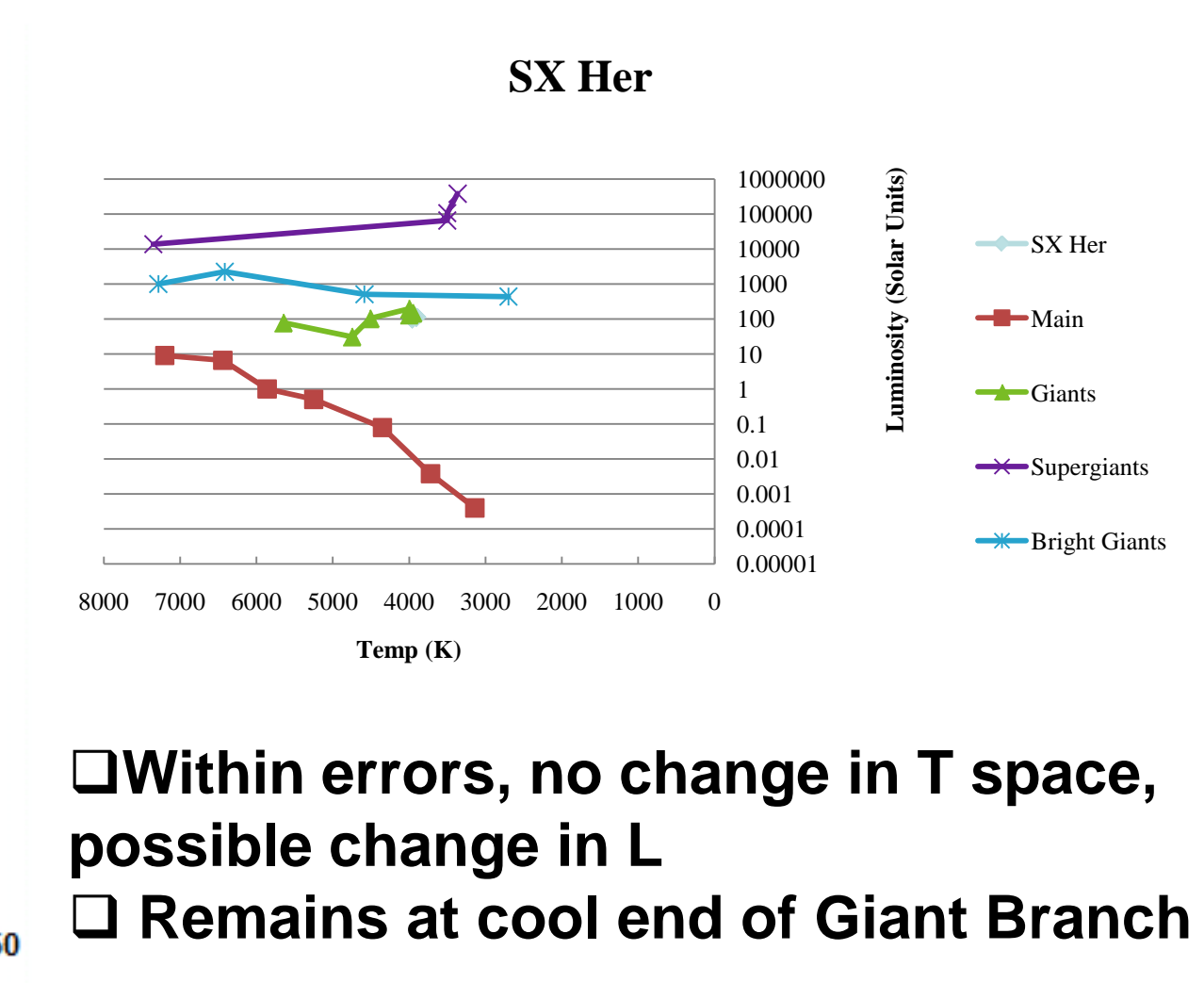
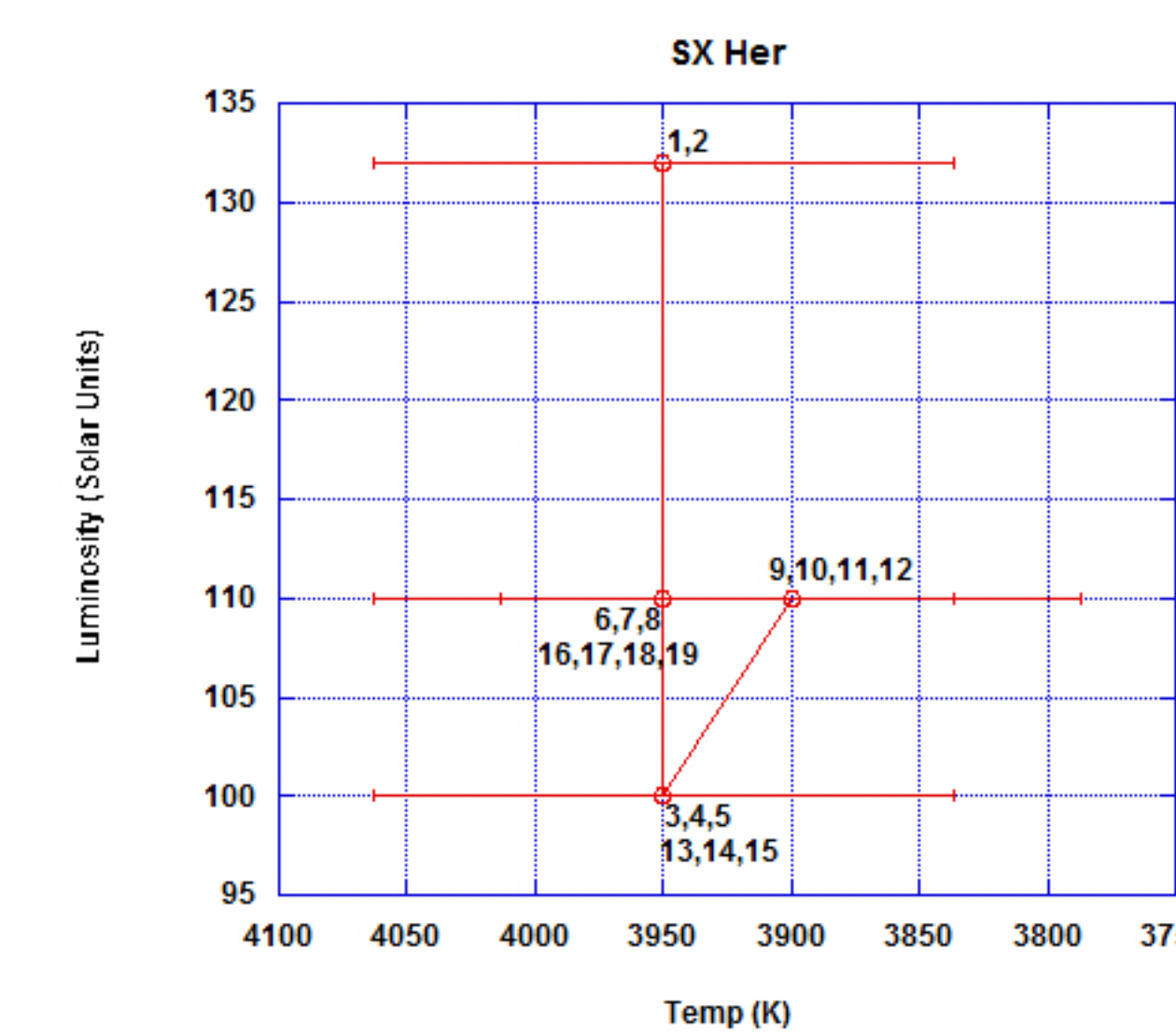
- Possible but inconclusive evidence of movement in L-T plane (need more spectra)
- Remains at cool end of Giant Branch



