Light curve analysis of M giant stars in the *Kepler* database

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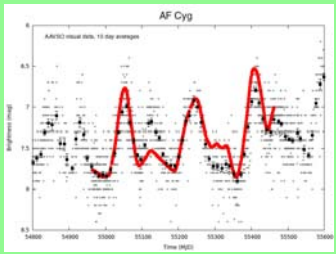
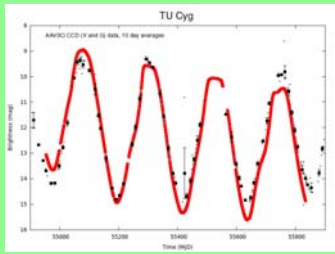
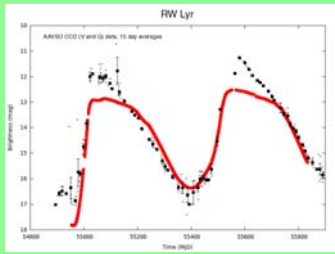
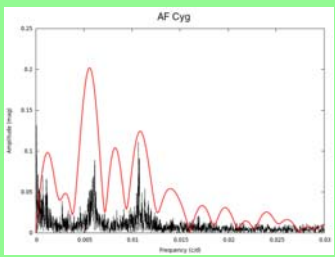
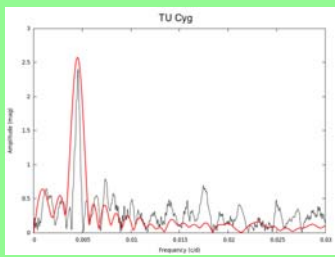
M giants are the longest period variable stars in the whole KASC program, studied within WG12. The typical time-scale of variability is in the order of one or two *Kepler* quarters, which means removing instrumental drifts is close to impossible. On the other hand, their amplitudes are way above the usual instrumental effects, so that stitching together the M giant light curves could be a relatively simple task (and hence essentially neglecting every systematic that goes beyond a constant vertical shift in the light curves from quarter to quarter).
After having combined more than two years of *Kepler* data (we used Q0 – Q10), we can characterize M giant variability in a homogeneous and meaningful way. Here we attempt to classify different types of M giant light curves ranging from the largest-amplitude Mira stars going down to the small amplitude semiregular variables. The total sample includes over 200 M giant stars that were initially selected from a dedicated northern ASAS variability survey of the *Kepler* field. We show how *Kepler* data revealed unprecedented details of long-period variability.

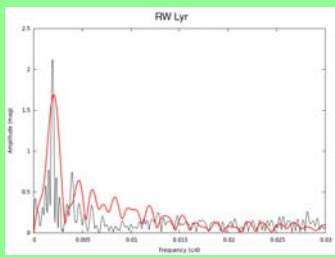




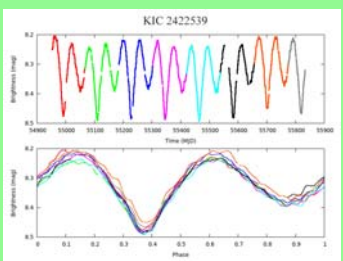


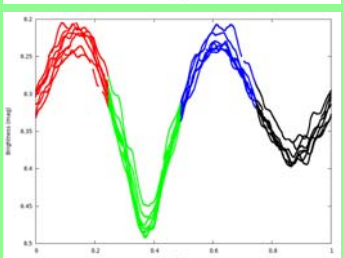


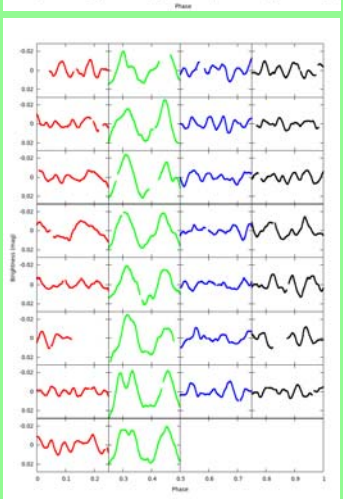


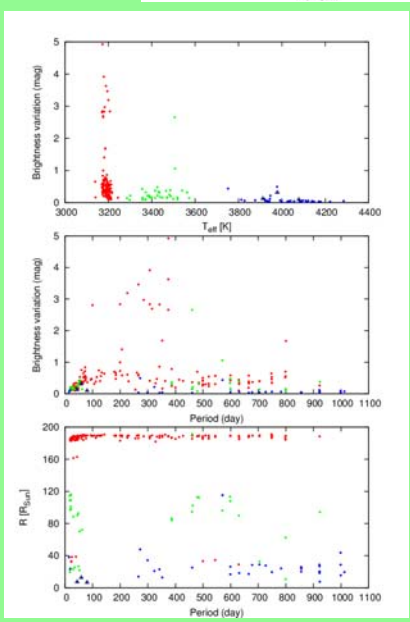


In the case of three well known LPVs we compared the AAVSO (black) and *Kepler* (red) light curves and frequency spectra. Surprisingly there are some strong differences in the light variations.