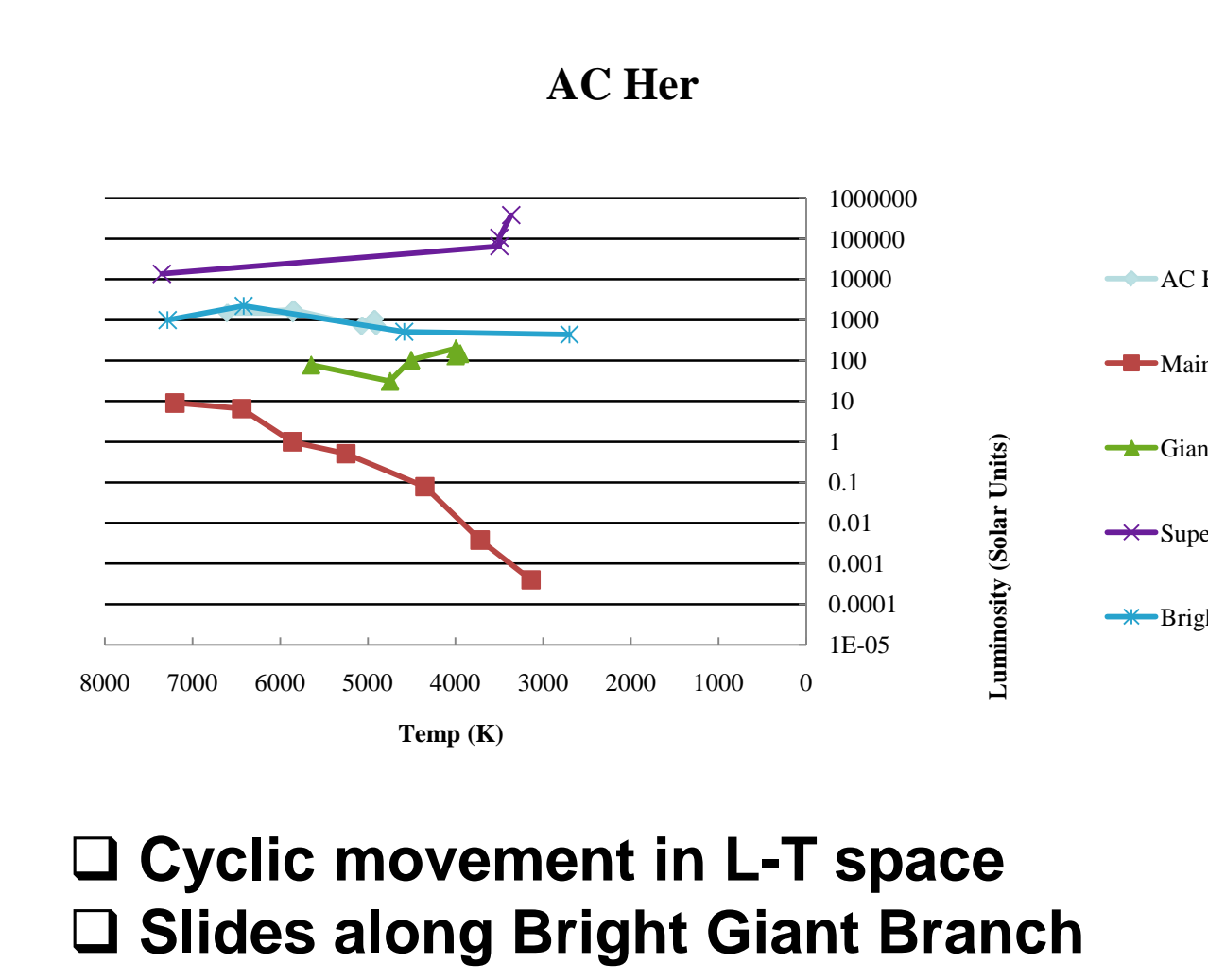
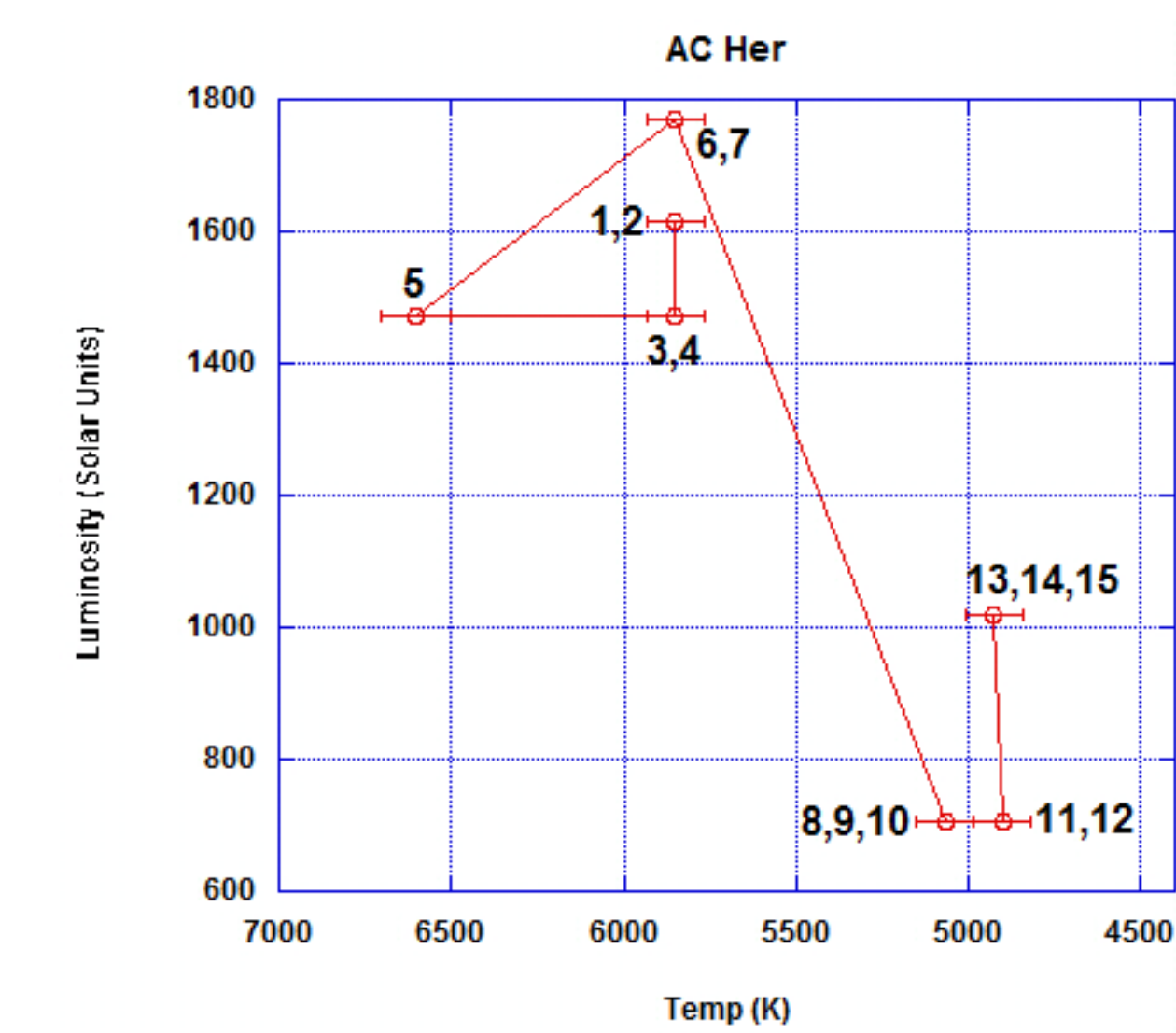
- Cyclic movement in L-T over time
- Varies between cool ends of Giant and Bright Giant Branches