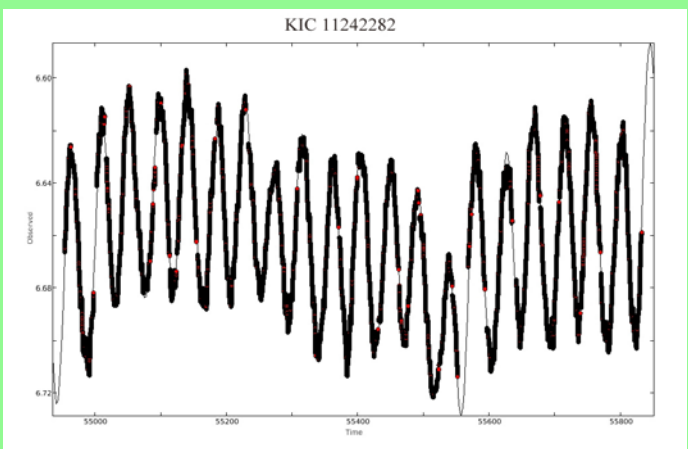


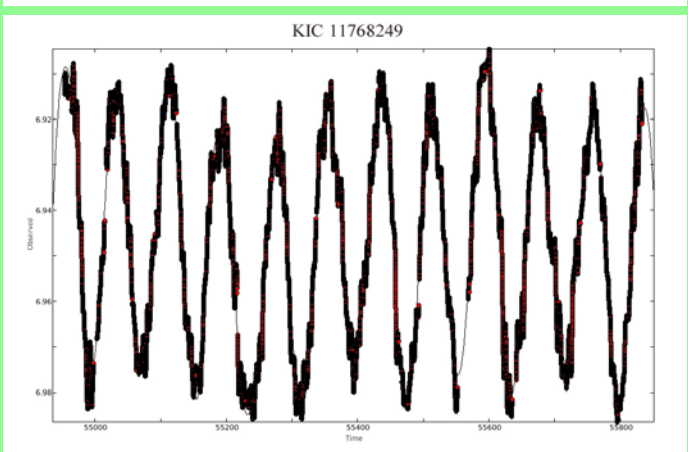






Parameters of 317 M giants from KIC. The period corresponds to the largest amplitude peak in the frequency spectrum. Stars can be clustered into three groups based on T_{eff}. The red dots are the largest cool stars. The three blue triangles are stars with long periods, together with small amplitude short period components (KIC 2422539, 11242282, 11768249).

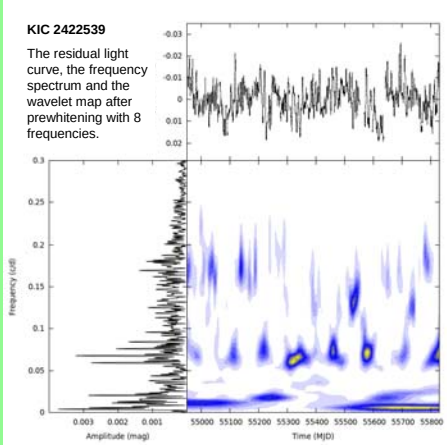




Two stars with long period combined with small amplitude short period components (on the merging method of quarters see the poster of Csányi et al.). The fitted curves (thin lines) contain 12 frequencies. The explanation of the origin of variations with short periods (4-8 days) is not clear yet (g modes?) .

KIC 2422539

The residual light curve, the frequency spectrum and the wavelet map after prewhitening with 8 frequencies.



The star KIC 2422539 is probably a contact eclipsing binary (P=118 d).
We studied of 7.5 cycles for the four different segments of the phase diagram. The eight primary minima (green) show a relatively stable structure and period (P=15 d), which is clearly appears on the wavelet map at f=0.07 c/d.

Acknowledgements:
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References:
Lenz P., Breger M., 2005, CoAst, 146, 53 (http://www.univie.ac.at/tops/Period04)
WWZ wavelet software (http://www.aavso.org/software-directory)