- Cyclic movement in L-T over time
- Slides along Bright Giant branch



- Within errors, no change in T space, possible change in L
- Remains at cool end of Giant Branch



- Cyclic movement in L-T space
- Slides along Bright Giant Branch

DISCUSSION

Cyclic movement in the L-T plane is obvious in those stars with a large number of spectra in our database. SX Her would appear to be an exception to that since it has 19 spectra but shows no movement in temperature. However, close examination of the timeline plot shows that all of SX Her spectra are clustered within 4 small regions over the 5 seasons of observations covered in the data table. It may be that we have sampled the star each observing season (June to July) during the same portion of the pulsation phase. We have new spectra of SX Her (and the others) at different times of the year that may help clarify this point.

A clearer picture of any movement in the L-T plane will be possible not only for SX Her but all of the stars once we convert the Julian Dates of our observations to fractional values (between 0 and 1) within the pulsation phase cycle. This will allow us to “fold over” all of our spectral observations into a single cycle. We will then be able to determine the correlations between pulsation phase and stellar properties such as L, T and R.

This will be the next step in our study. For details about how we will proceed to fit the light curves to a representative pulsation cycle, see the work at this conference in poster number 342.11 by Cash, *et. al.*

FUTURE WORK

- Include new spectra from 2009 to the present
- Include error estimates in luminosity
- Convert Julian Dates to fractional values of the pulsation phase
- Combine results with stars in poster 342.12 by Walter, *et. al.*
- Examine variations in stellar properties in pulsation phase space

ACKNOWLEDGEMENTS

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